Annual Report 2017

IST AUSTRIA
Institute of Science and Technology

The Scientists of IST Austria

Scientists come from all over the world to conduct research at IST Austria; this map gives an overview of the nationalities on campus.

IST Austria Scientists by Previous Institution

Austria	15.6%
Germany	13.8%
USA	11.1%
UK	7.2%
Spain	4.5%
France	4.5%
Italy	4.2%
Switzerland	3.6%
Czech Republic	3.3%
China	3.0%
Russia	2.7%
India	2.4%
Other	24.1%

North America
Canada
Mexico
USA

South America
Argentina
Bolivia
Brazil
Chile
Colombia

Europe
Austria
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Italy
Lithuania
Netherlands
Poland
Portugal
Romania
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine

Asia
Afghanistan
China
India
Iran
Israel
Japan
Jordan
Nepal
Palestine
Russia
Turkey
Vietnam

Oceania
Australia

IST Austria Scientists by Nationality

Austria	15.6%
Germany	11.1%
Italy	5.7%
Russia	5.1%
China	4.8%
Slovakia	4.5%
Hungary	4.2%
India	4.2%
Poland	3.3%
Czech Republic	3.3%
France	3.0%
Spain	2.7%
UK	2.4%
United States	2.4%
Other	27.7%

Content

Introduction
4 Foreword from the President
6 Interview with Peter Fratzl
10 IST Austria at a Glance
12 Guest Commentary

Climbing the Career Ladder
16 The Graduate School
20 Interns
22 Postdocs
24 Alumni
26 New Professors

Research at IST Austria
30 Biology
32 Computer Science
34 Mathematics
36 Neuroscience
38 Physics

Events and Outreach
42 Event Highlights
44 Outreach Highlights

Organization
48 Scientific Service Units
50 Administration
52 Technology Transfer
54 Donors
56 Growth and Future Perspectives

61 **Facts & Figures**

Foreword

Thomas A. Henzinger
President, IST Austria

2017 saw a variety of new developments at IST Austria, as well as growth and progress towards the Institute's founding goal: to build a graduate institution in Austria that is one of the top research centers for basic science worldwide.

Our most important asset, the staff of IST Austria, continues to increase in size and diversity: over 600 employees from upwards of 50 countries conduct and support cutting-edge research, and train the next generation of researchers. The more than 350 scientists at the Institute include 49 professors, among them the Institute's recent recruiting successes: in the last year, six new professors were hired from over 1'300 applicants. These new group leaders will strengthen the research profile of the Institute in structural biology, experimental solid-state and optical physics, theoretical biophysics, and chemistry.

Training and educating the next generation is one of our core missions, and this year we welcomed a class of 36 new doctoral students, the biggest yet. The Institute also awarded 15 doctoral degrees in 2017, celebrating the largest graduating class so far. Doctoral and postdoctoral alumni have continued their careers in academia, industry, and public service; of those in academia, nearly a third have obtained faculty positions. Their careers have taken them to over 30 countries, primarily in Europe and the US. As new postdocs join the Institute, many will be supported by the largest grant ever awarded to IST Austria: the EUR 4.6 million ISTplus Marie Skłodowska-Curie COFUND grant from the European Union will fund 60 postdocs for two years each.

With six new grants from the European Research Council (ERC)—the premier funding source for basic research in the EU—awarded to the Institute's faculty this year, the total number of ERC grants acquired so far has grown to 38. The new ERC grants comprise two Starting, two Consolidator, and two Advanced grants, in the areas of neuroscience, experimental physics, and evolutionary, developmental, and plant biology.

As an institute of technology as well as science, IST Austria invests in new facilities and instruments to increase its research capabilities and remain at the state of the art. As part of this, the past year saw the opening of the Nanofabrication Facility for semiconductor physics and, in connection with the hiring of two young structural biologists, the Institute will invest in a cryo-electron microscopy (cryo-EM) setup on campus. This Nobel prize-winning technology will become available at IST Austria in about a year.

Construction on campus also continues apace: preparatory construction work has begun for a new laboratory building, which will be completed in 2020 and will house the future chemistry labs. One more laboratory building is in the planning stages, allowing the Institute to grow to its target size of about 90 research groups by 2026. Five companies already rent space on campus, anticipating a move to the IST Park—a future technology park across the road from IST Austria which is currently under development. Technology transfer in Austria received an additional boost this year with the launch of IST CUBE: a cooperative effort between IST Austria and an external investor, this startup incubator and seed fund will support the creation and initial growth phase of new technology companies.

The first decade of IST Austria has given us many reasons to be confident about the future of the Institute. However, this future will continue to depend on the strong support of our public and private partners. We would like to express our gratitude to all donors, supporters, and friends of IST Austria, especially the Federal Minister for Education, Science, and Research, Heinz Faßmann, and the Governor of Lower Austria, Johanna Mikl-Leitner. For private donations, the Institute has started an endowment fund for the benefit of the research performed at IST Austria. As the Institute works towards its challenging and ambitious goals, we also count on engaging new partners to join us on our journey to develop a world-class institution for basic science and doctoral education in Austria.

Helping an Idea Grow

Interview with Professor Peter Fratzl,
Director of the Max Planck Institute of Colloids and Interfaces
and Chair of the Scientific Board of IST Austria

How did you first become involved with the Institute? Why did you remain involved?
Early on, I was contacted by the founding team, Haim Harari, Olaf Kübler, and Hubert Markl, with an interesting project—very interesting, because it envisioned a place where one could really focus on science. I began by helping to organize symposia in order to find interesting people for the Institute; this was before there was a formal scientific board. When the board was created, I was appointed member, and it is something I do with pleasure. One reason is that I am Viennese; I left Austria in 2003 to create a new department in the Max Planck Institute in Potsdam, but I still feel very connected to Austria and Vienna in particular. I also feel that this is a project that Austria needed, an institute focused on great people and excellent, fundamental science, without being guided by politics. While there are other smaller and larger research institutes in Austria doing great work, the difference is that IST Austria is also a graduate university.

Since its opening in 2009, the Institute has developed at a remarkable pace. What do you see as the most significant challenges IST Austria will face in the coming years?
Scientifically, I think this is a very interesting time for the Institute. IST Austria has grown very rapidly, and until now, the leadership was looking for the best scientists that could be hired, in a wide variety of fields. This was the correct strategy for the beginning—you have to have great people—but now the Institute has reached a point where further growth must be more directed.
This is the challenge to come: to implement the right hiring strategies in order to complement the existing areas, as well as break into physics and chemistry, which are underrepresented. I think it is important to increase diversity, in both science and people, but in a focused way: IST Austria is not big enough to be outstanding in every field, one must be selective.

What do you see as IST Austria's role in the international scientific community, at present and in the future?
This is quite an interesting question. A number of smaller institutions of scientific research have recently appeared in different parts of the world, and I think it's great: they are more dynamic, and can be more courageous in taking on the future, and in taking up unconventional methods in unconventional fields. I think that this is the role IST Austria could and should take, to be more unconventional, to take more risks, and therefore be closer to the cutting edge, when larger institutions have to compromise.

In what ways do you see the Institute as making the most significant impact on the Austrian public?
The Institute is, and should be, the spearhead of excellent fundamental science in Austria. Moreover, it should not stop making clear to the larger public what the role of science in our society is. First, science provides deep insights into our world and for our future. An institute such as IST Austria must do everything to foster public excitement for scientific discovery, so that people are proud of science, not afraid of it. But, in addition to this, scientific research trains scientific minds. This is not said often enough: the graduates of IST Austria, whether or not they stay in science, have scientific training and thus a particular way of looking at problems, different from someone with a commercial background, for example. Such people are very valuable and very important for our technology-based societies.
In addition, IST Austria can do a great deal to attract excellent people, projects, and ideas to Austria, both by increasing the quality of the research landscape, and by working together with the traditional universities to create the critical mass necessary to bring outstanding researchers and international funding to Austria. The Institute cannot exist in isolation, and should play a critical role in as many collaborative projects as possible.

What has surprised you about the development or direction of IST Austria?
There is a fairly unusual mix of mathematics and computer science with biology and neuroscience at the Institute—but while uncommon, this combination is both interesting and very productive. This was at least partly caused by the first very visible hires being in biology and computer science, but the effect is significant. In fact, a big strength of the Institute is this combination of formal with natural sciences, and has resulted in some very exciting results. One should not be afraid to be different—indeed, this is one of the ways IST Austria has made, and will make, a significant impact.

building an environment
for creative ideas

IST Austria at a Glance

The Institute of Science and Technology Austria (IST Austria) is a PhD-granting research institution dedicated to cutting-edge research in the physical, mathematical, computer, and life sciences.

Student admissions in 2017

Complete applications	1'669
Student offers made	62
Student offers accepted	36

Faculty recruiting in 2017

Applications	1'354
Faculty offers made	8
Faculty offers accepted	6

361 Scientists

(as of December 31, 2017)

PhD students	155
Postdocs	134
Professors	49
Scientific interns	19
Staff scientists	4

Total research grant funding acquired

(rounded; as of December 31, 2017)

ERC European Research Council	60'867'000 €
EU other	18'546'000 €
FWF Austrian Science Fund	17'843'000 €
HFSP Human Frontier Science Program	2'052'000 €
DFG German Research Foundation	1'469'000 €
NOMIS Foundation	1'400'000 €
ÖAW Austrian Academy of Sciences	1'225'000 €
EMBO European Molecular Biology Organization	901'000 €
NFB NÖ Forschung und Bildung	640'000 €
WWTF Vienna Science and Technology Fund	434'000 €
ONR Office of Naval Research	326'000€
Simons Foundation	267'000 €
SNF Swiss National Fund	216'000 €
Microsoft Research	151'000 €
BAYER	150'000 €
NSF National Science Foundation	119'000 €
FFG Austrian Research Promotion Agency	87'000 €
Other	1'739'000 €
Total	**108'432'000 €**

Founding Principles

IST Austria was established in 2006 by the federal government of Austria and the government of Lower Austria, and the campus opened in 2009 in the city of Klosterneuburg, on the outskirts of Vienna. The Institute was founded based on a set of eight principles, which were first formulated by Haim Harari, Olaf Kübler, and Hubert Markl, who distilled them from the world's most successful systems and ideas for research institutes.

Curiosity-driven, basic research

Scientists pursue their interests without limits or predefined research topics.

International

IST Austria brings together scientists and staff from all over the world; employees use English as their working language.

Interdisciplinary

Research on campus is not divided by departments or boundaries; communication and collaboration are encouraged across scientific fields.

PhD-granting

IST Austria pioneers a new kind of graduate education with one Institute-wide PhD program.

Career support and development

Scientists at all levels grow intellectually and professionally. Professors hired early in their careers are on a tenure-track system.

Independent boards

Trustees oversee the Institute; more than half are international scientists. Guidance and advice are also provided by the Scientific Board.

Exploiting results

Excellent basic research leads to unforeseen but useful discoveries, and intellectual property and technology transfer are important objectives.

Diverse funding sources

The Institute is publicly and privately financed. Scientists acquire third-party funds, donations to the Institute are transferred to an endowment, and revenue from technology transfer is a long-term goal.

Core Missions

IST Austria is performance-oriented, and only uses practices that have been successful. The Institute's founding principles remain relevant today, and continue to guide the growth and development of IST Austria as it works toward its core missions.

- **Perform world-class basic research**
- **Train the next generation of scientific leaders**
- **Implement best practices for management in science**
- **Support science education and technology transfer**

Outside Perspectives

Guest Commentary

Many international scientists have provided guidance and advice throughout IST Austria's development, and will continue to do so as the Institute works toward its goals. Professors Angelika Amon, Jonathan M. Dorfan, and Maria J. Esteban are three who have been deeply involved with the Institute: Professors Amon and Esteban are, respectively, member and vice-chair of the Scientific Board of IST Austria, and Professor Dorfan was part of the panel that evaluated the Institute in 2011, as well as a member of the academic review board that recently evaluated the progress of the Institute's PhD program. They provided their thoughts in response to two questions about the Institute and its past and future development.

Q1

Given your first impressions of the Institute, how does IST Austria's progress compare to your expectations?

Q2

Given IST Austria's development since its opening in 2009, what advice would you give the Institute for the future?

Angelika Amon

Professor, Department of Biology, Massachusetts Institute of Technology (MIT)
Member of the Scientific Board

Q1: When I first heard that IST Austria would be built in the middle of nowhere in Lower Austria, I was depressed because I thought that without the critical mass in Vienna, it was never going to work, that the place was doomed to forever be a mediocre university. I could not have been more wrong. Every year I am more amazed at how the place has flourished and how it has developed into a first-rate, cutting-edge research enterprise in Europe. The biology program is especially strong. The only thing I am hoping for is that they will hire more women PIs in the coming years.

Q2: My advice for the future? Stay edgy, continue to take risks, and repeat what you did in biology in chemistry and physics.

Jonathan M. Dorfan

Former President of the Okinawa Institute of Science and Technology Graduate University
2011 Evaluation Panel; 2017 Academic Review Board

Q1: The growth of IST Austria since the 2011 evaluation is most impressive. The faculty has expanded at a rate of about five per year, and by all accounts the quality of those hired is outstanding. The Graduate School has gone from a fledgling entity to a mature and diverse educational construct that is graduating excellent students. Perhaps the largest growth has been in the infrastructure, which is not only supporting a more diverse set of disciplines, but also houses effective core centers of common services. The scale of the technology transfer program is impressive given the small size of the faculty and the newness of the Institute.

Q2: Currently IST Austria is significantly underinvested in physics and chemistry, which greatly limits the possibilities for interdisciplinary research. While the graduate students are excellent, they are too European-centric. IST Austria should aggressively recruit students from North America and Asia.

Maria J. Esteban

Professor, Centre de Recherche en Mathématiques de la Décision, University of Paris-Dauphine
Vice-chair of the Scientific Board

Q1: When I joined the Scientific Board, I had no clear idea what IST Austria was, or at least not in depth. The past years have given me the opportunity to better understand the Institute, its goals, its functioning, and also its needs. IST Austria is growing very well, adding new fields, building and recruiting… The progress is steady and impressive.

Q2: There are some problems that IST Austria does not know how to solve at the moment. A big one is related to the gender imbalance in the faculty, and in some disciplines also at the students' level. IST Austria must find ways to solve this issue. Also, I think that IST Austria should place more emphasis on strengthening interdisciplinarity. This Institute is unique, and the extremely prominent groups that it has managed to build in such a short time should be able to interact more. Or perhaps the hiring strategy could be used to foster this. I would also advise IST Austria to strengthen its relations with other Austrian academic institutions, especially with Viennese universities. Well-designed, this could become a win-win project. As IST Austria's students and young researchers have access to a restricted number of courses and professors on campus, this could add cultural and scientific perspectives.

opening spaces
crossing borders

Training the Next Generation

PhD Students at IST Austria

Educating PhD students is a core mission of IST Austria. Its Graduate School offers an interdisciplinary PhD program that supports students in becoming experts in their fields while fostering communication and collaboration across research groups and disciplines.

The PhD program at IST Austria started in 2010, with a class of seven graduate students, and the goal of pioneering a new kind of graduate education. Over the past seven years, the program has developed and expanded in all aspects, from the available courses to professional development opportunities and beyond. The graduate student population has increased as well: as of December 31, 2017, there were over 150 graduate students at IST Austria, making them the largest group of scientists on campus.

Tracks, curriculum, and rotations

Graduate students at IST Austria can choose from six different tracks of study: biology, computer science, data science and scientific computing, mathematics, neuroscience, and physics. Many faculty are part of multiple tracks, reflecting the interdisciplinarity at the Institute, and allowing students to pursue research topics from a variety of perspectives. Each track has an associated general knowledge course, and regardless of track, students take courses to lay the groundwork for the breadth and depth of knowledge necessary to become leaders in their fields.

One particularly unique aspect of the curriculum is the IST Austria “core course”. Designed by and for the Institute, it is intended to promote communication between fields and teach an understanding of how to model and analyze data. All new graduate students take part in the core course. This year, students worked in groups to tackle a problem related to Professor Gaia Novarino’s research—namely, how to make sense of the heterogeneous genetic causes of autism spectrum disorders. The groups comprised students with diverse academic interests and experience, and they brought together elements of biology, neuroscience, and bioinformatics, as well as methods from computer and data science to make progress towards an open-ended question. The communication and collaboration skills developed in this class will help students to work across disciplines, as well as convey their research to a wider audience.

The three required rotations—short research projects completed with different professors—give students the opportunity to explore their interests in various areas, broaden their knowledge, try out different research styles, and test the waters with potential doctoral advisers. Some rotation cycles are more focused, such as one student who took a tour of quantum physics this year with Professors Lemeshko, Fink, and Katsaros. Other students may take a broader view of research—for example, one recently cycled from random matrices to biophysics and neuroscience to mathematical models of evolution. Allowing students from diverse backgrounds to tailor rotations to their own research interests—whether this entails a focus on research within one area, or an open-minded exploration of different fields—is one part of what makes the IST Austria PhD program both unique and valuable.

Affiliation and doctoral research

Once students decide on their topic of research, they take a qualifying exam and then affiliate with one (or more) research groups. They spend the next three to four years pursuing independent research and working towards their PhD thesis. Students are encouraged to disseminate their work by presenting at conferences and publishing papers—so far, IST Austria graduate students have (co-)authored nearly 200 original works.

Biannual reviews provide students with feedback on their progress. New in 2017 are the 4th-year presentations, which provide graduate students with the opportunity to present their research to their peers, faculty, and other scientists on campus, and receive feedback. The process encourages reflection, and ensures that students are on track for graduation.

Ethics considerations are important in scientific research and publishing. A required course lays the groundwork for ethical considerations and the responsible conduct of research, and as of 2017, all PhD students must fill out a self-assessment form to ensure that the highest ethical standards in research are adhered to.

Preparing for their next steps

The European Union emphasizes the importance of career development measures as part of its “Principles of Innovative Doctoral Training”. IST Austria is committed to supporting graduate students during this time of personal growth and professional development. One aspect of this is scientific presentation and communication, which is addressed through several measures. For instance, one required course gives students the

GRADUATE STUDENTS

How to apply

IST Austria is looking for highly motivated, exceptional students who are passionate about scientific research and have a drive to succeed. Students who have or will complete a bachelor's or master's degree by the time they begin their studies are invited to apply; the deadline is in January for a start in September of the same year. For further information, please consult **https://phd.ist.ac.at**

tools to effectively present their research. Another important skill in this area is teaching: every PhD student must spend at least one semester as a teaching assistant, and many take on additional teaching responsibilities. Some even design and teach their own courses: during 2017, students taught a variety of programming courses, and held math reviews for their fellow students. Teaching excellence is honored every year at the Institute's Internal Awards Ceremony. In 2017, Sebastian Novak, then a graduate student with Nick Barton, received the Institute's "Golden Sponge" Best Teaching Assistant Award.

The career development program at IST Austria is another resource, and organizes on-campus workshops, discussions, and seminars. Topics in 2017 included discussions on professional options for quantitative scientists, project planning and management workshops, and "Ask a Professor" panels, among others. This program is currently being expanded to include additional career events such as alumni talks, and from 2018 on, students (and postdocs) will have the opportunity to receive one-on-one career counseling, and be able to access a comprehensive online career portal.

Graduate student involvement

PhD students also have opportunities to organize events and engage with the campus in other ways. In 2017, graduate students organized the Young Scientists' Symposium for the sixth time in a row. The theme for 2017 was "Bits, Brains, and Cells: Memory across Sciences", and the six keynote speakers approached the topic from a variety of perspectives, including electrical engineering, neuroscience, and quantum networks.

All PhD students at IST Austria are represented by the Graduate Student Association (GSA). The GSA serves as a platform for exchanging opinions and fostering communication between students, and constitutes an interface between the graduate students of IST Austria and the rest of the Institute. There are two elected student representatives who communicate students' ideas, feedback, and criticism to the management and faculty. Regular meetings, organized by the GSA, promote the discussion of current issues and support networking between students. In addition, the GSA organizes a graduate student retreat every fall, just after the new students arrive. This year, the graduate students spent a weekend in Mariazell, Austria, getting to know each other better, exchanging thoughts and ideas—and simply enjoying themselves!

Graduation

Over the course of 2017, 15 students completed the doctoral requirements and received their PhD degrees. For a complete list of these students, their groups, and the titles of their dissertations, see the "Facts & Figures" section. The Institute celebrates its graduates every year during a ceremony in June. The Best Thesis Award is also given out during the ceremony; the 2017 winner was Anastasia Pentina, who completed her thesis work on "Theoretical Foundations of Multi-task and Lifelong Learning" under the supervision of Christoph Lampert.

Funding and grants for doctoral students

Every PhD student is a full-time employee of IST Austria for the duration of their studies. The ISTScholar PhD program is co-funded by the European Union's Horizon 2020 research and innovation program through a Marie Skłodowska-Curie grant. The European Union co-funded the ISTScholar PhD program for the 2016 and 2017 cohorts of incoming students, and will continue their support in the 2018-2019 academic year. The EUR 4.4 million grant supplements the costs of each student's first two years in the PhD program. Thereafter, the doctoral supervisor of each student supports them until the completion of their degree.

External funding schemes also have positive effects on promising early-career researchers. Planning a multi-year research project and presenting it in a project proposal are crucial skills, essential for the success of a scientist. A highlight of this year, five PhD students were awarded highly competitive DOC stipends by the Austrian Academy of Sciences. The stipend, which is worth EUR 38'500 per year per stipend, will fund their PhD research for a duration of three years, resulting in a total of EUR 115'500 per stipend. The 2017 awardees were Andi Harley Hansen, Stephanie Kainrath, Hana Semeradova, Julia Steiner, and Stephanie Wachner.

Internships and mobility

Graduate students have the opportunity to take short-term internships in industry and at other research institutions, rounding out their PhD experiences as well as their CVs. A number of graduate students completed internships during 2017; two are profiled here.

Mary Phuong
Lampert Group

Summer 2017 took Mary Phuong to Cambridge, England, where she spent three months at Microsoft Research. Her project there was on methods for representing natural language sentences as vectors, i.e., in a mathematical form. This is a more useful form, which can potentially lead to methods for automatically retrieving similar sentences, creating sentences with the opposite meaning, or modifying sentences along a desired axis. Though Phuong's internship focused on the theory and methodology behind this representation, her work could, for instance, be used to create an email writing app that allows the user to write an email, then have the computer rewrite it automatically by adjusting values for levels of formality, enthusiasm, etc. Phuong found the experience extremely valuable:

"I learned a great deal (of course!), but also met interesting people, improved my CV, and wrote a paper on the project, which we hope to publish soon."

Improving the PhD program

IST Austria works continuously to improve all programs on campus. As part of this, and as mandated by the ISTScholar grant, an external Academic Advisory Board spent two days at the Institute in July 2017 evaluating the PhD program. Comprising eminent scientists and education specialists, the members of the board were Jonathan M. Dorfan (Okinawa Institute of Science and Technology Graduate University), Bart Selman (Cornell University), Chris Golde (Stanford University), Ines Crisostomo (Vienna Biocenter), and Thomas Silhavy (Princeton University). Based on their site visit, presentations and interviews with faculty, students, and the leadership of the Graduate School, their report consisted of a series recommendations that will improve IST Austria's ability to achieve its educational missions.

The ISTScholar PhD program has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665385.

Amir Goharshady
Chatterjee Group

Amir Goharshady spent fall 2017 in Spain, at the Madrid Institute for Advanced Studies in Software (IMDEA), where he worked on a theoretical project: "Model checking hyperproperties in programs". Currently, most model checking approaches only consider program properties that constrain a single run of the program, and verify them for all runs—but what happens if a property points to more than one run? For example, if a program uses a secret value, then any two runs of the program that differ only in that secret value should be indistinguishable to someone who does not have access to the secret. Properties concerning relations between runs were the focus of his project. Goharshady and his collaborators managed to find a new exponential-time algorithm for solving practical cases of the problem—previously, the best result was doubly-exponential—and their results will be published soon. Goharshady, on his internship:

"Besides learning a variety of different approaches to solve logical problems on programs, the change of environment helped boost my productivity, and I was able to get new results on a project I had started before the internship. This led to a publication at ESOP 2018, an international computer science conference."

Opportunities at Every Level

Interns at IST Austria

Training the next generation does not just mean graduate students: IST Austria offers year-round opportunities for bachelor's and master's students from other institutions to intern in a laboratory or with a research group.

An internship in a laboratory or with a research group is a valuable opportunity for bachelor's and master's students for many reasons. The internship programs at IST Austria offer these students the chance to explore and broaden their interests in science, to learn about the process of conducting research and to build connections within academia and among their scientific peers. There are two types of internships available at IST Austria.

ISTernship program: For 8-12 weeks between May 15 and September 15, students from all over the world come to IST Austria to work closely with a faculty or laboratory member on a short research project. This year, 38 ISTerns—selected from over 1'000 applicants—spent their summers researching topics from rendering nanostructures to the applicability of new antibodies. Their research experiences were rounded out with lectures given by faculty and postdocs, and culminated with a poster session where ISTerns presented their projects to the campus community. Though their time at the Institute is short, the ISTerns' work often results in scientific papers. Besides the core mission of training future researchers, the Institute has an additional interest in hosting these young scientists: several former ISTerns have joined IST Austria to pursue their doctorates. The ISTernship program is run in collaboration with the OeAD.

Year-round scientific internships: Interns also join IST Austria throughout the year, collaborating with a particular research group for up to one year. During 2017, the Institute hosted 45 scientific interns in 26 different research groups. These students worked on a variety of projects, ranging from fluid animation to superconductivity in spin-orbit coupled systems.

INTERNSHIPS

How to apply

All bachelor's and master's students in the physical, mathematical, computer, and life sciences are eligible to apply—and the professors at IST Austria are looking forward to welcoming qualified and passionate interns into their research groups! More details on the programs and application deadlines can be found at **https://ist.ac.at/research/internships.**

ISTerns said the following about their summer 2017 experiences:

"It was an amazing experience, and it was a great opportunity for an undergraduate like me to get involved in cutting-edge research!"

"I will highly recommend the internship and PhD program at IST Austria to my friends. And I would like to apply to the doctoral program, too!"

"I am very happy I could take part in the ISTernship program. It was full of new and exciting experiences for me, and I met a lot of friendly and interesting people at IST Austria. I think that this internship is a really great opportunity for young researchers."

Jakob Vorlaufer
Bachelor's student, Technical University of Vienna, Austria

Jakob Vorlaufer was a 2017 ISTern, and is currently working towards his bachelor's in physics. Being interested in experimental and optical physics in particular, the biophotonics group of Johann Danzl represented a great opportunity for him to do an ISTernship. Over the summer, he worked on two projects: First, he performed frequency doubling on a pulsed femtosecond laser and measured the pulse length with an autocorrelator. In this process, the pulse is split, a difference in the path lengths is introduced, and the two pulses are merged; the location of their overlap determines the intensity of a nonlinear process. Second, Vorlaufer built a focus lock based on a feedback laser beam to stabilize the distance between a microscope objective and the imaged sample. As someone interested in various fields, he enjoyed the challenging and interdisciplinary atmosphere in the group, and also gained knowledge in fascinating areas such as cell biology and measurement control. After his ISTernship ended, he continued working on his projects in the Danzl group as a scientific intern, and will also write his bachelor's thesis in the lab.

Antonija Mravak
Research Assistant, ICAST Split, Croatia

As an undergraduate at the University of Split in Croatia, Antonija Mravak studied physics. Her interest in biology then pulled her towards a master's degree in biophysics working with the nematode *C. elegans* as part of her thesis project. Following this—and in true interdisciplinary style—her fascination with neuroscience led her to join the Siegert group as an intern from January to July 2017, where she gained insights into the field and enjoyed working with the group. During her time at IST Austria, she performed *in vivo* experiments on mice to target microglia. In addition, she learned a variety of new imaging techniques and studied microglial behavior on various environmental changes. Soon after her internship in Austria ended, she found a temporary position teaching physics at an elementary school. Starting in 2018, she will work as a research assistant at the Interdisciplinary Center for Advanced Science and Technology (ICAST) at the University of Split, where she will learn about and take part in the theoretical design of new materials for fuel cells.

A Chance to Grow

Postdocs at IST Austria

POSTDOCS

How to apply

Scientists interested in conducting postdoctoral research at IST Austria can apply by contacting professors directly, or by applying for an ISTplus grant. More details can be found on the website: **https://ist.ac.at/research/postdoctoral-research**.

The years following the completion of their PhD are important ones for early career scientists. IST Austria provides postdoctoral fellows with a world-class, interdisciplinary research environment, giving them the resources and opportunity to broaden their experience and deepen their expertise.

Climbing the career ladder

After the completion of their PhD, early career scientists may take one or more positions as a postdoc. This gives them the chance to grow professionally, while not yet shouldering the responsibilities of a research group leader. IST Austria brings together the faculty, facilities, and support to help postdocs develop the skills necessary for their next career steps elsewhere. Already at the beginning of their stay, postdocs assess their professional profiles and skill sets together with a career counselor. During their time at IST Austria, postdocs interact closely with colleagues from different fields through shared facilities, joint projects, and events.

Over the course of 2017, 180 postdocs were part of the campus community, designing and executing research projects, building connections in academia and industry, writing papers, and attending conferences.

Sharing enthusiasm and knowledge

Postdocs at IST Austria also take time to reach out and engage younger generations of scientists. Postdocs are valuable resources for the graduate students on campus, and are often involved in teaching courses. The Institute values excellence in teaching, and this year, postdoc Srdjan Sarikas was honored with the IST Austria "Golden Chalk" Best Lecturer Award for his work. Also during 2017, a variety of outreach programs were designed and carried out by IST Austria postdocs. These initiatives included creating and running a correspondence course in evolutionary biology, programming software for a visual secret-sharing activity, and leading a weekly math club meeting at a high school in Klosterneuburg.

Funding postdoctoral fellows

In order to continue to attract outstanding postdoctoral researchers, IST Austria submitted a proposal for a Marie Skłodowska-Curie COFUND scheme—this would serve as the next generation of postdoctoral funding, following the end of the ISTFELLOW COFUND scheme in June of 2017. Following a competitive, EU-wide application process, IST Austria succeeded in obtaining funds for an interdisciplinary, international, and intersectoral postdoc program in May 2017. The program, called ISTplus, will support postdocs at the interface between science and other sectors, such as industry and policy. These postdocs will have the opportunity to take short-term internships with external partners. With a total award amount of almost EUR 4.6 million, this was the single largest grant obtained so far by IST Austria. A first call for applications for postdoc positions supported by the grant was made in summer 2017 and received 93 applications. Of these, 10 ISTplus fellows will join the Institute. In total, the ISTplus program will support 60 postdocs for up to two years each.

Enderalp Yakaboylu
Postdoc, Lemeshko Group

"I had two motivations for coming to IST Austria: Professor Mikhail Lemeshko and the campus facilities. Before I joined his team, I worked on relativistic strong field ionization, and I was looking for an opportunity to switch topics and expand my knowledge. However, this is generally not so easy in the physics community. Misha gave me this opportunity. Under his excellent supervision, I have made a smooth transition and started to learn the language of many-body physics. My other motivation for coming was IST Austria's interdisciplinary environment, which allows me to exchange ideas with colleagues from different fields. At least once a week, I discuss something with someone from a different research group. In fact, our recent paper, in which we show a new manifestation of magnetic monopoles, is the consequence of such a collaboration."

Enderalp Yakaboylu completed completed his PhD in physics at the Max Planck Institute for Nuclear Physics (MPIK) in Heidelberg, Germany, in 2014, then continued there as a postdoc before joining IST Austria in 2016. For his work, in collaboration with researchers at IST Austria and at MPIK, he received the 2017 IST Austria Scientific Achievement Award.

Zuzana Patáková
Postdoc, Wagner Group

"The main reason I came to IST Austria was to work with Professor Uli Wagner. I like the math Uli is doing, and I had previous collaborations with him. Being at the same place is—for me—the best way to work with someone, and Uli and I have been doing exciting research since then. For instance, in a recent paper we and our collaborators proved that the problem of deciding if a simplicial complex, a kind of geometric object, can be put together in a "nice" way is NP-complete. In other words, we showed there is no algorithm that answers this question efficiently, which answered a nearly 40-year-old open question."

Zuzana Patáková conducted her doctoral research in computer science, with an emphasis on discrete models and algorithms, at the Charles University in Prague, Czech Republic. For the project "Bounding Helly numbers via Betti numbers", she received the Charles University's prestigious Bolzano Prize, which awards students for exceptionally innovative, interdisciplinary work. Before joining IST Austria in November 2016, she did research as a postdoc at the Hebrew University of Jerusalem. At IST Austria, Patáková continues to mix computer science and mathematics, and has particular interests in discrete geometry, algebraic methods, and algebraic topology.

These projects have received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under REA grant agreement No 291734 and from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 754411.

Taking Their Next Steps

IST Austria Alumni

Growing numbers of alumni are leaving IST Austria to make their mark on the world, and the development of their careers offers important feedback to IST Austria as an educational institution. IST Austria alumni have joined universities, research institutes, and companies around the world. Around two thirds have continued in academia, many of them in top international institutions such as Harvard University, Stanford University, MIT, ETH Zurich, and the Max Planck Institutes. In addition, computer scientist Thomas Wies, now at NYU, became the first IST Austria alumnus to receive tenure. Nearly 10 percent of alumni are engaged in industry research activities at companies such as Johnson & Johnson, BMW, and Roche, among many others. More details can be found in the "Facts & Figures" section of this report.

The Institute strives to keep in touch with its alumni, often inviting them back to IST Austria to share their experiences and engage with the campus community. Profiles of a few of the many successful alumni appear opposite; further stories can be found on the alumni homepage: https://alumni.pages.ist.ac.at.

IST Austria graduates at the 2017 ceremony.

Johannes Reiter

Instructor, Stanford University, USA

Johannes Reiter was a PhD student in the Chatterjee group at IST Austria whose thesis work focused on computational and mathematical biology. After graduating, he moved to Harvard University, where he was a postdoctoral research fellow in Martin Nowak's group in the Program for Evolutionary Dynamics. In June 2017, he took a position as an instructor at Stanford at Stanford University. In his research, he develops algorithms and mathematical models to study biological processes, in particular those related to the evolution and treatment of cancer. His research on metastases is funded by an Erwin Schrödinger Fellowship of the Austrian Science Fund (FWF). Reiter was one of the first PhD students to join the Institute. Looking back on his time at IST Austria he says: "I very much liked—from the beginning—the interdisciplinary system at IST Austria. I also enjoyed the fact that in my first and second year I could take courses from different areas. That helped me a lot."

A longer version of Reiter's interview can be found on the IST Austria alumni homepage.

Inma Sanchez Romero

Project Manager and Technology Transfer Officer, University of Vienna, Austria

Inma Sanchez Romero was a postdoc in Harald Janovjak's group at IST Austria. She now works for research services at the University of Vienna as a project manager supporting the INDICAR (Interdisciplinary Cancer Research) Postdoctoral Fellowship Programme and as a technology transfer officer with a focus on chemistry. After earning her PhD in chemistry, for which she worked on protein engineering at the University of Granada in collaboration with Columbia University in New York, Sanchez Romero did a postdoc at IST Austria working in synthetic biology in the Janovjak lab. At IST Austria, she developed an interest in organizing scientific events and research project management in an academic environment. This led to her shifting her career from active research to research management: "Besides all the support in scientific research at IST Austria, I had the opportunity to collaborate and plan and organize scientific events. As a result, I explored and developed my organizational and management skills."

Sanchez Romero joined the expert panel at IST Austria's Science and Industry Day in fall 2017.

Philipp Schönenberger

Research scientist, Roche, Switzerland

Philipp Schönenberger was a postdoc in the Csicsvari group until 2015, when he moved to his current position in industry as a research scientist at Roche, a multinational healthcare company. He works in preclinical drug discovery in neuroscience with a focus on electrophysiology, optogenetics, and data analysis. Schönenberger did his PhD at the Friedrich Miescher Institute for Biomedical Research in Basel before joining Jozsef Csicsvari's group at IST Austria as a postdoc. When asked about the role that IST Austria played in his current career he says: "Here, I learned the concepts behind this kind of research, and gained the expertise necessary to perform it. It was absolutely fun, and also a prerequisite for my current function. Plus, scientifically speaking, this kind of research is the most interesting thing you can do. My worldview is still influenced by these experiences."

Schönenberger returned to campus in spring 2017 and gave current students helpful tips on how to successfully apply for industry jobs.

New Professors in 2018

Research excellence and promise are the key hiring criteria for new faculty at IST Austria. Rather than seeking candidates for very specific areas, the Institute has an annual open call for professors in all fields of science. In addition, with assistance from the Scientific Board, the Institute works to identify outstanding research talent, and lets these scientists and their curiosity define which fields are pursued on campus. This year, six new assistant professors were selected from over 1'300 applicants, and will strengthen the research profile of IST Austria in the physical and life sciences. Two have already joined the campus community, Edouard Hannezo and Florian Schur; more details on their research programs and backgrounds can be found in the "Facts & Figures" section. The four presented here will join the Institute over the course of 2018.

Zhanybek Alpichshev

Zhanybek Alpichshev is an experimental physicist working to understand how large numbers of electrons behave in the presence of strong interactions. After completing his bachelor studies at the Moscow Institute of Physics and Technology, Russia, Alpichshev went to the physics department at Stanford University, USA, where he used scanning tunneling microscopy to study surface states in topological insulators. After receiving his PhD degree in 2012, he became a postdoc at the Massachusetts Institute of Technology, working on ultrafast spectroscopy of strongly correlated materials with a focus on the behavior of non-equilibrium excitations in frustrated Mott insulators such as Na_2IrO_3. In his new position, Alpichshev will apply the methods of ultrafast non-linear optical spectroscopy to analyze condensed matter systems. This will include studying the non-linear response functions of strongly correlated materials under various conditions as well as exploring the behavior of many-body systems in the presence of strong periodic driving.
Joining IST Austria in August 2018.

Carrie Bernecky

One of the Institute's new structural biologists, Carrie Bernecky works to understand the molecular mechanisms by which RNA controls human gene regulation. Bernecky completed her undergraduate education with a double-major in chemistry and biology at Cornell University, USA, then moved to Boulder, also in the USA, for her doctoral research in biochemistry. She received her PhD in 2010 for her work on the molecular architecture of the human transcriptional coactivator Mediator in complex with RNA polymerase II. Since then, Bernecky has conducted research as a postdoc in the Gene Center at the Ludwig Maximilian University of Munich and at the Max Planck Institute for Biophysical Chemistry in Göttingen, both in Germany. Her work at IST Austria will focus on unraveling how ncRNAs regulate transcription, and how RNA activity itself can be regulated through post-transcriptional processes. Bernecky will be one of the primary users of the Institute's upcoming cryo-EM facility, and will also employ X-ray crystallography in her research, among many other biochemical and structural methods.
Joining IST Austria in January 2018.

Onur Hosten

Quantum physicist Onur Hosten seeks to better understand and exploit the quantum mechanical world of atoms and light. As an undergraduate at Hacettepe University, Turkey, he studied physics engineering, then moved to the University of Illinois at Urbana-Champaign, USA, to conduct research in quantum optics and quantum information. While there, he experimentally demonstrated several new applications of quantum measurement techniques. After receiving his PhD in 2010, he joined the physics department at Stanford University, USA, as a postdoctoral researcher. His work there focused on cavity quantum electrodynamics with large ensembles of atoms for entanglement-enhanced measurement science. With his new group at IST Austria, Hosten will work to develop new precision sensing methods that make use of quantum entanglement, with the long-term goal of exploring deep and challenging questions related to, for instance, the nature of dark matter, or the interplay between gravity and quantum mechanics.
Joining IST Austria in May 2018.

Maria Ibáñez

A physical chemist, Maria Ibáñez brings together a variety of ideas, techniques, and disciplines, including material science, physics, thermoelectricity, energy harvesting, and nanocomposites to understand and develop functional nanomaterials. Ibáñez earned her bachelor's in physics at the University of Barcelona, Spain, then remained there for her master's in physical engineering, as well as her PhD in physics. While earning her doctorate, she also spent time in labs at the CEA Grenoble, University of Chicago, Caltech, and Cornell University. She received her doctorate in 2013, then conducted research in both the USA (Northwestern University) and Spain (IREC), before joining ETH Zurich, Switzerland, as a research fellow. With her group at IST Austria, she will focus on the synthesis of high-quality inorganic nanocrystals, the engineering of their surface, and their assembly and consolidation into functional nanocrystal-based solids to target applications such as thermoelectricity or catalysis, as well as developing a fundamental understanding of structure-property relationships.
Joining IST Austria in September 2018.

providing perspectives
supporting careers

Biology

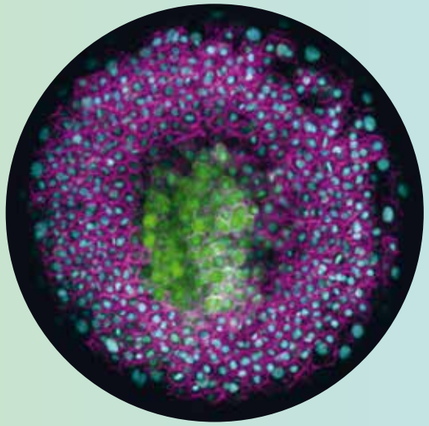
Biology, the study of living organisms in all their forms and phenomena, covers a wide range of questions—and similarly, biology research at IST Austria covers a wide range of research areas.

