THE SHAW PRIZE 邵逸夫獎

The Shaw Prize

The Shaw Prize is an international award to honour individuals who are currently active in their respective fields and who have recently achieved distinguished and significant advances, who have made outstanding contributions in academic and scientific research or applications, or who in other domains have achieved excellence. The award is dedicated to furthering societal progress, enhancing quality of life, and enriching humanity's spiritual civilization.

Preference is to be given to individuals whose significant work was recently achieved and who are currently active in their respective fields.

Founder's Biographical Note

The Shaw Prize was established under the auspices of Mr Run Run Shaw. Mr Shaw, born in China in 1907, was a native of Ningbo County, Zhejiang Province. He joined his brother's film company in China in the 1920s. During the 1950s he founded the film company Shaw Brothers (HK) Limited in Hong Kong. He was one of the founding members of Television Broadcasts Limited launched in Hong Kong in 1967. Mr Shaw also founded two charities, The Shaw Foundation Hong Kong and The Sir Run Run Shaw Charitable Trust, both dedicated to the promotion of education, scientific and technological research, medical and welfare services, and culture and the arts.

Message from the Chief Executive

I warmly congratulate the six Shaw Laureates of 2014.

Established in 2002 under the auspices of Mr Run Run Shaw, the Shaw Prize is a highly prestigious recognition of the role that scientists play in shaping the development of a modern world. Since the first award in 2004, 54 leading international scientists have been honoured for their ground-breaking discoveries which have expanded the frontiers of human knowledge and made significant contributions to humankind.

I sincerely congratulate our 2014 Shaw Laureates on their brilliant accomplishments, which have advanced human understanding of astronomy, life science and medicine, and mathematical sciences. I wish them every success in their future academic and scientific pursuits.

I have no doubt that the Shaw Prize will continue to inspire new scientific breakthroughs and serve as a lasting legacy to Mr Run Run Shaw and his vision for societal progress through academic and scientific advancement.

C Y Leung
Chief Executive
Hong Kong Special Administrative Region

In Memory of Sir Run Run Shaw

As an established figure in the film and media industry, Mr Shaw gained insight into the needs of the people, and as a visionary he saw how in addition to the fleeting escapism of entertainment, the more substantial benefits of education and healthcare would greatly impact lives for the better. He established the Shaw Foundation, which quickly gained momentum in a range of philanthropic work: supporting the setting up of educational institutions as well as hospitals and clinics in Hong Kong, the rest of the PRC and beyond. Expanding his vision into new areas convinced him that the quest for knowledge is key to sustaining the advancement of civilization and strengthened his belief that scientists focussed on unmasking the mysteries of nature are pivotal to our enhanced survival. He decided to use his modest influence, in the form of the Shaw Prize, to inspire and recognize imaginative individuals committed to scientific research and to highlight their discoveries. In the short span of ten years the award has gained in stature, casting a beam of recognition on outstanding scientific achievements. The man whose innovative thinking created such a worthy legacy may rest secure in the knowledge that exceptional individuals will follow him in spirit and in deed, sustaining the continued success of the Shaw Foundation and the Shaw Prize Foundation as a tribute to his wisdom and generosity. Mr Shaw, your cherished memory is the foundation for our future and you are present in our thoughts always.

The Shaw Prize Council

Message from Chairman of the Board of Adjudicators

Science in different fields made great progress in the twentieth century. But this progress also brought about unprecedented difficulties for mankind in the twenty-first century. Recognizing this Mr Shaw decided a dozen years ago to found the Shaw Prizes in three scientific fields to encourage and foster scientific research to help address these difficult problems for mankind. Tonight, at this first Shaw Prize Award Ceremony after Mr Shaw passed away at age one hundred and seven, it is appropriate for us to pay respect to the generosity, foresight and vision of this great philanthropist. We will continue following him in spirit and expand the horizons of his vision through the Shaw Prizes.

Shaw Prizes are awarded in three scientific fields: Astronomy, Life Science and Medicine, and Mathematical Sciences. These are among the scientific fields that enjoy vigorous and vibrant progress in recent years. Tonight we shall honour six scientists in these three fields for their distinguished contributions. They are Professors Eisenstein, Cole and Peacock in Astronomy; Professors Mori and Walter in Life Science and Medicine; and Professor Lusztig in Mathematical Sciences.

Chen Ning Yang

Chen-Ning Yang

The Shaw Prize Medal

The front of the medal displays a portrait of Run Run Shaw, next to which are the words and Chinese characters for the title of "The Shaw Prize". On the reverse, the medal shows the award category, the relevant year and the name of the prizewinner. A seal of imprint of the Chinese phrase "制天命而用之" (quoted from Xun Zi – a thinker in the warring states period of Chinese history in 313 – 238 B.C.) meaning "Grasp the law of nature and make use of it" appears in the upper right corner.

AGENDA

Arrival of Officiating Guest and Laureates

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Welcome Speech by Professor Chen-Ning Yang

Member of the Council

Chairman of the Board of Adjudicators, The Shaw Prize

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Speech by Professor Peter Goldreich

Member of the Board of Adjudicators

Chairman of the Selection Committee for the Prize in Astronomy

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Speech by Professor Yuet-Wai Kan

Member of the Board of Adjudicators

Chairman of the Selection Committee for

the Prize in Life Science and Medicine

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Speech by Professor Corrado De Concini

Member of the Selection Committee for

the Prize in Mathematical Sciences

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Award Presentation

Grand Hall

Hong Kong Convention and Exhibition Centre

24 September 2014

AWARD PRESENTATION

(Category listed in alphabetical order)

Astronomy

Professor Daniel Eisenstein,

Professor Shaun Cole

and

Professor John A Peacock

Life Science and Medicine

Professor Kazutoshi Mori

and

Professor Peter Walter

Mathematical Sciences

Professor George Lusztig

Professor Peter Goldreich

Member of the Board of Adjudicators

Chairman of the Selection Committee for the Prize in Astronomy

Professor Peter Goldreich is the Lee A DuBridge Professor of Astrophysics & Planetary Physics Emeritus at the California Institute of Technology in Pasadena, California.

He received a PhD from Cornell University in 1963. After spending one year as a postdoc at Cambridge University and two as an Assistant Professor at the University of California, Los Angeles, he joined the Caltech faculty as an Associate Professor in 1966. He was promoted to Full Professor in 1969 and remained at Caltech until he retired in 2002. Subsequently, he was appointed Professor in the School of Natural Sciences at the Institute for Advanced Study in Princeton from which he retired in 2009. Professor Goldreich is a Member of the US National Academy of Sciences and a Foreign Member of the Royal Society of London. His awards include the Henry Norris Russell Lectureship of the American Astronomical Society, the US National Medal of Science, the Gold Medal of the Royal Astronomical Society, the Grande Medaille of the French Academy of Sciences, and the Shaw Prize. Professor Goldreich's research involves the application of physics to the understanding of natural phenomena, in particular those revealed by astronomical observations.

The Prize in Astronomy 2014

Daniel Eisenstein,

Shaun Cole

and

John A Peacock

for their contributions to the measurements of features in the large-scale structure of galaxies used to constrain the cosmological model including baryon acoustic oscillations and redshift-space distortions.

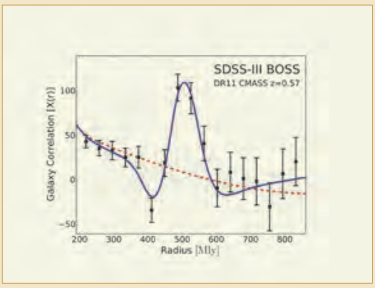
An Essay on the Prize in Astronomy 2014

The early universe was hot and dense. Baryonic matter was highly ionized and consisted of bare nuclei and free electrons, a state known as plasma. Then as now, photons were far more numerous than either nuclei or electrons. As a consequence of photon-electron scattering, the plasma and photons were tightly coupled into a single fluid whose pressure opposed gravity. This situation pertained during the first 400,000 years after the big bang. At that point the temperature had dropped to 3000 kelvin, the electrons and nuclei combined into neutral atoms which decoupled from the photons, and baryonic matter fell into gravitational potential wells of the dominant dark matter.