In 2017, biologists investigated questions including: How can bacteria with the same genotype still behave differently? What are the mechanisms by which vertebrate embryos take their shapes? How can social insect colonies defend themselves against infections? How can synthetic physiology be used to understand and manipulate cell signaling? Biology at IST Austria is a highly interconnected research area, with many collaborations both within and outside the immediate subject area.

Strange undertakings

Cremer Group

Ant queens usually focus on reproduction and do not engage in any risky or dangerous tasks, but 2017 PhD graduate Christopher Pull and Professor Sylvia Cremer have discovered that queens may bury other queens—a task normally performed by workers—to avoid infection when co-founding a new colony. In their study, published in *BMC Evolutionary Biology*, the team found that in cases where two ant-queens founded a colony together, and one of the queens died before the first workers emerged, the surviving queen performed "undertaking behaviors"—that is, behaviors directed at dead individuals, such as biting and burying the corpse, thereby preventing pathogen transmission. Their analysis showed that biting and burial of the cofoundress' corpse decreased seven fold the risk of dying for the surviving foundress compared to queens that did not perform undertaking behavior. The study substantiates the importance of hygiene at all life stages of the colony and reveals the behavioral flexibility of queens. Image: cofounding queens with brood.



Friction shapes zebrafish embryos

Heisenberg Group

A simple ball of cells is the starting point for humans—and zebrafish. At the end of embryonic development, however, a fish and a human look very different. While many biochemical signals involved in this process are known, the mechanical forces that shape the embryo have not been well studied—so far. In a study published in *Nature Cell Biology*, Postdoc Michael Smutny and Professor Carl-Philipp Heisenberg showed that friction between moving tissues generates force. This force is a key mechanism for the rearrangement of tissues during embryonic development. In particular, it regulates the formation of the neural tube, the precursor to the central nervous system. Image: a dorsal section through a zebrafish embryo during gastrulation.

When green means stop

Janovjak Group

Optogenetics, a technique that uses light to control key cellular processes, has revolutionized how researchers investigate cellular signaling pathways, cellular behavior and the function of tissues such as the brain. Light-sensitive proteins power optogenetics, and many of them have been engineered to bind to each other when stimulated by light. PhD student Stephanie Kainrath and Professor Harald Janovjak expanded this optogenetic protein toolbox. In work published in *Angewandte Chemie*, they repurposed light-sensitive domains that release their binding when exposed to green light. Researchers can now leave their study object in the dark to induce signaling, and move it into light at a precise time to interrupt signaling, preventing bleaching and the toxic side effects of light. Image: Kainrath tests the influence of green light on cultured cells in incubators with commercial LEDs.

Faculty Mathematical Models of Evolution NICK BARTON | Hormonal Cross-Talk in Plants EVA BENKOVÁ | Behavioral and Evolutionary Ecology SYLVIA CREMER | Nanoscale Photonics for Biology JOHANN DANZL | Developmental and Cell Biology of Plants JIŘÍ FRIML | Systems and Synthetic Biology of Genetic Networks CĂLIN GUET | Physical Principles in Biological Systems EDOUARD HANNEZO | Cell and Developmental Biology CARL-PHILIPP HEISENBERG | Tissue Growth and Developmental Pattern Formation ANNA KICHEVA | Evolutionary Genomics and Related Disciplines FYODOR KONDRASHOV | Self-Organization of the Cell MARTIN LOOSE | Structural Biology of Membrane Protein Complexes LEONID SAZANOV | Structural Biology of Cell Migration and Viral Infection FLORIAN SCHUR | Neuroimmunology in Health and Disease SANDRA SIEGERT | Invasive Migration of Immune Cells DARIA SIEKHAUS | Morphodynamics of Immune Cells MICHAEL SIXT | Biophysics and Neuroscience GAŠPER TKAČIK | Sex-Chromosome Biology and Evolution BEATRIZ VICOSO

Computer Science

Computer science at IST Austria stands out among similar departments at other institutes in two particular ways.

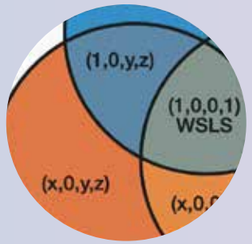
First, all computer science groups share an appreciation for foundational thinking, and base their research on a mathematically rigorous foundation. New insights are made, and new algorithms and formalisms developed, based on mathematical concepts and computational reasoning.

Second, the groups work to foster interdisciplinarity, strengthening the ties between the life and formal sciences—one of IST Austria's signature characteristics. This year, scientists asked questions such as: How can cryptocurrencies be made more sustainable? How can computers be trained to identify images? When do efficient solutions exist for optimization problems under certain constraints?

Equipping form with function

Bickel Group

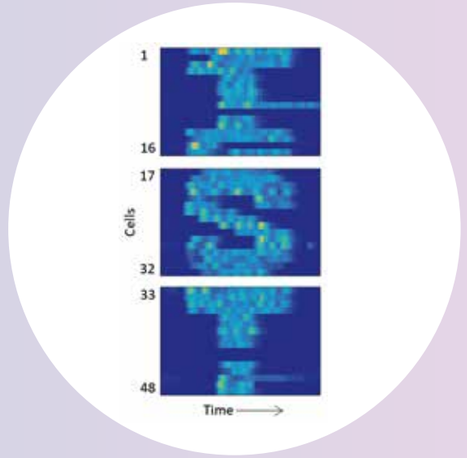
Many common toys such as steerable cars or waving wind-up figures are available as 3D-printable models that also contain their mechanical components. However, these mechanical structures are optimized to fit one particular shape of the toy, and if designers want to reuse a mechanism with different shapes, the necessary manual adjustments to the individual components are often unmanageable for non-experts, besides being extremely tedious. This year, scientists in the Bickel group, in collaboration with colleagues from Adobe Research, solved this problem by developing an interactive design tool that allows users to easily adjust a mechanical template to the shape of their choice. The software tool, which will be made available in the future, was presented by first author and PhD student Ran Zhang at the prestigious SIGGRAPH conference in summer 2017. Image: a functional model created using the software.



Evolution of cooperation through longer memory

Chatterjee Group

Decisions about whether or not to cooperate with someone are usually based on past experiences with that person, as well as the possibility of them returning the favor. These factors are then weighed against the possible benefits of not cooperating. Though important, accounting for long-term memory quickly becomes computationally intractable in simulations, and in the past, researchers have generally had to limit the possible strategies, or only allowed players to make decisions based on the previous round. To overcome this challenge, Postdoc Christian Hilbe, Professor Krishnendu Chatterjee, and their collaborators developed an alternative approach: they distilled a set of axioms that every robust cooperative strategy should have, and characterized the strategies that satisfy these conditions. Using this, the group was able to show that remembering more rounds increased the likelihood of cooperation between players evolving. They were also able to make predictions for a variety of cooperative situations. Image: different types of strategies and how they relate.



Virtual reality for bacteria

Guet and Tkačik Groups

An interdisciplinary team, including experimental biologist Remy Chait and control engineer Jakob Ruess, as well as Professors Călin Guet and Gašper Tkačik, has managed to control the behavior of individual bacteria by connecting them to a computer, creating a simulated environment that cells can interact with, and that responds to cells' reactions. Their experimental setup has implications in computer science as well as biology. One potential application is in synthetic biology: when scientists engineer a microorganism to fulfill a certain task, e.g. produce an antibiotic as part of its metabolic cycle, they usually have to make numerous changes to the original organism, but the combined effect of these changes is unpredictable. Their new setup could make it possible to "debug" complex biological systems in the same way complex computer codes are debugged: by testing each part individually while simulating its surroundings in a form of virtual reality. Image: the setup can be used to control individual cells to emit fluorescence, much like pixels in a conventional display, and thus form any desired image sequence.

Faculty Distributed Algorithms and Systems DAN ALISTARH | Computer Graphics and Digital Fabrication BERND BICKEL | Game Theory and Software Systems Theory KRISHNENDU CHATTERJEE | Algorithms, Computational Geometry and Topology HERBERT EDELSBRUNNER | Design and Analysis of Concurrent and Embedded Systems THOMAS A. HENZINGER | Computer Vision and Discrete Optimization VLADIMIR KOLMOGOROV | Computer Vision and Machine Learning CHRISTOPH LAMPERT | Cryptography KRZYSZTOF PIETRZAK | Discrete and Computational Geometry and Topology ULI WAGNER | Computer Graphics and Physics Simulation CHRIS WOJTAN

Mathematics

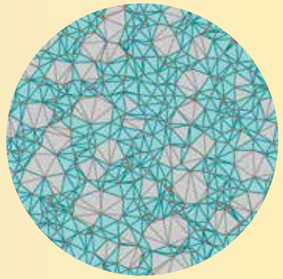
Mathematics allows us to distill ideas and observations, to abstract to their fundamentals, and precisely define concepts and objects and the connections between them. It provides a language to formalize quantitative aspects of the natural sciences, and a way of thinking that is useful across a wide spectrum of research fields.

Mathematicians at IST Austria understand their areas deeply, and combine this with the ability and openness to communicate with scientists in other disciplines. They have interests in a variety of areas, from analysis to topology to combinatorics to mathematical physics and beyond. In 2017, they explored a wide range of questions, including: How can we use topology to understand and interpret data? Can a labeled triangulation of the plane be transformed into any other labeled triangulation—and is there a fast algorithm to do this? How does the geometry of a space affect the movement of quantum particle systems within it?

Mathematical foundations of evolutionary genetics

Barton Group

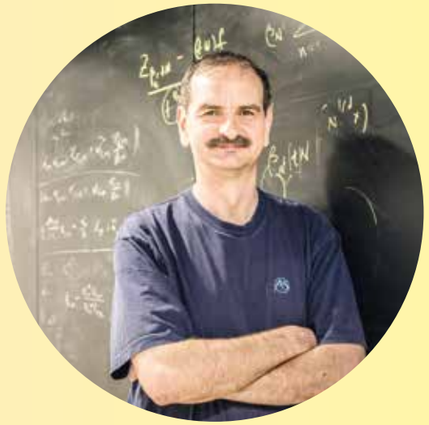
Rooted in observations made in the late 1800s, and established mathematically by Fisher in 1918, the infinitesimal model is a simple and robust model for the inheritance of complex traits, such as leg length. The basic idea is that if very many heritable factors contribute, then the trait could have a continuous range of values. Fisher relied informally on the central limit theorem, which states that when independent random variables are added, their sum tends toward a normal distribution (i.e. a bell curve). However, even though the infinitesimal model is the basis of practical plant and animal breeding, it had not been mathematically justified, or even precisely defined, until a 2017 paper by the Barton group and their collaborators. Now, they are working on extensions of these ideas, to allow for genetic linkage. In one project, they are analyzing an experiment in which mice were selected, leading to an increase in leg length of 3.5 standard deviations over 14 generations. Under the infinitesimal model, this can be explained by the increase in blocks of genome that increase the trait.



Discrete Morse theory for Poisson-Delaunay mosaics

Edelsbrunner and Wojtan Groups

Suppose you take a set of points scattered randomly in the plane, and connect the points according to a certain set of rules, ending up with a partition of the plane into triangles, called a *Delaunay mosaic*. Now, repeat this with different sets of points, but the same rules for forming triangles. What can be said in general about the topological features that appear? Recently, Professor Herbert Edelsbrunner, and PhD students Anton Nikitenko, Katharina Ölsböck, and Peter Synak used discrete Morse theory to prove a number of new results in the theory of random geometric complexes—a more general problem that includes the example above—with the goal of learning more about the stochastic topological features of random data, such as the number of connected components that form. In their upcoming work, the team uses simulations to illustrate the results (image), as well as formulate conjectures about the stochastic topological behavior of Delaunay mosaics and other objects.



Universality in Wigner random matrices

Erdős Group

In the 1950s, physicist Eugene Wigner was studying energy levels in atomic nuclei. At that time, it was not possible to predict these energy levels based on fundamental physical principles, so Wigner represented their statistical behavior using the eigenvalues of a matrix with randomly chosen entries. This was an extraordinary leap of intuition, and led to research in and applications of random matrices. There are, however, many different ways of randomly choosing the entries in such a matrix. But regardless of the method, researchers observed the same statistical patterns emerging in simulations of large random matrices. These patterns seemed to be universal, and the question of whether the observations could be formalized in a mathematical proof became known as the universality conjecture. Professor László Erdős (image) and his collaborator, Professor Horng-Tzer Yau, recently proved this conjecture; for this work, they were awarded the prestigious Leonard Eisenbud Prize in January 2017.

Faculty Mathematical Models of Evolution NICK BARTON | Algorithms, Computational Geometry and Topology HERBERT EDELSBRUNNER | Mathematical Physics, Probability LÁSZLÓ ERDŐS | Theory of Partial Differential Equations, Applied and Numerical Analysis JULIAN FISCHER | Geometry and its Interfaces TAMÁS HAUSEL | Stochastic Analysis, Optimal Transport JAN MAAS | Quantum Statistical Mechanics, Mathematical Physics ROBERT SEIRINGER | Discrete and Computational Geometry and Topology ULI WAGNER

Neuroscience

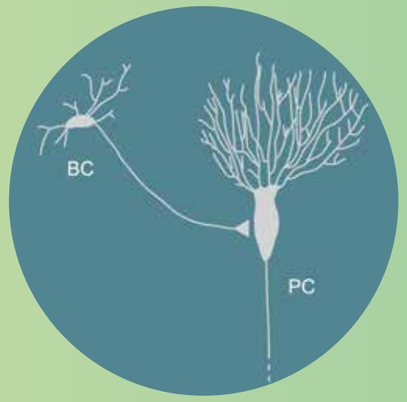
Neuroscientists investigate the nervous system to understand how our brains—and those of other animals—work. Neuroscience is a highly interdisciplinary area, with strong links to mathematics, computer science, and physics, and the research backgrounds of neuroscientists at IST Austria are, accordingly, diverse.

This year, they sought answers to questions such as: How is the production of nerve cells controlled? Which brain areas are important for memory formation? Which roles do parts of the molecular machinery play in sending signals between neurons? What is the basis of neurodevelopmental disorders, such as epilepsy or childhood dementia?

How neurons and glia cells are created

Hippenmeyer Group

Neurons and glia are the cells that make up our brains. In the cortex, the brain area that gives us the ability to think, speak and be conscious, neurons and most glia are produced by radial glia progenitors (RGPs). But how is this production of neurons and glia cells controlled? Postdoc Robert Beattie and Professor Simon Hippenmeyer reported in *Neuron* that a certain gene called *Lgl1* is required. In the early mouse embryo, *Lgl1* is needed in all RGPs for cortical neuron production. After birth, *Lgl1* is only required in specific RGPs for glia and neurons to be generated correctly. So, while the whole orchestra is needed to play the symphony (or generate neurons in the embryonic cortex), only the soloist is needed for a solo (produce neurons or glia in the postnatal cortex).



Roles for enigmatic synaptic proteins identified

Jonas Group

In our brains, neurons communicate by sending chemical signals across their connections, called synapses. Synaptotagmins are part of the complex molecular machinery required to send such a signal. Synaptotagmin proteins come in many flavors: humans and other mammals have 17 different varieties. The functions of a majority of these proteins, however, are not yet understood. In two studies published this year in *Cell Reports*, PhD student Chong Chen and Professor Peter Jonas identified the functions for two synaptotagmins. They showed that synaptotagmin 2 is the calcium sensor which allows synapses that use the neurotransmitter GABA to achieve their remarkable signaling speed, while synaptotagmin 7 ensures the efficiency of high-frequency inhibitory synaptic transmission. Image: synaptotagmins ensure the speed and efficiency of inhibitory synaptic transmission.

The role of immune cells in childhood dementia

Siegert Group

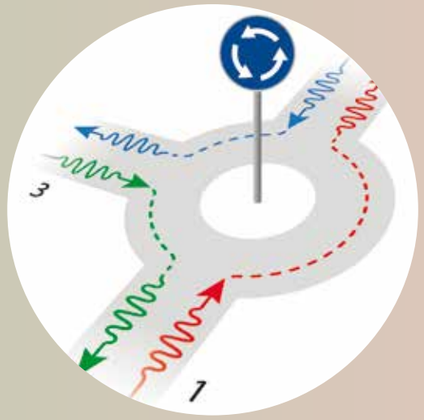
Dementia is commonly thought of as a disease that develops late in life. But around 50'000 children worldwide suffer from early dementia, called neuronal ceroid lipofuscinosis (NCL). Although 14 inherited disease-causing genes have been described, no cure for NCL exists. The disease starts with vision loss and invariably leads to early child's death. This year, Postdoc Rajeshwari Meli (left) received received the prestigious FWF Hertha Firnberg Grant to investigate what role microglia, a type of cell involved in the brain's immune defense, play in NCL. The study is based on the previous work of Professor Siegert (right), which showed that microglia in the mouse retina are highly enriched for a set of NCL-causing genes. In this project, they will study the human microglia that carry these disease-causing genes, and analyze their functions. The study will give important insights into what role microglia play in NCL, with the potential of offering new strategies for cell-based therapeutic drug approaches.

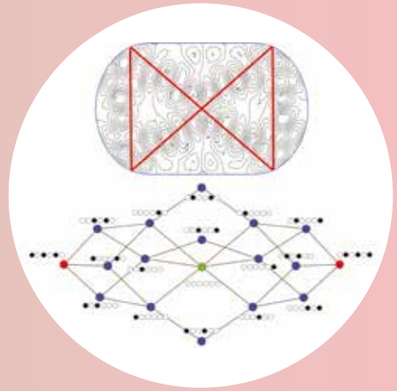
Faculty Systems Neuroscience JOZSEF CSICSVARI | Nanoscale Photonics for Biology JOHANN DANZL | Genetic Dissection of Cerebral Cortex Development SIMON HIPPENMEYER | Synaptic Communication in Hippocampal Microcircuits PETER JONAS | Neuroethology MAXIMILIAN JÖSCH | Genetic and Molecular Basis of Neurodevelopmental Disorders GAIA NOVARINO | Molecular Neuroscience RYUICHI SHIGEMOTO | Neuroimmunology in Health and Disease SANDRA SIEGERT | Biophysics and Neuroscience GAŠPER TKAČIK

Physics

Physics is one of the oldest and most fundamental disciplines, and at IST Austria, scientists have approached questions in and inspired by this field from many different perspectives, using both experimental and theoretical methods. The diverse interests of the physics groups have led to questions such as: How can turbulence in fluids be calmed? How do biological systems perform computations? What can be learned about holes in self-assembled nanostructures?

Research in physics often leads to technological advances, as scientists design new materials and machines to test their ideas and discoveries lead to novel applications. Physicists at IST Austria push boundaries in both aspects, and their research has led to developments in quantum devices, high-performance optical imaging, and more.





Essential quantum computer component downsized

Fink Group

Qubits, or quantum bits, are the key building blocks that lie at the heart of every quantum computer. In order to perform a computation, signals need to be directed to and from qubits, which are extremely sensitive, and must therefore be shielded from unwanted signals, in particular magnetic fields. It is thus a serious problem that the devices built to shield qubits—nonreciprocal devices—are themselves producing magnetic fields. Plus, they are several centimeters in size—another serious problem, given that a large number of such elements is required in each quantum processor. This year, the Fink group (simultaneously with competing groups in Switzerland and the United States), was able to decrease the size of nonreciprocal devices by two orders of magnitude. Their device, whose function they compare to that of a traffic roundabout for photons (image), is only about a tenth of a millimeter in size, and importantly, it is not magnetic.

New manifestation of magnetic monopoles discovered

Lemeshko and Seiringer Groups

The startling similarity between the laws of electricity and the laws of magnetism has been known since the 19th century. However, the one piece that would make the two perfectly symmetric was missing: magnetic monopoles. While magnetic monopoles in the form of elementary particles remain elusive, there have been some recent successes in engineering objects that behave effectively like magnetic monopoles. Now, Postdocs Enderalp Yakaboylu and Andreas Deuchert, together with Professor Mikhail Lemeshko, have shown that there is a much simpler way to observe such magnetic monopoles. Using a new quasiparticle previously proposed by Lemeshko (image), they demonstrated that superfluid helium droplets act as magnetic monopoles from the perspective of the molecules that are immersed inside them. These droplets have been studied for decades, but this property had gone entirely unnoticed until the interdisciplinary team put their minds to it.

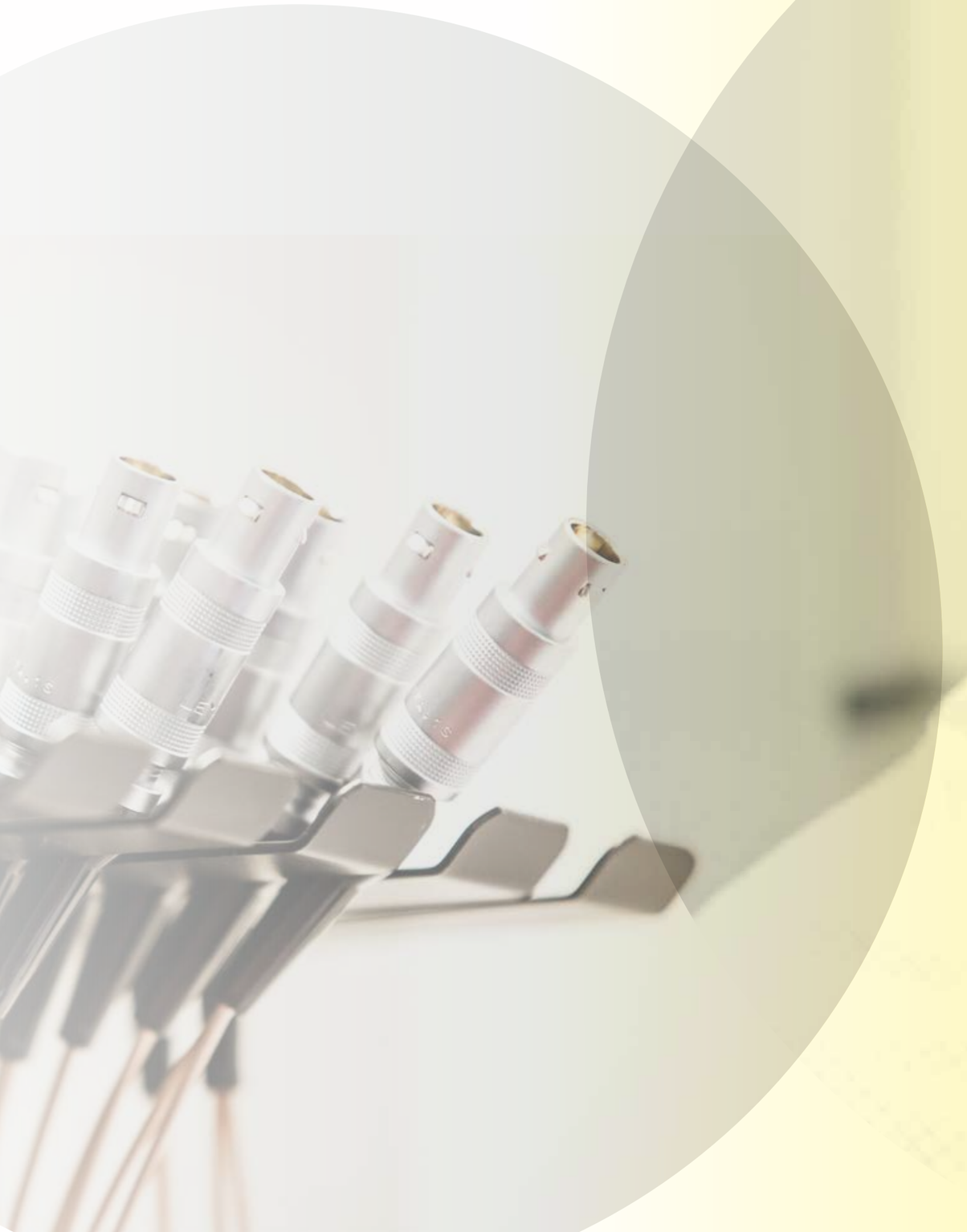
Many-body quantum scars

Serbyn Group

Naively, the word “chaos” implies a lack of any order and structure. In reality, chaos implies the presence of *hidden* order, which is often encoded by unstable periodic trajectories, like the one shown in the chaotic billiard (image, top). These trajectories lead to “quantum scars” in quantum eigenstates that are localized in the vicinity of the corresponding classical orbit. The Serbyn group and their collaborators recently generalized the notion of quantum scars to a system of many interacting degrees of freedom. There, the analogue of a classical orbit is the periodic dance of all atoms between excited and ground states (image, bottom). Such quantum scarred states can be created and manipulated experimentally, leading to long-lasting coherent oscillations in an otherwise relaxing quantum system. Their finding suggests a new universality class of quantum dynamics intermediate between thermalized and integrable systems.

Faculty Nanoscale photonics for biology JOHANN DANZL | Mathematical Physics, Probability LÁSZLÓ ERDŐS | Quantum Integrated Devices JOHANNES FINK | Self-Organizing Principles in Biological Tissues EDOUARD HANNEZO | Turbulence, Fluid Dynamics, Bio-Fluidics BJORN HOF | Nanoelectronics GEORGIOS KATSAROS | Theoretical Atomic, Molecular, and Optical Physics MIKHAIL LEMESHKO | Quantum Statistical Mechanics, Mathematical Physics ROBERT SEIRINGER | Condensed Matter Theory and Quantum Dynamics MAKSYM SERBYN | Biophysics and Neuroscience GAŠPER TKAČIK

encouraging collaborations
across scientific fields



Communicating Science

Over the course of 2017, IST Austria organized and hosted numerous scientific events, encompassing a wide variety of formats and disciplines. Ranging from colloquium lectures given by renowned scientists to special-topics conferences, these events brought science enthusiasts—members of the general public as well as top researchers—to campus to exchange ideas and discuss the latest scientific trends and discoveries. Four of the many events held on campus are highlighted here; a list of major talks and conferences can be found in the “Facts & Figures” section.

Science and Society Lecture – Walter Scheidel

On March 29, 2017, Stanford Professor Walter Scheidel took his audience of more than 220 people on a quantitative journey through history with his talk “The great leveler: violence and economic inequality from the Stone Age to the future”. He examined how, for thousands of years, economic inequality has been a defining feature of civilization, and how only violent shocks have significantly reduced inequality, before considering the prospects of economic leveling in today’s more stable world. A lively discussion followed the talk.

AXON 2017

IST Austria is proud to have welcomed more than 160 participants from all over the world to the European Conference on Molecular and Cellular Mechanisms of Neural Circuit Assembly (AXON2017), which took place on September 11-14, 2017. The conference was designed to attract and engage the best researchers in the field, and create an interactive platform for the exchange of ideas and latest technologies.

ANA 2017

The 15th meeting of the Austrian Neuroscience Association (ANA) was a huge success, bringing nearly 200 neuroscientists to campus at the end of September. Highlights of the congress included plenary lectures by invited speakers, such as Andreas Luethi, who talked about “deconstructing fear”. Another highlight was the Otto Loewi Award Ceremony, during which this prestigious prize was awarded to Professor Ruth Drdla-Schutting of the Medical University of Vienna, for her work on mechanisms of pain in the spinal cord in general, and of pathological pain in particular.

IST Lecture – Michael I. Jordan

IST Lectures are given by eminent scientists who are invited to present their research to the general public and the scientific community. As part of this series, UC Berkeley Professor Michael I. Jordan, one of the world’s most influential computer scientists, came to IST Austria to speak about “Computational thinking, inferential thinking, and data science”. The November 8 event saw the Raiffeisen Lecture Hall at IST Austria filled to the last seat: around 240 people came to hear about new perspectives on addressing the rapid growth in the size and scope of datasets.

Outreach and Science Education

A key role of research institutions is to share the wonder, excitement, and methods of scientific research, as well as the discoveries that result, with their local and global communities. With this in mind, IST Austria reaches out to the general public, especially to elementary and high-school students, through numerous community and science education events organized on campus, as well as by participating in many regional scientific events.

Science education in particular is a key mission of the Institute: it is essential to expose students to scientific discoveries and thinking, and build enthusiasm for science from early on, and to continue to foster curiosity and deeper learning as children grow. Scientists and scientific institutes can contribute expertise and facilities, adding breadth and depth to classroom and extracurricular activities. In order to expand current programs and develop new projects and partnerships in science education, IST Austria held several workshops designed to connect teachers and researchers over the course of 2017. A list of outreach events can be found in the “Facts & Figures” section; presented here are four highlights from the year.

Open Campus

IST Austria opens its doors to the public every year in spring, and invites everyone interested in science to explore a research exhibition, attend a general science lecture, and tour the laboratories, as well as to relax and enjoy the campus. This year, nearly 2000 visitors looked through microscopes into the world of fruit flies, tried their hands at various geometric and tiling problems, took a moment to ponder questions about evolution and the brain that are still baffling researchers, and much more. Professor Bernd Bickel wowed his audience with the possibilities for 3D-printing during the family science lecture, and schoolchildren who had taken part in a regional contest to submit “ideas of today for the world of tomorrow” were honored, and the winners announced.

Summer Camp for Science Youngsters

Every year at the end of summer, over fifty primary school children participate in IST Austria’s “Sommercampus”, where they take their first steps into the world of science and art. This year for the first time, the camp was organized jointly with the Museum Gugging, and students were split into four groups: biology, physics, computer science, and art. Their curricula ranged from discovering the elements of life and designing robots to measuring invisible forces and experimenting with colors and shapes. The week also included a treasure hunt and a very dramatic egg drop. On the final day, the pupils put together an exhibition for their parents and the campus community, at which they displayed and explained their projects. The week concluded with a ceremony in the Raiffeisen Lecture Hall, where the children received diplomas recognizing their accomplishments.

Children’s University of Vienna

In 2003, the first children conquered the University of Vienna. Now, 15 years later, the Vienna Children’s University is one of the largest science education projects in Europe, and IST Austria joined as a partner for the first time in 2017. Why is one ant different from another? How do animals adjust to different habitats like the desert, water, or the jungle, and why do they have different appearances? These were some of the questions that were explored during the Vienna Children’s University’s first excursion to IST Austria. About 150 children from Tulln and Vienna participated, and the Institute looks forward to welcoming the “KinderUni” again in 2018.

How do plants dance?

“Wie tanzen Pflanzen?” is a research project for primary school children developed by Professor Eva Benková and her group that is designed to convey the principles of plant development and observation as a scientific method. Over the course of summer, 25 pupils from a local school discovered the principles of how plants grow and drink during three half-day sessions and in experiments they ran on their own. During the first meeting, the Benková group gave a short talk about plants and their organs, and explained the experiment. At the end of summer, the class presented the plants they had grown and discussed their observations. A hands-on and minds-on activity, the students also prepared sunflower samples for a microscope in a session supervised by the Bioimaging Facility. The project will be developed further, and in the future made available to a larger number of schools in Austria.

pursuing scientific interests
exploiting results

Scientific Service Units at IST Austria

Cutting-edge science requires cutting-edge equipment and state-of-the-art facilities. To ensure availability, cost-effective usage, and optimal maintenance of these facilities, IST Austria organizes them centrally as the Scientific Service Units (SSUs), an approach that also fosters collaboration between research groups.

First set up in 2009, the SSUs have grown to 102 employees in eight facilities with the aim of providing know-how and service through central acquisition, customized development, and training. This infrastructure can be used by any research group at IST Austria, as well as by external users.

Eight Scientific Service Units are operational at IST Austria:

Bioimaging Facility: The Bioimaging Facility supports cell biologists with state-of-the-art microscopes and flow cytometry equipment.
Electron Microscopy Facility: The Electron Microscopy Facility provides electron microscopes, as well as sample preparation and image analysis facilities for the life sciences, physics, and chemistry. In 2018, the Electron Microscopy Facility will expand its portfolio to include cryo-EM infrastructure. More details about this addition can be found in the highlight on the right.
Nanofabrication Facility: The Nanofabrication Facility develops, optimizes, and maintains micro- and nanofabrication processes.
Library: The mainly electronic library provides access to all types of scientific information, including eJournals, eBooks, and databases, and supports open scientific communication.

Life Science Facility: The Life Science Facility supports experimental biologists by providing laboratory infrastructure for the biological sciences such as refrigerators and centrifuges. In addition, the LSF supplies a wide spectrum of supplies for experiments, from liquid nitrogen to agar plates, and runs the fish and plant facilities.
Miba Machine Shop: The Miba Machine Shop produces and provides custom-tailored mechanical and electronic equipment and setups for all experimental research groups.
Preclinical Facility: The Preclinical Facility provides the infrastructure for research groups using laboratory animals for scientific experiments. Breeding, documentation, and genetic identification of transgenic mouse and rat strains are part of its main duties, which also include hygienic sanitation of mouse strains.
Scientific Computing: Scientific Computing supports theoretical and experimental researchers for all scientific computing needs, primarily by providing a high-performance computing cluster.

Staff Scientists
Staff scientists work closely together with various research groups on campus, organize trainings in preparation, imaging, and analysis techniques, and assist in the development of SSUs at the Institute. Typically associated with a specific SSU, staff scientists possess skills, expertise, and experience not usually present within the research groups, and their support and collaboration are critical to the success of a variety of projects at IST Austria. The Institute currently employs four staff scientists (above, from left to right).
Robert Hauschild, Bioimaging Facility
Walter Kaufmann, Electron Microscopy Facility
Jack Merrin, Nanofabrication Facility
Christoph Sommer, Bioimaging Facility

Cryo-Electron Microscopy at IST Austria: an investment in cutting-edge technology
Cryo-EM, a new technology that allows scientists to image biological structures at near-atomic scales, has led to a series of breakthrough discoveries in biology in recent years. Using cryo-EM, biological samples can be observed in their natural state, rendering this method an indispensable tool. IST Austria has decided to invest in the infrastructure for cryo-EM, thereby extending the portfolio of the Electron Microscopy Facility. The new, state-of-the-art equipment, which should be up and running in 2018, will consist of one 300 kV, one 200 kV, and one cryo-dedicated focused ion beam (FIB) microscope. “Before the recent advances in cryo-EM technology, we were only able to obtain low resolution information for large biological molecules. Now, we can resolve fine molecular details, even for samples for which the structure could not have been solved before,” explains Carrie Bernecky, a structural biologist who will be one of the users of the new equipment. In her research projects she aims to determine the structure of protein RNA complexes that have interesting biological functions, and those that play a role in neurodegenerative diseases.

Ludek Lovicar, the manager of the facility, says: “Like all SSUs at IST Austria, we are a multi-user facility, and that means that we optimize our equipment to cover the widest possible range of applications. We will be able to do single-particle analysis, which is necessary to study proteins and viruses, as well as cryo-tomography, which enables the study of macromolecular complexes in their native cellular environment.”

The three new machines, the tallest of which is about 4 m in size, will be located in Lab Building East, close to the already established conventional electron microscopes, and close to the labs of IST Austria’s structural biologists who will be the main users of the facility: Carrie Bernecky, Leonid Sazanov, and Florian Schur.

Administration at IST Austria

Creating the best possible environment for world-class research is the central task of all administrative employees at IST Austria. Staffed with dedicated experts, the administration provides high-quality support in the areas listed here.

Academic Affairs is responsible for administrating all academic matters. Its team coordinates the quality control of research at the Institute, organizes the recruitment process for professors and staff scientists, and coordinates meetings of the Scientific Board. Academic Affairs moreover supports postdocs and scientific visitors during their time at the Institute, and deals with topics such as diversity and inclusion, research ethics, alumni tracking, and career development for scientists. The Graduate School Office within the division organizes the PhD program and academic courses, manages the admissions and progress-monitoring processes for students and supports international scientists.

Communications & Events provides services in media relations, scientific writing, web and social media management, alumni relations, event management, public outreach activities, and science education.

Construction & Maintenance prepares the space for new professors and facilities, operates the buildings on campus, which includes electricity, heating, ventilation, and air-conditioning, as well as providing equipment and furnishings. The division also includes Environment, Health & Safety, which ensures the well-being of everyone on and around campus, and Campus Services, which takes care of childcare, housing, food, transportation, sports facilities, and other non-scientific services on campus.

Executive Affairs was established with the aim of building up an adequate support structure for top-level management in parallel with the continuing growth of IST Austria and the continuous adaptation of its organizational structures. This unit includes Internal Audit, Legal Affairs, and Organization, Processes & Project Management.

Campus IT Services assists scientists and administrative staff with all their IT issues. IT provides basic infrastructure for all IT services and takes care of all application development and customization.

The **Office of the President** organizes and administrates all non-scientific affairs for the President and Vice President and acts as an interface between the scientific and administrative staff, board and committee members, institutional cooperation partners, and other external contacts. It includes Stakeholder Relations, which is responsible for expanding and administering IST Austria's network of supporters.

People & Financial Services comprises both the classic human resources unit of the Institute and the teams responsible for all aspects of accounting, controlling, and procurement. In addition to these tasks, this division supports scientists with funding schemes, assists in preparing research proposals, and administers approved grants through the Grant Office. The division also includes the Institute's team of Assistants to Professors, who support the research groups with a variety of administrative tasks.

The **Technology Transfer Office** takes care of all matters related to intellectual property developed at IST Austria, such as patent protection, licensing technology to companies, and supporting the creation of spin-off companies. The office supports aspiring entrepreneurs among IST Austria's young scientists and facilitates collaboration agreements with industry.

Feeding the Entrepreneurial Bug

Technology Transfer at IST Austria

With the slogan “Create. Connect. Translate.”, this year’s Science Industry Day featured the launch of IST CUBE, IST Austria’s new seed fund and incubator, and a panel discussion with experts, following a “Young Scientists’ and Founders’ Afternoon”.

Technology Transfer Office twist

The Technology Transfer Office is the one-stop shop for all matters related to intellectual property, industry liaison, and entrepreneurship at IST Austria. It is responsible for patent protection and licensing, and supports the creation of spin-off companies and cooperation with industry. A range of measures is available to help translate research results into product ideas that the Institute can commercialize through licensing and the support of startups. TWIST facilitates exchanges with industry, works with founders, and helps researchers interested in joining industry or startups to make career decisions.

IST cube

While business angel activity has grown over recent years and a range of government grants are now available, institutional equity investors addressing the seed and early stage segments are still rare in Austria. This year, IST Austria and a subsidiary of Lansdowne Partners took a significant step towards closing this gap and improving the situation for young tech-based founders who plan to host their ventures in Austria: they partnered to set up IST CUBE, a new investment platform that will support the creation and development of tech startups. With an initial investment of EUR 5 million, IST CUBE will be able to fund startups from technology-based founders in and outside of Austria. IST CUBE will invest in advanced technology companies, many of which are derived from academic research, and will help successful founders to generate viable business models, form strong teams, and develop their ventures, all with the goal of becoming global leaders in their fields.

Intellectual Property

As part of its ambition to develop technology transfer projects, IST Austria has continued to file patents on inventions with commercial potential. In total, IST Austria now has eleven patent families on file in such diverse areas as modeling systems for biological networks, photo-patterning research tools, potential treatments for diabetes, and algorithms to generate flexible casting molds.

IST PARK

The project to build a science and technology park for research-intensive enterprises adjacent to the IST Austria campus is moving ahead. The joint development company between ecoplus—the business agency of Lower Austria—and IST Austria has secured sufficient commitments to commence construction of the first phase. Two buildings providing offices, lab space, and advanced technical infrastructure will be available starting mid-2019. Until then, IST Austria is renting out office space in Lab Building West to future residents of the Technology Park.

Supporting IST Austria's Science and Future

A commitment to IST Austria not only indicates dedication to basic research and its societal impact; it plays a vital role in strengthening the Institute's independence and Austria's reputation as a center for science.

The Fink and Katsaros groups will be supported by a EUR 1.4 million grant from the NOMIS Foundation.

Philanthropy provides crucial support to independent research, and has the power to greatly impact the sciences—though the effects of these donations are often not immediately obvious. Supporters of basic research need to think long-term: experiments are often carried out over several years, and in most cases, the impact of new discoveries takes decades to be fully realized. Thus, basic research depends on long-term commitments—from both scientists and supporters. IST Austria is extremely grateful to its private and corporate patrons. These contributions have helped bring the Institute to the present level of scientific excellence, and moreover demonstrate the donors' trust in the principles on which IST Austria was founded.

Cutting-edge research requires top-class facilities. The next years will see significant construction work on the campus near Klosterneuburg. Initiating funding for IST Austria's Visitor Center, kindergarten, and an iconic bridge connecting the research institute with the technology park across the road, will be important targets for Stakeholder Relations in 2018. IST Austria honors its patrons with permanently named buildings or areas. In addition, donors can support world-class research through named scholarships and professorships, the latter a new opportunity introduced at the Institute during the past year. IST Austria will also continue to add extra value for its supporters by granting special access to its scientists and organizing events. All donations to IST Austria are tax-deductible and—importantly—are matched by the federal government of Austria. Donations to IST Austria are accumulating in a foundation that was established especially in late 2016 to fund IST Austria's own future endowment, thus underpinning the long-term nature of operations at the Institute.

In 2017, Stakeholder Relations continued liaison work for IST Austria and brought together scientists and supporters. The strategic goal to broaden the Institute's supporting network led to the signing of an agreement between IST Austria and the Swiss-based NOMIS Foundation. Over the course of four years, the foundation will support the collaborative research efforts of Professors Johannes Fink and Georgios Katsaros and their groups with EUR 1.4 million, fostering innovative research approaches in the field of quantum physics. With a stronger focus on the fruitful relationships the Institute has built so far, 2017 also saw the implementation of a new communication initiative: starting with last year's fall issue in October, IST Austria's quarterly newsletter is being sent to the Institute's stakeholders, keeping them up to date on the latest news and success stories on campus.