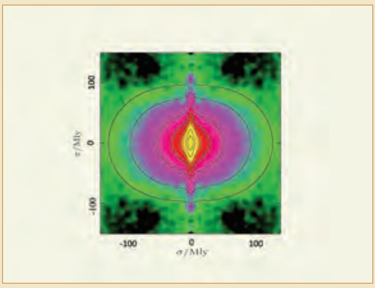
Primordial density perturbations on all scales arose shortly after the big bang and later seeded the formation of structure from galaxies to superclusters. The density perturbations excited baryon acoustic waves, essentially sound waves, that propagated through the primordial plasma at about half the speed of light prior to decoupling. After decoupling, these waves ceased propagating, thereby imprinting a well-defined length scale of about 500 million light years on matter density correlations at the current epoch.

The BAO scale provides a "standard ruler" with many applications in cosmology. It was first observed in temperature fluctuations of the cosmic microwave background on an angular scale of one degree. In 2005, two papers reported its detection in the spatial correlation of galaxies. Oriented perpendicular to the line of sight, the angle subtended by the ruler calibrates the relation between distance and redshift. Oriented parallel, it determines the Hubble parameter as a function of redshift. By now the BAO has confirmed the astonishing discovery, made by using type Ia supernovae as "standard candles", that the expansion of the universe recently transitioned from deceleration to acceleration.

Next some remarks about redshift-space distortions (RSD). A galaxy's red-shift provides an estimate for its distance, but one that is contaminated by the radial component of the galaxy's *peculiar* velocity with respect to the regular (Hubble) expansion of the universe. Density inhomogeneities and peculiar velocities go hand in hand. The former are the source of gravitational perturbations that excite the latter. Peculiar velocities then act to enhance the density fluctuations that caused them in the first place. This feedback loop describes gravitational instability, the mechanism by which tiny seeds planted in the early universe grew. It was recognized long ago that correlating density fluctuations and peculiar velocities would reveal the mean mass density of the universe. Accomplishing this had to wait until data from large redshift surveys became available at the turn of this century. Images of galaxy fields enable the determination of angular fluctuations in the number density of galaxies. Information about fluctuations along the line of sight is more difficult to come by. The contamination of the redshift-distance relation by peculiar velocities poses an insurmountable problem to surveying individual density fluctuations along lines of sight. To put this in perspective, consider how a spherical cluster of galaxies affects its environment. The more distant galaxies would still be expanding away from the cluster, but at a slightly reduced rate. As a consequence, there would be a small enhancement in their number density. Contours of fixed number density, which in real space



(a) Recent plot showing the peak of the galaxy correlation function at the BAO scale of ≈ 500 Mly. The blue line is the best fit to the data and the red line is the best fit of a model without the BAO.



(b) A statistical illustration of redshift-space distortions. Transverse (σ) separations are unaffected by peculiar velocities. Radial (π) separations are stretched along the line of sight at small separations and flattened at large separations.

are spherical, in redshift space would appear squashed into spheroids with their short axes oriented along the line of sight. Although real-space shapes of individual density fluctuations cannot be deduced from their redshift-space shapes, a statistical determination of the relation between the two follows from the assumption that the real-space shapes are isotropically oriented.

Now two comments on the synergy of the BAO and RSD. Both test the theory of gravitational structure formation, the former by showing how a feature is preserved as the universe expands by a factor of 10^3 and the latter by measuring how structure is presently growing. Moreover, large-scale flows of galaxies distort the BAO "standard ruler", an effect that is substantially mitigated by simulating the flows based on the gravitational field deduced from observations of large-scale structure. This procedure, referred to as reconstruction, straightens out the ruler.

Daniel Eisenstein
Laureate in Astronomy

I am a cosmologist in the Department of Astronomy at Harvard University. I have worked on a wide variety of topics in astrophysics but am best known for my use of the baryon acoustic oscillation phenomenon to measure the cosmological distance scale and thereby the evolution of dark energy.

I was born in 1970 in Israel to Drs Robert and Karolyn Eisenstein. My parents returned to the United States when I was a month old, taking up academic jobs in Pittsburgh, Pennsylvania, and later in Champaign, Illinois. My younger brother Bill and I have always been close; he is now an environmental planner at UC Berkeley. My interest in science and math started early, fed by my parents' scientific careers and by numerous encouraging teachers.

I was an undergraduate at Princeton University, majoring in physics and getting my first exposure to cosmology and astrophysics. College was very rewarding, not only for the excitement of pursuing advanced physics and mathematics but also for my personal development through campus activities and independent study. My senior thesis was advised by Professor David Spergel, who received the Shaw Prize in 2010. I graduated Princeton in 1992 as valedictorian.

I went to Harvard University for graduate work in physics. My 1996 PhD thesis with Professor Abraham Loeb focused on applications of the theory of cosmological structure formation to the origin of quasars and the Tully–Fisher relation of spiral galaxies.

I was a post-doctoral researcher at the Institute for Advanced Study in Princeton, New Jersey, and then a NASA Hubble Fellow at the University of Chicago. It was at this time that I started my work on the effects of baryon acoustic oscillations on the large-scale distribution of galaxies. Through my interest in the statistical methods in cosmology, I became active in the Sloan Digital Sky Survey, helping to implement the galaxy target selection and becoming the lead for the luminous red galaxy sample. This was my introduction to observational astronomy data and to large-scale collaborative astronomy.

I moved to a junior faculty position at the University of Arizona in 2001. My group and I continued development of the baryon acoustic oscillation method, forecasting the opportunity for the study of dark energy and refining the theory through both analytic work and cosmological *N*-body simulations. At the same time, I was leading the analysis of clustering of luminous red galaxies from the Sloan Digital Sky Survey. Our announcement in 2005 yielded the then-strongest detection of the baryon acoustic oscillations. We produced a 4% measurement of the distance to redshift 0.35 and provided a clear connection between the cosmic structure observed today and that seen in the cosmic microwave background from 400,000 years after the Big Bang.

I became Director of the Sloan Digital Sky Survey III in 2006. SDSS-III commenced operations in 2008 and includes over 800 scientists from fifty-one member institutions. The largest component of SDSS-III is the Baryon Oscillation Spectroscopic Survey (BOSS), which is currently the largest galaxy redshift survey in existence. With BOSS, the baryon acoustic oscillations method has fully come of age, providing a 1% distance measurement to the galaxy sample as well as robust detections of the same effect in the clustering of the intergalactic medium at redshift 2.4. SDSS-III completed its observations in June 2014 and we are looking forward to the final data release at the end of the year.

I moved to Harvard University in 2010, where I continue development of facilities for the next generation of wide-field surveys featuring the utilization of the baryon acoustic oscillations as their key application. Building on my work for early instrument concepts for the Gemini telescope and the NASA/DOE Joint Dark Energy Mission, I am now co-Spokesperson for the DOE-led Dark Energy Spectroscopic Instrument (DESI) and a member of SDSS-IV and the Euclid Collaboration. With these exciting new projects, cosmologists will map the Universe out to redshift 3 and use the baryon acoustic oscillation method to achieve precision on the distance scale below 0.3%.

My wife, Dr Annalisa Prahl, is a veterinarian, specializing in internal medicine. We met in Tucson, Arizona, in 2004 and were married in 2006. Following the cosmological concept that every observer perceives their own centre of the Universe, ours is centred around our two young sons, Alexander and Julian.