Since its foundation in 2015, the Strategic Advisory Board has also played a vital role in the expansion of the Institute's network of supporters; IST Austria is very grateful to the members of the board.

IST AUSTRIA DONORS CLUB
Platinum Club Invicta Foundation
Gold Club Mondi AG, OMV AG, Raiffeisen Group, voestalpine AG
Silver Club Berndorf AG, Steven Heinz, Miba AG, Oberbank AG, Prinzhorn Holding GmbH, Schoeller Bleckmann AG, W. Hamburger GmbH, DI Klaus Pöttinger
Donor Club Alcatel-Lucent-Austria AG; Allinvest Unternehmensbeteiligungs GmbH, Gebrüder Weiss GmbH, Kapsch AG

Oliver Lehmann
Head of Stakeholder Relations

Growth and Future Perspectives

Over ten years of growth, IST Austria has passed many milestones—in research, in recruitment, in construction, and in grants and fundraising—and 2017 continued the rapid pace of development. Despite, or because of, what it has already achieved, the Institute begins the next ten years still holding big visions for the future, and still guided by the same principles on which it was founded.

2006
IST Austria founded by law

2009
campus opens with 37 employees, including 4 professors

2010
first graduate students join the Institute, Bertalanffy Foundation building completed

2011
over 190 employees

2012
Lab Building East completed

2013
over 350 employees

2014
over 30 research groups on campus

2015
first PhD degree awarded, Lab and Office Building West opens

2016
more than EUR 100 million in third-party funding acquired

2017
600 employees, 31 ERC awardees among the 49 professors under contract

2026
over 90 research groups expected

Expanding the research landscape
Since the beginning, IST Austria has focused on hiring great minds, putting the emphasis on quality, rather than research focus. This has resulted in an outstanding group of scientists at all career levels. Of the 49 faculty members currently under contract at IST Austria, 14 professors conduct research in the formal sciences (computer science and mathematics), 26 in the life sciences (biology and neuroscience), and 9 in the physical sciences (physics and chemistry). At the end of the next phase, 2026, these three research clusters are expected to be roughly equally represented on campus.

Construction
As additional buildings are designed and erected, the Institute seeks to strike a balance between two goals: first, to foster interdisciplinarity by mixing groups with different research focuses within buildings, and second, to allow the needs of the scientists to inform the shape and facilities of a building. This year, preparation started for the construction of the next scientific laboratory building, and planning has begun for a future Visitor Center as well as another laboratory building. The coming years will also see an expanded machine shop, a central storage unit, a multi-purpose experimental facility, and the opening of the new administration building.

Campus community
The new buildings and new research facilities reflect the rapid and significant growth in the campus community: in October 2017, the Institute passed 600 employees, comprising approximately 400 scientists, 100 scientific support staff, and 100 administrative staff, together of some 60 nationalities. IST Austria will continue to grow through the next phase, eventually reaching more than 1’000 employees, and 90 to 100 research groups by 2026.

To support the growing community, 90 additional apartments for scientists have been built on campus; these will be handed over to the Institute in April of 2018. In addition, the kindergarten was expanded: children as young as three months can join one of three groups, and an additional group is expected to be created in early 2018.

Facts & Figures

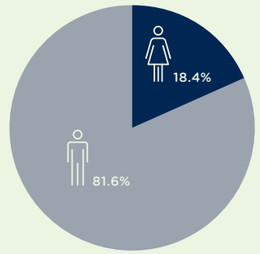
62 Professors at IST Austria
64 Research Groups on Campus
88 PhD Students at IST Austria
89 Postdocs at IST Austria
89 IST Austria Alumni
90 Interns at IST Austria
91 Scientific Service Units & Administration at IST Austria
92 Grants Active or Acquired in 2017
95 Publications in 2017
105 Selected Events in 2017
107 IST Austria Internal Awards 2017
107 IST Austria Donors Club
108 Boards of IST Austria
109 Leadership of IST Austria
110 Location & Campus Map
112 Imprint & Image Credits

Professors at IST Austria
(Under contract as of December 31, 2017)

Dan Alistarh Distributed Algorithms and Systems
Zhanybek Alpichshev Non-Linear and Time-Resolved Optical Spectroscopy of Strongly Correlated Electron Systems
Nick Barton Evolutionary and Mathematical Biology
Eva Benková Plant Developmental Biology
Carrie Bernecky RNA-Based Gene Regulation
Bernd Bickel Computer Graphics and Digital Fabrication
Krishnendu Chatterjee Computer-Aided Verification, Game Theory
Sylvia Cremer Social Immunity
Jozsef Csicsvari Systems Neuroscience
Johann Danzl High-Resolution Optical Imaging for Biology
Herbert Edelsbrunner Algorithms, Computational Geometry, and Computational Topology
László Erdős Mathematics of Disordered Quantum Systems and Matrices
Johannes Fink Quantum Integrated Devices
Julian Fischer Theory of Partial Differential Equations, Applied and Numerical Analysis
Jiří Friml Developmental and Cell Biology of Plants
Călin Guet Systems and Synthetic Biology of Genetic Networks
Edouard Hannezo Physical Principles in Biological Systems
Tamas Hausel Geometry and Its Interfaces
Carl-Philipp Heisenberg Morphogenesis in Development
Thomas A. Henzinger Design and Analysis of Concurrent and Embedded Systems
Simon Hippenmeyer Genetic Dissection of Cerebral Cortex Development
Björn Hof Nonlinear Dynamics and Turbulence
Onur Hosten Quantum Sensing with Atoms and Light
Maria Ibáñez Functional Nanomaterials
Harald Janovjak Synthetic Physiology
Peter Jonas Synaptic Communication in Hippocampal Microcircuits
Maximilian Jösch Neuroethology
Georgios Katsaros Nanoelectronics
Anna Kicheva Tissue Growth and Developmental Pattern Formation
Vladimir Kolmogorov Discrete Optimization
Fyodor Kondrashov Evolutionary Genomics
Christoph Lampert Computer Vision and Machine Learning
Mikhail Lemeshko Theoretical Atomic, Molecular, and Optical Physics
Martin Loose Self-Organization of the Cell
Jan Maas Stochastic Analysis
Gaia Novarino Genetic and Molecular Basis of Neurodevelopmental Disorders
Krzysztof Pietrzak Cryptography
Leonid Sazanov Structural Biology of Membrane Protein Complexes
Florian Schur Structural Biology of Cell Migration and Viral Infection
Robert Seiringer Mathematical Physics
Maksym Serbyn Condensed Matter Theory and Quantum Dynamics
Ryuichi Shigemoto Molecular Neuroscience
Sandra Siegert Neuroimmunology in Health and Disease
Daria Siekhaus Invasive Migration
Michael Sixt Morphodynamics of Immune Cells
Gašper Tkačik Theoretical Biophysics and Neuroscience
Beatriz Vicoso Sex-Chromosome Biology and Evolution
Uli Wagner Discrete and Computational Geometry and Topology
Chris Wojtan Computer Graphics and Physics Simulation

Total Number of Professors: 49

Gender Among Professors



Country of Nationality

Germany	20.4%
Austria	16.3%
USA	8.2%
Hungary	6.1%
Russia	6.1%
Romania	4.1%
Switzerland	4.1%
UK	4.1%
Other (15*)	30.6%

Country of PhD Institution

Germany	28.6%
USA	28.6%
Switzerland	14.3%
UK	8.2%
Austria	6.1%
Other (7*)	14.2%

Country of Previous Institution

USA	36.7%
Germany	26.5%
UK	12.2%
Switzerland	10.2%
Belgium	4.1%
Other (5*)	10.3%

* Number of countries

Visiting Professors
(Home Institution, Research Area)

Joost-Pieter Katoen, RWTH Aachen University and University of Twente (part-time), computer science
Emmanuel Letellier, Université Denis-Diderot - Paris 7, mathematics

Research Groups on Campus

Dan Alistarh

Distributed Algorithms and Systems

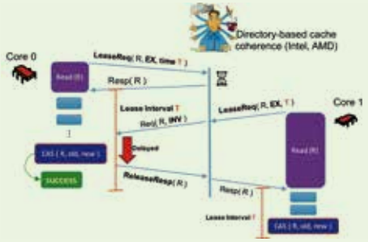
Distribution has been a major trend in computing over the last decade, which affects the way we compute in several ways: microprocessor architectures are now multi-core, offering several parallel threads of computation, while large-scale systems distribute storage and computation across several processors, machines, or data centers. The Alistarh group works to create algorithms that take advantage of these developments, by creating software that scales—in other words, it improves its performance when more computation is available.

This fundamental change in the way computation is performed puts forward exciting open questions. How do we design algorithms to extract every last bit of performance from the current generation of architectures? How do we design future architectures to support more scalable algorithms? Are there clean abstractions to render high-performance distribution accessible to programmers? The Alistarh group's research is focused on answering these questions. In particular, they are interested in designing efficient, practical algorithms for fundamental problems in distributed computing, in understanding the inherent limitations of distributed systems, and in developing new ways to overcome these limitations.

Current Projects Relaxed concurrent data structures and applications | Molecular computation | Large-scale distributed machine learning
Team Members 2017 Trevor Brown (postdoc), Giorgi Nadiradze (PhD student), Joel Rybicki (postdoc), Martin Thoresen (scientific intern)

Career
- since 2017 Assistant Professor, IST Austria
- 2016 – 2017 Visiting Researcher, Computer Science Department, ETH Zurich
- 2014 – 2016 Researcher, Microsoft Research, Cambridge, UK
- 2014 – 2016 Morgan Fellow, Downing College, University of Cambridge, UK
- 2012 – 2013 Postdoc, Massachusetts Institute of Technology, Cambridge, USA
- 2012 PhD, EPFL, Lausanne, Switzerland

Selected Distinctions
- 2015 Awarded Swiss National Foundation "Ambizione" Fellowship
- 2014 Elected Morgan Fellow at Downing College, University of Cambridge
- 2012 Postdoctoral Fellowship of the Swiss National Foundation
- 2011 Best Paper Award at the International Conference on Distributed Computing and Networking



Intuitive diagram of a timing-aware cache-coherence protocol developed by the Alistarh lab. Cores are allowed to process extra timing information about the workload, which can provide order-of-magnitude performance improvements.

Nick Barton

Mathematical Models of Evolution

The Barton group develops mathematical models to probe fundamental issues in evolution: for example, how do new species form, what limits adaptation, and what shapes the genetic system?

Nick Barton and his group study diverse topics in evolutionary genetics. The main focus of their work is the effects of natural selection on many genes, and the evolution of populations that are distributed across space. In collaboration with computer scientists, they apply population genetics to understand and improve evolutionary algorithms. Working with other groups at IST Austria, they study the evolution of gene regulation, using a thermodynamic model of transcription factor binding. They also apply models for the spatial spread of introduced genes to optimize biocontrol programs that aim to suppress transmission of dengue fever. Finally, a substantial component of the group's work is a long-term study of the hybrid zone between two populations of snapdragons (*Antirrhinum*) that differ in flower color. This combines detailed field observation with genetic data to estimate population structure and fitness variation over multiple scales.

Current Projects Evolution of sex and recombination | Evolutionary computation | Evolution of polygenic traits | Understanding genealogies in space and at multiple loci | Limits to a species' range | Speciation and hybridization in *Antirrhinum*
Team Members 2017 Stefanie Belohlavy (PhD student), Tanmay Dixit (ISTern), Christelle Fraisse (ISTFELLOW postdoc), Tamar Friedlander (ISTFELLOW postdoc), Nicholas Lade (scientific intern), Lenka Matejovičová (PhD student), Maria Melo Hurtado (postdoc), Sebastian Novak (postdoc), Tiago Paixão (postdoc), Pavel Payne (PhD student), Melinda Pickup (postdoc), Harald Ringbauer (PhD student), Himani Sachdeva (ISTFELLOW postdoc), Srdjan Sarikas (postdoc), Enikő Szép (PhD student), Barbora Trubenová (postdoc)

Career
- since 2008 Professor, IST Austria
- 1990 – 2008 Reader and Professor, University of Edinburgh, UK
- 1982 – 1990 Lecturer and Reader, University College London, UK
- 1980 – 1982 Demonstrator, Cambridge University, UK
- 1979 PhD, University of East Anglia, Norwich, UK

Selected Distinctions
- ISI Highly Cited Researcher
- 2016 Schrödinger Lecture, Dublin
- 2013 Erwin Schrödinger Prize, Austrian Academy of Sciences (ÖAW)
- 2013 Mendel Medal, German National Academy of Sciences Leopoldina
- 2009 Linnean Society Darwin-Wallace Medal
- 2009 ERC Advanced Grant
- 2006 Royal Society Darwin Medal
- 2001 President, Society for the Study of Evolution
- 1998 American Society of Naturalists President's Award
- 1994 Fellow, Royal Society of London
- 1994 David Starr Jordan Prize

Studies of hybridization between red- and yellow-flowered *Antirrhinum* in the Pyrenees tell us about the process of speciation.

Eva Benková

Plant Developmental Biology

True to their name's Greek roots, plant hormones "set in motion" a myriad of physiological processes. Influencing and modulating each other, an intricate network of interactions arises. The Benková group seeks to untangle this network and understand its molecular basis.

Post-embryonic formation of new organs, a major determinant of the plant body architecture, is responsive to a myriad of environmental inputs such as light, temperature, and nutrition. Plant hormones allow plants to rapidly adjust their development to these external cues. Physiological and genetic studies have investigated the signaling components of the individual hormonal pathways. However, over the last years it became clear that hormones are interconnected by a complex network of interactions. How these hormonal networks are established, maintained, and modulated to control specific developmental outputs is the focus of the Benková group. Recently, the group has located several convergence points that integrate different hormonal inputs. Importantly, some of these identified components exceed their function in the hormonal cross-talk and they provide functional links with pathways mediating perception of environmental stimuli.

Current Projects Convergence of hormonal pathways on transport-dependent auxin distribution | Identification of hormonal cross-talk components by genetic approaches | Hormonal crosstalk driven nutrient-dependent root development
Team Members 2017 Melinda Abas (senior laboratory technician), Rashed Abualia (PhD student), Christina Artner (PhD student), Nivola Cavallari (postdoc), Michelle Gallei (scientific intern), Marcas Gallemi Rovira (postdoc), Karla Huljev (PhD student), Andrej Hurny (PhD student), Mamoona Khan-Djamei (ISTFELLOW postdoc), Karolina Kubiasova (academic visitor), Juan Montesinos López (postdoc), Krisztina Ötvös (postdoc), Zlata Pavlovicova (scientific intern), Thomas Rauter (ISTern), Hana Semeradova (PhD student), Kaori Tabata (academic visitor), Petr Valosek (laboratory technician)

Career
- since 2016 Professor, IST Austria
- 2013 – 2016 Assistant Professor, IST Austria
- 2011 – 2013 Group Leader, Central European Institute of Technology (CEITEC), Brno, Czech Republic
- 2007 – 2013 Group Leader, Flanders Institute for Biotechnology, Ghent, Belgium
- 2003 – 2007 Habilitation position, University of Tübingen, Germany
- 2001 – 2003 Postdoc, Centre for Plant Molecular Biology, Tübingen, Germany
- 1998 – 2001 Postdoc, Max Planck Institute for Plant Breeding, Cologne, Germany
- 1998 PhD, Institute of Biophysics of the Academy of Sciences of the Czech Republic, Brno, Czech Republic

Selected Distinctions
- 2017 Member, EMBO
- 2014 FWF-ANR Bilateral Grant
- 2011 FWO Grants
- 2008 ERC Starting Grant
- 2003 – 2007 Margarete von Wrangell Habilitation Program

Plants in the plant growth chamber.

Bernd Bickel

Computer Graphics and Digital Fabrication

We are currently witnessing the emergence of novel, computer-controlled output devices that provide revolutionary possibilities for fabricating complex, functional, multi-material objects and meta-materials with stunning optical and mechanical properties. Leveraging the potential of advanced 3D printing technology is tightly coupled to efficient methods for content creation.

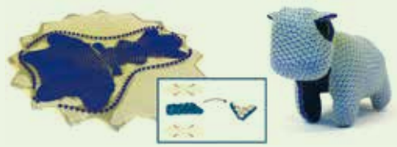
Bernd Bickel is a computer scientist interested in computer graphics and its overlap into animation, biomechanics, material science, and digital fabrication. The main objective of his research group is to push the boundaries of how functional digital models can be efficiently created, simulated, and reproduced. Given the digital nature of the process, three factors play a central role: computational models and efficient representations that facilitate intuitive design, accurate and fast simulation techniques, and intuitive authoring tools for physically realizable objects and materials. Accordingly, the work of the Bickel group focuses on two closely related challenges: (1) developing novel modeling and simulation methods, and (2) investigating efficient representation and editing algorithms for materials and functional objects.

Current Projects Computational synthesis of metamaterials | Soft robotics | Interactive design systems | Design of cyber-physical systems
Team Members 2017 Thomas Auzinger (postdoc), Gabor Birkas (scientific intern), Oskar Elek (academic visitor), Egor Gladin (ISTern), Ruslan Guseinov (PhD student), Emmanuel Iarussi (postdoc), Eder Miguel Villalba (postdoc), Kazutaka Nakashima (scientific intern), Jesus Perez Rodriguez (predoctoral visiting scientist), Charles Rajan (ISTern), Denis Sumin (academic visitor), Ran Zhang (PhD student)

Career
- since 2015 Assistant Professor, IST Austria
- 2012 – 2014 Research Scientist and Research Group Leader, Disney Research Zurich, Switzerland
- 2011 – 2012 Visiting Professor, TU Berlin, Germany
- 2011 – 2012 Postdoc, Disney Research Zurich, Switzerland
- 2010 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2017 ACM SIGGRAPH Significant New Researcher Award
- 2016 ERC Starting Grant
- 2015 Microsoft Visual Computing Award
- 2012 EUROGRAPHICS Best PhD Thesis
- 2011 ETH Medal for outstanding dissertation

A self-transforming structure: fabricated as a flat object, once released it deforms into a predefined surface through a process controlled locally by the assemblage of small-scale structures.



Krishnendu Chatterjee

Computer-Aided Verification, Game Theory

Life is a game—at least in theory. Game theory has implications for the verification of correctness of computer hardware and software, but also in biological applications, such as evolutionary game theory. The Chatterjee group works on the theoretical foundations of game theory, addressing central questions in computer science.

Game theory studies the interactive problems in decision making. It can be used to study problems in logic, automata theory, economics, evolutionary biology, and the design of the internet. The Chatterjee group is interested in the theoretical foundations of game theory, its application in formal verification, and evolutionary game theory. Game theory in formal verification involves the algorithmic analysis of various forms of games played on graphs, where the graph models a reactive system. This broad framework allows for the effective analysis of many important questions in computer science and helps to develop robust systems. The Chatterjee group also works on algorithmic aspects of evolutionary game theory on graphs, where the graph models a population structure. The goals of this research are to better understand games and to develop new algorithms.

Current Projects Quantitative verification | Stochastic game theory | Modern graph algorithms for verification problems | Evolutionary game theory
Team Members 2017 Sheshansh Agrawal (scientific intern), Bartosz Bednarczyk (ISTern), Bhavya Choudhary (scientific intern), Amir Goharshady (PhD student), Christian Hilbe (ISTFELLOW postdoc), Rasmus Ibsen-Jensen (postdoc), Joost Katoen (visiting professor), Petr Novotny (ISTFELLOW postdoc), Andreas Pavlogiannis (PhD student), Josef Tkadlec (PhD student), Viktor Toman (PhD student)

Career
- since 2014 Professor, IST Austria
- 2009 – 2014 Assistant Professor, IST Austria
- 2008 – 2009 Postdoc, University of California, Santa Cruz, USA
- 2007 PhD, University of California, Berkeley, USA

Selected Distinctions
- 2011 Microsoft Research Faculty Fellowship
- 2011 ERC Starting Grant
- 2008 Ackerman Award, best thesis worldwide in Computer Science Logic
- 2007 David J. Sakrison Prize, best thesis in EECS, University of California, Berkeley, USA
- 2001 President of India Gold Medal, best IIT student of the year

Sylvia Cremer

Social Immunity

Social insects fight disease as a collective. They team up to perform nest hygiene and mutual sanitary care, which effectively reduces the risk of infection and disease transmission through the colony. The Cremer group studies how collective protection arises at the colony level from individual behaviors and social interactions in ants, and how such social immunity affects colony fitness.

Similar to the immune cells in a body, ants in a colony can develop memories of a past infection. The Cremer group found that the individual infection history of colony members not only alters their future disease susceptibility to the same or similar pathogens, but also the sanitary care they perform on contagious nestmates. Importantly, ants never stop taking care of their pathogen-exposed nestmates, but they modulate their sanitary care behaviors depending on how susceptible they themselves are to the pathogen. Ants perform less grooming behavior, e.g. mechanically removing infectious particles by biting them off, and more chemical disinfection, e.g. spraying their antimicrobial poison, on nestmates from which they may contract pathogens that are particularly detrimental to themselves. Hence, they provide sanitary care in a self-protective manner.

Current Projects Collective hygiene in ant societies | Social interaction networks and epidemiology | Disease resistance and tolerance | Evolution of social immunization
Team Members 2017 Ernesto Bonadies (ISTern), Barbara Casillas Perez (PhD student), Eva Flechl (laboratory technician), Anna Franschitz (PhD student), Matthias Fürst (Lise Meitner FWF postdoc), Anna Grasse (senior laboratory technician), Megan Kutzer (ISTFELLOW postdoc), Barbara Leyrer (laboratory technician), Sina Metzler (PhD student), Barbara Milutinović (postdoc), Elisabeth Naderlinger (project technician), Christopher Pull (PhD student), Florian Wiesenhofer (laboratory technician)

Career
- since 2015 Professor, IST Austria
- 2010 – 2015 Assistant Professor, IST Austria
- 2010 Habilitation, University of Regensburg, Germany
- 2006 – 2010 Group Leader, University of Regensburg, Germany
- 2006 Junior Fellow, Institute of Advanced Studies, Berlin, Germany
- 2002 – 2006 Postdoc, University of Copenhagen, Denmark
- 2002 PhD, University of Regensburg, Germany

Selected Distinctions
- 2017 ERC Consolidator Grant
- 2015 Elisabeth Lutz Prize, Austrian Academy of Sciences (ÖAW)
- 2013 Walther Arndt Prize of the German Zoological Society (DZG)
- 2012 Research Award Lower Austria: Anerkennungspreis des Landes Niederösterreich
- 2011 Elected Member of the Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2009 ERC Starting Grant
- 2008 Member of the Young Academy of the German National Academy of Sciences Leopoldina and the Berlin-Brandenburg Academy of Sciences and Humanities; Alumna since 2013

Poison spraying in ants. One worker (left) spraying its antimicrobial poison onto another. Poison spraying is displayed both in fights and as hygienic measure. Picture by Roland Ferrigato and Sina Metzler.

Jozsef Csicsvari

Systems Neuroscience

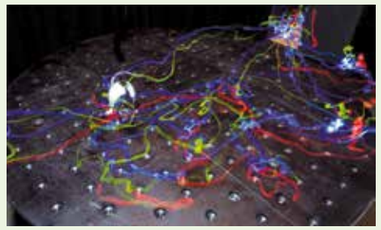
Memory formation is crucial for learning new facts and skills. This process of encoding, storing, and ultimately recalling memories involves complex interactions between various brain regions and neurons in embedded circuits that form complex code to encode these memory traces. The Csicsvari group studies how learning is implemented in the brain.

During learning, new memories are acquired and subsequently consolidated to ensure their successful later recall. The Csicsvari group focuses on understanding how learning leads to memory formation in neuronal circuits by investigating the neuronal system mechanisms of memory formation and stabilization. They also investigate the mnemonic role of neuronal populations and their interactions in brain areas involved in spatial memory processing. The group seeks to understand how neuronal circuits process information and form spatial memories by recording the activity of many neurons in different brain regions during spatial learning tasks and sleep. In their research, the group uses optogenetic methods to selectively manipulate neuronal activity in different brain areas.

Current Projects Oscillatory interactions in working memory | Role of hippocampal formation in spatial learning | Activation of brain structures using light sensitive channels to study memory formation
Team Members 2017 Yosman Bapatdhar (PhD student), Peter Baracskay (postdoc), Karel Blahna (postdoc), Igor Gridchyn (PhD student), Agnes Hermann (scientific intern), Karola Käfer (PhD student), Kristof Klein (scientific intern), Anna Levina (ISTFELLOW postdoc), Michele Nardin (PhD student), Joseph O'Neill (postdoc), Dámaris Rangel Guerrero (PhD student), Mariia Seleznova (ISTern), Federico Stella (postdoc), Jago Wallenschus (senior laboratory technician), Haibing Xu (postdoc)

Career
- since 2011 Professor, IST Austria
- 2008 – 2011 MRC Senior Scientist (tenured), MRC Anatomical Neuropharmacology Unit, University of Oxford, UK
- 2003 – 2008 MRC Senior Scientist (tenure-track), MRC Anatomical Neuropharmacology Unit, University of Oxford, UK
- 2001 – 2002 Research Associate, Center for Behavioral and Molecular Neuroscience, Rutgers University, New Brunswick, USA
- 1999 – 2001 Postdoctoral Fellow, Center for Behavioral and Molecular Neuroscience, Rutgers University, New Brunswick, USA
- 1999 PhD, Rutgers University, New Brunswick, USA

Selected Distinctions
- 2011 ERC Starting Grant
- 2010 Title of Ad Hominem Professor in Neuroscience at the University of Oxford



Ultra slow exposure image of a learning experiment on the "cheeseboard" maze.

Johann Danzl

High-Resolution Optical Imaging for Biology

How can we decode the molecular architecture of biological systems? How can we analyze living cells and tissues at the required nanoscale spatial resolution? The central aim of the Danzl lab, an interdisciplinary team of physicists, biologist, and neuroscientists, is to shed light on problems of biological and ultimately also medical relevance by developing and using a set of advanced light microscopy tools.

In conventional light microscopy, spatial resolution is limited by diffraction of light waves to about half the wavelength of light, or 200 nm. The Danzl group thus explores and extends the possibilities of diffraction-unlimited methods. These enable resolution of tens of nanometers, allowing them to capture a wealth of details of biological specimens. Analyzing living cells and tissues at high spatial and temporal resolution in a minimally perturbative way poses additional challenges. To this end, the group works toward the development of novel imaging approaches, building on their expertise both in fundamental physics and in high-resolution imaging. They integrate the imaging with state-of-the-art technologies to manipulate cells and tissues, and also to label them.

Current Projects Deep-tissue nanoscale imaging | Minimally perturbing high-resolution imaging | Decoding of synapse nano-architecture
Team Members 2017 Giulio Abagnale (postdoc), Tanja Fritz (scientific intern), Wiebke Jahr (postdoc), Caroline Kreuzinger (laboratory technician), Jakob Vorlaufer (ISTern, predoctoral visiting scientist), Anna Wang (ISTern)

Career
- since 2017 Assistant Professor, IST Austria
- 2012 – 2016 Postdoc, Department of NanoBiophotonics, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany
- 2010 – 2011 Postdoc, Institute for Experimental Physics, University of Innsbruck, Austria
- 2010 PhD, University of Innsbruck, Austria
- 2005 MD, Medical University of Innsbruck, Austria

Selected Distinctions
- 2012 – 2014 Marie Curie Intra-European Fellowship
- 2011 PhD Thesis selected as one of the four best in the years 2009 and 2010 by the AMO (Atomic, Molecular, Optical) section of the German Physical Society
- 2009 Liechtenstein Prize
- 2006 Scholarship for Intellectually Highly Gifted Persons, Rotary Club Innsbruck

3D rendering of a portion of a living neuron recorded with diffraction-unlimited resolution in all spatial directions. Scale bar: 1 µm. Image taken from Nature Photonics 10, 122 (2016).

Herbert Edelsbrunner

Algorithms, Computational Geometry, and Computational Topology

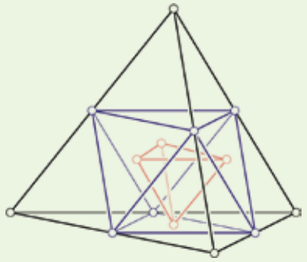
Understanding the world in terms of patterns and relations is the undercurrent in computational geometry and topology, the broad research area of the Edelsbrunner group.

While geometry measures shapes, topology focuses its attention on how the shapes are connected. These shapes may be three-dimensional (an artistic sculpture or a cave in a mountain), it may be four-dimensional (a galloping horse or a flexing protein), or it may even have many more than four dimensions (the configuration space of a robot or the expression pattern of a cancer). The Edelsbrunner group approaches the two related subjects of geometry and topology from a computational point of view. The computer aids in this study and it is used to make the insights useful in applications and workable for non-specialists. The group believes in a broad approach that does not sacrifice depth, including the development of new mathematics, the design of new algorithms and software, and the application in industry and other areas of science. Candidate areas for fruitful collaborations include 3D printing, structural molecular biology, neuroscience, and, more generally, data analysis.

Current Projects Discretization in geometry and dynamics | Topological data analysis in information space
Team Members 2017 Arseniy Akopyan (postdoc), Jose Carlos Gomez Larranaga (academic visitor), Mabel Iglesias Ham (PhD student), Grzegorz Jablonski (postdoc), Mirko Klukas (postdoc), Zuzana Masárová (PhD student), Anton Nikitenko (PhD student), Katharina Ölsböck (PhD student), Georg Osang (PhD student), Elizabeth Stephenson (academic visitor), Ziga Virk (postdoc), Hubert Wagner (postdoc)

Career
- since 2009 Professor, IST Austria
- 2004 – 2012 Professor of Mathematics, Duke University, Durham, USA
- 1999 – 2012 Arts and Sciences Professor for Computer Science, Duke University, Durham, USA
- 1996 – 2013 Founder, Principal, and Director, Raindrop Geomagic
- 1985 – 1999 Assistant, Associate, and Full Professor, University of Illinois, Urbana-Champaign, USA
- 1981 – 1985 Assistant, Graz University of Technology, Austria
- 1982 PhD, Graz University of Technology, Austria

Selected Distinctions
- ISI Highly Cited Researcher
- 2014 Fellow of the European Association for Theoretical Computer Science
- 2014 Member, Austrian Academy of Sciences (ÖAW)
- 2012 Corresponding Member of the Austrian Academy of Sciences
- 2008 Member, German Academy of Sciences Leopoldina
- 2006 Honorary Doctorate, Graz University of Technology
- 2005 Member, American Academy of Arts and Sciences
- 1991 Alan T. Waterman Award, National Science Foundation



The three nested barycenter polytopes in three dimensions.

László Erdős

Mathematics of Disordered Quantum Systems and Matrices

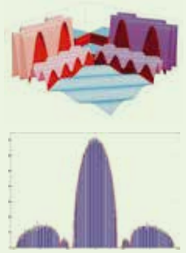
How do energy levels of large quantum systems behave? What do the eigenvalues of a typical large matrix look like? Surprisingly, these two very different questions have the same answer!

Large complex systems tend to develop universal patterns that often represent their essential characteristics. A pioneering vision of Eugene Wigner was that the distribution of the gaps between energy levels of complicated quantum systems depends only on the basic symmetry of the model and is otherwise independent of the physical details. This thesis has never been rigorously proved for any realistic physical system but experimental data and extensive numerics leave no doubt as to its correctness. Erdős' group took up the challenge to verify Wigner's vision with full mathematical rigor as well as to understand the underlying mechanism. Starting from the simplest model, a large random matrix with independent identically distributed entries, they are now able to deal with arbitrary distributions and even matrices with correlated entries. The mathematical ideas and tools developed along the way will extend the scope of random matrix theory and are likely to be used in its many applications beyond quantum physics such as wireless communications and statistics.

Current Projects Self-consistent resolvent equation and application in random matrices | Next order correction in the form factor for Wigner matrices | Local spectral universality for random band matrices | Spectral statistics of random matrices with correlated entries | Quantum spin glasses
Team Members 2017 Johannes Alt (PhD student), Torben Krüger (postdoc), Dangzheng Liu (postdoc), Balazs Maga (ISTern), Peter Mühlbacher (scientific intern), Peter Nejjar (postdoc), Yuriy Nemish (postdoc), David Renfrew (postdoc), Dominik Schröder (PhD student), Daniel Viosztek (ISTFELLOW postdoc), Ben Wallace (postdoc)

Career
- since 2013 Professor, IST Austria
- 2003 – 2013 Chair of Applied Mathematics (C4/W3), Ludwig Maximilian University of Munich, Germany
- 1998 – 2003 Assistant, Associate, Full Professor, Georgia Institute of Technology, Atlanta, USA
- 1995 – 1998 Courant Instructor/ Assistant Professor, Courant Institute, New York University, USA
- 1994 – 1995 Postdoc, ETH Zurich, Switzerland
- 1994 PhD, Princeton University, USA

Selected Distinctions
- ISI Highly Cited Researcher
- 2017 Leonard Eisenbud Prize
- 2016 Foreign Member, Hungarian Academy of Sciences
- 2015 Corresponding Member, Austrian Academy of Sciences (ÖAW)
- 2015 Member, Academia Europaea
- 2014 Invited Speaker, ICM
- 2013 ERC Advanced Grant
- 2007 – 2016 Participant of SFB TR12, Symmetries and Universality
- 1999 – 2005 NSF Grants
- 1993 – 1994 Alfred P. Sloan Foundation Dissertation Fellowship



Variance profile of an inhomogeneous random matrix H (top). Eigenvalue distribution of H and its limiting density (bottom).

Johannes Fink

Quantum Integrated Devices

The Fink group's research is positioned between quantum optics and mesoscopic condensed matter physics. The team studies quantum effects in electrical, mechanical, and optical chip-based devices with the goal to advance and integrate quantum technology for simulation, communication, metrology, and sensing.

One of Fink's goals is to develop a microchip-based router that will be able to convert a microwave signal to an optical signal with near unity efficiency. With such devices, the Fink group seeks to perform quantum communication with superconducting circuits and telecom wavelength photons. In one project, the group uses a qubit to create a single photon state. With the router, this microwave photon is converted into an optical photon, which can then be transmitted over long distances using low-loss optical fiber. The Fink group will also use this technique to entangle microwave and optical photons—an important step toward realizing worldwide quantum networks. Another direction is to develop higher quality qubits by using new electrical circuit elements called geometric superinductors which help suppress charge fluctuations that can wash out the quantum information stored on-chip.

Current Projects Quantum electro-mechanics | Quantum microwave photonics | Ultra-high impedance physics for hardware protected qubits | Quantum phononics | Multi-qubit quantum electrodynamics
Team Members 2017 Georg Arnold (scientific intern), Shabir Barzanjeh (postdoc), William Hughes (ISTern), Nikolaj Kuntner (laboratory technician), Dylan Lewis (scientific intern), Matilda Peruzzo (PhD student), Elena Redchenko (PhD student), Alfredo Rueda Sanchez (predoctoral visiting scientist), Donald Swen (ISTern), Andrea Trioni (scientific intern), Matthias Wulf (postdoc), Martin Zemlicka (postdoc)

Career
- since 2016 Assistant Professor, IST Austria
- 2015 – 2016 Senior Staff Scientist, California Institute of Technology, Pasadena, USA
- 2012 – 2015 IQIM Postdoctoral Research Scholar, California Institute of Technology, Pasadena, USA
- 2011 – 2012 Postdoctoral Research Fellow, ETH Zurich, Switzerland
- 2010 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2017 ERC Starting Grant
- 2012 IQIM Postdoctoral Prize Fellowship
- 2010 ETH Medal for Outstanding Dissertation
- 2009 CSF Award at the QSIT Conference on Quantum Engineering

Julian Fischer

Theory of Partial Differential Equations, Applied and Numerical Analysis

Diverse phenomena such as the motion of fluids or elastic objects, the evolution of interfaces, or the physics of quantum-mechanical particles are described accurately by partial differential equations. The Fischer group works on the mathematical analysis of partial differential equations that arise in the sciences, connecting also to areas like numerical analysis or probability.

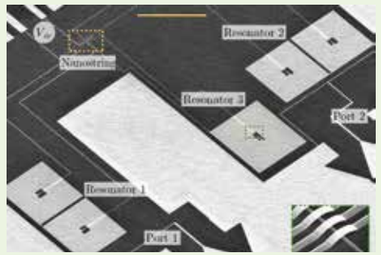
Partial differential equations are a fundamental tool for the description of many phenomena in the sciences, ranging from the physics of continua like fluids or elastic solids over quantum mechanics to population biology. Julian Fischer and his group work on the mathematical aspects of partial differential equations. One of the group's main themes is the mathematical justification of model simplifications: For example, an elastic material with a highly heterogeneous small-scale structure may in many cases be approximated as a homogeneous material. Likewise, a fluid with low compressibility may in many cases be approximated as ideally incompressible. To justify such approximations, the group derives rigorous estimates for the approximation error. The techniques they employ connect the analysis of PDEs with adjacent mathematical areas like numerical analysis and probability.

Current Projects Effective behavior of random materials | Evolution of interfaces in fluid mechanics | Structure of fluctuations in stochastic homogenization | Entropy-dissipative PDEs
Team Members 2017 Sanchit Chaturvedi (scientific intern)

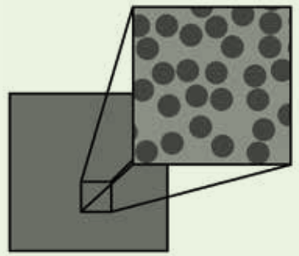
Career
- since 2017 Assistant Professor, IST Austria
- 2014 – 2016 Postdoc, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
- 2013 – 2014 Postdoc, University of Zurich, Switzerland
- 2013 PhD, University of Erlangen-Nürnberg, Germany

Selected Distinctions
- 2015 Dr. Körper Prize, PhD Award of the GAMM

Mechanical microwave circulator. Three lumped element microwave resonators (thin film aluminum spirals on the left) are capacitively coupled to a silicon micro-machined nanostring mechanical oscillator (top left). In the presence of appropriate pump fields this microchip device (yellow scale bar corresponds to 0.1 mm) breaks time-reversal symmetry and acts like a roundabout for microwave photons.



A schematic picture of upscaling for a material with a heterogeneous small-scale structure.



Jiří Friml

Developmental and Cell Biology of Plants

When conditions get tough, animals typically fight or flee, but plants are rooted in their environment, and, as a result, have become remarkably adaptable. The Friml group investigates the mechanisms underlying plants' adaptability during embryonic and postembryonic development.

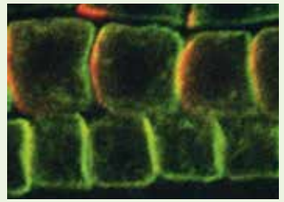
Plants and animals have different life strategies. Plants are highly adaptive, and able to modify development and physiology to environmental changes; they can easily regulate growth, initiate new organs or regenerate tissues. Many of these developmental events are mediated by the plant hormone auxin. The Friml group investigates the unique properties of auxin signaling, which can integrate both environmental and endogenous signals. Employing methods spanning molecular physiology, developmental and cell biology, genetics, biochemistry, and mathematical modeling, the group focuses on auxin transport, cell polarity, endocytic recycling, as well as non-transcriptional mechanisms of signaling. In their work, the Friml group gains insights into the mechanisms governing plant development, and have shown how signals from the environment are integrated into plant signaling and result in changes to plant growth and development.

Current Projects Polar auxin transport | Cell polarity and polar targeting | Endocytosis and recycling | Non-transcriptional mechanisms of signaling
Team Members 2017 Matyas Fendrych (postdoc), Matous Glanc (predoctoral visiting scientist), Huibin Han (PhD student), Alexander Johnson (postdoc), Ivan Kulik (scientific intern), Lanxin Li (PhD student), Gergely Molnar (postdoc), Madhumitha Narasimhan (PhD student), Jana Riederer (ISTern), Yuliya Salanenka (postdoc), Lesia Solovey (ISTFELLOW postdoc), Shutang Tan (ISTFELLOW postdoc), Mina Vasileva (PhD student), Inge Verstaeten (postdoc), Daniel von Wangenheim (ISTFELLOW postdoc), XiXi Zhang (predoctoral visiting scientist), Yuzhou Zhang (postdoc)

Career
- since 2013 Professor, IST Austria
- 2007 – 2012 Full Professor, University of Ghent, Belgium
- 2006 Full Professor, University of Göttingen, Germany
- 2002 – 2005 Group Leader, Habilitation, University of Tübingen, Germany
- 2002 PhD, Masaryk University, Brno, Czech Republic
- 2000 PhD, University of Cologne, Germany

Selected Distinctions
- 2017 ERC Advanced Grant
- 2016 Charles Albert Shull Award, ASPB
- 2015 Selected to 2015 World's Most Influential Scientific Minds
- 2015 Erwin Schrödinger Prize, Austrian Academy of Science (ÖAW)
- 2014 Běhounek Prize, Czech Ministry of Education
- 2012 EMBO Gold Medal
- 2011 Elected Elected Fellow of the American Association for the Advancement of Science (AAAS)
- 2010 Member, EMBO
- 2010 Körber European Science Award
- 2010 Olchemim Scientific Award
- 2005 Heinz Maier-Leibnitz Prize
- 2004 EMBO Young Investigator Award
- 2000 Max Planck Society Award: The Otto Hahn Medal

Polarity in *Arabidopsis* cells.



Călin Guet

Systems and Synthetic Biology of Genetic Networks

Living systems are characterized by connections and interactions across many scales—from genes, to organelles, to cells, to organs, to ecologies—as parts of networks. Which basic rules, if any, do these networks follow? The Guet group studies the molecular biology and evolution of gene regulatory networks by analyzing both natural and synthetic networks.

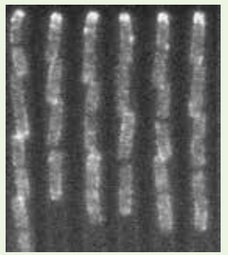
Genes and proteins constitute themselves into bio-molecular networks in cells. These genetic networks are engaged in a constant process of decision-making and computation over time scales of a few seconds to the time it takes a cell to divide, and beyond. By studying existing networks and constructing synthetic networks in living cells, the group works to understand how molecular mechanisms interact with evolutionary forces that ultimately shape each other. They use a variety of classical and modern experimental techniques that together enable them to construct any imaginable network in living bacteria and thus to study the network dynamics from the single-cell level all the way to the level of small ecologies, in which bacteria interact with bacteriophages.

Current Projects Information processing and evolution of complex promoters | Single-cell biology of multi-drug resistance | Biology, ecology, and evolutionary dynamics of restriction-modification systems
Team Members 2017 Remy Chait (postdoc, shared with Tkačik group), Rok Grah (PhD student, shared with Tkačik group), Claudia Igler (PhD student), Kirti Jain (ISTFELLOW postdoc), Mato Lagator (postdoc), Moritz Lang (postdoc), Anny Nagy-Staron (postdoc), Nela Nikolic (ISTFELLOW postdoc), Magdalena Steinrück (PhD student), Isabella Tomanek (PhD student), Kathrin Tomasek (PhD student, shared with Sixt group)

Career
- since 2011 Assistant Professor, IST Austria
- 2009 Postdoc, Harvard University, USA
- 2005 – 2008 Postdoc, The University of Chicago, USA
- 2004 PhD, Princeton University, USA

Selected Distinctions
- 2017 ESPCI Chair, Paris
- 2015 ETAPS EASST Best Paper Award
- 2011 HFSP Young Investigator Grant
- 2005 Yen Fellow, The University of Chicago

Fluorescent microscopy images of *Escherichia coli* cells grown in a 'mother-machine', express AcrB-GFP to visualize the AcrAB-TolC trans-membrane complex, the main multi-drug resistance determinant of Gram negative bacteria, which undergoes biased partitioning at cell division (Bergmiller et al Science 356, 311-15, 2017).



Edouard Hannezo

Physical Principles in Biological Systems

During embryo development, cells must "know" how to behave at the right place and at the right time. The Hannezo group applies methods from theoretical physics to understand how these robust choices occur.

The Hannezo group is particularly interested in design principles and processes of self-organization in biology, at various scales, in close collaboration with cell and developmental biologists. Their methods include tools from solid and fluid mechanics, statistical physics as well as soft matter approaches. Examples of problems that the group is working on—at three different scales—include:
1) how do cytoskeletal elements, which generate forces within cells, self-organize to produce complex spatio-temporal patterns?
2) how do cells concomitantly acquire identities and shape a tissue during development? and 3) how does complex tissue architecture derive from simple self-organizing principles, for instance during branching morphogenesis (in organs such as the kidneys, mammary glands, pancreas, and prostate) as a prototypical example.

Current Projects Stochastic branching in mammalian organs | Active fluids and cell cytoskeleton | Models of fate choices of stem cells during homeostasis and embryo development

Career
- since 2017 Assistant Professor, IST Austria
- 2015 – 2017 Sir Henry Wellcome Postdoctoral Fellow, Gurdon Institute, Cambridge, UK
- 2015 – 2017 Junior Research Fellow, Trinity College, University of Cambridge, UK
- 2014 Postdoc, Institut Curie, Paris, France
- 2014 PhD, Institut Curie and Université Pierre et Marie Curie, Paris, France

Selected Distinctions
- 2015 Wellcome Trust Fellowship
- 2014 Young Researcher Prize of the Bettencourt-Schuller Foundation
- 2014 Trinity College Junior Research Fellowship
- 2010 PhD grant from the French Ministry of Research

Tamás Hausel

Geometry and Its Interfaces

How can we understand spaces too large for traditional analysis? Combining ideas from representation theory and combinatorics, the Hausel group develops tools to study the topology of spaces arising from string theory and quantum field theory.

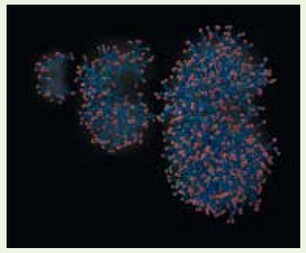
Suppose you have many particles, and consider the space made up of all the ways each particle can move between two points. Now, play the same game with more complicated objects, such as vector fields. The resulting spaces are too large to analyze, but it is possible to simplify them along structural symmetries, giving rise to moduli spaces that are finite-dimensional, but non-compact—again, defying traditional methods. The Hausel group studies the topology, geometry, and arithmetic of these moduli spaces, which include the moduli spaces of Yang-Mills instantons in four dimensions, and Higgs bundles in two dimensions, among others. One question is the number of high-dimensional holes of the spaces. Using methods from representation theory and combinatorics, Hausel and his team are able to give results and conjectures that have previously been described by physicists and number theorists in other terms—connecting a wide variety of fields and ideas.

Current Projects Geometry, topology, and arithmetic of moduli spaces arising in supersymmetric quantum field theories | Representation theory of quivers, finite groups, Lie and Hecke algebras
Team Members 2017 Iordan Ganev (postdoc), Quoc Ho (postdoc), Emmanuel Letellier (visiting professor), Penghui Li (postdoc), Anton Mellit (postdoc), Martin Mereb (postdoc), András Sándor (PhD student), Mikhail Shkolnikov (ISTFELLOW postdoc), Dimitri Wyss (predoctoral visiting scientist), Yaping Yang (postdoc), Gufang Zhao (postdoc)

Career
- since 2016 Professor, IST Austria
- 2012 – 2016 Professor and Chair of Geometry, EPFL, Lausanne, Switzerland
- 2007 – 2012 Tutorial Fellow, Wadham College, Oxford, UK
- 2007 – 2012 University Lecturer, University of Oxford, UK
- 2005 – 2012 Royal Society University Research Fellow, University of Oxford, UK
- 2002 – 2010 Assistant, Associate Professor, University of Texas, Austin, USA
- 1999 – 2002 Miller Research Fellow, Miller Institute for Basic Research in Science, University of California, Berkeley, USA
- 1998 – 1999 Member, Institute for Advanced Study, Princeton, USA
- 1998 PhD, Trinity College, University of Cambridge, UK

Selected Distinctions
- 2013 ERC Advanced Grant
- 2009 EPSRC First Grant
- 2008 Whitehead Prize
- 2005 Sloan Research Fellow

Successive snapshots from a numerical simulation of branching morphogenesis in the mouse kidney.



Hitchin fibration on the real points of the toy model Higgs moduli space.

Carl-Philipp Heisenberg

Morphogenesis in Development

The most elaborate shapes of multicellular organisms—the elephant's trunk, the orchid blossom, the lobster's claw—all start off from a simple bunch of cells. This transformation of a seemingly unstructured cluster of cells into highly elaborate shapes is a common and fundamental principle in cell and developmental biology and the focus of the Heisenberg group's work.

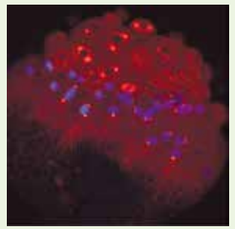
To gain insights into critical processes by which the developing organism takes shape, the Heisenberg group focuses on gastrulation in zebrafish and ascidians, a highly conserved process in which a seemingly unstructured blastula is transformed into an organized embryo. The group has chosen a transdisciplinary approach, employing a combination of genetic, cell biological, biochemical, and biophysical tools. Using these tools, the group is addressing how the interplay between the physical processes driving cell and tissue morphogenesis and the gene regulatory pathways determining cell fate specification control gastrulation. Insights derived from this work may ultimately have implications for the study of wound healing and cancer biology, as immune and cancer cells share many morphogenetic properties of embryonic cells.

Current Projects Cell adhesion | Actomyosin contraction | Cell and tissue morphogenesis | Cell polarization and migration
Team Members 2017 Feyza Arslan (PhD student), Vanessa Barone (postdoc), Silvia Caballero Mancebo (PhD student), Daniel Capek (PhD student), Benoit Godard (postdoc), Roland Kardos (ISTFELLOW postdoc), Yuuta Moriyama (academic visitor), Diana Nunes Pinheiro (postdoc), Nicoletta Petridou (postdoc), Saurabh Pradhan (visiting scientist), Kornelija Pranjic-Ferscha (laboratory technician), Alexandra Schauer (PhD student), Thomas Schultheiss (academic visitor), Cornelia Schwayer (PhD student), Mateusz Sikora (postdoc), Jana Slovakova (ISTFELLOW postdoc), Zoltan Spiro (ISTFELLOW postdoc), Peng Xia (postdoc)

Career
- since 2010 Professor, IST Austria
- 2001 – 2010 Group Leader, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany
- 1997 – 2000 Postdoc, University College London, UK
- 1996 PhD, Max Planck Institute of Developmental Biology, Tübingen, Germany

Selected Distinctions
- 2017 ERC Advanced Grant
- 2017 Lower Austrian Science Award
- 2015 Member, EMBO
- 2015 Member, German Academy of Sciences Leopoldina
- 2000 Emmy Noether Junior Professorship

Zebrafish embryo at the onset of gastrulation, stained for nuclei (blue), microtubules (red) and microtubule organizing centers (white).



Thomas A. Henzinger

Design and Analysis of Concurrent and Embedded Systems

Humans and computers are surprisingly similar: while the interaction between two actors may be simple, every additional actor complicates matters. The Henzinger group builds the mathematical foundations for designing complex hardware and software systems.

Over 90% of today's worldwide computing power is found in unexpected places like cell phones or kitchen appliances. Software has become one of the most complicated man-made artifacts, making software bugs unavoidable. The Henzinger group addresses the challenge of reducing software bugs in concurrent and embedded systems. The former consist of parallel processes that interact with one another, whether in a global network or on a tiny chip. Because of the large number of possible interactions between parallel processes, concurrent software is particularly error-prone, and sometimes bugs show up after years of flawless operation. Embedded systems interact with the physical world; an additional challenge for this kind of safety-critical software is to react sufficiently quickly. The Henzinger group invents mathematical methods and develops computational tools for improving the reliability of software in concurrent and embedded systems.

Current Projects Analysis and synthesis of concurrent software | Quantitative modeling and verification of reactive systems | Predictability and robustness for real-time and embedded systems | Model checking biochemical reaction networks
Team Members 2017 Guy Avni (postdoc), Duc Hiep Chu (postdoc), Przemyslaw Daca (PhD student), Thomas Ferrere (postdoc), Mirco Giacobbe (PhD student), Bharat Khandelwal (scientific intern), Hui Kong (postdoc), Bernhard Kragl (PhD student), Andrey Kupriyanov (postdoc), Ege Sarac (ISTern)

Career
- since 2009 Professor, IST Austria
- 2004 – 2009 Professor, EPFL, Lausanne, Switzerland
- 1999 – 2000 Director, Max Planck Institute for Computer Science, Saarbrücken, Germany
- 1998 – 2004 Professor, University of California, Berkeley, USA
- 1997 – 1998 Associate Professor, University of California, Berkeley, USA
- 1996 – 1997 Assistant Professor, University of California, Berkeley, USA
- 1992 – 1995 Assistant Professor, Cornell University, Ithaca, USA
- 1991 Postdoc, University Joseph Fourier, Grenoble, France
- 1991 PhD, Stanford University, Palo Alto, USA

Selected Distinctions
- ISI Highly Cited Researcher
- 2015 Royal Society Milner Award
- 2015 EATCS Fellow
- 2015 Honorary Doctorate, Masaryk University, Brno, Czech Republic
- 2014 Most Influential 2004 POPL Paper Award
- 2013 AAAS Fellow
- 2012 Wittgenstein Award
- 2012 Honorary Doctorate, University Joseph Fourier, Grenoble, France
- 2012 Logic in Computer Science Test-of-Time Award
- 2011 Member, Austrian Academy of Sciences (ÖAW)
- 2011 ACM SIGSOFT Impact Paper Award
- 2010 ERC Advanced Grant
- 2006 ACM Fellow
- 2006 IEEE Fellow
- 2006 Member, Academia Europaea
- 2005 Member, German Academy of Sciences Leopoldina
- 1995 ONR Young Investigator Award
- 1995 NSF Faculty Early Career Development Award

Simon Hippenmeyer

Genetic Dissection of Cerebral Cortex Development

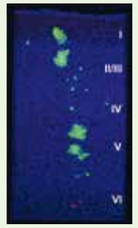
The human cerebral cortex, the seat of our cognitive abilities, is composed of an enormous number and diversity of neurons and glia cells. How the cortex arises from neural stem cells is an unsolved but fundamental question in neuroscience. In the pursuit of mechanistic insights, the Hippenmeyer group genetically dissects corticogenesis at unprecedented single cell resolution using the unique MADM (Mosaic Analysis with Double Markers) technology.

The Hippenmeyer group's current objectives are 1) to establish a definitive quantitative and mechanistic model of cortical neural stem cell lineage progression; 2) to dissect the cellular and molecular mechanisms generating cell-type diversity; 3) to determine the role of genomic imprinting, an epigenetic phenomenon, in cortex development. In a broader context, the group's research has the ultimate goal to advance the general understanding of brain function and why human brain development is so sensitive to disruption of particular signaling pathways in pathological neurodevelopmental diseases and psychiatric disorders.

Current Projects Determine neuronal lineages by clonal analysis | Mechanisms generating cell-type diversity | Probing genomic imprinting in cortex development
Team Members 2017 Nicole Amberg (postdoc), Robert Beattie (postdoc), Ximena Contreras Paniagua (PhD student), Andi Hansen (PhD student), Susanne Laukoter (PhD student), Sona Mikovicova (laboratory technician), Florian Pauler (senior laboratory technician), Julio Rodarte (laboratory technician), Lena Schwarz (ISTern), Olivia Slepecka (scientific intern), Aysan Cerag Yahya (scientific intern), Johanna Sonntag (laboratory technician), Carmen Streicher (laboratory technician)

Career
- since 2012 Assistant Professor, IST Austria
- 2011 – 2012 Research Associate, Stanford University, Palo Alto, USA
- 2006 – 2011 Postdoctoral Fellow, Stanford University, Palo Alto, USA
- 2004 – 2006 Postdoctoral Associate, University of Basel and Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland
- 2004 PhD, University of Basel, Switzerland

Selected Distinctions
- 2016 ERC Consolidator Grant
- 2014 HFSP Program Grant
- 2013 Marie Curie Career Integration Grant
- 2009 – 2011 Fellowship for Advanced Researchers, Swiss National Science Foundation, Bern, Switzerland
- 2007 – 2009 HFSP Long-term Fellowship
- 2006 EMBO Long-term Fellowship
- 2005 Natural Sciences Faculty Prize for the best PhD thesis of the year 2004, University of Basel, Switzerland
- 2005 Edmond H. Fischer Prize



MADM-labeled clonally related neurons and glia cells distributed across the six layers in the cerebral cortex.

Björn Hof

Nonlinear Dynamics and Turbulence

Most fluid flows of practical interest are turbulent, yet our understanding of this phenomenon is very limited. The Hof group seeks to gain insight into the nature of turbulence and the dynamics of complex fluids.

Flows in oceans, around vehicles, and through pipelines are all highly turbulent. Turbulence governs friction losses and transport and mixing properties. Despite its ubiquity, insights into the nature of turbulence are very limited. To obtain a fundamental understanding of the origin and the principles underlying this phenomenon, the Hof group investigates turbulence when it first arises from smooth, laminar flow. The group combines detailed laboratory experiments with highly resolved computer simulations, and applies methods from nonlinear dynamics and statistical physics, enabling them to decipher key aspects of the transition from smooth to turbulent flow, and identify universal features shared with disordered systems in other areas of physics. Some of these insights can be used to control turbulent flow, and the group actively develops such methods. In addition, the group investigates instabilities in fluids with more complex properties, such as dense suspensions of particles and polymer solutions.

Current Projects Transition from laminar to turbulent flow | Dynamics of complex fluids | Control of fully turbulent flows | Cytoplasmic streaming | Instabilities in cardiovascular flows
Team Members 2017 Nishchal Agrawal (PhD student), Sebastian Altmeyer (postdoc), Nazmi Budanur (postdoc), George Choueiri (ISTFELLOW postdoc), Akshunna Dogra (ISTern), Lukasz Klotz (ISTplus postdoc), Grégoire Lemoult (postdoc), José Lopez Alonso (ISTFELLOW postdoc), Xingyu Ma (postdoc), Philipp Maier (technician), Chaitanya Paranjape (PhD student), Davide Scarselli (PhD student), Shayan Shamipour (PhD student), Atul Varshney (ISTplus postdoc), Mukund Vasudevan (postdoc)

Career
- since 2013 Professor, IST Austria
- 2007 – 2013 Research Group Leader, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany
- 2005 – 2007 Lecturer, University of Manchester, UK
- 2003 – 2005 Research Associate, Delft University of Technology, The Netherlands
- 2001 PhD, University of Manchester, UK

Selected Distinctions
- 2012 ERC Consolidator Grant
- 2011 Dr. Meyer Struckmann Science Prize
- 2005 RCUK Fellowship

Harald Janovjak

Synthetic Physiology

When first faced with a new machine, an engineer's instinct is to disassemble it to understand its inner workings. The Janovjak group applies engineering principles to take apart the cell's signaling machinery and gain a better insight into how it orchestrates virtually all physiological functions.

The receptors on the surfaces of cells are the antennas that receive chemical signals and pass them on to the inside of the cell, causing specific and tightly controlled responses of multifaceted signaling pathways. The Janovjak group seeks to understand cellular signals and takes a unique synthetic biology approach to actively manipulate this process. Receptors are engineered to respond to new physical stimuli, such as light or ultrasound, rather than to their native chemical signals. The artificial stimuli are then used to study circuits and networks by activating or inactivating them at any given point, as well as to synthetically create or restore aberrant signaling in health and disease.

Current Projects Synthetic control of receptors and signaling pathways | Remote restoration of cell and animal behavior
Team Members 2017 Eva Gschaider-Reichhart (PhD student), Raimund Huf (scientific intern), Álvaro Inglés Prieto (postdoc), Stephanie Kainrath (PhD student) Kristian Kolev (laboratory technician), Christina Manner (scientific intern), Catherine Mckenzie (PhD student), Laura Rodriguez Hernandez (ISTFELLOW postdoc), Inma Sanchez Romero (postdoc), Miroslava Spanova (laboratory technician), Lucie Studena (ISTern), Alexandra-Madelaine Tichy (PhD student)

Career
- since 2011 Assistant Professor, IST Austria
- 2010 – 2011 Postdoc, University of Munich, Germany
- 2006 – 2010 Postdoc, University of California, Berkeley, USA
- 2005 PhD, University of Dresden, Germany

Selected Distinctions
- 2011 HFSP Young Investigator Grant
- 2011 EU FP7 Career Integration Grant
- 2007 – 2009 EMBO Long-term Fellowship
- 2005 PhD with highest honors (summa cum laude)

Using optogenetics to manipulate the cell signaling machinery.

Peter Jonas

Synaptic Communication in Hippocampal Microcircuits

Synapses enable communication between neurons in the brain. The Jonas group investigates how signals pass through these vital interfaces—a major undertaking in the field of neuroscience.

Understanding the function of the brain is a major challenge in the 21st century. The human brain comprises ~10 billion neurons, which communicate through ~10000 synapses per cell. Excitatory synapses use glutamate as a transmitter, whereas inhibitory synapses release Gamma-Aminobutyric acid (GABA). The group addresses two major questions. First, what are the biophysical signaling and plasticity mechanisms at glutamatergic and GABAergic synapses in the cortex? Second, how do specific synaptic properties generate higher network functions? In their work, the group combines nanophysiology, presynaptic patch-clamp and multi-cell recording, two-photon Ca^{2+} imaging, optogenetics, *in vivo* recording, and modeling. One focus is hippocampal mossy fiber synapses and output synapses of parvalbumin-expressing GABAergic interneurons.

Current Projects Nanophysiology of fast-spiking, parvalbumin-expressing GABAergic interneurons | Biophysics and circuit function of hippocampal mossy fiber synapses | Analysis of neuronal coding *in vivo* and in realistic network models
Team Members 2017 Christina Altmutter (laboratory technician), Yoav Ben Simon (ISTFELLOW postdoc), Carolina Borges-Merjane (Marie Curie postdoctoral fellow), Chong Chen (PhD student), Claudia Espinoza Martinez (PhD student), Jian Gan (postdoc), Xiaoqi Geng (postdoc), José Guzmán (postdoc), Olena Kim (PhD student), Florian Marr (senior laboratory technician), Rajiv Mishra (postdoc), Magdalena Picher (postdoc), Alois Schlögl (software engineer), Benjamin Suter (Marie Curie postdoctoral fellow), David Vandael (postdoc), Victor Vargas Barroso (ISTplus postdoc), Xiaomin Zhang (ISTFELLOW postdoc)

Career
- since 2010 Professor, IST Austria
- 1995 – 2010 Professor of Physiology and Department Head, University of Freiburg, Germany
- 1994 – 1995 Associate Professor, Technical University of Munich, Germany
- 1990 – 1994 Research Assistant, Max Planck Institute for Medical Research, Heidelberg, Germany
- 1988 – 1989 Postdoc, University of Giessen, Germany
- 1987 MD / PhD, University of Giessen, Germany

Selected Distinctions
- 2016 FWF Wittgenstein Award
- 2016 ERC Advanced Grant GIANTSYN
- 2016 Elected Member Editorial Board, Neuron
- 2015 Member, Academia Europaea
- 2011 ERC Advanced Grant NANOPHYS
- 2009 Adolf Fick Award, Physical-Medical Society, Würzburg, Germany
- 2008 Member, Academy of Sciences, Heidelberg, Germany
- 2007 Member of the Board of Reviewing Editors, Science
- 2007 Tsungming Tu Award, National Science Council Taiwan
- 2006 DFG Gottfried Wilhelm Leibniz Award
- 2002 Member, German Academy of Sciences Leopoldina
- 1998 Max Planck Research Award
- 1997 Medinfar European Prize in Physiology, President of Portugal
- 1994 BMBF Heinz Maier Leibnitz Award
- 1992 DFG Heisenberg Fellowship

Ensemble of eight reconstructed pyramidal neurons in the hippocampal CA3 region. The synapses between these neurons are believed to store information through synaptic plasticity.

Maximilian Jösch

Neuroethology

Maximilian Jösch and his team study the neuronal basis of innate behaviors, i.e. the processes implemented by neuronal circuits to transform sensory information into motor commands. Using a combination of molecular and physiological approaches, they monitor brain activity during animal behavior to reveal the principles and motifs of neuronal computation.

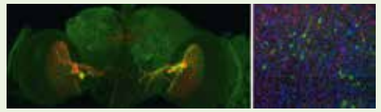
Two different model organisms, the mouse and the fruit fly (*Drosophila melanogaster*), are being used in parallel to take advantage of their unique strengths and gather a general, cross-phyla understanding of computational principles. Experiments in the mouse will allow the group to study the mechanisms used by the nervous system to send behaviorally relevant information from the eye to the brain, e.g., to easily detect a red apple in the green foliage. By conducting experiments in the fly, the group intends to obtain comprehensive understanding of the molecular, anatomical, and physiological instructions conveyed by a highly defined circuit involved in course control. This is possible because neuronal circuits in the fly brain are highly stereotyped, allowing high-throughput screenings of the behavioral role of identified cells.

Current Projects Comprehensive mapping of the behavioral repertoire instructed by defined neuronal circuitries | Role of electrical synapses in sensory transformations | Mechanisms of visual saliency and attention | State dependent modulation of sensory information | Sensorimotor transformation in the superior colliculus
Team Members 2017 Laura Burnett (PhD student), Mia Juracic (scientific intern), José Maria Martinez de Paz (ISTern), Victoria Pokusaeva (PhD student), Anton Sumser (postdoc)

Career
- since 2017 Assistant Professor, IST Austria
- 2010 – 2016 Postdoc and Research Associate, Harvard University, Cambridge, USA
- 2009 Postdoc, Max Planck Institute of Neurobiology, Martinsried, Germany
- 2009 PhD, Max Planck Institute of Neurobiology, Martinsried, Germany and Ludwig Maximilian University, Munich, Germany

Selected Distinctions
- 2017 ERC Starting Grant
- 2016 Article Recommendation by F1000
- 2014 Best Poster Award, Retina FASEB Meeting
- 2011 Otto Hahn Medal, Max Planck Society
- 2011 Best Neuroscience Article, Neuroforum
- 2010 HFSP Long-term Fellowship
- 2009 Summa Cum Laude, PhD thesis

On the left, a fly brain showing a randomized expression of different genetic tools (green and red) in neurons involved in course control. On the right, a close-up to neurons in a circuit of the mouse brain that are known to modulate innate visualdriven behaviors.



Georgios Katsaros

Nanoelectronics

Computers are becoming ever more powerful due to the continuous miniaturization of transistors. In his research, Georgios Katsaros uses semiconductor nano-transistors with a height of just 15-20 atoms. With these nano-devices, the solid-state physicist investigates the fundamental physical concepts on which quantum computing could be based in the future.

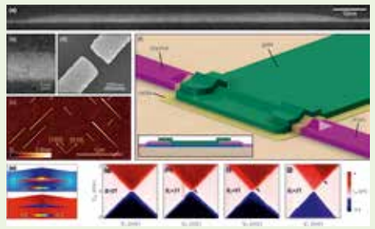
Georgios Katsaros develops semiconductor nanodevices and studies the quantum effects that appear when these nano-transistors are cooled down. One quantum mechanical property of a charge carrier is its spin. Katsaros investigates such quantum bits or qubits by manipulating them with microwaves. In classic computers, a bit can be in only one of two states, ON or OFF. In quantum computers, a qubit can be both ON and OFF at the same time. By combining semiconductor nanodevices with superconductors, the Katsaros group is aiming to study Majorana fermions. These have been suggested as building blocks for a topological quantum computer in which quantum information would be protected from environmental perturbations.

Current Projects Towards hole spin qubits and Majorana fermions in Germanium | Hybrid semiconductor-superconductor quantum devices | Hole spin orbit qubits in Ge quantum wells
Team Members 2017 Matthias Brauns (postdoc), Jason Jung (laboratory technician), Josip Kukucka (PhD student), Lada Vukušić (PhD student), Hannes Watzinger (PhD student)

Career
- since 2016 Assistant Professor, IST Austria
- 2012 – 2016 Group Leader, Johannes Kepler University, Linz, Austria
- 2011 – 2012 Group Leader, Leibniz Institute for Solid State and Materials Research, Dresden, Germany
- 2006 – 2010 Postdoc, CEA, Grenoble, France
- 2006 PhD, Max Planck Institute for Solid State Research, Stuttgart, Germany
- 2001 – 2002 Research Assistant, National Center for Scientific Research "Demokritos", Athens, Greece

Selected Distinctions
- 2015 Elected member of the Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2013 ERC Starting Grant
- 2013 FWF START Award
- 2012 FWF Lise Meitner Fellowship
- 2011 Marie Curie Carrier Integration Grant

(a) Scanning transmission electron microscope image along a hut wire embedded in epitaxial silicon. (b) Wire cross section at higher resolution. (c) Atomic force microscopy image of uncapped Ge HWs. (d) Scanning electron micrograph of a HW contacted by Pd source and drain electrodes. (e) COMSOL simulations of the out-of-plane (top) and the in-plane (bottom) strain distribution of a capped HW. (f) Schematic representation of a processed three-terminal device studied in this work. (g)-(j) Magnetotransport measurements around a charge degeneracy points taken for magnetic fields applied at different directions.



Anna Kicheva

Tissue Growth and Developmental Pattern Formation

Individuals of the same species can differ widely in size, but their organs have reproducible proportions and patterns of cell types. This requires the coordination of tissue growth with the generation of diverse cell types during development. The Kicheva group studies how this coordination is achieved in the vertebrate neural tube, the embryonic precursor of the spinal cord and brain.

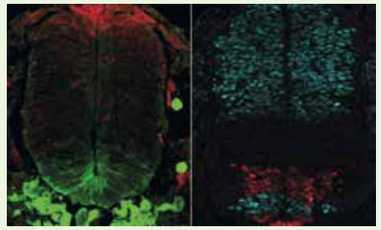
Neural tube development is controlled by signaling molecules called morphogens. Morphogens determine what type of neuron a neural progenitor cell will become. They also control tissue growth by influencing the decisions of cells to divide or exit the cell cycle. The goal of the Kicheva group is to better understand how morphogen signaling is controlled and interpreted by cells to determine cell fate and cell cycle progression. One of the main projects in the lab investigates the role of the morphogen sonic hedgehog in controlling the size of the mouse neural tube. The group uses diverse quantitative experimental approaches. This includes collection of high-resolution spatiotemporal datasets of signaling and gene expression in mouse and chick neural tube development, imaging, and *ex vivo* assays. The group collaborates with biophysicists to relate their experiments to theoretical frameworks.

Current Projects Integration of opposing morphogen gradients | Morphogen control of tissue growth | Morphogen gradient formation
Team Members 2017 Martina Greunz (laboratory technician), Laura Bocanegra (PhD student), Katarzyna Kuzmicz (PhD student), Stefanie Rus (scientific intern), Marcin Zagórski (postdoc)

Career
- since 2015 Assistant Professor, IST Austria
- 2008 – 2015 Postdoc, National Institute for Medical Research (The Francis Crick Institute), UK
- 2008 PhD, University of Geneva, Switzerland and Max Planck Institute of Cell Biology and Genetics, Dresden, Germany

Selected Distinctions
- 2015 ERC Starting Grant
- 2009 Marie-Curie Intra-European Fellowship
- 2008 FEBS Long-term Fellowship

The opposing Shh (green) and BMP (red) morphogen signaling gradients (left) and the striped pattern of target gene expression (right) in the mouse neural tube.



Vladimir Kolmogorov

Discrete Optimization

As we step out into the street, we automatically judge the distance and speed of cars. For computers, estimating the depth of objects in an image requires complex computations. A popular approach for tackling this problem is to use discrete optimization algorithms—the research focus of the Kolmogorov group.

The work of Vladimir Kolmogorov's group can be divided into three topics. The first is the development of efficient algorithms for inference in graphical models and combinatorial optimization problems. Some of their techniques are widely used in computer vision and other areas, for example the "Boykov-Kolmogorov" maximum flow algorithm and the "TRW-S" algorithm for MAP inference in pairwise graphical models. Kolmogorov's "Blossom V" algorithm is currently the fastest technique in practice for computing a minimum cost perfect matching in a graph. Their second focus is theoretical investigations of the complexity of discrete optimization, in particular using the framework of valued constraint satisfaction problems and their variants. Finally, the Kolmogorov group has worked on applications of discrete optimization in computer vision, such as image segmentation and stereo reconstruction.

Current Projects Inference in graphical models | Combinatorial optimization problems | Theory of discrete optimization
Team Members 2017 Senanayak Karri (postdoc), Alexandr Kazda (postdoc), Michal Rolinek (PhD student), Paul Swoboda (postdoc)

Career
- since 2014 Professor, IST Austria
- 2011 – 2014 Assistant Professor, IST Austria
- 2005 – 2011 Lecturer, University College London, UK
- 2003 – 2005 Assistant Researcher, Microsoft Research, Cambridge, UK
- 2003 PhD, Cornell University, Ithaca, USA

Selected Distinctions
- 2013 ERC Consolidator Grant
- 2012 Koenderink Prize at the European Conference on Computer Vision for fundamental contributions to computer vision
- 2007 Honorable mention, outstanding student paper award (to M. Pawan Kumar) at Neural Information Processing Systems Conference
- 2006 – 2011 Royal Academy of Engineering/EPSRC Research Fellowship
- 2005 Best paper honorable mention award at IEEE Conference on Computer Vision and Pattern Recognition
- 2002 Best paper award at the European Conference on Computer Vision

Example of the "Grabcut" interactive image segmentation algorithm based on graph cuts, which has been incorporated in Microsoft Office 2010.

Fyodor Kondrashov

Evolutionary Genomics

How did living organisms become the way we know them today? The Kondrashov lab is focused on understanding the natural world in an evolutionary context, typically focusing on studying genetic information due the abundance of DNA and protein sequence data.

Kondrashov and his group do not restrict themselves to studying specific functions or phenotypes, instead, a staple feature of their research is a focus on how functions and phenotypes change over time. Therefore, their research is inherently interdisciplinary, grounded in classical evolutionary fields of population genetics and molecular evolution while drawing from other fields, such as cell and molecular biology, bioinformatics, and biophysics. Recently, the group has become increasingly interested in the experimental assay of fitness landscapes. Combining experiments, theory, and computational biology, they query how changes in the genotype affect fitness or specific phenotypes. In the near future, they hope to expand their experimental capabilities in order to query a wider range of interesting phenotypes in a high-throughput manner.

Current Projects Empirical fitness landscapes | Protein evolution in the context of epistasis | Population genomics of the spoon-billed sandpiper
Team Members 2017 Pilar Baldominos Flores (laboratory technician), Louisa Gonzalez Somermeyer (laboratory technician), Dmitrii Ivankov (postdoc), Nasia Lyulina (laboratory technician), Katya Putintseva (postdoc), Karen Sarkisyan (postdoc), Petr Vlasov (postdoc)

Career
- since 2017 Professor, IST Austria
- since 2012 Scientific Director of the School of Molecular and Theoretical Biology
- 2011 – 2017 ICREA Research Professor, Centre for Genomic Regulation, Barcelona, Spain
- 2008 – 2017 Junior Group Leader, Centre for Genomic Regulation, Barcelona, Spain
- 2008 PhD, University of California, San Diego, USA

Selected Distinctions
- 2017 ERC Consolidator Grant
- 2016 Plan Estatal, Spanish Ministry of Economics and Competitiveness
- 2016 Zimin Foundation Grant for School of Molecular and Theoretical Biology
- 2014 ERC Starting Grant
- 2013 Plan Nacional Grant, Spanish Ministry of Economics and Competitiveness
- 2012 Howard Hughes Medical Institute International Early Career Scientist Award
- 2011 EMBO Young Investigator Award
- 2010 Theodosius Dobzhansky Prize from Society for the Study of Evolution
- 2010 Plan Nacional Grant, Spanish Ministry of Science and Innovation
- 2005 National Science Foundation Graduate Research Fellow

Christoph Lampert

Computer Vision and Machine Learning

Today's computer programs are "idiots savant": software that is extremely good at a certain task, such as playing chess, is completely useless for most other tasks like searching a database, and vice versa. The Lampert group works on methods for computers to break out of this limitation by sharing information between different tasks.

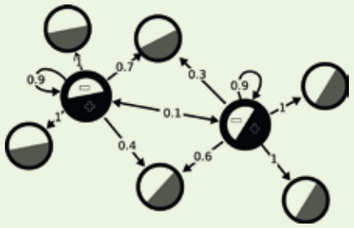
Modern computer software adapts to its users, e.g. voice recognition software learns to understand its speaker better over time, and email programs learn which of all incoming emails are spam and should therefore be suppressed. However, this learning process happens independently for each task that the computer is meant to solve. The Lampert group develops and analyzes algorithms that allow computers to learn new tasks while making use of the knowledge acquired from previous tasks. A particular application area is automatic image understanding, whereby the goal of the software is to analyze the contents of a natural image and automatically answer questions such as: What objects are visible in the image? Where are they located? How do they interact?

Current Projects Life-long visual learning | Transfer learning | Image understanding with weak supervision | Structured prediction and learning
Team Members 2017 Phuong Bui Thi Mai (PhD student), Alexander Kolesnikov (PhD student), Ilja Kuzborskij (academic visitor), Georg Martius (ISTFELLOW postdoc), Anastasia Pentina (postdoc), Amélie Royer (PhD student), Remy Sun (academic visitor), Alexander Zimin (PhD student)

Career
- since 2015 Professor, IST Austria
- 2010 – 2015 Assistant Professor, IST Austria
- 2007 – 2010 Senior Research Scientist, Max Planck Institute for Biological Cybernetics, Tübingen, Germany
- 2004 – 2007 Senior Researcher, German Research Center for Artificial Intelligence, Kaiserslautern, Germany
- 2003 PhD, University of Bonn, Germany

Selected Distinctions
- since 2015 Associate Editor in Chief of the IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)
- 2012 ERC Starting Grant
- 2008 Best Paper Award, IEEE Conference for Computer Vision and Pattern Recognition (CVPR)
- 2008 Best Student Paper Award, European Conference for Computer Vision (ECCV)
- 2008 Main Prize, German Society for Pattern Recognition (DAGM)

Lowland coastal tundra in the Chukotka region, seen here from a helicopter, is the breeding habitat of the spoon-billed sandpiper, a model species of migrating waders.



Schematic illustration of multi-task learning: information is transferred between different learning tasks through a suitably weighted sharing of annotated training examples. As a consequence, the number of necessary training examples per task is reduced and the prediction quality improved.

Mikhail Lemeshko

Theoretical Atomic, Molecular, and Optical Physics

"The whole is greater than the sum of its parts." Aristotle's saying also holds true in many systems studied in quantum physics. Mikhail Lemeshko investigates how macroscopic quantum phenomena emerge in ensembles of atoms and molecules.

Most polyatomic systems in physics, chemistry, and biology are strongly correlated: their complex behavior cannot be deduced from the properties of their individual components. Despite considerable effort, understanding strongly correlated, many-body systems still presents a formidable challenge. For instance, given a single atom of a certain kind, it is hard to predict whether the resulting bulk material will be solid, gaseous, or liquid, crystalline or amorphous, magnetic or non-magnetic, conductive or insulating. The Lemeshko group studies how many-particle quantum phenomena emerge in ensembles of atoms and molecules, and in so doing, answers questions such as: How many particles are sufficient for a given property to emerge? How does an external environment modify the properties of quantum systems? Their theoretical efforts aim to explain experiments on cold molecules and ultra-cold quantum gases, as well as predict novel, previously unobserved phenomena.

Current Projects Understanding angular momentum properties of quantum many-particle systems | Studying open quantum systems and understanding how dissipation acts at the microscopic scale | Many-body physics of ultra-cold quantum gases | Developing techniques to manipulate atoms, molecules, and interactions between them with electromagnetic fields
Team Members 2017 Giacomo Bighin (postdoc), Igor Cherepanov (PhD student), Xiang Li (PhD student), Pawel Matus (ISTern), Bikashkali Midya (ISTFELLOW postdoc), Laleh Safari (ISTFELLOW postdoc), Enderalp Yakaboylu (ISTFELLOW postdoc)

Career
- since 2014 Assistant Professor, IST Austria
- 2011 – 2014 ITAMP Postdoctoral Fellow, Harvard University, Cambridge, USA
- 2011 PhD, Fritz Haber Institute of the Max Planck Society, Berlin, Germany

Selected Distinctions
- 2017 Ludwig Boltzmann Prize, Austrian Physical Society
- 2012 One of four finalists, worldwide Thesis Prize competition, AMO division of the American Physical Society
- 2011 ITAMP Postdoctoral Fellowship

Martin Loose

Self-Organization of the Cell

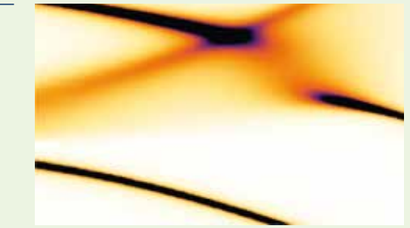
How are nanometer-sized proteins able to perform complex functions on a cellular scale? The Loose group studies the molecular mechanisms of intracellular self-organization by using purified components and advanced fluorescence in a bottom-up approach.

Although most individual players required for specific cellular processes have been identified, how they act together to accomplish their specific function is not yet understood. Instead of looking at complex phenomena in an intact cell, the Loose group aims to rebuild cellular functions from purified components. This bottom-up approach allows for better control of the experimental conditions and a quantitative characterization of the underlying molecular processes. Ultimately, this helps to identify the mechanistic principles that allow to give rise to living systems. The interdisciplinary approach of the Loose group combines biochemical reconstitution experiments with advanced fluorescence microscopy, biomimetic membrane systems, and micro-patterning techniques. They currently focus on the protein machinery behind bacterial cell division and the emergent properties of small GTPase networks involved in membrane identity formation and cell polarization.

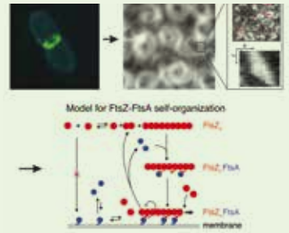
Current Projects Identifying biochemical networks that determine intracellular organization | Studying the mechanism of polarity establishment and cell division
Team Members 2017 Albert Auer (scientific intern), Natalia Baranova (postdoc), Urban Bezeljak (PhD student), Paulo Dos Santos Caldas (PhD student), Christian Düllberg (postdoc), Katrin Loibl (laboratory technician), Maria Lopez Pelegrin (laboratory technician), Christine Mieck (postdoc), Daria Petrova (ISTern), Philipp Radler (scientific intern)

Career
- since 2015 Assistant Professor, IST Austria
- 2011 – 2014 Departmental Fellow, Harvard Medical School, Boston, USA
- 2010 – 2011 Postdoc, TU Dresden and Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany
- 2010 PhD, TU Dresden and Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany

Selected Distinctions
- 2015 HFSP Young Investigator Grant
- 2015 ERC Starting Grant
- 2012 – 2014 HSFP Long-term fellowship
- 2011 – 2012 EMBO Long-term fellowship
- 2010 Dr. Walter Seipp Award for best dissertation at TU Dresden
- 2001 – 2009 Student and PhD Fellowship of the German National Scholarship Foundation



Fine structure appearing in the rotational spectrum of a molecule due to the interaction with a quantum many-body environment.