Shaun Cole
Laureate in Astronomy

I was born in the Northwest of England in November 1963. Until the age of 19, I lived in the rural Lancashire village of Chipping, with my sister Carolyn (1958–) and our parents Vic (1921–) and Marion (1933–1999). My father worked as a weaving technologist and travelled daily around weaving mills of Lancashire and beyond. My interest and aptitude for maths and physics began to develop early on as a pupil at the local, traditional state school, Clitheroe Royal Grammar School. My teachers encouraged me to apply for a university place at Oxford and I gained a place at Jesus College to read physics. Having grown up with the Apollo moon landings and Star Trek, I was fascinated by space and astronomy and opted to take all the astronomy options offered in the Oxford physics degree. I graduated with first class honours in 1985.

Keen to continue learning more astronomy and physics, I managed to gain a place on the one-year "Part III" of the Mathematics Tripos at Clare College and the Department of Applied Maths and Theoretical Physics at Cambridge (turning down an opportunity to start a PhD with John Peacock in Edinburgh!). A distinction in Part III enabled me to secure a studentship to read for a PhD at Cambridge's Institute of Astronomy. My PhD supervisors were Nick Kaiser and George Efstathiou. They guided me through a series of projects on galaxy clusters, gravitational lensing and galaxy formation which became the basis for my thesis, "The Evolution of Large Scale Structure and Galaxy Formation". The final year of my PhD was spent back in Oxford as George Efstathiou had moved from Cambridge to Oxford to take up the Savilian Chair of Astronomy, while Nick Kaiser had moved to the Canadian Institute of Theoretical Astronomy in Toronto. This was an important year in my life. Not only did I complete my PhD, but I also met Maggie, my wife to be. Soon after I took up a two-year postdoctoral position at the University of California in Berkeley which I enjoyed greatly.

In 1991 Maggie and I moved to Durham, a small, beautiful medieval city in the North of England, where I was appointed to a combined postdoc and teaching position working with Carlos Frenk and Richard Ellis. Maggie and I were married the following year and still live happily in Durham. Our children, Hannah and Daniel, were born there in 1993 and 1999 respectively. I have had various positions during my career in Durham. I was a PPARC Advanced Fellow from 1994 to 2001 when I was appointed to the Durham Physics Department faculty. During this time I worked with my Durham colleagues on developing a useful analytic model of the way galaxies form and evolve through repeated mergers of small fragments over cosmic time. We used this model as a backbone for building the GALFORM computer code to model the formation of galaxies in a full cosmological setting. GALFORM is still widely used today. In 2005 I was promoted to Professor.

My involvement in the "2-degree galaxy redshift survey", the 2dFGRS, began when I joined a breakout meeting during a lunch break at the 1994 National Astronomy Meeting in Edinburgh. The meeting included Richard Ellis, John Peacock, George Efstathiou, Carlos Frenk and fellow former students of George Efstathiou: Will Sutherland and Steve Maddox whom I knew well from our Cambridge and Oxford days. This group soon grew into the 30 strong Anglo-Australian collaboration which designed and implemented the 2dFGRS utilizing the innovative 400 fibre robotic 2dF spectrographic instrument on the Anglo-Australian Telescope (AAT). The then unique ability of this instrument to measure 400 galaxy spectra simultaneously and the pre-existing "APM galaxy catalogue", produced by Steve Maddox and George Efstathiou, enabled us to measure 220,000 galaxy redshifts between 1995 and 2003. The resulting 3-dimensional map of the large scale galaxy distribution was 10 times larger than pre-existing surveys — though it was soon to be overhauled by the Sloan Digital Sky Survey. The 2dFGRS team was a wonderfully productive collaboration. Innovative analysis led by a wide range of team members led to a stream of important results that pushed the study of the largest scale structure of the Universe to a new level.

Throughout my time at Durham I have enjoyed the mentorship of my colleague Carlos Frenk. Together we have worked on numerous projects and jointly supervised many excellent PhD students. When I started in Durham the theory group led by him consisted of just two students and two postdocs. I have had the pleasure of seeing the steady growth of the group which came of age with the founding of the Institute for Computational Cosmology (ICC), housed in the Ogden Centre for Fundamental Physics in 2002. Currently, I am the Deputy Director of the ICC. The institute has continued to expand and has outgrown the original Ogden building. I am now looking forward to moving with the group into an iconic new building, designed by the internationally renowned architect Daniel Libeskind, in 2016.