Using *in vitro* reconstitution of minimal biochemical systems to understand self-organized processes in the living cell.

Jan Maas

Stochastic Analysis

Airplane turbulence, stock rate fluctuations, and epidemic spreading are examples of highly irregular real-world phenomena subject to randomness, noise, or uncertainty. Mathematician Jan Maas develops new methods for the study of such random processes in science and engineering.

Random processes are often so irregular that existing mathematical methods are insufficient to describe them accurately. The Maas group combines ideas from probability theory, mathematical analysis, and geometry to gain new insights into the complex behavior of these processes. Their recent work has been inspired by ideas from optimal transport, a subject originating in economics and engineering that deals with the optimal allocation of resources. The Maas group applies these techniques to diverse problems involving complex networks, chemical reaction systems, and quantum mechanics. Another research focus is stochastic partial differential equations. These equations are commonly used to model high-dimensional random systems in science and engineering, ranging from bacteria colony growth to weather forecasting. The Maas group develops robust mathematical methods to study these equations, which is expected to lead to new insights into the underlying models.

Current Projects Structure-preserving discretization of gradient flow dynamics | Curvature-dimension criteria for Markov processes | Optimal transport metrics for dissipative quantum systems
Team Members 2017 Dominik Forkert (PhD student), Mate Gerencser (ISTFELLOW postdoc), Balazs Maga (ISTern), Peter Nejjar (postdoc), Giovanni Zanco (postdoc)

Career
- since 2014 Assistant Professor, IST Austria
- 2009 – 2014 Postdoc, University of Bonn, Germany
- 2009 Postdoc, University of Warwick, UK
- 2009 PhD, Delft University of Technology, The Netherlands

Selected Distinctions
- 2016 ERC Starting Grant
- 2013 – 2014 Project Leader in Collaborative Research Centre “The mathematics of emergent effects”
- 2009 – 2011 NWO Rubicon Fellowship

Gaia Novarino

Genetic and Molecular Basis of Neurodevelopmental Disorders

Gaia Novarino’s research aims to study genes underlying inherited forms of neurodevelopmental disorders such as epilepsy, intellectual disability, and autism. Neurodevelopmental disorders affect millions of people and are often refractory to treatments. Her group employs many different techniques, from molecular biology to behavior, to identify common pathophysiological mechanisms underlying this group of disorders.

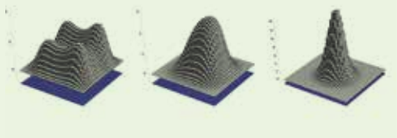
Neurodevelopmental disorders are caused by mutations in a plethora of genes, whose role in the brain is mostly unknown. Identifying the molecular mechanisms underlying these genetic forms of seizure, autism syndromes, and intellectual disability may retain the key to develop therapeutic strategies for this group of conditions. The Novarino group studies the function of epilepsy, intellectual disability, and autism-causing genes at the system, cellular, and molecular levels with the goal of providing a framework for the development of effective pharmacological therapies and the background for the identification of new pathological genetic variants. Their work in understanding the underlying mechanisms will moreover advance the overall understanding of the human brain.

Current Projects Molecular mechanisms underlying autism spectrum disorders | SETD5 gene in intellectual disability | Modeling epileptic encephalopathies in human brain organoids | Role of the autism-associated gene CHD8 in cortical development
Team Members 2017 Ilaria Chiaradia (academic visitor), Alberto Coll Manzano (laboratory technician), Federica Danti (PhD student), Elena Deliu (postdoc), Christoph Dotter (PhD student), Lisa Knaus (scientific intern), Jasmin Morandell (PhD student), Eva Reinthaler (postdoc), Roberto Sacco (postdoc), Katalin Szagati (postdoc), Dora-Clara Tarlungeanu (PhD student)

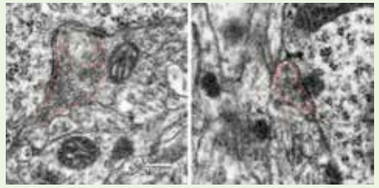
Career
- since 2014 Assistant Professor, IST Austria
- 2010 – 2013 Postdoc, UCSD (Joseph Gleeson Lab), La Jolla, USA
- 2006 – 2010 Postdoc, Center for Molecular Neurobiology, Hamburg, Germany and MDC/FMP (Thomas Jentsch Lab) Berlin, Germany
- 2006 PhD, University “La Sapienza”, Rome, Italy

Selected Distinctions
- 2017 Knight Grand Cross, Order of Merit of the Italian Republic
- 2016 Simons Foundation Autism Research Initiative (SFARI) Investigator
- 2016 ERC Starting Grant
- 2016 FENS-Kavli Scholar
- 2015 Boehringer Ingelheim FENS Research Award 2016
- 2014 Citizens United for Research in Epilepsy (CURE) Taking Flight Award
- 2012 Citizens United for Research in Epilepsy (CURE) Young Investigator Travel Award
- 2011 DFG 2-year Fellowship

Gradient flow discretization of a fourth-order diffusion equation.



GABAergic synaptic boutons of a control (left) and an autism spectrum disorder mouse model (right).



Krzysztof Pietrzak

Cryptography

Cryptography, the science of information security, is often relegated to the realm of spies and secret agents. However, we all rely on cryptography on a daily basis, for example when using internet banking or a wireless car key.

The cryptography group at IST Austria works on theoretical and practical aspects of cryptography, including:
Crypto for light-weight devices. The team works towards provably secure cryptographic schemes for light-weight devices such as RFID tags, which are too constrained to run existing cryptographic schemes.
Leakage-resilient cryptography. This project aims to construct schemes that are provably secure against “side-channel attacks”. These are attacks in which an attacker exploits information leaked during computation from a cryptographic device like a smart card.
Sustainable Cryptocurrencies. Bitcoin is the first successful digital currency. Its popularity comes from the fact that it is decentralized, so no central authority controls it. To achieve security despite decentralization, a huge amount of computing power is constantly wasted towards generating “proofs of work”. This is economically and ecologically problematic. The Pietrzak group works towards more sustainable cryptocurrencies.

Current Projects Leakage-resilient cryptography | Cryptosystems for light-weight devices | Computational entropy | Memory-hard functions | Cryptocurrencies
Team Members 2017 Hamza Abusalah (PhD student), Joël Alwen (postdoc), Hana Dlouha (ISTern), Peter Gaži (postdoc), Chethan Kamath Hosdurg (PhD student), Karen Klein (PhD student), Anastasiia Kucherenko (ISTern), Michal Rybar (PhD student), Maciej Skorski (predoctoral visiting scientist)

Career
- since 2016 Professor, IST Austria
- 2011 – 2016 Assistant Professor, IST Austria
- 2005 – 2011 Scientific Staff Member, Centrum Wiskunde & Informatica, Amsterdam, The Netherlands
- 2006 Postdoc, École Normale Supérieure, Paris, France
- 2005 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2015 ERC Consolidator Grant
- 2010 ERC Starting Grant

Leonid Sazanov

Structural Biology of Membrane Protein Complexes

Membrane proteins are responsible for many fundamental cellular processes including the transport of ions and metabolites, energy conversion, and signal transduction. They are the target of about two thirds of modern drugs. However, membrane proteins, especially large complexes, are challenging for structural studies and so are underrepresented in structural databases.

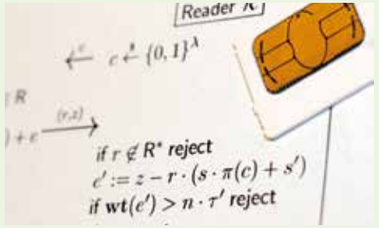
The Sazanov group has long been interested in the structural biology of membrane proteins. The main emphasis has been on complex I of the respiratory chain, a huge (~1 MDa) enzyme central to cellular energy production. So far, they have determined all the first atomic structures of complex I, from bacterial to the more elaborate mammalian version. The structures suggest a unique mechanism of proton translocation, which they are studying using both X-ray crystallography and cryo-electron microscopy. They are also investigating other related membrane protein complexes, such as antiporters. Their studies will help to understand the molecular design of some of the most intricate biological machines. Medical implications are multifaceted and the Sazanov group is interested in developing potential drug candidates.

Current Projects Mechanism of coupling between electron transfer and proton translocation in complex I | Structure and function of mitochondrial respiratory supercomplexes | Structure and function of other membrane protein complexes relevant to bioenergetics
Team Members 2017 Alexej Charnagalov (laboratory technician), James Letts (postdoc), Javier Gutiérrez-Fernandez (postdoc), Karol Kaszuba (postdoc), Long Zhou (postdoc), Domen Kampjut (PhD student), Julia Steiner (PhD student), Kristina Lukic (PhD student), Gergely Pinke (scientific intern)

Career
- since 2015 Professor, IST Austria
- 2006 – 2015 Program Leader, MRC Mitochondrial Biology Unit, Cambridge, UK
- 2000 – 2006 Group Leader, MRC Mitochondrial Biology Unit, Cambridge, UK
- 1997 – 2000 Research Associate, MRC Laboratory of Molecular Biology, Cambridge, UK
- 1994 – 1997 Research Fellow, Imperial College, London, UK
- 1992 – 1994 Postdoc, University of Birmingham, UK
- 1990 – 1992 Postdoc, Belozersky Institute of Physico-Chemical Biology, Moscow State University, Russia
- 1990 PhD, Moscow State University, Russia

Selected Distinctions
- 2016 Academic Editor, Cell Stress
- 2013 Member of Faculty of 1000
- 2012 EMBO Grant
- 2004 Royal Society Grant
- 2002 Royal Society Grant
- 1992 Wellcome Trust Fellowship

Light-weight devices require simple and efficient cryptographic schemes.



Structure of the entire mitochondrial respiratory complex I (mammalian enzyme from *Ovis aries*, solved by cryo-EM). Each of 45 protein subunits is colored differently. Approximate location of the mitochondrial membrane is indicated in grey.

Florian Schur

Structural Biology of Cell Migration and Viral Infection

Structural plasticity and movement play fundamental roles in life, from the level of whole organisms down to cells, viruses and individual molecules. The Schur group uses advanced cryo-electron microscopy and image processing methods to study the structure and function of protein complexes in situ, where they can adopt different conformations or are continuously remodeled.

The Schur group focuses on the dynamic actin cytoskeleton, the key player in the ability of cells to move. Actin-mediated cell migration is important in physiological events as embryonic development or wound healing, but deregulation of these processes leads to pathologies including tumor cell metastasis and pathogen infection. The team thus aims to understand the underlying structural principles that control these complex mechanisms. In addition, they are studying complex and irregular viruses, including retroviruses and selected DNA-viruses, where the latter are also important model organisms to understand actin-mediated pathogen propulsion. Viruses are useful tools for electron microscopy method development, but deciphering their structure is also crucial for understanding features of the viral lifecycle, as assembly and infection.

Current Projects *In situ* structural biology of actin-mediated processes in cell migration | Structural characterization of pleomorphic viruses | Small retroviral co-assembly molecules
Team Members 2017 Andreas Thader (project technician)

Career
- since 2017 Assistant Professor, IST Austria
- 2016 – 2017 Postdoc, European Molecular Biology Laboratory, Heidelberg, Germany
- 2016 PhD, European Molecular Biology Laboratory, Heidelberg and University of Heidelberg, Germany

Selected Distinctions
- 2016 Paper of the Year Award, Journal of Structural Biology
- 2011 Poster Prize, 26th Annual European Cytoskeleton Forum

Robert Seiringer

Mathematical Physics

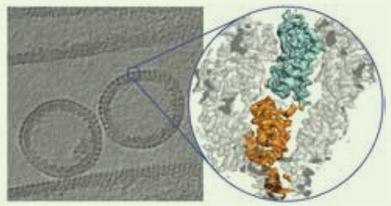
The Seiringer group develops new mathematical tools for the rigorous analysis of many-particle systems in quantum mechanics, with a special focus on exotic phenomena in quantum gases, like Bose-Einstein condensation and superfluidity.

A basic problem in statistical mechanics is to understand how the same equations on a microscopic level lead to a variety of very different manifestations on a macroscopic level. Due to the intrinsic mathematical complexity of this problem, one typically has to resort to perturbation theory or other uncontrolled approximations, whose justification remains open. It therefore remains a challenge to derive non-perturbative results and to obtain precise conditions under which the various approximations can or cannot be justified. For this purpose it is necessary to develop new mathematical techniques and methods. These new methods lead to different points of view and thus increase their understanding of physical systems. Concrete problems under current investigation include the spin-wave approximation in magnetism, the validity of the Bogoliubov approximation for the excitation spectrum of dilute Bose gases, and pattern formation in Ising models with competing interactions.

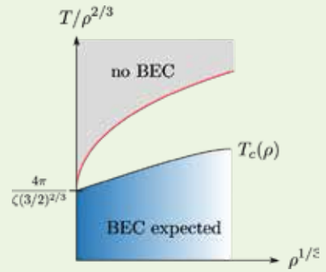
Current Projects Stability of many-body systems with point interactions | The Heisenberg ferromagnet at low temperature and the spin-wave approximation | Excitation spectrum and superfluidity for weakly interacting Bose gases
Team Members 2017 Niels Benedikter (postdoc), Chiara Boccato (postdoc), Andreas Deuchert (postdoc), Nikolai Leopold (predoctoral visiting scientist), Simon Mayer (PhD student), Thomas Moser (PhD student)

Career
- since 2013 Professor, IST Austria
- 2010 – 2013 Associate Professor, McGill University, Montreal, Canada
- 2005 Habilitation, University of Vienna, Austria
- 2003 – 2010 Assistant Professor, Princeton University, USA
- 2001 – 2003 Postdoc, Princeton University, USA
- 2000 – 2001 Assistant, University of Vienna, Austria
- 2000 PhD, University of Vienna, Austria

Selected Distinctions
- 2016 ERC Advanced Grant
- 2012 – 2017 William Dawson Scholarship
- 2012 – 2014 NSERC E.W.R. Steacie Memorial Fellowship
- 2009 – 2010 U.S. National Science Foundation CAREER Grant
- 2009 Henri Poincaré Prize of the International Association of Mathematical Physics
- 2004 – 2006 Alfred P. Sloan Fellow
- 2001 – 2003 Erwin Schrödinger Fellow



Near-atomic resolution structure of retroviral assemblies by cryo-electron tomography reveals important features in viral assembly and maturation.



Phase diagram of a dilute Bose gas.

Maksym Serbyn

Condensed Matter Theory and Quantum Dynamics

How do isolated quantum systems behave when prepared in a highly non-equilibrium state? How can such quantum systems avoid the ubiquitous relaxation to a thermal equilibrium? How can we gain novel insights into properties of quantum matter using modern non-equilibrium probes? These and other open questions in the field of quantum non-equilibrium matter are the focus of the Serbyn group.

The majority of isolated quantum systems thermalize—i.e. they reach thermal equilibrium when starting from non-equilibrium states. The first research direction of the Serbyn group is to understand mechanisms of thermalization breakdown. Many-body localized systems present one generic example of thermalization breakdown due to the presence of strong disorder. The Serbyn group is studying properties of many-body localized phase and phase transition into thermalizing phase. Kinetically constrained models present another class of systems with some signatures of thermalization breakdown. The Serbyn group is actively working on non-equilibrium properties of quantum models with constrained dynamics. A second area of interest to the Serbyn group is related to non-equilibrium probes in condensed matter systems.

Current Projects Many-body localization | Quantum ergodicity breaking | Non-equilibrium probes of solids | Spin-orbit coupled materials
Team Members 2017 Anya Goremykina (academic visitor), Alexios Michailidis (postdoc), Peng Rao (scientific intern)

Career
- since 2017 Assistant Professor, IST Austria
- 2014 – 2017 Gordon and Betty Moore Postdoctoral Fellow, University of California, Berkeley, USA
- 2014 PhD, Massachusetts Institute of Technology, Cambridge, USA

Selected Distinctions
- 2013 Andrew Locket III Memorial Fund Award, Massachusetts Institute of Technology
- 2009 – 2010 Praecis Presidential Graduate Fellowship, Massachusetts Institute of Technology
- 2005 – 2006 Enrico Fermi Junior Grant

Ryuichi Shigemoto

Molecular Neuroscience

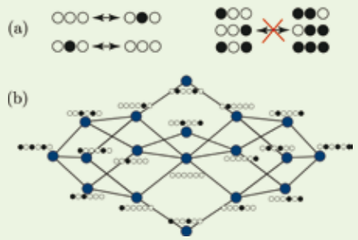
Information transmission, the formation of memory, and plasticity are all controlled by various molecules at work in the brain. Focusing on the localization and distribution of molecules in brain cells, the Shigemoto group investigates their functional roles in higher brain functions.

The release of neurotransmitters from a nerve cell into the synapse, where they act on receptors on the connecting nerve cell, is the primary process of information transmission and computation in the brain. The Shigemoto group studies the localization of single neurotransmitter receptors, ion channels, and other functional molecules to understand the molecular basis of neuronal information processing. The group has pioneered several methods for studying the localization of functional molecules at an unprecedented sensitivity, detecting and visualizing even single membrane proteins in nerve cells using SDS-digested freeze-fracture replica labeling. They apply these methods to investigate the mechanisms of signaling and plasticity in the brain, with questions ranging from neurotransmission to learning.

Current Projects Ultrastructural localization and function of receptors and ion channels in the brain | Mechanisms of long-term memory formation | Left-right asymmetry of hippocampal circuitry
Team Members 2017 Catarina Alcarva (PhD student), Pradeep Bhandari (PhD student), Matthew Case (PhD student), Kohgaku Eguchi (postdoc), Felipe Fredes Tolorza (postdoc), Harumi Harada (postdoc), Elena Hollergschwandtner (laboratory technician), Meet Jariwala (scientific intern), Marijo Jevtic (PhD student), David Kleindienst (PhD student), Peter Koppensteiner (postdoc), Elodie Le Monnier (laboratory technician), Jacqueline-Claire Montanaro-Punzengruber (senior laboratory technician), Yuliia Nikonishyna (ISTern), Maria Silva Sifuentes (laboratory technician), Shigekazu Tabata (postdoc), Manuel Weninger (scientific intern)

Career
- since 2013 Professor, IST Austria
- 1998 – 2014 Professor, National Institute for Physiological Sciences, Okazaki, Japan
- 1990 – 1998 Assistant Professor, Kyoto University Faculty of Medicine, Kyoto, Japan
- 1994 PhD, Kyoto University, Japan
- 1985 MD, Kyoto University Faculty of Medicine, Japan

Selected Distinctions
- ISI Highly Cited Researcher
- 2017 Member, Academia Europaea
- 2016 ERC Advanced Grant
- 2000 ISI Citation Laureate Award



(a) Local constraint disallows two occupied sites next to each other, defining a kinematically constrained model; (b) The Hilbert space and Hamiltonian of a kinematically constrained model with 6 sites can be conveniently represented as a graph.

Clustering of P/Q-type voltage-dependent calcium channels (red) in the presynaptic active zone (blue) of parallel fiber-Purkinje cell synapses in the rat cerebellum.

Sandra Siegert

Neuroimmunology in Health and Disease

Identifying the brain function has primarily focused on how environmental signals are encoded within a complex neuronal network—the impact of the immune system was mostly overseen. The Siegert group focuses on how neurons and microglia interact with each other and how malfunctions within this relationship impact neuronal circuit formation and function in health and disease.

Microglia are the CNS-resident macrophages and continually sense their neuronal environment. They switch between functional states that either promote or counteract removal of circuit elements. But how microglia decide when to alter circuit elements without inducing circuit malfunction is not known. Activated microglia are a feature of CNS pathologies such as glaucoma and Alzheimer's disease. Thus, it is important to study the contribution of these cells and to develop strategies for manipulating them in a beneficial manner. The Siegert lab addresses this using the mammalian retina, which consists of morphologically well-defined cell types that are precisely mapped in their connection and functional properties. They combine molecular biology, virology, genomics, computational, and functional imaging as well as iPS technology to translate their observations to a human-relevant perspective.

Current Projects Functional and genetic fundamentals of microglia responses during postnatal neuronal circuit formation | Modeling and manipulating microglial dynamics | Impact of microglial disease genes in the human 3D-organoid system
Team Members 2017 Katarina Bartalska (laboratory technician), Paulo Bastos (scientific intern), Gloria Colombo (PhD student), Tanja Himmel (scientific intern), Verena Hübschmann (master's student), Teresa Lassacher (scientific intern), Margaret Maes (ISTFELLOW postdoc), Mansi Maheta (scientific intern), Rajeshwari Meli (FWF-funded postdoc), Antonija Mravak (scientific intern), Bálint Nagy (predoctoral visiting scientist), Francis Belen Pacheco Fiallos (ISTern), Rouven Schulz (PhD student), Iris Soliman (master's student), Alessandro Venturino (laboratory technician)

Career
- since 2015 Assistant Professor, IST Austria
- 2011 – 2015 Postdoctoral Associate, Massachusetts Institute of Technology, Cambridge, USA
- 2010 PhD, Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland

Selected Distinctions
- 2017 Liese Prokop Award
- 2016 ERC Starting Grant
- 2013 SWISS OphthAWARD
- 2012 HFSP Long-term Fellowship
- 2011 EMBO Long-term Fellowship
- 2011 SNSF Fellowship for prospective researchers

Daria Siekhaus

Invasive Migration

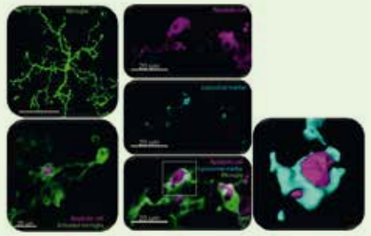
The ability of cells to migrate is crucial for their function in the immune system, the formation of the body, and the spread of cancer. The Siekhaus group investigates how cells move within the complex environment of an organism, using the genetic power of the fruit fly to interrogate this process and identify ways in which it is regulated.

Vertebrate immune and cancer cells need to squeeze between closely connected cells to disseminate in the body. Daria Siekhaus and her group study how cells penetrate such tissue barriers, using the developmental movement of macrophages in the fruit fly *Drosophila melanogaster* as a model. The Siekhaus group uses a combination of imaging, genetics, cell biology, and biophysics to identify the strategies that underlie tissue invasion. The group has recently found that a cytokine conserved in vertebrates facilitates macrophage invasion by reducing tension in surrounding tissues, acting through a previously unidentified pathway. The group is also focusing on studying the functions of novel genes required in *Drosophila* macrophages for tissue penetration that are conserved in vertebrates, and studies their roles in immune function and cancer metastasis.

Current Projects The role of tissue tension in regulating invasive migration | A novel transporter and its effect on glycosylation, immune function and metastasis | The role of transcriptional control to tune a subpopulation of macrophages to facilitate invasion
Team Members 2017 Maria Akhmanova (laboratory technician), Vera Belyaeva (PhD student), Julia Biebl (laboratory technician), Shamsi Emtenani (PhD student), Attila György (laboratory technician), Aparna Ratheesh (postdoc), Justine Renno (project technician), Marko Roblek (postdoc), Katarina Valosková (PhD student), Stephanie Wachner (PhD student)

Career
- since 2012 Assistant Professor, IST Austria
- 2003 – 2011 Research Scientist, Skirball Institute, New York University Medical Center, USA
- 1999 – 2003 Postdoctoral Fellow, University of California, Berkeley, USA
- 1998 PhD, Stanford University, USA

Selected Distinctions
- 2016 FWF Grant
- 2012 Marie Curie Career Integration Grant
- 2003 – 2005 NIH Fellowship



Left column: top-view of a microglia in a healthy, adult neuronal environment. Bottom, activated microglia engulfing an apoptotic cell (magenta). Middle column: Immunostaining of an activated microglia (green) containing a lysosomal marker (cyan) and engulfing apoptotic cells (magenta). Right column: Surface rendering of one of the engulfments. Scale bar: 20 µm.

Immune cells (red) of the fruit fly *Drosophila melanogaster* before and after tissue entry; images are tracings of primary data.

Michael Sixt

Morphodynamics of Immune Cells

Immune cells zip through our bodies at high speeds to fight off infections and diseases. The Sixt group works at the interface of cell biology and immunology to investigate how cells are able to migrate through tissues.

Most cells in our bodies are stationary, forming solid tissues and encapsulated organs. One exception are leukocytes, immune cells essential for both the innate and adaptive immune responses to infections. Leukocytes migrate with extraordinary speed and are used by the Sixt group as a model to study cell migration. The group works at the interface of cell biology, immunology, and biophysics, and aims to identify basic mechanistic principles that are equally important for developmental processes and cancer cells. One research focus is how the cell's internal skeleton generates and transduces the force to move the cell forward. The group also investigates how cells navigate along guidance cues, specifically how they orient their polarity axis in response to chemotactic gradients. In their work, the members of the Sixt group combine genetics, pharmacology, microengineering, surface chemistry, and advanced imaging approaches, as well as *in vivo* imaging techniques.

Current Projects Environmental control of leukocyte migration | Cellular force generation and transduction | Interpretation of chemo-attractive gradients
Team Members 2017 Jonna Alanko (postdoc), Frank Assen (PhD student), Alessandra Casano (postdoc), Ingrid de Vries (senior laboratory technician), Florian Gärtner (postdoc), Alba Juanes Garcia (postdoc), Aglaja Kopf (PhD student), Alexander Leithner (PhD student), Maria Nemethova (laboratory technician), Jörg Renkawitz (postdoc), Anne Reversat (postdoc), Julian Stopp (PhD student), Saren Tasciyan (PhD student), Kathrin Tomasek (PhD student, shared with Guet group)

Career
- since 2013 Professor, IST Austria
- 2010 – 2013 Assistant Professor, IST Austria
- 2008 – 2010 Endowed Professor, Peter Hans Hofschneider Foundation for Experimental Biomedicine
- 2005 – 2010 Group Leader, Max Planck Institute of Biochemistry, Martinsried, Germany
- 2003 – 2005 Postdoc, Institute for Experimental Pathology, Lund, Sweden
- 2003 MD, University of Erlangen, Germany
- 2002 Approbation in human medicine

Selected Distinctions
- 2016 ERC Consolidator Grant
- 2014 EMBO Member
- 2013 European Biophysical Societies Association (EBSA) Young Investigator Medal
- 2013 Elected member of the Young Academy of the Austrian Academy of Sciences (ÖAW)
- 2012 Ignaz L. Lieben Award
- 2011 ERC Starting Grant
- 2011 FWF START Award
- 2008 Endowed Professor of the Peter Hans Hofschneider Foundation
- 2003 Novartis dissertation prize

Gašper Tkačik

Theoretical Biophysics and Neuroscience

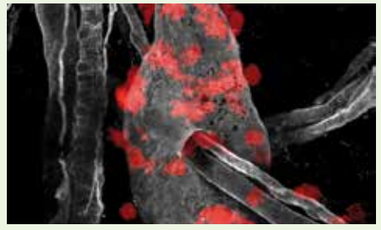
How do networks built out of biological components—neurons, signaling molecules, genes, or even cooperating organisms—process information? In contrast to engineered systems, biological networks operate under strong constraints due to noise, limited energy, or specificity, yet nevertheless perform their functions reliably. The group uses biophysics and information theory to understand the principles and mechanisms behind this remarkable phenomenon.

How can cells in a multicellular organism reproducibly decide what tissue they are going to become? How do neurons in the retina cooperate to best encode visual information into neural spikes? How does the physics at the microscopic scale, which dictates how individual regulatory molecules interact with each other, constrain the kinds of regulatory networks that are observed in real organisms today, and how can such networks evolve? These are some of the questions addressed by the Tkačik group. About half of their time is dedicated to data-driven projects performed in close collaboration with experimentalists, and half on purely theoretical projects. Their goal is to develop theoretical ideas about biological network function and connect them to high-precision data.

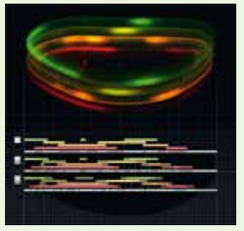
Current Projects Visual encoding in the retina | Genetic regulation during early embryogenesis | Collective dynamics | Evolution of gene regulation
Team Members 2017 Anna Andersson (postdoc), Katarina Bodova (postdoc), Sarah Cepeda Humerez (PhD student), Remy Chait (postdoc, shared with Guet group), Matthew Chalk (postdoc), Daniele De Martino (ISTFELLOW postdoc), Tamar Friedlander (ISTFELLOW postdoc), Mantas Gabrielaitis (ISTFELLOW postdoc), Rok Grah (PhD student, shared with Guet group), Jan Humplik (PhD student), Bor Kavčič (PhD student), Moritz Lang (ISTFELLOW postdoc), Anna Levina (ISTFELLOW postdoc), Georg Martius (ISTFELLOW postdoc), Sreyas Mohan (ISTern), Roshan Prizak (PhD student), Thomas Sokolowski (postdoc)

Career
- since 2017 Professor, IST Austria
- 2011 – 2016 Assistant Professor, IST Austria
- 2008 – 2010 Postdoc, University of Pennsylvania, Philadelphia, USA
- 2007 Postdoc, Princeton University, USA
- 2007 PhD, Princeton University, USA

Selected Distinctions
- 2012 HFSP Grant
- 2003 Burroughs-Wellcome Fellowship, Princeton University
- 2002 Golden Sign of the University of Ljubljana



Cells entering a lymph vessel.



Analyzing positional information during fruit fly development.

Beatriz Vicoso

Sex-Chromosome Biology and Evolution

Sex chromosomes, such as the X and Y of mammals, are involved in sex-determination in many animal and plant species. Their sex-specificity leads them to evolve differently from other chromosomes, and acquire distinctive biological properties. The Vicoso group investigates how sex chromosomes evolve over time, and what biological forces are driving their patterns of differentiation.

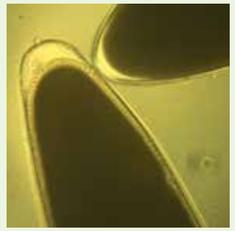
The Vicoso group is interested in understanding several aspects of the biology of sex chromosomes, and the evolutionary processes that shape their peculiar features. By combining the use of next-generation sequencing technologies with studies in several model and non-model organisms, they can address a variety of standing questions, such as: Why do some Y chromosomes degenerate while others remain homomorphic, and how does this relate to the extent of sexual dimorphism of the species? What forces drive some species to acquire global dosage compensation of the X, while others only compensate specific genes? What are the frequency and molecular dynamics of sex-chromosome turnover?

Current Projects Sex chromosome turnover and conservation | Dosage compensation in female-heterogametic species | Gene expression evolution in sexual and asexual species
Team Members 2017 Claire Fourcade (PhD student), Christelle Fraisse (ISTFELLOW postdoc), Ann Kathrin Huylmans (postdoc), Réka Kelemen (PhD student), Ariana Macon (laboratory technician), Marion Picard (postdoc), Melissa Toups (postdoc)

Career
- since 2015 Assistant Professor, IST Austria
- 2009 – 2014 Postdoc, University of California, Berkeley, USA
- 2010 PhD, University of Edinburgh, Scotland, UK

Selected Distinctions
- 2016 ERC Starting Grant
- 2016 FWF Standalone Grant
- 2011 DeLill Nasser Travel Award from the Genetics Society of America

Sex is determined early in embryogenesis.



Uli Wagner

Discrete and Computational Geometry and Topology

How and when can a geometric shape be embedded in n-dimensional space without self-intersections? What restrictions does this place on the shape? These and other questions in combinatorial and computational geometry and topology are central to the Wagner group's research program.

A simplicial complex is a description of how to represent a geometric shape by gluing together points, edges, triangles, and their n-dimensional counterparts in a "nice" way. Simplicial complexes are a natural way to represent shapes for the purposes of computation and algorithm design, and the Wagner group explores both their topological properties, such as embeddability, as well as what can be proved about their combinatorics—e.g. bounds on the number of simplices—given a particular geometric or topological constraint. More generally, they take classically topological questions and consider them from a combinatorial point of view, and conversely, they use techniques and ideas from topology to approach questions in combinatorics. They are moreover interested in the computational aspects of such problems, in particular questions of decidability (does an algorithm exist?) and complexity (if so, what are the costs in terms of time or space?).

Current Projects Higher-dimensional embeddings (generalizations of graph planarity) | Topological Tverberg-type problems and multiple self-intersections of maps | Discrete isoperimetric inequalities and higher-dimensional expanders
Team Members 2017 Sergey Avvakumov (PhD student), Marek Filakovský (postdoc), Peter Franek (FWF-supported postdoc), Radoslav Fulek (ISTFELLOW postdoc), Georg Hofstätter (scientific intern), Kristóf Huszár (PhD student), Zuzana Masárová (PhD student), Pavel Paták (postdoc), Zuzana Patáková (ISTFELLOW postdoc), David Pires Tavares Martins (ISTern), Souktik Roy (ISTern), Pascal Wild (PhD student), Stephan Zhechev (PhD student)

Career
- since 2013 Assistant Professor, IST Austria
- 2012 – 2013 SNSF Research Assistant Professor, Institut de Mathématiques de Géométrie et Applications, EPFL, Lausanne, Switzerland
- 2008 – 2012 Senior Research Associate, Institute of Theoretical Computer Science, ETH Zurich, Switzerland
- 2006 – 2008 Postdoctoral Researcher, Institute of Theoretical Computer Science, ETH Zurich, Switzerland
- 2004 – 2006 Postdoc, Einstein Institute for Mathematics, The Hebrew University of Jerusalem, Israel
- 2004 Postdoc, Univerzita Karlova, Prague, Czech Republic
- 2003 Postdoc, Mathematical Sciences Research Institute, Berkeley, USA
- 2003 PhD, ETH Zurich, Switzerland

Selected Distinctions
- 2014 Best Paper Award at the Symposium on Computational Geometry (SoCG)
- 2012 Research Assistant Professorship Grant of Swiss National Science Foundation (SNSF)
- 2012 Best Paper Award at Symposium of Discrete Algorithms (SODA)
- 2004 Richard Rado Prize

Chris Wojtan

Computer Graphics and Physics Simulation

Computer simulations of natural phenomena are indispensable for modern scientific discoveries, modern engineering, and the digital arts. The Wojtan group uses techniques from physics, geometry, and computer science to create efficient simulations and detailed computer animations.

Natural phenomena like flowing fluids and shattering solids are both beautifully chaotic and overwhelmingly complex. This complexity makes them extremely difficult to compute without the aid of a supercomputer. The Wojtan group overcomes this complexity by combining laws of motion from physics, geometric theories from mathematics, and algorithmic optimizations from computer science to efficiently compute highly complicated natural phenomena on consumer-grade computing hardware. Their research achieves some of the world's fastest and most detailed simulations through a deeper understanding of the underlying mathematical models and inventing novel computational techniques.

Current Projects Efficient simulation of fluid and fracture dynamics | Numerical and geometric algorithms for solving partial differential equations | Algorithms for re-using simulation data
Team Members 2017 Patrick Blies (postdoc), Ewa Gajda-Zagórska (postdoc), David Hahn (PhD student), Hikaru Ibayashi (scientific intern), Krystof Kolar (ISTern), Klint Qinami (academic visitor), Camille Schreck (postdoc), Tomas Skrivan (PhD student), Georg Sperl (PhD student), Peter Synak (PhD student)

Career
- since 2015 Professor, IST Austria
- 2011 – 2014 Assistant Professor, IST Austria
- 2010 PhD, Georgia Institute of Technology, Atlanta, USA

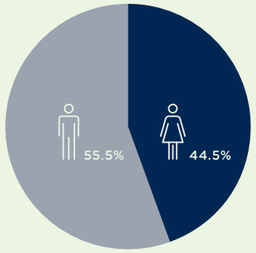
Selected Distinctions
- 2016 ACM SIGGRAPH Significant New Researcher Award
- 2015 Eurographics Young Researcher Award
- 2015 Eurographics Günter Enderle Best Paper Award
- 2014 ERC Starting Grant
- 2013 Microsoft Visual Computing Award
- 2011 Georgia Institute of Technology Sigma Chi Best PhD Thesis Award
- 2005 National Science Foundation Graduate Research Fellowship

Simulation of highly detailed surface tension phenomena such as the formation of water droplets using mesh-based surface tracking.

PhD Students at IST Austria
(Data as of December 31, 2017)

Total Number of PhD Students: 155

Gender Among PhD Students



Country of Nationality

Austria	24.5%
Slovakia	7.1%
Germany	6.5%
Italy	6.5%
Russia	5.8%
India	4.5%
Other (29*)	45.1%

Country of Previous (BS or MA) Institution

Austria	27.1%
Germany	8.4%
UK	7.7%
Czech Republic	5.8%
Italy	5.8%
Russia	5.2%
Other (25*)	40.0%

Field of Research

Biology	29.7%
Computer Science	14.2%
Mathematics	5.2%
Neuroscience	15.5%
Physics	11.6%
Unaffiliated **	23.8%

* Number of countries

** Pre-qualifying exam

2017 Graduates

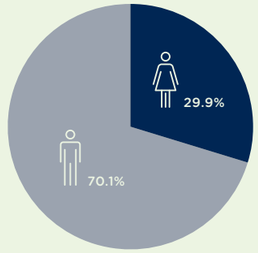
This year, 15 students completed their PhDs, bringing the total number of graduates to 42. These students, with the names of their groups and dissertation titles, are listed below.

Maciek Adamowski, *Friml group*, “Investigations into cell polarity and trafficking in the plant model *Arabidopsis thaliana*”
Vanessa Barone, *Heisenberg group*, “Cell adhesion and cell fate: An effective feedback loop during zebrafish gastrulation”
Przemek Daca, *Henzinger group*, “Statistical and logical methods for property checking”
David Hahn, *Wojtan group*, “Brittle fracture simulation with boundary elements for computer graphics”
Fabienne Jesse, *Bollback group*, “The lac operon in the wild”
Karin Mitosch, *Bollenbach group*, “Timing, variability and cross-protection in bacteria – insights from dynamic gene expression responses to antibiotics”
Anton Nikitenko, *Edelsbrunner group*, “Discrete Morse theory for random complexes”
Pavel Payne, *Bollback and Barton groups*, “Bacterial herd and social immunity to phages”
Andreas Pavlogiannis, *Chatterjee group*, “Algorithmic advances in program analysis and their applications”
Maros Pleska, *Guet group*, “Biology of restriction-modification systems at the single-cell and population level”
Tomas Prat, *Friml group*, “Identification of novel regulators of PIN polarity and development of novel auxin sensor”
Christopher Pull, *Cremer group*, “Disease defense in garden ants”
Michal Rolinek, *Kolmogorov group*, “Complexity of constraint satisfaction”
Michal Rybar, *Pietrzak group*, “(The exact security of) Message authentication codes”
Haibing Xu, *Csicsvari group*, “Reactivation of the hippocampal cognitive map in goal-directed spatial tasks”

Postdocs at IST Austria
(Data as of December 31, 2017)

Total Number of Postdocs: 134

Gender Among Postdocs



Country of Nationality

Germany	12.9%
China	7.6%
Italy	6.1%
Poland	6.1%
France	5.3%
Hungary	5.3%
Spain	5.3%
Other (33*)	51.4%

Country of Previous Institution

Germany	15.7%
USA	12.7%
France	9.0%
Spain	9.0%
Austria	6.7%
Switzerland	5.2%
Other (21*)	41.7%

Field of Research

Biology	42.6%
Computer Science	11.9%
Mathematics	11.9%
Neuroscience	15.7%
Physics	17.9%

* Number of countries

IST Austria Alumni
(Data as of December 31, 2017; data are self-reported, actual counts may be higher)

Total Number of Alumni: 206

PhD Graduates	42
Postdocs (at least one year spent at IST Austria)	164

Country of Nationality

Germany	14.6%
Austria	9.3%
China	7.8%
Czech Republic	6.3%
Spain	5.4%
France	4.9%
Other (36**)	51.7%

Current Country of Employment

Austria	14.6%
USA	13.7%
Germany	12.7%
UK	7.8%
France	5.9%
Switzerland	5.9%
Other (25**)	39.4%

Alumni by Employment Sector

Academia	69.3%
I/P Sector***	20.0%
Public Sector	2.0%
Unknown	8.7%

** Number of countries/Unknown

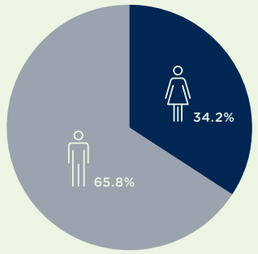
*** Industry/Private Sector

Interns at IST Austria
(Data for the entirety of 2017)

ISTerns

Total Number of ISTerns: 38

Gender Among ISTerns



Country of Nationality

India	18.4%
Russia	15.9%
Ukraine	10.6%
Czech Republic	7.9%
UK	7.9%
Austria	5.3%
Germany	5.3%
Poland	5.3%
Other (9*)	23.4%

Country of Current Institution

UK	23.7%
Russia	21.1%
India	13.2%
Austria	10.5%
Poland	5.3%
Ukraine	5.3%
USA	5.3%
Other (6*)	15.6%

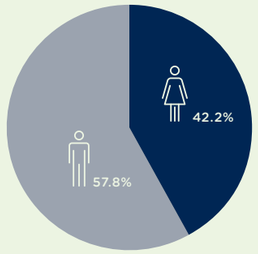
Field of Research at IST Austria

Biology	34.1%
Computer Science	21.1%
Mathematics	7.9%
Neuroscience	15.8%
Physics	21.1%

Other Interns at IST Austria

Total Number of Other Interns: 45

Gender Among Other Interns



Country of Nationality

Austria	44.6%
India	13.4%
Hungary	9.0%
Croatia	4.4%
Germany	4.4%
Italy	4.4%
Japan	4.4%
UK	4.4%
Other (5*)	11.0%

Country of Current Institution

Austria	46.8%
UK	13.4%
India	6.8%
Croatia	4.4%
Hungary	4.4%
Japan	4.4%
Lithuania	4.4%
USA	4.4%
Other (5*)	11.0%

Field of Research at IST Austria

Biology	37.8%
Computer Science	13.3%
Mathematics	6.7%
Neuroscience	33.3%
Physics	8.9%

* Number of countries

Scientific Service Units at IST Austria

Scientific Service Units currently operational at IST Austria:
- Bioimaging Facility
- Electron Microscopy Facility
- Nanofabrication Facility
- Library
- Life Science Facility
- Miba Machine Shop
- Preclinical Facility
- Scientific Computing

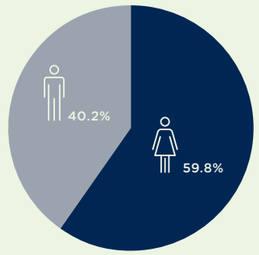
Staff Scientists at IST Austria

Robert Hauschild, Bioimaging Facility
Walter Kaufmann, *Electron Microscopy Facility*
Jack Merrin, *Nanofabrication Facility*
Christoph Sommer, *Bioimaging Facility*

Technical Support at IST Austria
(Comprises Scientific Service Units and laboratory technicians; data as of December 31, 2017)

Total Number of Technical Support Staff: 102

Gender Among Technical Support Staff



Country of Nationality

Austria	47.8%
Germany	10.6%
Hungary	6.2%
Czech Republic	3.5%
Poland	3.5%
Spain	3.5%
Other (20*)	24.9%

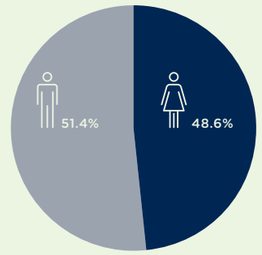
Administration at IST Austria

Administration at IST Austria comprises the following areas:
- Academic Affairs
  - Graduate School
- Campus IT Services
- Communications & Events
- Construction & Maintenance
  - Campus Services
  - Environment, Health & Safety
- Executive Affairs
- Office of the President
- People & Financial Services
  - Grant Office
  - People Services
- Technology Transfer Office

Administrative Staff at IST Austria
(Data as of December 31, 2017)

Total Number of Administrative Staff: 109

Gender Among Administrative Staff



Country of Nationality

Austria	73.8%
Germany	4.2%
USA	3.0%
Romania	1.8%
UK	1.8%
Other (20*)	15.4%

* Number of countries

Grants Active or Acquired in 2017

Alistarh Group
- NSERC CA Postdoctoral Fellowship, €61'000, 10/2017-10/2019

Barton Group
- Mating system and the evolutionary dynamics of hybrid zones, FP7 People MC-IIF, €179'000, 5/2014-9/2017
- Rate of adaptation in changing environment, H2020 MSCA IF, €166'000, 1/2017-2/2020
- Selected Topics in Evolutionary Biology (STEB), ESEB Outreach initiative, €2'000, 5/2017-5/2018

Benková Group
- Hormone cross-talk drives nutrient dependent plant development, FWF International program, €353'000, 1/2015-12/2017
- Molecular mechanism of auxin-driven formative divisions delineating lateral root organogenesis in plants, EMBO LTF, €75'000, 7/2016-7/2018
- Auxin perception, FFG Femtech, €8'000, 7/2017-12/2017
- Molecular mechanisms of the cytokinin-regulated endomembrane trafficking to coordinate plant organogenesis, OEAW DOC, €116'000, 8/2017-7/2020
- Plant endocytosis, FFG Femtech, €8'000, 10/2017-3/2018

Bickel Group
- Distributed 3D object design, H2020 MSCA ITN, €256'000, 1/2015-12/2018
- Soft-bodied intelligence for Manipulation, H2020 Cooperation ICT, €261'000, 5/2015-4/2019
- MATERIALIZABLE: Intelligent fabrication-oriented computational design and modeling, H2020 ERC Starting Grant, €1'498'000, 2/2017-1/2022

Bollback Group
- Selective barriers to horizontal gene transfer, H2020 ERC Consolidator Grant, €303'000, 6/2015-5/2020

Bollenbach Group
- Optimality principles in responses to antibiotics, FP7 People MC-CIG, €100'000, 2/2013-1/2017
- Revealing the mechanisms underlying drug interactions, FWF Stand-alone, €281'000, 1/2015-9/2017

Chatterjee Group
- Microsoft Research Faculty Fellowship, Microsoft Research Studio Award, €143'000, 4/2011-3/2021 Game theory, FWF NFN, €370'000, 3/2015-2/2019
- Efficient algorithms for computer-aided verification, WWTF Coop. project, €82'000, 3/2016-3/2020

Cremer Group
- Individual function and social role of oxytocin-like neuropeptides in ants, WWTF Coop. project, €163'000, 1/2014-12/2017
- Viral pathogens and social immunity in ants, FWF Meitner, €164'000, 7/2016-2/2018
- Epidemics in ant societies on a chip, H2020 ERC Consolidator Grant, €1'992'000, 4/2018-3/2023

Csicsvari Group
- Inter- and intracellular signaling in schizophrenia, FP7 People MC-ITN, €234'000, 10/2013-9/2017
- Interneuron plasticity during spatial learning, FWF International program, €260'000, 1/2015-12/2017
- Interneuron plasticity during spatial learning, FWF International program, €299'000, 2/2018-1/2021

Edelsbrunner Group
- Persistence and stability of geometric complexes, FWF International program, €154'000, 9/2016-8/2020
- Toward computational information topology, Office of Naval Research Grant, €326'000, 11/2017-10/2020
- Topological data analysis for a faster discovery of new materials, Royal Society International Exchanges Scheme, €11'000, 12/2017-12/2019

Erdős Group
- Random matrices, universality and disordered quantum systems, FP7 ERC Advanced Grant, €1'755'000, 3/2014-2/2019
- Structured non-Hermitian random matrices, FWF Meitner, €161'000, 1/2017-4/2019

Fink Group
- Microwave-to-optical quantum link: quantum teleportation and quantum illumination with cavity optomechanics SUPEREOM, H2020 MSCA IF, €178'000, 4/2016-3/2018
- Hybrid optomechanical technologies, H2020 Cooperation FET-Proactive, €548'000, 1/2017-12/2020
- Hybrid semiconductor - superconductor quantum devices, NOMIS Research Grants, €700'000, 9/2017-8/2021
- A fiber-optic transceiver for superconducting qubits, H2020 ERC Starting Grant, €1'500'000, 2/2018-1/2023

Friml Group
- Polarity and subcellular dynamics in plants, FP7 ERC Starting Grant, €1'269'000, 4/2013-1/2017
- Körber Stiftung Körber Prize, €41'000, 4/2015-3/2018
- EMBO Long Term Fellowship, €79'000, 2/2016-2/2018
- Molecular basis of root growth inhibition by auxin, FWF Meitner, €98'000, 11/2016-11/2017
- Cell surface receptor complexes for auxin signaling in plants, EMBO LTF, €75'000, 6/2017-5/2019
- RNA-directed DNA methylation in plant development, FWF Stand-alone, €352'000, 7/2017-6/2020
- Tracing evolution of auxin transport and polarity in plants, H2020 ERC Advanced Grant, €2'410'000, 1/2018-12/2022
- Molecular mechanisms of endocytic cargo recognition in plants, FWF International program, €339'000, 2/2018-1/2022

Guet Group
- The systems biology of transcriptional read-through in bacteria: from Synthetic Networks to Genomic Studies, FP7 People MC-IEF, €187'000, 3/2014-3/2017
- Effects of stochasticity on the function of restriction-modification systems at the single-cell level, OEAW DOC, €107'000, 1/2015-12/2017
- Design principles underlying genetic switch architecture, OEAW DOC, €113'000, 1/2016-12/2018
- Sigma switches, FFG Femtech, €8'000, 8/2016-1/2017
- Bioinformatics of transcriptional termination, FFG Praktika für Schüler, €1'000, 7/2017-8/2017
- TransTerm, FFG Femtech, €8'000, 9/2017-2/2018

Hausel Group
- Arithmetic quantization of character and quiver varieties, SNF Professorships, €42'000, 9/2016-7/2017
- Arithmetic and physics of Higgs moduli spaces, FP7 ERC Advanced Grant, €760'000, 9/2016-8/2018

Heisenberg Group
- Nano-analytics of cellular systems, FWF DK, €147'000, 3/2014-2/2018
- Cell segregation in gastrulation: the role of cell fate specification, FWF International program, €315'000, 10/2014-9/2017
- Role of chromatin organizer SATB2 in gastrulation in danio rerio, OEAD WTZ, €4'000, 6/2015-5/2017
- The generation and function of anisotropic tissue tension in zebrafish epiboly, EMBO LTF, €79'000, 7/2016-6/2018
- Control of epithelial cell layer spreading in zebrafish, FWF International program, €350'000, 2/2017-1/2020
- Interaction and feedback between cell mechanics and fate specification in vertebrate gastrulation, H2020 ERC Advanced Grant, €2'307'000, 7/2017-6/2022
- Coordination of mesendoderm cell fate specification and internalization during zebrafish gastrulation, EMBO LTF, €78'000, 2/2018-1/2020
- Control of embryonic cleavage pattern, FWF International program, €229'000, 5/2018-4/2021

Henzinger Group
- Automated tutoring system for automata theory, Microsoft Research Studio Award, €7'000, 1/2011-12/2021
- The Wittgenstein Prize, FWF, €1'502'000, 1/2014-12/2018
- Modern concurrency paradigms, FWF NFN, €492'000, 3/2015-2/2019
- Formal methods meets algorithmic game theory, FWF Meitner, €153'000, 2/2018-1/2020

Hippenmeyer Group
- Molecular mechanisms of cerebral cortex development, FP7 People MC-CIG, €100'000, 9/2013-8/2017
- Quantitative structure-function analysis of cerebral cortex assembly at clonal level, HFSP Program grant, €327'000, 9/2014-12/2017
- Mapping cell-type specificity of the genomic imprintome in the brain, NFB Life Science, €245'000, 3/2015-2/2018
- Molecular mechanisms of radial neuronal migration, OEAW DOC, €116'000, 8/2017-7/2020
- Principles of neural stem cell lineage progression in cerebral cortex development, H2020 ERC Consolidator Grant, €1'996'000, 12/2017-11/2022
- Molecular mechanisms regulating gliogenesis in the cerebral cortex, FWF Meitner, €166'000, 3/2018-2/2020

Hof Group
- Decoding the complexity of turbulence at its origin, FP7 ERC Starting Grant, €1'397'000, 6/2013-12/2017
- Eliminating turbulence in oil pipelines, H2020 ERC Proof of Concept, €150'000, 7/2017-12/2018

Janovjak Group
- Molecular drug targets, FWF DK, €210'000, 3/2015-2/2019
- Light-regulated ligand traps for spatio-temporal inhibition of cell signaling, OEAW DOC, €116'000, 8/2017-7/2020

Jonas Group
- Nanophysiology of fast-spiking, parvalbumin-expressing GABAergic interneurons, FP7 ERC Advanced Grant, €2'496'000, 6/2011-2/2017
- Is the hippocampal mossy fiber synapse a detonator in vivo?, H2020 MSCA IF, €166'000, 4/2016-3/2018
- Presynaptic calcium channels distribution and impact on coupling at the hippocampal mossy fiber synapse, H2020 MSCA IF, €166'000, 1/2017-12/2018
- Biophysics and circuit function of a giant cortical glutamatergic synapse, H2020 ERC Advanced Grant, €2'678'000, 3/2017-2/2022
- Cell Communication in Health and Disease (CCHD), FWF DK, €143'000, 1/2016-6/2020
- CONACyT Postdoc fellowship, €20'000, 10/2017-9/2018
- Mechanisms of transmitter release at GABAergic synapses, FWF Stand-alone, €510'000, 10/2012-9/2017
- The Wittgenstein Prize, FWF, €1'500'000, 10/2017-9/2022

Jösch Group
- Circuits of visual attention, H2020 ERC Starting Grant, €1'447'000, 12/2017-11/2022
- Connecting sensory with motor processing in the superior colliculus, EMBO LTF, €78'000, 1/2018-12/2019

Katsaros Group
- Towards spin qubits and Majorana fermions in Germanium self-assembled hut-wires, FP7 ERC Starting Grant, €1'388'000, 2/2016-12/2018
- Loch spin-qubits and Majorana fermions in Germanium, FWF START, €200'000, 7/2016-4/2021
- Hybrid semiconductor - super conductor quantum devices, NOMIS Research Grants, €700'000, 9/2017-8/2021
- Hole spin orbit qubits in Ge quantum wells, FWF Stand-alone, €400'000, 2/2018-1/2022

Kicheva Group
- Coordination of patterning and growth in the spinal cord, H2020 ERC Starting Grant, €1'499'000, 7/2016-6/2021
- Kinetics of DNA repair in neural differentiation of embryonic stem cells, OEAD WTZ, €7'000, 7/2017-6/2019

Kolmogorov Group
- Discrete optimization in computer vision: theory and practice, FP7 ERC Consolidator Grant, €1'642'000, 6/2014-5/2019

Kondrashov Group
- Experimental exploration of global fitness landscape of a protein family, EMBO LTF, €36'000, 9/2017-7/2018
- Systematic investigation of epistasis in molecular evolution, FP7 ERC Starting Grant, €304'000, 10/2017-12/2018
- Characterizing the fitness landscape on population and global scales, H2020 ERC Consolidator Grant, €1'998'000, 1/2019-12/2023

Lampert Group
- Lifelong learning of visual scene understanding, FP7 ERC Starting Grant, €1'465'000, 1/2013-6/2018

Lemeshko Group
- Quantum rotations in the presence of a many-body environment, FWF Stand-alone, €318'000, 2/2017-1/2020

Loose Group
- The biochemical basis of PAR polarization, FWF Firnberg, €96'000, 1/2016-4/2017
- Self-organization of the bacterial cell, H2020 ERC Starting Grant, €1'497'000, 4/2016-3/2021
- Reconstitution of bacterial cell wall synthesis, HFSP LTF, €157'000, 6/2016-5/2019
- Reconstitution of cell polarity and axis determination in a cell-free system, HFSP Young investigators' grant, €300'000, 10/2016-9/2019
- Reconstitution of bacterial cell division using purified components, BIF PhD fellowship, €46'000, 9/2017-8/2019

Maas Group
- Optimal transport and stochastic dynamics, H2020 ERC Starting Grant, €1'075'000, 2/2017-1/2022
- Dissipation and dispersion in nonlinear partial differential equations, FWF DK, €161'000, 3/2017-2/2021
- Taming complexity in partial differential systems, FWF SFB, €328'000, 3/2017-2/2021

Novarino Group
- Transmembrane transporters in health and disease, FWF SFB, €353'000, 2/2015-9/2018
- Molecular drug targets, FWF DK, €223'000, 3/2015-2/2019
- Probing the development and reversibility of autism-related phenotypes in SETD5 conditional knockout mice, Simons Foundation Pilot, €267'000, 9/2016-8/2019
- Improving brain distribution of drugs targeted to the brain, NFB Life Science, €23'000, 12/2016-11/2019
- Probing the reversibility of autism spectrum disorders by employing in vivo and in vitro models, H2020 ERC Starting Grant, €1'498'000, 10/2017-9/2022

Pietrzak Group
- Teaching old crypto new tricks, H2020 ERC Consolidator Grant, €1'882'000, 4/2016-3/2021

Sazanov Group
- The crystallization and co-crystal structure determination of bacterial mitochondrial complex I with proprietary inhibitors, BAYER, €150'000, 5/2015-4/2017
- Atomic-resolution structures of mitochondrial respiratory chain supercomplexes, H2020 MSCA IF, €178'000, 9/2016-8/2018
- Deciphering the proton-translocation mechanism of complex I, FWF Meitner, €162'000, 6/2017-5/2019
- Revealing the functional mechanism of Mrp antiporter, an ancestor of complex I, OEAW DOC, €116'000, 8/2017-7/2020

Seiringer Group
- Structure of the excitation spectrum for many-body quantum systems, FWF Stand-alone, €317'000, 4/2015-9/2018
- Analysis of quantum many-body systems, H2020 ERC Advanced Grant, €1'498'000, 10/2016-9/2021

Shigemoto Group
- Mechanism of formation and maintenance of input side-dependent asymmetry in the hippocampus, OEAW DOC, €113'000, 1/2016-12/2018
- Human Brain Project Specific Grant Agreement 1 (HBP SGA 1), H2020 Cooperation FET-Flagships, €274'000, 4/2016-3/2018
- In situ analysis of single channel subunit composition in neurons: physiological implication in synaptic plasticity and behavior, H202ERC Advanced Grant, €2'481'000, 7/2016-6/2021
- Anatomical and functional properties of auditory nerve synapses, NIH, €13'000, 3/2017-2/2018
- Human Brain Project Specific Grant Agreement 2 (HBP SGA 2), H2020 Cooperation FET-Flagships, €225'000, 4/2018-3/2020

Siegert Group
- Microglia action towards neuronal circuit formation and function in health and disease, H2020 ERC Starting Grant, €1'500'000, 5/2017-4/2022
- The role of microglia in neuronal ceroid lipofuscionosis, FWF Firnberg, €230'000, 8/2017-7/2020

Siekhaus Group
- Investigating the role of transporters in invasive migration through junctions, FP7 People MC-CIG, €100'000, 4/2013-3/2017
- Examination of the role of a MFS transporter in the migration of Drosophila immune cells, OEAW DOC, €74'000, 7/2015-6/2017
- Drosophila TNFa's Funktion in Immunzellen, FWF Stand-alone, €346'000, 11/2016-10/2019
- Invasive migration, FFG Femtech, €6'000, 1/2017-4/2017
- Investigating the role of the novel major superfamily facilitator transporter family member MFSD1 in metastasis, NFB Life Science, €251'000, 8/2017-7/2020
- Tissue barrier penetration is crucial for immunity and metastasis, OEAW DOC, €116'000, 8/2017-7/2020
- Modeling epithelial tissue mechanics during cell invasion, FWF Meitner, €153'000, 1/2018-12/2019

Sixt Group
- Cytoskeletal force generation and force transduction of migrating leukocytes, FP7 ERC Starting Grant, €1'458'000, 4/2012-3/2017
- Nano-analytics of cellular systems, FWF DK, €147'000, 3/2014-2/2018
- Modeling of polarization and motility of leukocytes in three-dimensional environments, WWTF Coop. project, €160'000, 3/2014-2/2018
- Molecular and system level view of immune cell migration, EMBO LTF, €101'000, 3/2015-2/2017
- Mechanical adaptation of lamellipodial actin, FWF Stand-alone, €387'000, 3/2017-2/2020
- Mechanical adaptation of lamellipodial actin networks in migrating cells, H2020 MSCA IF, €178'000, 3/2017-2/2019
- Cellular navigation along spatial gradients, H2020 ERC Consolidator Grant, €1'985'000, 4/2017-3/2022
- Quantitative understanding of a cell-autonomous component in chemotaxis, EMBO LTF, €76'000, 7/2017-6/2019
- Spatiotemporal regulation of chemokine-induced signaling in leukocyte chemotaxis, Finnish Found PD Pool postdoctoral fellowship, €102'000, 7/2017-7/2019

Tkačik Group
- Sensitivity to higher-order statistics in natural scenes, FWF Stand-alone, €356'000, 9/2013-8/2017
- Biophysics of information processing in gene regulation, FWF Stand-alone, €345'000, 1/2016-12/2018

Uhler Group
- Gaussian graphical models: theory and applications, FWF START, €987'000, 7/2015-6/2018

Vicoso Group
- Sex chromosome evolution under male- and female-heterogamety, FWF Stand-alone, €224'000, 1/2016-12/2018
- Prevalence and influence of sexual antagonism on genome evolution, H2020 ERC Starting Grant, €1'444'000, 3/2017-2/2022

Wagner Group
- Robust invariants of nonlinear systems, FWF Meitner, €167'000, 2/2016-1/2018
- Eliminating intersections in drawings of graphs, FWF Meitner, €162'000, 7/2017-6/2019

Wojtan Group
- Efficient simulation of natural phenomena at extremely large scales, H2020 ERC Starting Grant, €1'500'000, 3/2015-2/2020

Publications in 2017

Publications by IST Austria members that were published in 2017;
joint publications involving several groups are listed multiple times.

Alistarh Group
- Alistarh D, Aspnes J, Eisenstat D, Rivest RL, Gelashvili R. 2017. Time-space trade-offs in population protocols. In Klein P, Ed., ACM-SIAM Symposium on Discrete Algorithms (SODA 2017), ACM-SIAM, 2560-2579.
- Alistarh D, Dudek B, Kosowski A, Soloveichik D, Uznański P. 2017. Robust detection in leak-prone population protocols. In Brijder R, Qian L, Eds., DNA Computing and Molecular Programming (DNA 2017). Springer Lecture Notes in Computer Science, vol 10467, 155-171.
- Alistarh D, Grubic D, Li J, Tomioka R, Vojnovic M. 2017. QSGD: Communication-efficient SGD via gradient quantization and encoding. In Guyon I, Luxburg UV, Bengio S, Wallach H, Fergus R, Vishwanathan S, Garnett R, Eds., Advances in Neural Processing Systems (NIPS 2017), Curran Associates, Inc., 1709-1720.
- Alistarh D, Kopinsky J, Li J, Nadiradze G. 2017. The power of choice in priority scheduling. In Schiller EM, Ed., ACM Symposium on Principles of Distributed Computing (PODC 2017), ACM, Part F129314, 283-292.
- Alistarh D, Leiserson WM, Matveev A, Shavit NN. 2017. Forkscan: Conservative memory reclamation for modern operating systems. In European Conference on Computer Systems (EuroSys 2017), ACM, 483-498.
- Baig G, Radunovic B, Alistarh D, Balkwill M, Karagiannis T, Qiu L. 2017. Towards unlicensed cellular networks in TV white spaces. In Conference on emerging Networking EXperiments and Technologies (CoNEXT 2017), ACM, 2-14.
- Kara K, Alistarh D, Alonso G, Mutlu O, Zhang C. 2017. FPGA-accelerated dense linear machine learning: A precision-convergence trade-off. In Field-Programmable Custom Computing Machines (FCCM 2017), 160-167.
- Zhang H, Li J, Kara K, Alistarh D, Liu J, Zhang C. 2017. ZipML: Training linear models with end-to-end low precision, and a little bit of deep learning. In Precup D, Teh YW, Eds., International Conference on Machine Learning (ICML 2017), vol 70, 4035-4043.

Barton Group
- Barton NH. 2017. How does epistasis influence the response to selection?. Heredity. 118, 96-109.
- Barton NH, Etheridge AM, Véber A. 2017. The infinitesimal model: Definition derivation and implications. Theoretical Population Biology. 118, 50-73.
- Bradley D, Xu P, Mohorianu I, Whibley A, Field D, Tavares H, Couchman M, Copsey L, Carpenter R, Li M, Li Q, Xue Y, Dalmay T, Coen E. 2017. Evolution of flower color pattern through selection on regulatory small RNAs. Science. 358(6365), 925-928.
- Charlesworth D, Barton NH, Charlesworth B. 2017. The sources of adaptive evolution. Proceedings of the Royal Society B. 284, Article number: 20162864.
- Fraisse C, Picard MA, Vicoso B. 2017. The deep conservation of the Lepidoptera Z chromosome suggests a non-canonical origin of the W. Nature Communications. 8(1), Article number: 1486.
- Friedlander T, Prizak R, Barton NH, Tkačik G. 2017. Evolution of new regulatory functions on biophysically realistic fitness landscapes. Nature Communications. 8, Article number: 216.
- Giacobbe M, Guet CC, Gupta AK, Henzinger TA, Paixão T, Petrov TP. 2017. Model checking the evolution of gene regulatory networks. Acta Informatica. 54(8), 765-787.
- Pérez JH, Trubenová B, Sudholt D, Paixão T. 2017. Selection limits to adaptive walks on correlated landscapes. Genetics. 205(2), 803-825.
- Lagator M, Paixão T, Barton NH, Bollback JP, Guet CC. 2017. On the mechanistic nature of epistasis in a canonical cis-regulatory element. eLife. 6, Article number: e25192.
- Lagator M, Sarikas S, Acar H, Bollback JP, Guet CC. 2017. Regulatory network structure determines patterns of intermolecular epistasis. eLife. 6, Article number: e28921.
- Lukačišinová M, Novak S, Paixão T. 2017. Stress induced mutagenesis: Stress diversity facilitates the persistence of mutator genes. PLoS Computational Biology. 13(7), Article number: e1005609.
- Mitosch K, Rieckh G, Bollenbach T. 2017. Noisy response to antibiotic stress predicts subsequent single cell survival in an acidic environment. Cell Systems. 4(4), 393-403.
- Novak S, Barton NH. 2017. When does frequency-independent selection maintain genetic variation?. Genetics. 207(2), 653-668.
- Novak S, Kollár R. 2017. Spatial gene frequency waves under genotype dependent dispersal. Genetics. 205(1), 367-374.
- Paixão T, Pérez JH 2017. An application of stochastic differential equations to evolutionary algorithms. In Igel C, Sudholt D, Witt C, Eds., Proceedings of the 14th ACM/SIGEVO Conference on Foundations of Genetic Algorithms (FOGA 2017), ACM, 3-11.
- Paixão T, Pérez JH, Sudholt D, Trubenová B. 2017. Towards a runtime comparison of natural and artificial evolution. Algorithmica. 78(2), 681-713.
- Priklopil T, Chatterjee K, Nowak MA. 2017. Optional interactions and suspicious behaviour facilitates trustful cooperation in prisoner's dilemma. Journal of Theoretical Biology. 433, 64-72.
- Redondo RA, Vladar HP, Włodarski T, Bollback JP. 2017. Evolutionary interplay between structure, energy and epistasis in the coat protein of the fX174 phage family. Journal of the Royal Society Interface. 14(126), Article number: 20160139.
- Ringbauer H, Coop G, Barton NH. 2017. Inferring recent demography from isolation by distance of long shared sequence blocks. Genetics. 205(3), 1335-1351.
- Sachdeva H, Barton NH. 2017. Divergence and evolution of assortative mating in a polygenic trait model of speciation with gene flow. Evolution; International Journal of Organic Evolution. 71(6), 1478-1493.
- Schmidt TL, Barton NH, Rasic G, Turley AP, Montgomery BL, Iturbe-Ormaetxe I, Cook PE, Ryan PA, Ritchie SA, Hoffmann AA, O'Neill S, Turelli M. 2017. Successful local introduction and heterogeneous spatial spread of dengue-suppressing Wolbachia through an urban population of *Aedes aegypti.* PLoS Biology. 15(5), Article number: e2001894.
- Turelli M, Barton NH. 2017. Deploying dengue-suppressing Wolbachia: Robust models predict slow but effective spatial spread in *Aedes aegypti.* Theoretical Population Biology. 115, 45-60.
- Uecker H. 2017. Evolutionary rescue in randomly mating, selfing, and clonal populations. Evolution. 71(4), 845-858.

Benková Group
- Dobisova T, Hrdinova V, Cuesta Moliner C, Michlickova S, Urbankova I, Hejatkova R, Žádníková P, Pernisová M, Benková E, Hejátko J. 2017. Light regulated expression of sensor histidine kinase CKI1 controls cytokinin-related development. Plant Physiology. 174(1), 387-404.
- Von Wangenheim D, Hauschild R, Fendrych M, Barone V, Benková E, Friml J. 2017. Live tracking of moving samples in confocal microscopy for vertically grown roots. eLife. 6, Article number: e26792.
- Ötvös K, Benková E. 2017. Spatiotemporal mechanisms of root branching. Current Opinion in Genetics & Development. 45, 82-89.

Bickel Group
- Elek O, Sumin D, Zhang R, Weyrich T, Myszkowski K, Bickel B, Wilkie A, Krivanek J. 2017. Scattering-aware texture reproduction for 3D printing. ACM Transactions on Graphics. 36(6), Article number: a241.
- Guseinov R, Miguel E, Bickel B. 2017. CurveUps: Shaping objects from flat plates with tension-actuated curvature. SIGGRAPH: Special Interest Group on Computer Graphics and Interactive Techniques. ACM Transactions on Graphics, vol. 36. Article number: 64.
- Zhang R, Auzinger T, Ceylan D, Li W, Bickel B. 2017. Functionality-aware retargeting of mechanisms to 3D shapes. SIGGRAPH: Computer Graphics and Interactive Techniques. ACM Transactions on Graphics, vol. 36. Article number: 81.

Bollback Group
- Lagator M, Paixão T, Barton NH, Bollback JP, Guet CC. 2017. On the mechanistic nature of epistasis in a canonical cis-regulatory element. eLife. 6, Article number: e25192.
- Lagator M, Sarikas S, Acar H, Bollback JP, Guet CC. 2017. Regulatory network structure determines patterns of intermolecular epistasis. eLife. 6, Article number: e28921.
- Redondo RA, Vladar HP, Włodarski T, Bollback JP. 2017. Evolutionary interplay between structure, energy and epistasis in the coat protein of the fX174 phage family. Journal of the Royal Society Interface. 14(126), Article number: 20160139.

Bollenbach Group

- De Vos MG, Zagorski M, McNally A, Bollenbach T. 2017. Interaction networks, ecological stability, and collective antibiotic tolerance in polymicrobial infections. PNAS. 114(40), 10666-10671.
- Du W, Angermayr AS, Jongbloets JA, Molenaar D, Bachmann H, Hellingwerf KJ, Branco Dos Santos F. 2017. Nonhierarchical flux regulation exposes the fitness burden associated with lactate production in Synechocystis sp. PCC6803. ACS Synthetic Biology. 6(3), 395-401.
- Lukacisin M, Landon M, Jajoo R. 2017. Sequence-specific thermodynamic properties of nucleic acids influence both transcriptional pausing and backtracking in yeast. PLoS One. 12(3), e0174066.
- Lukačišinová M, Bollenbach T. 2017. Toward a quantitative understanding of antibiotic resistance evolution. Current Opinion in Biotechnology. 46, 90-97.
- Lukačišinová M, Novak S, Paixão T. 2017. Stress induced mutagenesis: Stress diversity facilitates the persistence of mutator genes. PLoS Computational Biology. 13(7), Article number: e1005609.
- Mitosch K, Rieckh G, Bollenbach T. 2017. Noisy response to antibiotic stress predicts subsequent single cell survival in an acidic environment. Cell Systems. 4(4), 393-403.
- Schwarz J, Bierbaum V, Vaahtomeri K, Hauschild R, Brown M, de Vries I, Leithner A, Reversat A, Merrin J, Tarrant T, Bollenbach T, Sixt M. 2017. Dendritic cells interpret haptotactic chemokine gradients in a manner governed by signal to noise ratio and dependent on GRK6. Current Biology. 27(9), 1314-1325.
- Veetil VP, Angermayr A, Hellingwerf KJ. 2017. Ethylene production with engineered Synechocystis sp PCC 6803 strains. Microbial Cell Factories. 16(1), Article number 34.
- Zagorski M, Tabata Y, Brandenberg N, Lutolf MP, Tkačik G, Bollenbach T, Briscoe J, Kicheva A. 2017. Decoding of position in the developing neural tube from antiparallel morphogen gradients. Science. 356(6345), 1379-1383.

Chatterjee Group

- Ashok P, Chatterjee K, Daca P, Křetínský J, Meggendorfer T. 2017. Value iteration for long run average reward in Markov decision processes. In Majumdar R, Kunčak V, Eds., Computer Aided Verification (CAV 2017), Springer Lecture Notes in Computer Science, vol 10426, 201-221.
- Brázdil T, Chatterjee K, Forejt V, Kučera A. 2017. Trading performance for stability in Markov decision processes. Journal of Computer and System Sciences. 84, 144-170.
- Chatterjee K, Doyen L, Filiot E, Raskin JF. 2017. Doomsday equilibria for omega-regular games. Information and Computation. 254, 296-315.
- Chatterjee K, Doyen L, Henzinger TA. 2017. The cost of exactness in quantitative reachability. In Aceto L, Bacci G, Bacci G, Ingólfsdóttir A, Legay A, Mardare R, Eds. Models, Algorithms, Logics and Tools. Springer Lecture Notes in Computer Science, vol 10460, 367-381.
- Chatterjee K, Ehlers R. 2017. Special issue: Synthesis and SYNT 2014. Acta Informatica. 54(6), 543-544.
- Chatterjee K, Fu H, Goharshady AK. 2017. Non-polynomial worst case analysis of recursive programs. In Majumdar R, Kunčak V, Eds., Computer Aided Verification (CAV 2017), Springer Lecture Notes in Computer Science, vol 10427, 41-63.
- Chatterjee K, Fu H, Murhekar A. 2017. Automated recurrence analysis for almost linear expected runtime bounds. In Majumdar R, Kunčak V, Eds., Computer Aided Verification (CAV 2017), Springer Lecture Notes in Computer Science, vol 10426, 118-139.
- Chatterjee K, Hansen KA, Ibsen-Jensen R. 2017. Strategy complexity of concurrent safety games. In Larsen K, Bodlaender H, Raskin JF, Eds., Mathematical Foundations of Computer Science (MFCS 2017), Leibniz International Proceedings in Informatics, vol 83, Article number: 55.
- Chatterjee K, Henzinger M, Loitzenbauer V. 2017. Improved algorithms for parity and Streett objectives. Logical Methods in Computer Science. 13(3), Article number: lmcs: 3953.
- Chatterjee K, Henzinger M, Svozil A. 2017. Faster algorithms for mean payoff parity games. In Larsen K, Bodlaender H, Raskin JF, Eds., Mathematical Foundations of Computer Science (MFCS 2017), Leibniz International Proceedings in Informatics, vol 83, Article number: 39.
- Chatterjee K, Henzinger TA, Ibsen-Jensen R, Otop J. 2017. Edit distance for pushdown automata. Logical Methods in Computer Science. 13(3).
- Chatterjee K, Henzinger TA, Otop J. 2017. Nested weighted automata. ACM Transactions on Computational Logic (TOCL). 18(4), Article number: 31.
- Chatterjee K, Henzinger TA, Otop J. 2017. Bidirectional nested weighted automata. In Meyer R, Nestmann U, Eds., Conference on Concurrency Theory (CONCUR 2017), Leibniz International Proceedings in Informatics, vol 85, Article number: 5.
- Chatterjee K, Henzinger TA, Otop J, Velner Y. 2017. Quantitative fair simulation games. Information and Computation. 254(2), 143-166.
- Chatterjee K, Ibsen-Jensen R, Nowak MA. 2017. Faster Monte Carlo algorithms for fixation probability of the Moran process on undirected graphs. In Larsen K, Bodlaender H, Raskin JF, Eds., Mathematical Foundations of Computer Science (MFCS 2017), Leibniz International Proceedings in Informatics, vol 83, Article number: 61.
- Chatterjee K, Kafshdar Goharshady A, Pavlogiannis A. 2017. JTDec: A tool for tree decompositions in soot. D'Souza D, Kumar KN, Eds., Automated Technology for Verification and Analysis (ATVA 2017), Springer Lecture Notes in Computer Science, vol 10482, 59-66.
- Chatterjee K, Kragl B, Mishra S, Pavlogiannis A. 2017. Faster algorithms for weighted recursive state machines. In Yang H, Ed., European Symposium on Programming: Programming Languages and Systems (ESOP 2017), Springer Lecture Notes in Computer Science, vol 10201, 287-313.
- Chatterjee K, Křetínská Z, Křetínský J. 2017. Unifying two views on multiple mean-payoff objectives in Markov decision processes. Logical Methods in Computer Science. 13(2), Article number: lmcs: 3757.
- Chatterjee K, Novotný P, Pérez GA, Raskin J, Zikelic D. 2017. Optimizing expectation with guarantees in POMDPs. Singh SP, Markovitch S, Eds., Artificial Intelligence (AAAI 2017), AAAI Press, vol 5, 3725-3732.
- Chatterjee K, Novotný P, Zikelic D. 2017. Stochastic invariants for probabilistic termination. In Castagna G, Gordon A, Eds., Principles of Programming Languages (POPL 2017), ACM, vol 52, 145-160.
- Chatterjee K, Osang G. 2017. Pushdown reachability with constant treewidth. Information Processing Letters. 122, 25-29.
- Chatterjee K, Pavlogiannis A, Kößler A, Schmid U. 2017. Automated competitive analysis of real time scheduling with graph games. Real-Time Systems. 54(1), 166-207.
- Chatterjee K, Piterman N. 2017. Obligation blackwell games and p-automata. Journal of Symbolic Logic. 82(2), 420-452.
- Chatterjee K, Velner Y. 2017. Hyperplane separation technique for multidimensional mean-payoff games. Journal of Computer and System Sciences. 88, 236-259.
- Chatterjee K, Velner Y. 2017. The complexity of mean-payoff pushdown games. Journal of the ACM. 64(5), Article number: 34.
- Hilbe C, Martinez Vaquero LA, Chatterjee K, Nowak MA. 2017. Memory-n strategies of direct reciprocity. PNAS. 114(18), 4715-4720.
- Makohon-Moore AP, Zhang M, Reiter JG, Božić I, Allen B, Kundu D, Chatterjee K, Wong F, Jiao Y, Kohutek ZA, Hong J, Attiyeh M, Javier B, Wood LD, Hruban RH, Nowak MA, Papadopoulos N, Kinzler KW, Vogelstein B, Iacobuzio-Donahue CA. 2017. Limited heterogeneity of known driver gene mutations among the metastases of individual patients with pancreatic cancer. Nature Genetics. 49(3), 358-366.
- Pavlogiannis A, Tkadlec J, Chatterjee K, Nowak MA. 2017. Amplification on undirected population structures: Comets beat stars. Scientific Reports. 7(1), Article number: 82.
- Priklopil T, Chatterjee K, Nowak MA. 2017. Optional interactions and suspicious behaviour facilitates trustful cooperation in prisoner's dilemma. Journal of Theoretical Biology. 433, 64-72.
- Reiter JG, Makohon-Moore AP, Gerold JM, Božić I, Chatterjee K, Iacobuzio-Donahue CA, Vogelstein B, Nowak MA. 2017. Reconstructing metastatic seeding patterns of human cancers. Nature Communications. 8, Article number: 14114.
- Svoreňová M, Křetínský J, Chmelík M, Chatterjee K, Cěrná I, Belta CA. 2017. Temporal logic control for stochastic linear systems using abstraction refinement of probabilistic games. Nonlinear Analysis: Hybrid Systems. 23, 230-253.
- Veller C, Hayward LK, Hilbe C, Nowak MA. 2017. The red queen and king in finite populations. PNAS. 114(27), E5396-E5405.

Cremer Group

- Di Giglio MG, Muttenthaler M, Harpsøe K, Liutkeviciute Z, Keov P, Eder T, Rattei T, Arrowsmith S, Wray S, Marek A, Elbert T, Alewood PF, Gloriam DE, Gruber CW. 2017. Development of a human vasopressin V1a-receptor antagonist from an evolutionary-related insect neuropeptide. Scientific Reports. 7, Article number: 41002.
- Franke F, Armitage SA, Kutzer MA, Kurtz J, Scharsack JP. 2017. Environmental temperature variation influences fitness trade-offs in a fish-tapeworm association. Parasites & Vectors. 10(252).
- Futo M, Sell MP, Kutzer MA, Kurtz J. 2017. Specificity of oral immune priming in the red flour beetle Tribolium castaneum. Biology Letters. 13(12), Article number: 20170632.
- Giehr J, Grasse AV, Cremer S, Heinze J, Schrempf A. 2017. Ant queens increase their reproductive efforts after pathogen infection. Royal Society Open Science. 4, Article number: 170547.
- Greenwood J, Milutinović B, Peuß R, Behrens S, Essar D, Rosenstiel P, Schulenburg H, Kurtz J. 2017. Oral immune priming with Bacillus thuringiensis induces a shift in the gene expression of Tribolium castaneum larvae. BMC Genomics. 18(329).
- Kennedy P, Baron G, Qiu B, Freitak D, Helantera H, Hunt ER, Manfredini F, O'Shea-Wheller T, Patalano S, Pull CD, Sasaki T, Taylor D, Wyatt CD, Sumner S. 2017. Deconstructing superorganisms and societies to address big questions in biology. Trends in Ecology and Evolution. 32(11), 861-872.
- Pull CD, Cremer S. 2017. Co-founding ant queens prevent disease by performing prophylactic undertaking behaviour. BMC Evolutionary Biology. 17, Article number: 219.
- Cremer S. 2017. Invasive Ameisen in Europa: Wie sie sich ausbreiten und die heimische Fauna verändern. Rundgespräche Forum Ökologie. 46, 105-116.