John A Peacock
Laureate in Astronomy

I was born in 1956, in the far South of England: Shaftesbury, Dorset. But my mother was Scottish and I have subsequently moved steadily North, first to the beautiful Cotswolds near Cheltenham, then to Leighton Buzzard in Bedfordshire in 1965, when my father was appointed Director of Bletchley Park.

My secondary education took place at an outstanding grammar school, the Cedars. The tuition in science and maths was excellent, and I also started to learn the clarinet. Eventually I joined the County Youth Orchestra, which gave me a thirst for playing music at the highest level.

I arrived at Jesus College, Cambridge in October 1974, intending to be a chemist. But Cambridge insists on broad study in "natural sciences" for the first year. By the end of this, I realised that I was much better suited to physics and maths.

The idea of research in astronomy came rather late to me. In Cambridge, this involved a choice between the Institute of Astronomy founded by Fred Hoyle, or Martin Ryle's radio astronomy group. As a physicist, I signed up for Ryle's group without much thought. To be honest, I was just happy to be staying in the outstanding Cambridge music scene.

At this stage, I actually knew very little about astronomy. All this changed after graduation when I encountered Michael Berry's short text on cosmology and gravitation. By the end of the summer of 1977 I had found Weinberg's book on the subject and was completely hooked.

For Ryle's group, cosmology meant surveying radio galaxies. Jasper Wall gave me an invaluable introduction to this area, and to the subject of astronomical statistics. When Jasper left after one year, Malcolm Longair took over my supervision and was influential in pushing me towards working on particle acceleration.

By the summer of 1980, my PhD work was done, but I had no job. Then Malcolm Longair was appointed Director of the Royal Observatory Edinburgh (ROE). He was able to offer me a research fellowship at Edinburgh, and this completely transformed my career.

I arrived at the ROE in February 1981 and immediately became interested in the new field of gravitational lensing, writing the first paper to calculate the "optical depth", i.e. the probability that distant objects will be magnified by the deflection of light by intervening masses. By the end of 1982 I was a permanent research astronomer at the ROE.

Also in 1982 I married Heather. She was a nurse at the time, and now oversees a significant fraction of the training of general practitioners in SE Scotland. We have been blessed with three wonderful children: Duncan (1986); Imogen (1989); Sophie (1991).

Edinburgh has now been our home for over 30 years. Its architecture continues to astound, and it is culturally rich. I became principal clarinet of the Scottish Sinfonia in 1983 and have enjoyed hundreds of concerts in subsequent years. It's hard to imagine a better personal foundation to a satisfying career.

During the 1980s, my interests evolved towards structure formation, including the first paper on peaks in Gaussian density fields. In 1991 I made one of the first direct estimates of the 3D Fourier power spectrum of large-scale structure. By 1994 I had combined this with other probes plus an understanding of nonlinear gravitational evolution.

In 1998, I transferred to a Professorship in the University. By this time, I had completed a postgraduate textbook "cosmological physics", which appeared in 1999 and has sold over 10,000 copies.

By 1999, the Two-degree Field Galaxy Redshift Survey had been in existence for several years, and I became UK Chairman of this UK–Australian consortium. In 2001, we published the first power-spectrum measurement suggesting Baryon Acoustic Oscillation (BAO) features from primordial sound waves; this signal was confirmed with further data in 2005. We also made the first accurate measurements of Redshift-Space Distortions (RSD), which arise from the velocities associated with forming structures.

These techniques will have a long-term importance in cosmology. BAO will allow us to observe the expansion history of the universe, measuring the properties of the Dark Energy that fills all space, and RSD will test the correctness of Einstein's relativistic theory of gravity.

In these developments, as in the start of my career, I have been fortunate to be in the right place at the right time, and I am proud and honoured by the recognition that this work has received: first through my election as a Fellow of the Royal Society in 2007 and now through the Shaw Prize. But it should never be forgotten that modern astronomy, and especially the 2dFGRS, depends on contributions from many people within large teams. This Prize is a tribute to my collaborators, and to the achievements we created together.