Csicsvari Group

- Gan J, Weng S, Pernía-Andrade AJ, Csicsvári J, Jonas P. 2017. Phase-locked inhibition, but not excitation, underlies hippocampal ripple oscillations in awake mice in vivo. Neuron. 93(2), 308-314.
- Levina A, Priesemann V. 2017. Subsampling scaling. Nature Communications. 8, Article number: 15140.
- O'Neill J, Boccara CN, Stella F, Schönenberger P, Csicsvári J. 2017. Superficial layers of the medial entorhinal cortex replay independently of the hippocampus. Science. 355(6321), 184-188.
- Simonnet J, Nassar M, Stella F, Cohen I, Mathon B, Boccara CN, Miles R, Fricker D. 2017. Activity dependent feedback inhibition may maintain head direction signals in mouse presubiculum. Nature Communications. 8, Article number: 16032.

Edelsbrunner Group

- Akopyan A, Bárány I, Robins S. 2017. Algebraic vertices of non-convex polyhedra. Advances in Mathematics. 308, 627-644.
- Akopyan A, Karasev R. 2017. A tight estimate for the waist of the ball. Bulletin of the London Mathematical Society. 49(4), 690-693.
- Akopyan A, Vysotsky V. 2017. On the lengths of curves passing through boundary points of a planar convex shape. The American Mathematical Monthly. 124(7), 588-596.
- Austin K, Virk Ž. 2017. Higson compactification and dimension raising. Topology and its Applications. 215, 45-57.
- Bauer U, Edelsbrunner H. 2017. The Morse theory of Čech and Delaunay complexes. Transactions of the American Mathematical Society. 369(5), 3741-3762.
- Bauer U, Kerber M, Reininghaus J, Wagner H. 2017. Phat - Persistent homology algorithms toolbox. Journal of Symbolic Computation. 78, 76-90.
- Chatterjee K, Osang G. 2017. Pushdown reachability with constant treewidth. Information Processing Letters. 122, 25-29.
- Edelsbrunner H, Glazyrin A, Musin OR, Nikitenko A. 2017. The Voronoi functional is maximized by the Delaunay triangulation in the plane. Combinatorica. 37(5), 887-910.
- Edelsbrunner H, Nikitenko A, Reitzner M. 2017. Expected sizes of poisson Delaunay mosaics and their discrete Morse functions. Advances in Applied Probability. 49(3), 745-767.
- Edelsbrunner H, Wagner H. 2017. Topological data analysis with Bregman divergences. In Aronov B, Katz MJ, Eds., 33rd International Symposium on Computational Geometry (SoCG 2017), Leibniz International Proceedings in Informatics, vol 77, Article number: 39.
- Ethier M, Jablonski G, Mrozek M. 2017. Finding eigenvalues of self-maps with the Kronecker canonical form. In Kotsireas I, Martínez-Moro E, Eds., Applications of Computer Algebra (ACA 2015). Springer Proceedings in Mathematics & Statistics, vol 198, 119-136.
- Heiss T, Wagner H. 2017. Streaming algorithm for Euler characteristic curves of multidimensional images. In Felsberg M, Heyden A, Eds., Computer Analysis of Images and Patterns - 17th International Conference (CAIP 2017), Springer Lecture Notes in Computer Science, vol 10424, 397-409.
- Lubiw A, Masárová Z, Wagner U. 2017. A proof of the orbit conjecture for flipping edge labelled triangulations. In Aronov B, Katz MJ, Eds., 33rd International Symposium on Computational Geometry (SoCG 2017), Leibniz International Proceedings in Informatics, vol 77, Article number: 49.
- Pranav P, Edelsbrunner H, van de Weygaert R, Vegter G, Kerber M, Jones BJ, Wintraecken MH. 2017. The topology of the cosmic web in terms of persistent Betti numbers. Monthly Notices of the Royal Astronomical Society. 465(4), 4281-4310.
- Virk Ž, Zastrow A. 2017. A new topology on the universal path space. Topology and its Applications. 231, 186-196.

Erdős Group

- Ajanki O, Krüger T, Erdős L. 2017. Singularities of solutions to quadratic vector equations on the complex upper half plane. Communications on Pure and Applied Mathematics. 70(9), 1672-1705.
- Ajanki O, Erdős L, Krüger T. 2017. Universality for general Wigner-type matrices. Probability Theory and Related Fields. 169(3-4), 667-727.
- Alt J. 2017. Singularities of the density of states of random Gram matrices. Electronic Communications in Probability. 22, Article number: 63.
- Alt J, Erdős L, Krüger T. 2017. Local law for random Gram matrices. Electronic Journal of Probability. 22, Article Number: 25.
- Bao Z, Erdős L. 2017. Delocalization for a class of random block band matrices. Probability Theory and Related Fields. 167(3), 673-776.
- Bao Z, Erdős L, Schnelli K. 2017. Convergence rate for spectral distribution of addition of random matrices. Advances in Mathematics. 319, 251-291.
- Bao Z, Erdős L, Schnelli K. 2017. Local law of addition of random matrices on optimal scale. Communications in Mathematical Physics. 349(4), 947-990.
- Betea D, Bouttier J, Nejjar P, Vuletić M. 2017. The Free Boundary Schur Process and Applications. Séminaire Lotharingien de Combinatoire 78B, Article number: 44.
- Bourgade P, Erdős L, Yau H, Yin J. 2017. Universality for a class of random band matrices. Advances in Theoretical and Mathematical Physics. 21(3), 739-800.
- Erdős L, Schnelli K. 2017. Universality for random matrix flows with time dependent density. Annales de l'institut Henri Poincare (B) Probability and Statistics. 53(4), 1606-1656.
- Erdős L, Schröder D. 2017. Fluctuations of rectangular young diagrams of interlacing Wigner eigenvalues. International Mathematics Research Notices., Article number: rnw330.
- Erdős L, Yau H. 2017. Courant Lecture Notes, vol 28: *A dynamical approach to random matrix theory*. AMS.
- Ferrari, P. L., Nejjar, P. 2017. Fluctuations of the competition interface in presence of shocks. ALEA. Latin American Journal of Probability and Mathematical Statistics 14(1), 299-325.
- Nemish Y. 2017. Local law for the product of independent non-Hermitian random matrices with independent entries. Electronic Journal of Probability. 22, Article number: 22.

Fink Group

- Barzanjeh S, Salari V, Tuszynski JA, Cifra M, Simon C. 2017. Optomechanical proposal for monitoring microtubule mechanical vibrations. Physical Review E Statistical Nonlinear and Soft Matter Physics. 96(1), Article number: ea012404.
- Barzanjeh S, Wulf M, Peruzzo M, Kalaee M, Dieterle PB, Painter O, Fink J. 2017. Mechanical on-chip microwave circulator. Nature Communications. 8(1), Article number: 953.
- Caixeiro S, Peruzzo M, Onelli OD, Vignolini S, Sapienza R. 2017. Disordered cellulose based nanostructures for enhanced light scattering. ACS Applied Materials and Interfaces. 9(9), 7885-7890.
- Fink J. 2017. Photonenblockade aufgelöst. Physik in unserer Zeit. 48(3), 111-113.
- Fink J. 2017. Viewpoint: Microwave quantum states beat the heat. Physics. 10(32).
- Fink J, Dombi A, Vukics A, Wallraff A, Domokos P. 2017. Observation of the photon blockade breakdown phase transition. Physical Review X. 7(1), Article number: 011012.
- Keller A J, Dieterle PB, Fang M, Berger B, Fink J, Painter O. 2017. Al transmon qubits on silicon-on-insulator for quantum device integration. Applied Physics Letters. 111(4), Article Number: 042603.
- Rueda A, Sedlmeir F, Collodo MC, Vogl U, Stiller B, Schunk G, Strekalov DV, Marquardt C, Fink JM, Painter O, Leuchs G, Schwefel HG. 2017. Single sideband microwave to optical photon conversion – an electro-optic-realization. In Nonlinear Optics (NLO 2017), OSA Technical Digest, Optical Society of America, Paper number: NM3A.1.

Fischer Group

- Fischer J. 2017. Weak-strong uniqueness of solutions to entropy dissipating reaction-diffusion equations. Nonlinear Analysis: Theory, Methods and Applications. 159, 181-207.
- Fischer J, Raithel C. 2017. Liouville principles and a large-scale regularity theory for random elliptic operators on the half-space. SIAM Journal on Mathematical Analysis. 49(1), 82-114.

Friml Group

- Kitakura S, Adamowski M, Matsuura Yuki, Santuari Luca, Kouno Hirotaka, Arima Kohei, Hardtke Christian S, Friml J, Kakimoto T, Tanaka H. 2017. BEN3/BIG2 ARF GEF is involved in Brefeldin A-Sensitive Trafficking at the trans-Golgi Network/Early Endosome in Arabidopsis thaliana. Plant and Cell Physiology. Article number: pcx118.
- Kuhn BM, Nodzyński T, Errafi S, Bucher R, Gupta S, Aryal B, Dobrev P, Bigler L, Geisler M, Zažímalová E, Friml J, Ringli C. 2017. Flavonol-induced changes in PIN2 polarity and auxin transport in the Arabidopsis thaliana rol1-2 mutant require phosphatase activity. Scientific Reports. 7, Article number: 41906.
- Mazur E, Friml J. 2017. Vascular tissue development and regeneration in the model plant Arabidopsis. Plant Engineering. Agricultural and Biological Sciences, 113-140.
- Morris EC, Griffiths M, Golebiowska A, Mairhofer S, Burr Hersey J, Goh T, von Wangenheim D, Atkinson B, Sturrock CJ, Lynch JP, Vissenberg K, Ritz K, Wells DM, Mooney SJ, Bennett MJ. 2017. Shaping 3D root system architecture. Current Biology. 27(17), R919-R930.
- Möller BK, Ten Hove CA, Xiang D, Williams N, López LG, Yoshida S, Smit M, Datla R, Weijers D. 2017. Auxin response cell autonomously controls ground tissue initiation in the early Arabidopsis embryo. PNAS. 114(12), E2533-E2539.
- Olatunji D, Geelen D, Verstraeten I. 2017. Control of endogenous auxin levels in plant root development. International Journal of Molecular Sciences. 18(12), Article number: 2587.
- Steenackers W, Klíma P, Quareshy MQ, Cesarino I, Kumpf RP, Corneillie S, Araújo P, Viaene T, Goeminne G, Nowack MK, Ljung K, Friml J, Blakeslee JJ, Novák O, Zažímalová E, Napier R, Boerjan W, Vanholme B. 2017. Cis-Cinnamic acid is a novel natural auxin efflux inhibitor that promotes lateral root formation. Plant Physiology. 173(1), 552-565.
- Synek L, Vukašinović N, Kulich I, Hála M, Aldorfová K, Fendrych M, Žárský V. 2017. EXO70C2 is a key regulatory factor for optimal tip growth of pollen. Plant Physiology. 174(1), 223-240.
- Tejos R, Rodríguez-Furlán C, Adamowski M, Sauer M, Norambuena L, Friml J. 2017. PATELLINS are regulators of auxin mediated PIN1 relocation and plant development in Arabidopsis thaliana. Journal of Cell Science. 131, Article number: jcs204198.
- Von Wangenheim D, Goh T, Dietrich D, Bennett MJ. 2017. Plant biology: Building barriers…in roots. Current Biology. 27(5), R172-R174.
- Von Wangenheim D, Hauschild R, Fendrych M, Barone V, Benková E, Friml J. 2017. Live tracking of moving samples in confocal microscopy for vertically grown roots. eLife. 6, Article number: e26792.
- Von Wangenheim D, Hauschild R, Friml J. 2017. Light sheet fluorescence microscopy of plant roots growing on the surface of a gel. Journal of visualized experiments JoVE. 2017(119), Article number: e55044.

Guet Group

- Barone V, Lang M, Krens G, Pradhan SJ, Shami Pour S, Sako K, Sikora M, Guet CC, Heisenberg C. 2017. An effective feedback loop between cell-cell contact duration and morphogen signaling determines cell fate. Developmental Cell. 43(2), 198-211.
- Bergmiller T, Andersson AM, Tomasek K, Balleza E, Kiviet Daniel J, Hauschild R, Tkačik G, Guet CC. 2017. Biased partitioning of the multidrug efflux pump AcrAB TolC underlies long lived phenotypic heterogeneity. Science. 356(6335), 311-315.
- Chait R, Ruess J, Bergmiller T, Tkačik G, Guet CC. 2017. Shaping bacterial population behavior through computer interfaced control of individual cells. Nature Communications. 8(1), Article number: 1535.
- Daca P, Henzinger TA, Křetínský J, Petrov T. 2017. Faster statistical model checking for unbounded temporal properties. ACM Transactions on Computational Logic (TOCL). 18(2), Article number: 12.
- Fang C, Nagy-Staron A, Grafe M, Heermann R, Jung K, Gebhard S, Mascher T. 2017. Insulation and wiring specificity of BceR like response regulators and their target promoters in Bacillus subtilis. Molecular Microbiology. 104(1), 16-31.
- Friedlander T, Prizak R, Barton NH, Tkačik G. 2017. Evolution of new regulatory functions on biophysically realistic fitness landscapes. Nature Communications. 8, Article number: 216.
- Giacobbe M, Guet CC, Gupta AK, Henzinger TA, Paixão T, Petrov TP. 2017. Model checking the evolution of gene regulatory networks. Acta Informatica. 54(8), 765-787.
- Lagator M, Paixão T, Barton NH, Bollback JP, Guet CC. 2017. On the mechanistic nature of epistasis in a canonical cis-regulatory element. eLife. 6, Article number: e25192.
- Lagator M, Sarikas S, Acar H, Bollback JP, Guet CC. 2017. Regulatory network structure determines patterns of intermolecular epistasis. eLife. 6, Article number: e28921.
- Lang M, Sontag E. 2017. Zeros of nonlinear systems with input invariances. Automatica. 81C, 46-55.
- Nikolic N, Didara Z, Moll I. 2017. MazF activation promotes translational heterogeneity of the grcA mRNA in Escherichia coli populations. PeerJ. 2017(9), Article number: 3830.
- Nikolic N, Schreiber Frank, Dal Co Alma, Kiviet Daniel J, Bergmiller T, Littmann Sten, Kuypers MM, Ackermann M. 2017. Cell-to-cell variation and specialization in sugar metabolism in clonal bacterial populations. PLoS Genetics. 13(12), Article number: e1007122.
- Pleska M, Guet CC. 2017. Effects of mutations in phage restriction sites during escape from restriction-modification. Biology Letters. 13(12), Article number: 2017064.
- Renault TT, Abraham AO, Bergmiller T, Paradis G, Rainville S, Charpentier E, Guet CC, Tu Y, Namba K, Keener JP, Minamino T, Erhardt M. 2017. Bacterial flagella grow through an injection diffusion mechanism. eLife. 6, Article number: e23136.
- Steinrück M, Guet CC. 2017. Complex chromosomal neighborhood effects determine the adaptive potential of a gene under selection. eLife. 6, Article number: e25100.

Hannezo Group

- Hannezo E, Scheele CL, Moad M, Drogo N, Heer R, Sampogna RV, Van Rheenen J, Simons BD. 2017. A unifying theory of branching morphogenesis. Cell. 171(1), 242-255.
- Pinheiro D, Hannezo E, Herszterg S, Bosveld F, Gaugué I, Balakireva MG, Wang Z, Cristo I, Rigaud SU, Markova O, Bellaïche Y. 2017. Transmission of cytokinesis forces via E cadherin dilution and actomyosin flows. Nature. 545(7652), 103-107.
- Scheele CLG, Hannezo E, Muraro MJ, Zomer A, Langedijk NSM, Van Oudenaarden A, Simons BD, Van Rheenen J. 2017.Identity and dynamics of mammary stem cells during branching morphogenesis. Nature. 542(7641), 313-317.
- Sedzinski J, Hannezo E, Tu F, Biro M, Wallingford JB. 2017. RhoA regulates actin network dynamics during apical surface emergence in multiciliated epithelial cells. Journal of Cell Science. 130(2), 420-428.

Hausel Group

- Davison B. 2017. The critical CoHA of a quiver with potential. Quarterly Journal of Mathematics. 68(2), 635-703.

Heisenberg Group

- Barone V, Lang M, Krens G, Pradhan SJ, Shami Pour S, Sako K, Sikora M, Guet CC, Heisenberg C. 2017. An effective feedback loop between cell-cell contact duration and morphogen signaling determines cell fate. Developmental Cell. 43(2), 198-211.
- Chan CJ, Heisenberg C, Hiiragi T. 2017. Coordination of morphogenesis and cell fate specification in development. Current Biology. 27(18), R1024-R1035.
- Heisenberg C. 2017. Cell biology: Stretched divisions. Nature. 543(7643), 43-44.
- Heisenberg C. 2017. D'Arcy Thompson's 'on growth and form': From soap bubbles to tissue self-organization. Mechanisms of Development. 145, 32-37.
- Krens G, Veldhuis JH, Barone V, Čapek D, Maître J, Brodland W, Heisenberg C. 2017. Interstitial fluid osmolarity modulates the action of differential tissue surface tension in progenitor cell segregation during gastrulation. Development. 144(10), 1798-1806.
- Morita H, Grigolon S, Bock M, Krens G, Salbreux G, Heisenberg C. 2017. The physical basis of coordinated tissue spreading in zebrafish gastrulation. Developmental Cell. 40(4), 354-366.
- Petridou NI, Spiró Z, Heisenberg C. 2017. Multiscale force sensing in development. Nature Cell Biology. 19(6), 581-588.
- Schmalhorst PS, Deluweit F, Scherrers R, Heisenberg C, Sikora M. 2017. Overcoming the limitations of the MARTINI force field in simulations of polysaccharides. Journal of Chemical Theory and Computation. 13(10), 5039-5053.
- Smutny M, Ákos Z, Grigolon S, Shamipour S, Ruprecht V, Čapek D, Behrndt M, Papusheva E, Tada M, Hof B, Vicsek T, Salbreux G, Heisenberg C. 2017. Friction forces position the neural anlage. Nature Cell Biology. 19, 306-317.
- Spiró Z, Heisenberg C. 2017. Regeneration tensed up polyploidy takes the lead. Developmental Cell. 42(6), 559-560.
- Von Wangenheim D, Hauschild R, Fendrych M, Barone V, Benková E, Friml J. 2017. Live tracking of moving samples in confocal microscopy for vertically grown roots. eLife. 6, Article number: e26792.

Henzinger Group

- Ashok P, Chatterjee K, Daca P, Křetínský J, Meggendorfer T. 2017. Value iteration for long-run average reward in Markov decision processes. In Majumdar R, Kunčak V, Eds., Computer-Aided Verification (CAV 2017), Springer Lecture Notes in Computer Science, vol 10426, 201-221.
- Avni G, Goel S, Henzinger TA, Rodríguez-Navas G. 2017. Computing scores of forwarding schemes in switched networks with probabilistic faults. In Legay A, Margaria T, Eds., Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2017), Springer Lecture Notes in Computer Science, vol 10206, 169-187.
- Avni G, Guha S, Kupferman O. 2017. An abstraction-refinement methodology for reasoning about network games. In Sierra C, Ed., International Joint Conference on Artificial Intelligence (IJCAI 2017), 70-76.
- Avni G, Guha S, Kupferman O. 2017. Timed network games. In Larsen K, Bodlaender H, Raskin JF, Eds., Mathematical Foundations of Computer Science (MFCS 2017), Leibniz International Proceedings in Informatics, vol 83, Article number: 37.
- Avni G, Henzinger TA, Chonev V. 2017. Infinite-duration bidding games. . In Meyer R, Nestmann U, Eds., Concurrency Theory (CONCUR 2017), Leibniz International Proceedings in Informatics, vol 85, Article number: 21.
- Bak S, Bogomolov S, Henzinger TA, Kumar A. 2017. Challenges and tool implementation of hybrid rapidly exploring random trees. In Abate A, Boldo S, Eds., Numerical Software Verification (NSV 2017), Springer Lecture Notes in Computer Science, vol 10381, 83-89.
- Bakhirkin A, Ferrère T, Maler O, Ulus D. 2017. On the quantitative semantics of regular expressions over real-valued signals. In Abate A, Geeraerts G, Eds., Formal Modeling and Analysis of Timed Systems (FORMATS 2017), Springer Lecture Notes in Computer Science, vol 10419, 189-206.
- Bogomolov S, Frehse G, Giacobbe M, Henzinger TA. 2017. Counterexample-guided refinement of template polyhedra. In Legay A, Margaria T, Eds., Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2017), Springer Lecture Notes in Computer Science, vol 10205, 589-606.
- Bogomolov S, Giacobbe M, Henzinger TA, Kong H. 2017. Conic abstractions for hybrid systems. In Abate A, Geeraerts G, Eds., Formal Modeling and Analysis of Timed Systems (FORMATS 2017), Springer Lecture Notes in Computer Science, vol 10419, 116-132.
- Cerný P, Clarke EM, Henzinger TA, Radhakrishna A, Ryzhyk L, Samanta R, Tarrach T. 2017. From non-preemptive to preemptive scheduling using synchronization synthesis. Formal Methods in System Design. 50(2-3), 97-139.
- Chatterjee K, Doyen L, Henzinger TA. 2017. The cost of exactness in quantitative reachability. In Aceto L, Bacci G, Bacci G, Ingólfsdóttir A, Legay A, Mardare R, Eds. Models, Algorithms, Logics, and Tools. Springer Lecture Notes in Computer Science, vol 10460, 367-381.
- Chatterjee K, Henzinger TA, Ibsen-Jensen R, Otop J. 2017. Edit distance for pushdown automata. Logical Methods in Computer Science. 13(3).
- Chatterjee K, Henzinger TA, Otop J. 2017. Bidirectional nested weighted automata. In Meyer R, Nestmann U, Eds., Concurrency Theory (CONCUR 2017), Leibniz International Proceedings in Informatics, vol 85, Article number: 5.
- Chatterjee K, Henzinger TA, Otop J. 2017. Nested weighted automata. ACM Transactions on Computational Logic. 18(4), Article number: 31.
- Chatterjee K, Henzinger TA, Otop J, Velner Y. 2017. Quantitative fair simulation games. Information and Computation. 254(2), 143-166.
- Chatterjee K, Kragl B, Mishra S, Pavlogiannis A. 2017. Faster algorithms for weighted recursive state machines. In Yang H, Ed., European Symposium on Programming (ESOP 2017), Springer Lecture Notes in Computer Science, vol 10201, 287-313.
- Daca P, Henzinger TA, Křetínský J, Petrov T. 2017. Faster statistical model checking for unbounded temporal properties. ACM Transactions on Computational Logic. 18(2), Article number: 12.
- Finkbeiner B, Kupriyanov A. 2017. Causality-based model checking. In Groce A, Leue S, Eds., Causal Reasoning for Embedded and Safety-critical Systems Technologies (CREST 2017), Electronic Proceedings in Theoretical Computer Science, vol 259, 31-38.
- Giacobbe M, Guet CC, Gupta AK, Henzinger TA, Paixão T, Petrov TP. 2017. Model checking the evolution of gene regulatory networks. Acta Informatica. 54(8), 765-787.
- Henzinger TA, Otop J. 2017. Model measuring for discrete and hybrid systems. Nonlinear Analysis: Hybrid Systems. 23, 166-190.
- Kong H, Bogomolov S, Schilling C, Jiang Y, Henzinger TA. 2017. Safety verification of nonlinear hybrid systems based on invariant clusters. In Frehse G, Mitra S, Eds., Hybrid Systems: Computation and Control (HSCC 2017), ACM, 163-172.
- Le XD, Chu D, Lo D, Le Goues C, Visser W. 2017. S3: Syntax- and semantic-guided repair synthesis via programming by examples. In Bodden E, Schäfer W, van Deursen A, Zisman A, Eds., Foundations of Software Engineering (FSE 2017), ACM, 593-604.
- Trinh M, Chu D, Jaffar J. 2017 Model counting for recursively-defined strings. In Majumdar R, Kunčak V, Eds., Computer-Aided Verification (CAV 2017), Springer Lecture Notes in Computer Science, vol 10427, 399-418.

Hippenmeyer Group

- Andergassen D, Dotter CP, Wenzel D, Sigl V, Bammer PC, Muckenhuber M, Mayer D, Kulinski TM, Theussl H, Penninger JM, Bock C, Barlow DP, Pauler FM, Hudson QJ. 2017. Mapping the mouse Allelome reveals tissue specific regulation of allelic expression. eLife. 6, Article number: e25125.
- Beattie R, Hippenmeyer S. 2017. Mechanisms of radial glia progenitor cell lineage progression. FEBS Letters. 591, 3993-4008.
- Beattie R, Postiglione MP, Burnett LE, Laukoter S, Streicher C, Pauler FM, Xiao G, Klezovitch Olga, Vasioukhin V, Ghashghaei TH, Hippenmeyer S. 2017. Mosaic analysis with double markers reveals distinct sequential functions of Lgl1 in neural stem cells. Neuron. 94(3), 517-533.
- Breuss MW, Hansen AH, Landler L, Keays DA. 2017. Brain specific knockin of the pathogenic Tubb5 E401K allele causes defects in motor coordination and prepulse inhibition. Behavioural Brain Research. 323, 47-55.
- Breuss MW, Leca I, Gstrein T, Hansen AH, Keays DA. 2017. Tubulins and brain development – the origins of functional specification. Molecular and Cellular Neuroscience. 84, 58-67.
- Breuss MW, Nguyen T, Srivatsan A, Leca I, Tian G, Fritz T, Hansen AH, Musaev D, McEvoy-Venneri J, Kiely JN, Rosti RO, Scott E, Tan U, Kolodner RD, Cowan NJ, Keays DA, Gleeson JG. 2017. Uner Tan syndrome caused by a homozygous TUBB2B mutation affecting microtubule stability. Human Molecular Genetics. 26(2), 258-269.
- Hansen AH, Duellberg C, Mieck C, Loose M, Hippenmeyer S. 2017. Cell polarity in cerebral cortex development - cellular architecture shaped by biochemical networks. Frontiers in Cellular Neuroscience. 11, Article number: 176.
- Pfurr S, Chu Y, Bohrer C, Greulich F, Beattie R, Mammadzada K, Hils M, Arnold SJ, Taylor V, Schachtrup K, Uhlenhaut NH, Schachtrup C. 2017. The E2A splice variant E47 regulates the differentiation of projection neurons via p57(KIP2) during cortical development. Development. 144, 3917-3931.

Hof Group

- Altmeyer S, Do Y, Lai Y. 2017. Dynamics of ferrofluidic flow in the Taylor-Couette system with a small aspect ratio. Scientific Reports. 7, Article number: 40012.
- Altmeyer S, Do Y, Ryu S. 2017. Transient behavior between multi-cell flow states in ferrofluidic Taylor-Couette flow. Chaos. 27(11), Article number: 113112.
- Altmeyer S, Lueptow RM. 2017. Wave propagation reversal for wavy vortices in wide gap counter rotating cylindrical Couette flow. Physical Review E - Statistical, Nonlinear, and Soft Matter Physics. 95(5), Article number: 053103.
- Barone V, Lang M, Krens G, Pradhan SJ, Shami Pour S, Sako K, Sikora M, Guet CC, Heisenberg C. 2017. An effective feedback loop between cell-cell contact duration and morphogen signaling determines cell fate. Developmental Cell. 43(2), 198-211.
- Budanur NB, Hof B. 2017. Heteroclinic path to spatially localized chaos in pipe flow. Journal of Fluid Mechanics. 827, Article number: 827.
- Budanur NB, Short KY, Farazmand M, Willis AP, Cvitanović P. 2017. Relative periodic orbits form the backbone of turbulent pipe flow. Journal of Fluid Mechanics. 833, 274-301.
- Hof B. 2017. Fluid dynamics: Water flows out of touch. Nature. 541(7636), 161-162.
- Klotz L, Lemoult G, Frontczak I, Tuckerman LS, Wesfreid JE. 2017. Couette-Poiseuille flow experiment with zero mean advection velocity: Subcritical transition to turbulence. Physical Review Fluids. 2(4), Article number: 043904.
- Lopez J, Avila M. 2017. Boundary layer turbulence in experiments on quasi Keplerian flows. Journal of Fluid Mechanics. 817, 21-34.
- Shi L, Hof B, Rampp M, Avila M. 2017. Hydrodynamic turbulence in quasi Keplerian rotating flows. Physics of Fluids. 29(4), Article number: 044107.
- Smutny M, Ákos Z, Grigolon S, Shamipour S, Ruprecht V, Čapek D, Behrndt M, Papusheva E, Tada M, Hof B, Vicsek T, Salbreux G, Heisenberg C. 2017. Friction forces position the neural anlage. Nature Cell Biology. 19, 306-317.
- Song B, Barkley D, Hof B, Avila M. 2017. Speed and structure of turbulent fronts in pipe flow. Journal of Fluid Mechanics. 813, 1045-1059.
- Xu D, Warnecke S, Song B, Ma X, Hof B. 2017. Transition to turbulence in pulsating pipe flow. Journal of Fluid Mechanics. 831, 418-432.

Janovjak Group

- Agus V, Janovjak H. 2017. Optogenetic methods in drug screening: Technologies and applications. Current Opinion in Biotechnology. 48, 8-14.
- Clifton BE, Whitfield JH, Sanchez-Romero I, Herde MK, Henneberger C, Janovjak H, Jackson CJ. 2017. Ancestral protein reconstruction and circular permutation for improving the stability and dynamic range of FRET sensors. Synthetic Protein Switches. Methods in Molecular Biology vol. 1596. 71-87.
- Kainrath S, Stadler M, Reichhart E, Distel M, Janovjak H. 2017. Grünlicht-induzierte Rezeptorinaktivierung durch Cobalamin-bindende Domänen. Angewandte Chemie. 129(16), 4679-4682.
- Kainrath S, Stadler M, Reichhart E, Distel M, Janovjak H. 2017. Green-light-induced inactivation of receptor signaling using cobalamin-binding domains. Angewandte Chemie - International Edition. 129(16), 460-4611.
- Mitchell JA, Zhang WH, Herde MK, Henneberger C, Janovjak H, O'Mara ML, Jackson CJ. 2017. Method for developing optical sensors using a synthetic dye fluorescent protein FRET pair and computational modeling and assessment. Synthetic Protein Switches. Methods in Molecular Biology vol. 1596. 89-99.

Jonas Group

- Chen C, Arai I, Satterield R, Young SM Jr., Jonas P. 2017. Synaptotagmin 2 is the fast Ca^{2+} sensor at a central inhibitory synapse. Cell Reports. 18(3), 723-736.
- Chen C, Jonas P. 2017. Synaptotagmins: That's why so many. Neuron. 94(4), 694-696.
- Chen C, Satterfield R, Young SM Jr., Jonas P. 2017. Triple function of Synaptotagmin 7 ensures efficiency of high-frequency transmission at central GABAergic synapses. Cell Reports. 21(8), 2082-2089.
- Gan J, Weng S, Pernía-Andrade AJ, Csicsvári J, Jonas P. 2017. Phase-locked inhibition, but not excitation, underlies hippocampal ripple oscillations in awake mice in vivo. Neuron. 93(2), 308-314.
- Geng X, Maruo T, Mandai K, Supriyanto I, Miyata M, Sakakibara S, Mizoguchi A, Takai Y, Mori M. 2017. Roles of afadin in functional differentiations of hippocampal mossy fiber synapse. Genes to Cells. 22(8), 715-722.
- Guarina L, Vandael DH, Carabelli V, Carbone E. 2017. Low pHo boosts burst firing and catecholamine release by blocking TASK-1 and BK channels while preserving Cav1 channels in mouse chromaffin cells. Journal of Physiology. 595(8), 2587-2609.
- Strüber M, Sauer J, Jonas P, Bartos M. 2017. Distance-dependent inhibition facilitates focality of gamma oscillations in the dentate gyrus. Nature Communications. 8, Article number: 758.

Jösch Group

- Shigemoto R, Jösch M. 2017. The genetic encoded toolbox for electron microscopy and connectomics. WIREs Developmental Biology. 6(6), Article Number: 6:e288.

Katsaros Group

- Vukušić L, Kukučka J, Watzinger H, Katsaros G. 2017. Fast hole tunneling times in germanium hut wires probed by single-shot reflectometry. Nano Letters. 17(9), 5706-5710.

Kicheva Group

- Briscoe J, Kicheva A. 2017. The physics of development 100 years after D'Arcy Thompson's "on growth and form". Mechanisms of Development. 145, 26-31.
- Kicheva A, Rivron NC. 2017. Creating to understand – developmental biology meets engineering in Paris. Development. 144(5), 733-736.
- Zagorski M, Tabata Y, Brandenberg N, Lutolf MP, Tkačik G, Bollenbach T, Briscoe J, Kicheva A. 2017. Decoding of position in the developing neural tube from antiparallel morphogen gradients. Science. 356(6345), 1379-1383.

Kolmogorov Group

- Kazda A, Kolmogorov V, Rolinek M. 2017. Even delta-matroids and the complexity of planar Boolean CSPs. In Klein P, Ed., Symposium on Discrete Algorithms (SODA 2017), ACM-SIAM, 307-326.
- Kolmogorov V, Krokhin A, Rolinek M. 2017. The complexity of general valued CSPs. SIAM Journal on Computing. 46(3), 1087-1110.
- Kuske J, Swoboda P, Petra S. 2017. A novel convex relaxation for non-binary discrete tomography. In Lauze F, Dong Y, Dahl AB, Eds., Scale Space and Variational Methods in Computer Vision (SSVM 2017), Springer Lecture Notes in Computer Science, vol 10302, 235-246.
- Shekhovtsov A, Swoboda P, Savchynskyy B. 2017. Maximum persistency via iterative relaxed inference with graphical models. In Computer Vision and Pattern Recognition (CVPR 2015), IEEE Computer Society. 521-529.
- Swoboda P, Andres B. 2017. A message passing algorithm for the minimum cost multicut problem. In Computer Vision and Pattern Recognition (CVPR 2017), IEEE Computer Society, 4990-4999.
- Swoboda P, Kuske J, Savchynskyy B. 2017. A dual ascent framework for Lagrangian decomposition of combinatorial problems. In Computer Vision and Pattern Recognition (CVPR 2017), IEEE Computer Society, 4950-4960.
- Swoboda P, Rother C, Abu Alhaija C, Kainmueller D, Savchynskyy B. 2017. A study of Lagrangian decompositions and dual ascent solvers for graph matching. In Computer Vision and Pattern Recognition (CVPR 2017), IEEE Computer Society, 7062-7071.
- Trajkovska V, Swoboda P, Åström F, Petra S. 2017. Graphical model parameter learning by inverse linear programming. In Lauze F, Dong Y, Dahl AB, Eds., Scale Space and Variational Methods in Computer Vision (SSVM 2017), Springer Lecture Notes in Computer Science, vol 10302, 323-334.

Lampert Group

- Der R, Martius G. 2017. Self-organized behavior generation for musculoskeletal robots. Frontiers in Neurorobotics. 11, Article number: 00008.
- Kolesnikov A, Lampert CH. 2017. PixelCNN models with auxiliary variables for natural image modeling. In Precup D, Teh YW, Eds., International Conference on Machine Learning (ICML 2017), vol 70, 1905-1914.
- Pentina A, Lampert CH. 2017. Multi-task learning with labeled and unlabeled tasks. In Precup D, Teh YW, Eds., International Conference on Machine Learning (ICML 2017), vol 70, 2807-2816.
- Pielorz J, Prandtstetter M, Straub M, Lampert CH. 2017. Optimal geospatial volunteer allocation needs realistic distances. Workshop Data Science for Emergency Management at IEEE International Conference on Big Data, IEEE, 3760-3763.
- Rebuffi S, Kolesnikov A, Sperl G, Lampert CH. 2017. iCaRL: Incremental classifier and representation learning. In Computer Vision and Pattern Recognition (CVPR 2017), IEEE Computer Society, 5533-5542.
- Royer A, Kolesnikov A, Lampert CH. 2017. Probabilistic image colorization. In British Machine Vision Conference (BMVC 2017). BMVA Press.
- Zimin A, Lampert CH. 2017. Learning theory for conditional risk minimization. In Singh A, Zhu X, Eds., Artificial Intelligence and Statistics (AISTATS 2017), vol 54, 213-222.

Lemeshko Group

- Bighin G, Lemeshko M. 2017. Diagrammatic approach to orbital quantum impurities interacting with a many-particle environment. Physical Review B - Condensed Matter and Materials Physics. 96(8), Article number: 085410.
- Bighin G, Salasnich L. 2017. Vortices and antivortices in two-dimensional ultracold Fermi gases. Scientific Reports. 7, Article number: 45702.
- Camus N, Yakaboylu E, Fechner L, Laux M, Mi Y, Hatsagortsyan KZ, Pfeifer T, Keitel CH, Moshammer R. 2017. Experimental evidence for quantum tunneling time. Physical Review Letters. 119, Article number: 023201.
- Cherepanov IN, Lemeshko M. 2017. Fingerprints of angulon instabilities in the spectra of matrix-isolated molecules. Physical Review Materials. 1(3), Article number: 035602.
- Klaiber M, Daněk J, Yakaboylu E, Hatsagortsyan KZ, Keitel CH. 2017. Strong-field ionization via a high-order Coulomb-corrected strong-field approximation. Physical Review A - Atomic, Molecular, and Optical Physics. 95, Article number: 023403.
- Lemeshko M. 2017. Quasiparticle approach to molecules interacting with quantum solvents. Physical Review Letters. 118, Article number: 095301.
- Lemeshko M, Schmidt R. 2017. Molecular impurities interacting with a many-particle environment: From ultracold gases to helium nanodroplets. Cold Chemistry: Molecular Scattering and Reactivity Near Absolute Zero. Theoretical and Computational Chemistry Series vol. 11. 444-495.
- Li X, Seiringer R, Lemeshko M. 2017. Angular self-localization of impurities rotating in a bosonic bath. Physical Review A. 95, Article number: 033608.
- Midya B, Konotop VV. 2017. Waveguides with absorbing boundaries: Nonlinearity controlled by an exceptional point and solitons. Physical Review Letters. 119(3), 033905.
- Shepperson B, Chatterley AS, Søndergaard AA, Christiansen L, Lemeshko M, Stapelfeldt H. 2017. Strongly aligned molecules inside helium droplets in the near-adiabatic regime. The Journal of Chemical Physics. 147(1), Article number: 013946.
- Shepperson B, Søndergaard AA, Christiansen L, Kaczmarczyk J, Zillich RE, Lemeshko M, Stapelfeldt H. 2017. Laser-induced rotation of iodine molecules in He-nanodroplets: Revivals and breaking-free. Physical Review Letters. 118, Article number: 203203.
- Spałek J, Zegrodnik M, Kaczmarczyk J. 2017. Universal properties of high temperature superconductors from real space pairing t-J-U model and its quantitative comparison with experiment. Physical Review B - Condensed Matter and Materials Physics. 95(2), 024506.
- Wysokiński MM, Kaczmarczyk J. 2017. Unconventional superconductivity in generalized Hubbard model role of electron—hole symmetry breaking terms. Journal of Physics: Condensed Matter. 29(8), Article number: 085604.
- Yakaboylu E, Deuchert A, Lemeshko M. 2017. Emergence of non-abelian magnetic monopoles in a quantum impurity problem. APS Physics, Physical Review Letters. 119, Article number: 235301-6.
- Yakaboylu E, Lemeshko M. 2017. Anomalous screening of quantum impurities by a neutral environment. Physical Review Letters. 118, Article number: 085302.

Loose Group

- Baranova NS, Loose M. 2017. Single-molecule measurements to study polymerization dynamics of FtsZ-FtsA copolymers.Methods in Cell Biology. 137, 355-370.
- Hansen AH, Duellberg C, Mieck C, Loose M, Hippenmeyer S. 2017. Cell polarity in cerebral cortex development - cellular architecture shaped by biochemical networks. Frontiers in Cellular Neuroscience. 11, Article number: 176.
- Loose M, Zieske K, Schwille P. 2017. Reconstitution of protein dynamics involved in bacterial cell division. Subcellular Biochemistry. 84, 419-444.
- Rickman J, Duellberg C, Cade NI, Griffin LD, Surrey T. 2017. Steady state EB cap size fluctuations are determined by stochastic microtubule growth and maturation. PNAS. 114(13), 3427-3432.

Maas Group

- Betea D, Bouttier J, Nejjar P, Vuletić M. 2017. The Free Boundary Schur Process and Applications. Séminaire Lotharingien de Combinatoire 78B, Article number: 44, 12 pp.
- Carlen EA, Maas J. 2017. Gradient flow and entropy inequalities for quantum Markov semigroups with detailed balance. Journal of Functional Analysis. 273(5), 1810-1869.
- Ferrari, P. L., Nejjar, P. 2017. Fluctuations of the competition interface in presence of shocks. ALEA. Latin American Journal of Probability and Mathematical Statistics. 14(1), 299-325.
- Gerencsér M, Gyöngy I. 2017. Localization errors in solving stochastic partial differential equations in the whole space. Mathematics of Computation. 86(307), 2373-2397.
- Gerencsér M, Jentzen A, Salimova D. 2017. On stochastic differential equations with arbitrarily slow convergence rates for strong approximation in two space dimensions. Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences. 473(2207), Article number: 20170104.
- Maas J. 2017. Entropic Ricci curvature for discrete spaces. In Najman L, Romon P, Eds., Modern Approaches to Discrete Curvature. Springer Lecture Notes in Mathematics, vol 2184, 159-174.
- Maas J, Rumpf M, Simon S. 2017. Transport based image morphing with intensity modulation. In Lauze F, Dong Y, Dahl AB, Eds., Scale Space and Variational Methods in Computer Vision - 6th International Conference (SSVM 2017), Springer Lecture Notes in Computer Science, vol 10302, 563-577.