Professor Yuet-Wai Kan

Member of the Board of Adjudicators
Chairman of the Selection Committee for the Prize in Life Science and Medicine

Professor Yuet-Wai Kan is currently the Louis K Diamond Professor of Hematology at the University of California, San Francisco and he focuses his research on the use of gene and cell therapy to treat sickle cell anemia and thalassemia. Professor Kan was born in Hong Kong, graduated from the Faculty of Medicine at the University of Hong Kong and trained at Queen Mary Hospital, Hong Kong, before going to the United States for further studies.

Professor Kan's contributions led to the innovation of DNA diagnosis and the discovery of human DNA polymorphism that have found wide application in genetics and human diseases. For his work, he has received many national and international awards including the Albert Lasker Clinical Medical Research Award, the Gairdner Foundation International Award and the Shaw Prize. He is the first Chinese elected to the Royal Society, London, and is a Member of the US National Academy of Sciences, Academia Sinica, the Third World Academy of Sciences and the Chinese Academy of Sciences. He has received honorary degrees from The University of Caglieri, Italy, The Chinese University of Hong Kong, The University of Hong Kong and The Open University of Hong Kong.

The Prize in Life Science and Medicine 2014

Kazutoshi Mori

and

Peter Walter

for their discovery of the Unfolded Protein Response of the endoplasmic reticulum, a cell signalling pathway that controls organelle homeostasis and quality of protein export in eukaryotic cells.

An Essay on the Prize in
Life Science and Medicine 2014

All eukaryotic cells, including the cells in our body, possess a membrane-enclosed compartment, the endoplasmic reticulum (ER), for the production of proteins that are destined for transport to the cell surface or export into the extracellular fluids. A total of about 10,000 different proteins pass through the ER, including hormones such as insulin, a plethora of other proteins required for cell communication, as well as millions of antibody molecules responsible for our immune defense. Generally, these proteins are subject to intense scrutiny. They are only discharged from the ER when their amino acid chains are properly folded and assembled. For this purpose the ER contains an elaborate molecular machinery of protein folding factors. Imbalances in the production of active species of one or another of the transient ER proteins are the cause of a broad variety of diseases, such as type II diabetes, cystic fibrosis, retinitis pigmentosa, neurodegeneration and certain forms of cancer. Thus, the protein production capacity of the ER must be carefully regulated and adjusted to demands. This year's awardees of the Shaw Prize in Life Science and Medicine, Kazutoshi Mori and Peter Walter, have discovered the cellular signalling pathway — the so-called Unfolded Protein Response (UPR) — by which protein homeostasis in the ER is regulated. Understanding the UPR not only is of fundamental significance in biology, but also provides new opportunities for the treatment of a wide range of important diseases.

The elucidation of the UPR pathway is one of the most fascinating detective stories of molecular cell biology. It revealed a hitherto unknown mechanism of intracellular stress signalling and regulation of organelle homeostasis. Briefly, when unfolded or incompletely processed proteins accumulate in the ER, their presence must be sensed and a stress signal must be sent to the cell nucleus resulting in the activation of a genetic program that leads to increased production of ER-folding machinery. This is somewhat like opening up additional check-out lanes in a supermarket when customers begin to form queues. The sensor molecule is the protein Ire1, a transmembrane receptor with kinase activity. Ire1, when activated, in turn activates a transcription factor, Hac1. Hac1 then moves into the nucleus to initiate the transcription of genes encoding ER-folding components (molecular chaperones and other factors). These proteins are synthesized in the cytosol and then imported into the ER. As a result, protein flux through the ER is accelerated and the Ire1 sensor is converted back to its inactive state.