Novarino Group

- Andergassen D, Dotter CP, Wenzel D, Sigl V, Bammer PC, Muckenhuber M, Mayer D, Kulinski TM, Theussl H, Penninger JM, Bock C, Barlow DP, Pauler FM, Hudson QJ. 2017. Mapping the mouse Allelome reveals tissue specific regulation of allelic expression. eLife. 6, Article number: e25125.
- Brailoiu GC, Deliu E, Barr JL, Console-Bram LM, Ciuciu AM, Abood ME, Unterwald EM, Brăiloiu E. 2017. HIV Tat excites D1 receptor-like expressing neurons from rat nucleus accumbens. Drug and Alcohol Dependence. 178, 7-14.
- Brăiloiu E, McGuire M, Shuler SA, Deliu E, Barr JL, Abood ME, Brailoiu GC. 2017. Modulation of cardiac vagal tone by bradykinin acting on nucleus ambiguus. Neuroscience. 365, 23-32.
- Gherghina FL, Tica AA, Deliu E, Abood ME, Brailoiu GC, Brăiloiu E. 2017. Effects of VPAC1 activation in nucleus ambiguus neurons. Brain Research. 1657, 297-303.
- Hill Yardin EL, McKeown SJ, Novarino G, Grabrucker AM. 2017. Extracerebral dysfunction in animal models of autism spectrum disorder. In Schmeisser M, Boeckers T, Eds., Translational Anatomy and Cell Biology of Autism Spectrum Disorder. Advances in Anatomy, Embryology and Cell Biology, vol 224. Springer. 159-187.
- Khamina K, Lercher A, Caldera M, Schliehe C, Vilagos B, Sahin M, Kosack L, Bhattacharya A, Májek P, Stukalov A, Sacco R, James LC, Pinschewer DD, Bennett KL, Menche J, Bergthaler A. 2017. Characterization of host proteins interacting with the lymphocytic choriomeningitis virus L protein. PLoS Pathogens. 13(12), Article number: e1006758.
- Novarino G. 2017. The science of love in ASD and ADHD. Science Translational Medicine. 9(411), Article number: eaap8168.
- Novarino G. 2017. Rett syndrome modeling goes simian. Science Translational Medicine. 9(393), Article number: eaan8196.
- Novarino G. 2017. Modeling Alzheimer's disease in mice with human neurons. Science Translational Medicine. 9(381), Article number: eaam9867.
- Novarino G. 2017. The riddle of CHD8 haploinsufficiency in autism spectrum disorder. Science Translational Medicine. 9(399), Article number: eaao0972.
- Novarino G. 2017. The antisocial side of antibiotics. Science Translational Medicine. 9(387), Article number: 2786.
- Novarino G. 2017. More excitation for Rett syndrome. Science Translational Medicine. 9(405), Article number: eaao4218.
- Sauerzopf U, Sacco R, Novarino G, Niello M, Weidenauer A, Praschak-Rieder N, Sitte HH, Willeit M. 2017. Are reprogrammed cells a useful tool for studying dopamine dysfunction in psychotic disorders? A review of the current evidence. European Journal of Neuroscience. 45, 45-57.
- Schroeder JC, Deliu E, Novarino G, Schmeisser MJ. 2017. Genetic and pharmacological reversibility of phenotypes in mouse models of autism spectrum disorder. In Schmeisser M, Boeckers T, Eds., Translational Anatomy and Cell Biology of Autism Spectrum Disorder. Advances in Anatomy, Embryology and Cell Biology, vol 224. Springer. 189-211.

Pietrzak Group

- Abusalah H, Alwen J, Cohen B, Khilko D, Pietrzak K, Reyzin L. 2017. Beyond Hellman's time-memory trade-offs with applications to proofs of space. In Tagaki T, Peyrin T. Advances in Cryptology - Conference on the Theory and Applications of Cryptology and Information Security (ASIACRYPT 2017), Springer Lecture Notes in Computer Science, vol 10625, 357-379.
- Alwen J, Blocki J. 2017. Towards practical attacks on Argon2i and balloon hashing. In 2017 IEEE European Symposium on Security and Privacy (EuroS&P 2017), IEEE, 142-157.
- Alwen J, Blocki J, Harsha B. 2017. Practical Graphs for Optimal Side-Channel Resistant Memory-Hard Functions. In Thuraisingham B, Evans D, Malkin T, Xu D, Eds., ACM-SIGSAC Computer and Communications Security (CCS 2017), ACM, 1001-1017.
- Alwen J, Blocki J, Pietrzak K. 2017. Depth-robust graphs and their cumulative memory complexity. In Coron JS, Nielsen JB, Eds., Advances in Cryptology - International Conference on the Theory and Applications of Cryptographic Techniques (EUROCRYPT 2017), Springer Lecture Notes in Computer Science, vol 10212, 3-32.
- Alwen J, Chen B, Pietrzak K, Reyzin L, Tessaro S. 2017. Scrypt is maximally memory hard. In Coron JS, Nielsen JB, Eds., Advances in Cryptology - Conference on the Theory and Applications of Cryptographic Techniques (EUROCRYPT 2017), Springer Lecture Notes in Computer Science, vol 10212, 33-62.
- Alwen J, Tackmann B. 2017. Moderately hard functions: Definition, instantiations, and applications. In Kalei Y, Reyzin L, Eds., Theory of Cryptography (TCC 2017), Springer Lecture Notes in Computer Science, vol 10677, 493-526.
- Alwen J, de Rezende SF, Nordstrom J, Vinyals M. 2017. Cumulative space in black-white pebbling and resolution. In Papadimitriou CH, Ed., Innovations in Theoretical Computer Science Conference (ITCS 2017), Leibniz International Proceedings in Informatics, vol 67, Article number: 38.
- Brody J, Dziembowski S, Faust S, Pietrzak K. 2017. Position based cryptography and multiparty communication complexity. In Kalei Y, Reyzin L, Eds., Theory of Cryptography (TCC 2017), Springer Lecture Notes in Computer Science, vol 10677, 56-81.
- Jafargholi Z, Kamath C, Klein K, Komargodski I, Pietrzak K, Wichs D. 2017. Be adaptive avoid overcommitting. In Katz J, Shacham H, Eds., Advances in Cryptology - Cryptology Conference (CRYPTO 2017), Springer Lecture Notes in Computer Science, vol 10401, 133-163.
- Kiltz E, Pietrzak K, Venturi D, Cash DM, Jain AK. 2017. Efficient authentication from hard learning problems. Journal of Cryptology. 30(4), 1238-1275.
- Obremski M, Skórski M. 2017. Renyi entropy estimation revisited. In Jansen K, Rolim J, Williamson D, Vempala S, Eds., Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques (APPROX/RANDOM 2017), Leibniz International Proceedings in Informatics, vol 81, Article number: 20.
- Pietrzak K, Skórski M. 2017. Non uniform attacks against pseudoentropy. In Chatzigiannakis I, Indyk P, Kuhn Fabian, Muscholl A, Eds., International Colloquium on Automata, Languages, and Programming (ICALP 2017), Leibniz International Proceedings in Informatics, vol 80, Article number 39.
- Skórski M. 2017. On the complexity of breaking pseudoentropy. In Gopal TV, Jäger G, Steila S, Eds., Theory and Applications of Models of Computation (TAMC 2017), Springer Lecture Notes in Computer Science, vol 10185, 600-613.
- Skórski M. 2017. On the complexity of estimating Rènyi divergences. In IEEE International Symposium on Information Theory (ISIT 2017), IEEE, 256-260.
- Skórski M. 2017. Key derivation for squared-friendly applications: Lower bounds. In Vollmer H, Vallée B, Eds., Theoretical Aspects of Computer Science (STACS 2017). Leibniz International Proceedings in Informatics, vol 66, Article number: 57.
- Skórski M. 2017. A cryptographic view of regularity lemmas: Simpler unified proofs and refined bounds. In Gopal TV, Jäger G, Steila S, Eds., Theory and Applications of Models of Computation (TAMC 2017), Springer Lecture Notes in Computer Science, vol 10185, 586-599.

Sazanov Group

- Letts JA, Sazanov LA. 2017. Clarifying the supercomplex: The higher-order organization of the mitochondrial electron transport chain. Nature Structural and Molecular Biology. 24(10), 800-808.
- Sazanov LA. 2017. Structure of respiratory complex I: "minimal" bacterial and "de luxe" mammalian versions. In *Mechanisms of Primary Energy Transduction in Biology*. UK: The Royal Society of Chemistry.

Seiringer Group

- Deuchert A. 2017. A lower bound for the BCS functional with boundary conditions at infinity. Journal of Mathematical Physics. 58(8), Article number: 081901.
- Lewin M, Nam PT, Rougerie N. 2017. A note on 2D focusing many boson systems. Proceedings of the American Mathematical Society. 145(6), 2441-2454.
- Li X, Seiringer R, Lemeshko M. 2017. Angular self-localization of impurities rotating in a bosonic bath. Physical Review A. 95, Article number: 033608.
- Moser T, Seiringer R. 2017. Stability of a fermionic N+1 particle system with point interactions. Communications in Mathematical Physics. 356(1), 329-355.
- Moser T, Seiringer R. 2017. Triviality of a model of particles with point interactions in the thermodynamic limit. Letters in Mathematical Physics. 107(3), 533-552.
- Nam PT, Napiórkowski M. 2017. Bogoliubov correction to the mean-field dynamics of interacting bosons. Advances in Theoretical and Mathematical Physics. 21(3), 683-738.
- Nam PT, Napiórkowski M. 2017. A note on the validity of Bogoliubov correction to mean field dynamics. Journal de Mathématiques Pures et Appliquées. 108(5), 662-688.
- Nam PT, Van Den Bosch H. 2017. Nonexistence in Thomas Fermi-Dirac-von Weizsäcker theory with small nuclear charges. Mathematical Physics, Analysis and Geometry. 20(2), Article number: 6.
- Yakaboylu E, Deuchert A, Lemeshko M. 2017. Emergence of non-abelian magnetic monopoles in a quantum impurity problem. APS Physics, Physical Review Letters. 119, Article number: 235301-6.

Serbyn Group

- Hetterich D, Serbyn M, Domínguez F, Pollmann F, Trauzettel B. 2017. Noninteracting central site model localization and logarithmic entanglement growth. Physical Review B - Condensed Matter and Materials Physics. 96(10), Article number: 104203.
- Serbyn M, Zlatko P, Abanin D. 2017. Thouless energy and multifractality across the many-body localization transition. Physical Review B - Condensed Matter and Materials Physics. 96, Article number: 104201.

Shigemoto Group

- Aloisi E, Le Corf K, Dupuis JP, Zhang P, Ginger M, Labrousse VF, Spatuzza M, Georg Haberl M, Costa L, Shigemoto R, Tappe-Theodor A, Drago F, Vincenzo Piazza P, Mulle C, Groc L, Ciranna L, Catania MV, Frick A. 2017. Altered surface mGluR5 dynamics provoke synaptic NMDAR dysfunction and cognitive defects in Fmr1 knockout mice. Nature Communications. 8(1), Article number: 1103.
- Jiang C, Zhai M, Yan D, Li D, Li C, Zhang Y, Xiao L, Xiong D, Deng Q, Sun W. 2017. Dietary menthol-induced TRPM8 activation enhances WAT "browning" and ameliorates diet-induced obesity. Oncotarget. 8(43), 75114-75126.
- Miki T, Kaufmann WA, Malagon G, Gomez L, Tabuchi K, Watanabe M, Shigemoto R, Marty A. 2017. Numbers of presynaptic Ca^{2+} channel clusters match those of functionally defined vesicular docking sites in single central synapses. PNAS. 114(26), E5246-E5255.
- Rubio ME, Matsui K, Fukazawa Y, Kamasawa N, Harada H, Itakura M, Molnár E, Abe M, Sakimura K, Shigemoto R. 2017.The number and distribution of AMPA receptor channels containing fast kinetic GluA3 and GluA4 subunits at auditory nerve synapses depend on the target cells. Brain Structure and Function. 222(8), 3375-3393.
- Shigemoto R, Jösch M. 2017. The genetic encoded toolbox for electron microscopy and connectomics. WIREs Developmental Biology. 6(6), Article Number: 6:e288.
- Sun W, Li C, Zhang Y, Jiang C, Zhai M, Zhou Q, Xiao L, Deng Q. 2017. Gene expression changes of thermo sensitive transient receptor potential channels in obese mice. Cell Biology International. 41(8), 908-913.
- Sun W, Zhai M, Zhou Q, Qian C, Jiang C. 2017. Effects of B vitamins overload on plasma insulin level and hydrogen peroxide generation in rats. Chinese Journal of Physiology. 60(4), 207-214.
- Ukai H, Kawahara A, Hirayama K, Case MJ, Aino S, Miyabe M, Wakita K, Oogi R, Kasayuki M, Kawashima S, Sugimoto S, Chikamatsu K, Nitta N, Koga T, Shigemoto R, Takai T, Ito I. 2017. PirB regulates asymmetries in hippocampal circuitry. PLoS One. 12(6), Article number: e0179377.

Siegert Group

- Nagy B, Hovhannisyan A, Barzan R, Chen T, Kukley M. 2017. Different patterns of neuronal activity trigger distinct responses of oligodendrocyte precursor cells in the corpus callosum. PLoS Biology. 15(8), Article number: e2001993.
- Nickells RW, Schmitt HM, Maes ME, Schlamp CL. 2017. AAV2 mediated transduction of the mouse retina after optic nerve injury. Investigative Ophthalmology and Visual Science. 58(14), 6091-6104.

Siekhaus Group

- Makhijani K, Alexander B, Rao D, Petraki S, Herboso L, Kukar K, Batool I, Wachner S, Gold KS, Wong C, O'Connor MB, Brückner K. 2017. Regulation of Drosophila hematopoietic sites by Activin-β from active sensory neurons. Nature Communications. 8, Article number: 15990.
- Matsubayashi Y, Louani A, Dragu A, Sanchez-Sanchez BJ, Serna Morales E, Yolland L, György A, Vizcay G, Fleck RA, Heddleston JM, Chew T, Siekhaus DE, Stramer BM. 2017. A moving source of matrix components is essential for De Novo basement membrane formation. Current Biology. 27(22), 3526-3534.

Sixt Group

- Assen FP, Sixt M. 2017. The dynamic cytokine niche. Immunity. 46(4), 519-520.
- Ebner F, Sedlyarov V, Tasciyan S, Ivin M, Kratochvill F, Gratz N, Kenner L, Villunger A, Sixt M, Kovarik P. 2017. The RNA-binding protein tristetraprolin schedules apoptosis of pathogen-engaged neutrophils during bacterial infection. The Journal of Clinical Investigation. 127(6), 2051-2065.
- Gaertner F, Ahmad Z, Rosenberger G, Fan S, Nicolai L, Busch B, Yavuz G, Luckner M, Ishikawa Ankerhold H, Hennel R, Benechet A, Lorenz M, Chandraratne S, Schubert I, Helmer S, Striednig B, Stark K, Janko M, Böttcher RT, Verschoor A, Leon C, Gachet C, Gudermann T, Mederos y Schnitzler M, Pincus Z, Iannacone M, Haas R, Wanner G, Lauber K, Sixt M, Massberg S. 2017. Migrating platelets are mechano scavengers that collect and bundle bacteria. Cell. 171(6), 1368-1382.
- Horsthemke M, Bachg AC, Groll K, Moyzio S, Müther B, Hemkemeyer SA, Wedlich-Söldner R, Sixt M, Tacke S, Bähler M, Hanley PJ. 2017. Multiple roles of filopodial dynamics in particle capture and phagocytosis and phenotypes of Cdc42 and Myo10 deletion. Journal of Biological Chemistry. 292(17), 7258-7273.
- Kage F, Winterhoff M, Dimchev V, Mueller J, Thalheim T, Freise A, Brühmann S, Kollasser J, Block J, Dimchev G, Geyer M, Schnittler H, Brakebusch C, Stradal TE, Carlier M, Sixt M, Käs J, Faix J, Rottner K. 2017. FMNL formins boost lamellipodial force generation. Nature Communications. 8, Article number: 14832.
- Lademann CA, Renkawitz J, Pfander B, Jentsch S. 2017. The INO80 complex removes H2A.Z to promote presynaptic filament formation during homologous recombination. Cell Reports. 19(7), 1294-1303.
- Mueller J, Szep G, Nemethova M, de Vries I, Lieber AD, Winkler C, Kruse K, Small JV, Schmeiser C, Keren K, Hauschild R, Sixt M. 2017. Load adaptation of lamellipodial actin networks. Cell. 171(1), 188-200.
- Müller J, Sixt M. 2017. Cell migration: Making the waves. Current Biology. 27(1), R24-R25.
- Schwarz J, Bierbaum V, Vaahtomeri K, Hauschild R, Brown M, de Vries I, Leithner A, Reversat A, Merrin J, Tarrant T, Bollenbach T, Sixt M. 2017. Dendritic cells interpret haptotactic chemokine gradients in a manner governed by signal to noise ratio and dependent on GRK6. Current Biology. 27(9), 1314-1325.
- Spira F, Cuylen Haering S, Mehta S, Samwer M, Reversat A, Verma A, Oldenbourg R, Sixt M, Gerlich DW. 2017. Cytokinesis in vertebrate cells initiates by contraction of an equatorial actomyosin network composed of randomly oriented filaments.eLife. 6, Article number: e30867.
- Vaahtomeri K, Brown M, Hauschild R, de Vries I, Leithner AF, Mehling M, Kaufmann WA, Sixt M. 2017. Locally triggered release of the chemokine CCL21 promotes dendritic cell transmigration across lymphatic endothelia. Cell Reports. 19(5), 902-909.
- Veß A, Blache U, Leitner L, Kurz AR, Ehrenpfordt A, Sixt M, Posern G. 2017. A dual phenotype of MDA MB 468 cancer cells reveals mutual regulation of tensin3 and adhesion plasticity. Journal of Cell Science. 130(13), 2172-2184.

Tkačik Group

- Barone V, Lang M, Krens G, Pradhan SJ, Shami Pour S, Sako K, Sikora M, Guet CC, Heisenberg C. 2017. An effective feedback loop between cell-cell contact duration and morphogen signaling determines cell fate. Developmental Cell. 43(2), 198-211.
- Bergmiller T, Andersson AM, Tomasek K, Balleza E, Kiviet Daniel J, Hauschild R, Tkačik G, Guet CC. 2017. Biased partitioning of the multidrug efflux pump AcrAB TolC underlies long lived phenotypic heterogeneity. Science. 356(6335), 311-315.
- Chait R, Ruess J, Bergmiller T, Tkačik G, Guet CC. 2017. Shaping bacterial population behavior through computer interfaced control of individual cells. Nature Communications. 8(1), Article number: 1535.
- Chalk M, Masset P, Gutkin BS, Denève S. 2017. Sensory noise predicts divisive reshaping of receptive fields. PLoS Computational Biology. 13(6), Article number: e1005582.
- Colabrese S, De Martino D, Leuzzi L, Marinari E. 2017. Phase transitions in integer linear problems. Journal of Statistical Mechanics: Theory and Experiment. 2017, Article number: 093404.
- De Martino D. 2017. Maximum entropy modeling of metabolic networks by constraining growth-rate moments predicts coexistence of phenotypes. Physical Review E Statistical Nonlinear and Soft Matter Physics. 96, Article number: 060401.
- De Martino D. 2017. Scales and multimodal flux distributions in stationary metabolic network models via thermodynamics. Physical Review E Statistical Nonlinear and Soft Matter Physics. 95, Article number: 062419.
- De Martino D, Capuani F, De Martino A. 2017. Quantifying the entropic cost of cellular growth control. Physical Review E Statistical Nonlinear and Soft Matter Physics. 96(1), Article Number: 010401.
- Deny S, Ferrari U, Mace E, Yger P, Caplette R, Picaud S,, Tkačik G, Marre O. 2017.Multiplexed computations in retinal ganglion cells of a single type. Nature Communications. 8, Article number: 1964.
- Friedlander T, Prizak R, Barton NH, Tkačik G. 2017. Evolution of new regulatory functions on biophysically realistic fitness landscapes. Nature Communications. 8, Article number: 216.
- Harpaz R, Tkačik G, Schneidman E. 2017. Discrete modes of social information processing predict individual behavior of fish in a group. PNAS. 114(38), 10149-10154.
- Humplik J, Tkačik G. 2017. Probabilistic models for neural populations that naturally capture global coupling and criticality.PLoS Computational Biology. 13(9), Article number: e1005763.
- Lang M, Sontag E. 2017. Zeros of nonlinear systems with input invariances. Automatica. 81C, 46-55.
- Levina A, Priesemann V. 2017. Subsampling scaling. Nature Communications. 8, Article number: 15140.
- Savin C, Tkačik G. 2017. Maximum entropy models as a tool for building precise neural controls. Current Opinion in Neurobiology. 46, 120-126.
- Zagorski M, Tabata Y, Brandenberg N, Lutolf MP, Tkačik G, Bollenbach T, Briscoe J, Kicheva A. 2017. Decoding of position in the developing neural tube from antiparallel morphogen gradients. Science. 356(6345), 1379-1383.

Uhler Group

- Fallat S, Lauritzen S, Sadeghi K, Uhler C, Wermuth N, Zwiernik P. 2017. Total positivity in Markov structures. Annals of Statistics. 45(3), 1152-1184.
- Martín del Campo Sanchez A, Cepeda Humarez S, Uhler C. 2017. Exact goodness-of-fit testing for the Ising model. Scandinavian Journal of Statistics. 44(2), 285-306.
- Perrone E, Rappold A, Müller WG. 2017. D inf s optimality in copula models. Statistical Methods and Applications. 26(3), 403-418.
- Wang Y, Nagarajan M, Uhler C, Shivashankar G. 2017. Orientation and repositioning of chromosomes correlate with cell geometry dependent gene expression. Molecular Biology of the Cell. 28(14), 1997-2009.
- Zwiernik P, Uhler C, Richards D. 2017. Maximum likelihood estimation for linear Gaussian covariance models. Journal of the Royal Statistical Society. Series B: Statistical Methodology. 79(4), 1269-1292.

Vicoso Group

- Argyridou E, Huylmans AK, Königer A, Parsch J. 2017. X-linkage is not a general inhibitor of tissue-specific gene expression in Drosophila melanogaster. Heredity. 119, 27-34.
- Fraisse C, Picard MA, Vicoso B. 2017. The deep conservation of the Lepidoptera Z chromosome suggests a non-canonical origin of the W. Nature Communications. 8(1), Article number: 1486.
- Huylmans AK, Macon A, Vicoso B. 2017. Global dosage compensation is ubiquitous in Lepidoptera, but counteracted by the masculinization of the Z chromosome. Molecular Biology and Evolution. 34(10), 2637-2649.
- Wright AE, Darolti I, Bloch NI, Oostra V, Sandkam BA, Buechel SD, Kolm N, Breden FJ, Vicoso B, Mank JE. 2017. Convergent recombination suppression suggests role of sexual selection in guppy sex chromosome formation. Nature Communications. 8, Article number: 14251.

Wagner Group

- Burton BA, de Mesmay A, Wagner U. 2017. Finding non-orientable surfaces in 3-Manifolds. Discrete & Computational Geometry. 58(4), 871-888.
- Franek P, Krčál M. 2017. Persistence of zero sets. Homology, Homotopy and Applications. 19(2), 313-342.
- Fulek R. 2017. C-planarity of embedded cyclic c-graphs. Computational Geometry: Theory and Applications. 66, 1-13.
- Fulek R, Kynčl J, Pálvölgyi D. 2017. Unified Hanani Tutte theorem. Electronic Journal of Combinatorics. 24(3), Article number: P3.18.
- Fulek R, Mojarrad HN, Naszódi M, Solymosi J, Stich SU, Szedlák M. 2017. On the existence of ordinary triangles. Computational Geometry: Theory and Applications. 66, 28-31.
- Fulek R, Pelsmajer M, Schaefer M. 2017. Hanani-Tutte for radial planarity. Journal of Graph Algorithms and Applications. 21(1), 135-154.
- Goaoc X, Mabillard I, Paták P, Patáková Z, Tancer M, Wagner U. 2017. On generalized Heawood inequalities for manifolds: A van Kampen-Flores type non-embeddability result. Israel Journal of Mathematics. 222(2), 841-866.
- Kynčl J, Patáková Z. 2017. On the nonexistence of k-reptile simplices in R3and R4. Electronic Journal of Combinatorics. 24(3), 1-44.
- Lubiw A, Masárová Z, Wagner U. 2017. A proof of the orbit conjecture for flipping edge labelled triangulations.
- In Aronov B, Katz MJ, Eds., 33rd International Symposium on Computational Geometry (SoCG 2017), Leibniz International Proceedings in Informatics, vol 77, Article number: 49.
- Čadek M, Krčál M, Vokřínek L. 2017. Algorithmic solvability of the lifting extension problem. Discrete & Computational Geometry. 54(4), 915-965.

Wojtan Group

- Gajda-Zagórska E, Schaefer RF, Smołka MI, Pardo D, Alvarez-Aramberri J. 2017. A multi-objective memetic inverse solver reinforced by local optimization methods. Journal of Computational Science. 18, 85-94.
- Jeschke S, Wojtan C. 2017. Water wave packets. ACM Transactions on Graphics. 36(4), Article number: 103.
- Manteaux P, Wojtan C, Narain R, Redon S, Faure F, Cani M. 2017. Adaptive physically based models in computer graphics. Computer Graphics Forum. 36(6), 312-337.
- Schreck C, Rohmer D, Hahmann S. 2017. Interactive paper-tearing. Computer Graphics Forum. 36(2), 95-106.

Selected Events in 2017

Scientific Conferences, Workshops, and Symposia

Date	Event	Description
May 12	Young Scientists' Symposium	Organized by young scientists at IST Austria; featured six keynote speakers approaching the theme "Bits, Brains, and Cells: Memory Across Sciences" from different perspectives
June 6-8	Modern Trends in Solid State Quantum Physics	Workshop on the latest developments and future directions in solid state quantum physics
August 16-18	CoQIPC-2017	Conference on controllable quantum impurities in physics and chemistry
September 5	Psychiatric Illnesses: From Freud to their Biological Mechanisms	Symposium that brought together researchers from a variety of fields to provide an overview of what is known about the causes of psychiatric illnesses
September 11-13	AXON 2017	Conference on molecular and cellular mechanisms of neural circuit assembly
September 24-26	ANA 2017	15th meeting of the Austrian Neuroscience Association
December 3-5	FKNE Kavli Winter Symposium	A multidisciplinary forum for early to mid-career European neuroscientists

Outreach and Education Events

Date	Event	Description
January 31	Konrad Lorenz Gymnasium Campus Visit	18 high school students from the gymnasium in Gänserndorf, Lower Austria toured the Electron Microscopy Facility.
March 1	International School Klosterneuburg Campus Visit	Students from the international baccalaureate program at the International School in Klosterneuburg explored the IST Austria Library offline and online and attended a talk by Carolina Borges Merjane from the Jonas group.
March 17	Science Experts	IST Austria's Daria Siekhaus and the Fish Facility presented at a science exhibition for students at the Aula der Wissenschaften in Vienna.
May 21	Open Campus	The Institute's annual open house and school contest award ceremony. The winners of the school contest spent a day on campus in September visiting the Nanofabrication Facility and the Preclinical Facility.
June 14	How do plants dance?	The first of three visits from a local primary school; the Benková group presented a biology project that the children carried out at home, then presented at the Institute. (*Continued on September 8 and 20.*)
June 26-28	CPSA Match with Friends	Training camp for the International Mathematics Olympiad; participants came from the Czech Republic, Poland, Slovakia, and Austria.
July 14	Children's University of Vienna Excursion	150 primary school children from Tulln and Klosterneuburg participated in a workshop and attended a children's lecture, both organized and given by Matthias Fürst of the Cremer group.
August 21-25	Sommercampus	60 primary school children spent a week at the Institute and Museum Gugging exploring science and art.
August 28-30	Top Models in Science	11 teenagers attended a series of research days focused on mathematics and computer science.
September 15	Forschungsfest NÖ	The Barton group presented various activities on evolutionary biology at Lower Austria's first research festival, which took place at the Palais Niederösterreich in Vienna.
September 27	Science Industry Day 2017: Create. Connect. Translate.	Event connecting science, scientists, and industry; comprised a career development afternoon and a panel discussion in the evening.
November 14	Science Education Workshop with Teachers	37 teachers from a local high school, the Bundesrealgymnasium (BRG) Klosterneuburg, and IST Austria scientists came together to develop science education projects at a workshop hosted by the Institute.
Ongoing	Math Circle	Postdoc Arsenyi Akopyan and several rotating IST Austria volunteers organize weekly extracurricular math activities at BRG Klosterneuburg.

Public Lectures

Date	Speaker/Affiliation	Talk Series and Title
March 29	**Walter Scheidel** Stanford University	IST Science and Society Lecture “The great leveler: violence and economic inequality from the Stone Age to the future”
May 30	**Christiane Nüsslein-Volhard** Max Planck Institute for Developmental Biology	ÖAW-IST Austria Lecture “The development of color patterns in fishes: towards an understanding of the evolution of beauty”
November 8	**Michael I. Jordan** University of California, Berkeley	IST Lecture “On computational thinking, inferential thinking, and data science”
December 7	**Peter Donnelly** Oxford University	IST Lecture “Meiosis, recombination, and the origin of a species”

Institute Colloquia

Speaker and Affiliation

Laure Saint-Raymond École Normale Supérieure
Patricia Wittkopp University of Michigan
Elaine Ostrander National Institutes of Health
Thomas König Institute for Advanced Studies, Vienna
Frank Jülicher Max Planck Institute for the Physics of Complex Systems
Fiona Doetsch University of Basel
Erik Sahai The Francis Crick Institute
Daniel A. Fletcher University of California, Berkeley
Claudia Bagni University of Lausanne
Ottoline Leyser University of Cambridge
Lakshminarayanan Mahadevan Harvard University
Konrad Lehnert University of Colorado, Boulder
Dianne Newman Caltech
Irit Dinur Weizmann Institute of Technology
Robert Tarjan Princeton University
Christine Jacobs-Wagner Yale University
Vinod Vaikuntanathan Massachusetts Institute of Technology
Tobias Walther Harvard University
Kenneth Birnbaum New York University
Susan Gasser Friedrich Miescher Institute for Biomedical Research
David Schneider Stanford University
Marcos Gonzalez-Gaitan University of Geneva
Jean-Michel Raimond Kastler Brossel Laboratory
Alexey Kondrashov University of Michigan
Cosma Shalizi Carnegie Mellon University

TWIST (Technology Transfer) Talks

Speaker and Affiliation

Haim Harari Weizmann Institute of Technology
Balthasar Fischer XARION Laser Acoustics GmbH
Shuguang Zhang Massachusetts Institute of Technology
Stefan Kubicek Research Center for Molecular Medicine (CeMM)

IST Austria Internal Awards 2017

Outstanding PhD Thesis
Anastasia Pentina, Lampert group

Outstanding Scientific Achievement
Enderalp Yakaboylu, Lemeshko group

Outstanding Scientific Support
Janos Kiss, Scientific Computing

Outstanding Administrative Support
Rita Six, Assistant to professors

Golden Chalk Award for Excellence in Teaching
Srdjan Sarikas, Barton group

Golden Sponge Award for Excellent Teaching Assistance
Sebastian Novak, Barton group

IST Austria Donors Club

Platinum Club
Invicta Foundation

Gold Club
Mondi AG
OMV AG
Raiffeisen Group
voestalpine AG

Silver Club
Berndorf AG
Steven Heinz
Miba AG
Oberbank AG
Prinzhorn Holding GmbH
Schoeller Bleckmann AG
W. Hamburger GmbH
DI Klaus Pöttinger

Donor Club
Alcatel-Lucent Austria AG
Allinvest Unternehmensbeteiligungs GmbH
Gebrüder Weiss GmbH
Kapsch AG

Boards of IST Austria

Board of Trustees

Chair: **Claus J. Raidl**, President, Oesterreichische Nationalbank, Vienna, Austria
Vice-Chair: **Olaf Kübler**, Former President of ETH Zurich, Switzerland
Catherine Cesarsky, Chief Scientific Advisor, Former High Commissioner for Atomic Energy, CEA-Saclay, Gif-sur-Yvette, France
Alice Dautry, Former Managing Director of Institut Pasteur, Paris, France
Elisabeth Engelbrechtsmüller-Strauß, CEO/CFO, Fronius International GmbH, Pettenbach, Austria
Peter Fratzl, Director, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
Haim Harari, Former President of Weizmann Institute of Science, Rehovot, Israel
Alexander Hartig, Member of the Management Board, Industrieliegenschaftenverwaltungs AG, Vienna, Austria
Reinhard Jahn, Director, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany
Monika Kircher, Senior Director Industrial Affairs, Infineon Technologies Austria AG, Villach, Austria
Iain Mattaj, Director General, European Molecular Biology Laboratory (EMBL), Heidelberg, Germany
Kurt Mehlhorn, Director, Max Planck Institute for Informatics, Saarbrücken, Germany (until June 2017)
Pietro Perona, Allen E. Puckett Professor of Electrical Engineering and Computation and Neural Systems, California Institute of Technology, Pasadena, USA
Wolfgang Ruttenstorfer, Chairman of the Supervisory Board, Telekom Austria AG, Vienna, Austria
Elisabeth Stadler, CEO, Vienna Insurance Group, Vienna, Austria
Stefan Szyszkowitz, Spokesman of the Executive Board, EVN, Maria Enzersdorf, Austria

The Board of Trustees oversees the development of the Institute, while acting as its highest authority and ensuring that it adheres to its founding principles and vision. It provides guidance to the management and—among other tasks—is responsible for approving:

- the statutes of the organization and its strategic direction,
- the budget and annual financial statements,
- the appointment of the President, the Scientific Board, and the Managing Director, and
- the procedures for academic appointments and the promotion of scientists.

The Board of Trustees consists of 15 members. Eight of them are internationally successful scientists, four are appointed by the Federal Government, and three are appointed by the Government of Lower Austria.

Executive Committee of the Board of Trustees

Chair: **Haim Harari**
Vice-Chair: **Reinhard Jahn**
Elisabeth Engelbrechtsmüller-Strauß
Iain Mattaj
Claus J. Raidl
Wolfgang Ruttenstorfer

The Executive Committee is a subcommittee of the Board of Trustees and has, among others, the following rights and duties:

- Act on behalf of the Board of Trustees in all matters between the meetings of the Board of Trustees.
- Hold preliminary discussions on matters to be brought for approval to the Board of Trustees, such as the annual budget.

Scientific Board

Chair: **Peter Fratzl**, Director, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany
Vice-Chair: **Maria J. Esteban**, Professor, Centre de Recherche en Mathématiques de la Décision, University of Paris-Dauphine, France
Angelika Amon, Professor, Department of Biology, Massachusetts Institute of Technology (MIT), Cambridge, USA
Ben Feringa, Professor, Stratingh Institute for Chemistry, University of Groningen, The Netherlands
Tony F. Heinz, Professor, Department of Applied Physics, Stanford University, Palo Alto, USA
Gene Myers, Director, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany
Hannah Monyer, Professor, Department of Clinical Neurobiology, University of Heidelberg, Germany
Martin Nowak, Professor, Program for Evolutionary Dynamics, Harvard University, Cambridge, USA
Gordon Plotkin, Professor, Laboratory for Foundations of Computer Science, University of Edinburgh, UK
Petra Schwille, Director, Max Planck Institute for Biochemistry, Martinsried, Germany
Non-voting Member: **Claus J. Raidl**, President, Oesterreichische Nationalbank, Vienna, Austria
Previous Chair: **Kurt Mehlhorn**, Director, Max Planck Institute for Informatics, Saarbrücken, Germany (until June 2017)

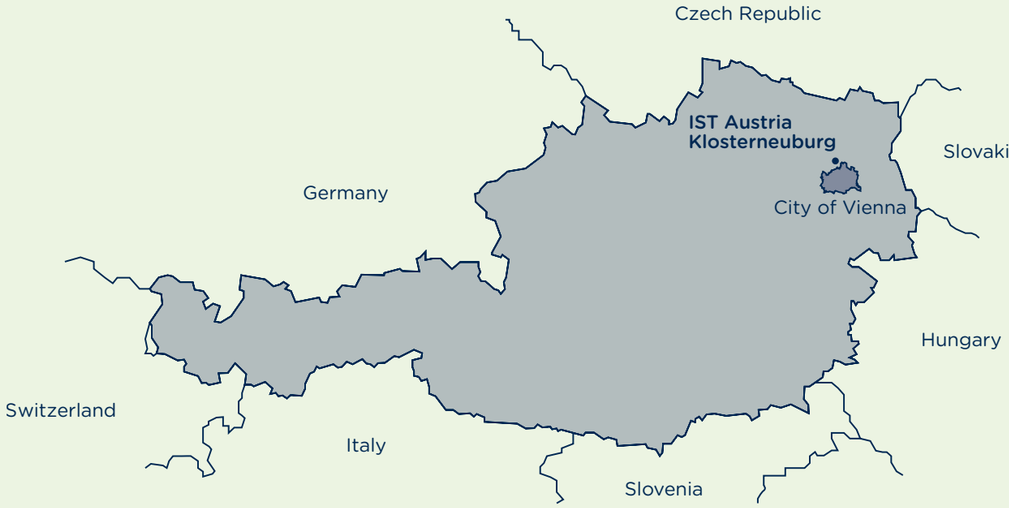
The Scientific Board prepares recommendations for the scientific direction of the Institute. It provides guidance to ensure a high degree of scientific productivity, and among other duties, it organizes internal evaluations of the various research fields. The Scientific Board consists of ten researchers who are recognized internationally at the highest levels and an additional (non-voting) member with outstanding management experience.

Leadership of IST Austria

Thomas A. Henzinger, President
Michael Sixt, Vice President
Georg Schneider, Managing Director
Nick Barton, Dean of the Graduate School

Location & Campus Map

Visiting the Institute
The Institute is located 18 km from the center of Vienna, and is easily reachable via public transportation. The IST Austria Shuttle Bus 142 goes directly from the U4 Station Heiligenstadt to campus, and there are additional public buses connecting IST Austria to Vienna.



01 Central Building
Science Offices, Guesthouse, Oberbank Ballroom, Mondi Seminar Center, Cafe/Pub
02 Raiffeisen Lecture Hall
03 voestalpine Building
Administration
04 Bertalanffy Foundation Building
05 Preclinical Facility
06 Lab Building East
07 Administration Building
11 Facility Management
Security
12 Heating Plant
13 Miba Machine Shop
16 Power Control
21 Lab and Office Building West
22 Cafeteria
27 Kindergarten
29 Multi-purpose Experimental Facility
31-35 Apartments
37-45 Apartments
60 Tennis Courts
61 Soccer Field

Imprint
Institute of Science and Technology Austria
Am Campus 1, 3400 Klosterneuburg
+43 (0)2243–9000
office@ist.ac.at
www.ist.ac.at

Editors Lisa Cichocki, Yvonne Kemper **Texts** IST Austria **Graphic Design** Perndl+Co **Photography** Gregor Buchhaus, May Chan, Lisa Cichocki, Elisabeth Guggenberger, Roland Ferrigato, Sabine Hauswirth, Peter Hautzinger, Robert Herbst, Walter Kaufmann, Yvonne Kemper, Kathrin Pauser, Sebastian Philipp, Nadine Poncioni, Paul Pölleritzer, Reiner Riedler, Anna Stöcher, Bernhard Wenzl **Print** gugler* **Copyright** Institute of Science and Technology Austria, 2018

Additional Image Credits *page (image): author*
6 (Peter Fratzl): ©MPI für Kolloid- und Grenzflächenforschung/Gnaudschun; 27 (Carrie Bernecky): ©MPIbpc; 31 (ants): Christopher Pull; 33 (turtle): Bernd Bickel; 33 (Venn diagram): Christian Hilbe, et al.; 33 ("IST" image): Remy Chait; 35 (mouse): George Shuklin, https://commons.wikimedia.org/wiki/File:Мышь_2.jpg, CC BY-SA 1.0; 35 (Delaunay mosaic): Herbert Edelsbrunner; 37 (brain bench): Maria Cristina Travaglio; 37 (synaptotagmins): Chong Chen, et al.; 39 (roundabout, angulon): Birgit Rieger; 39 (quantum scars): Maksym Serbyn; Cover inside (Heinz Faßmann): BMBWF/Martin Lusser; Cover inside (Johanna Mikl-Leitner): Markus Hintzen

Cover Feyza Nur Arslan, PhD student, Heisenberg Group, photo by Nadine Poncioni

“The Institute was an experiment and a risky endeavor, but the policy of talent before research area, as well as IST Austria’s exacting and achievement-based standards of excellence, have resulted in a superb research institution. I look forward to the continuation and further success of this project.”

Heinz Faßmann
Federal Minister of Education, Science, and Research

“For nearly ten years, IST Austria has been at the forefront of scientific research and has now established itself as a leading research institute of international standing. With around 600 employees working in a wide diversity of scientific fields, IST Austria enhances the economic and innovative position of Lower Austria.

The Federal State of Lower Austria is committed to supporting research, technology, and innovation as a means of securing economic growth for future generations. Research conducted at IST Austria is an integral part of this strategy.

We hope that IST Austria will continue to develop and flourish, providing inspiration for the scientists of future generations here in Lower Austria.”

Johanna Mikl-Leitner
Governor of Lower Austria