Both awardees contributed equally to this important discovery. In 1993, Peter Walter and Kazutoshi Mori, working independently, discovered the Ire1 kinase (termed ERN1 by Mori) and proposed that Ire1 transmits signals from the ER to the nucleus (Cell 73, 1197–206, 1993; Cell 74, 743–56, 1993). In 1996 Mori took the next step and discovered the protein Hac1, the nuclear transcription factor required for transcription of ER-folding components (Genes Cells 1, 803–17, 1996). Two months later, Walter independently described Hac1 and made the surprising discovery that the HAC1 message undergoes splicing upon activation of the UPR (Cell 87, 391–04, 1996). He showed that the Ire1 kinase is also an endoribonuclease specific for HAC1 mRNA (Cell 90, 1031–39, 1997). Mori confirmed HAC1 splicing one month later (Mol Biol Cell 8, 1845–62, 1997). Next Walter reconstituted HAC1 splicing in vitro and showed that the process resembles pre-tRNA splicing (EMBO J 18, 3119–32, 1999). Also in 1999 Mori discovered the mammalian transcription factor ATF6 (all previous discoveries were made in yeast cells), which is made as an ER membrane protein. He found that ATF6 is a second ER-resident effector of the UPR (in higher eukaryotes and mammals) and that it is proteolytically severed from the ER upon UPR induction (Mol Biol Cell 10, 3787–99, 1999). In 2001 Mori independently (Cell 107, 881–891, 2001) and together with Randall Kaufman (Cell 107, 893–903, 2001) discovered XBP1 as the mammalian HAC1 ortholog. The next big step forward followed in 2005 when Walter together with his collaborator Stroud reported the crystal structure of the ER luminal domain of Ire1. They suggested that the protein forms a MHC1-like peptide binding groove, which may bind misfolded proteins directly.

The Selection Committee carefully considered the contribution by other scientists to the elucidation of the UPR pathway and concluded unanimously that Mori and Walter have by far made the most seminal discoveries. Walter and Mori also shared the Canadian Gairdner International Award and the American Wiley Prize.

Kazutoshi Mori
Laureate in Life Science and Medicine

I was born on July 7, 1958 in a small town facing the Seto Inland Sea. My father, Chuichi, worked at an automobile company and my mother, Fukiko, and grandparents Sakae and Aiko raised agricultural products in the small fields around our house. Although there was no atmosphere of science in my family, it was my dream since childhood to be a PhD scientist. My interest was driven by the comics I loved to read, such as Mighty Atom (called Astroboy in the American movie) and Mach Go Go Go (Speed Racer in the American movie). I found a bright future in Science and Technology. I was also affected by the movie "Modern Times" by Charlie Chaplin. I did not want to work for a company, but rather to obtain an academic position in a university, and to ultimately work as a professor. Although my family was not rich, my parents worked hard and allowed me to go to school for as long as I wished.

I first studied biochemistry in the lab of Dr Ikuo Yamashina, who passed away this January (2014), at the Graduate School of Pharmaceutical Sciences of Kyoto University (1981–1985). My mentors are Drs Yamashina and Toshisuke Kawasaki, who is currently at Ritsumeikan University. After finishing the graduate school programme, I was fortunate to obtain a permanent position as an instructor in the lab of Dr Kyozo Hayashi at a local university (Gifu Pharmaceutical University). Dr Hayashi tasked me with biochemically investigating a factor secreted by cancer cells. I worked hard and published eight papers in the four years from 1985 to 1989. As I did not think this project held much promise for me, and wanted to do something of greater interest and importance, I decided to quit that job and go to the USA to pursue my real interest and learn molecular biology. I sent applications to three labs but was not accepted. Dr Yasunori Kozutsumi, my senior at Dr Yamashina's lab, suggested that I apply to the lab of Drs Mary-Jane Gething and Joe Sambrook at the University of Texas Southwestern Medical Center at Dallas. Joe is one of the three authors of the book "Molecular Cloning", which is considered to be the bible of molecular biology. Very fortunately, they accepted me. I joined their lab as a post-doc in April, 1989, and encountered the Unfolded Protein Response (UPR). This happy meeting was to change my entire life.

My wife Sachiko and I married one year before we went to Texas. I worked hard at the lab, but we had time for tennis with friends every Saturday evening. During summer and winter holidays we loved travelling within the US, a huge country, and visited around thirty national parks, each unique and beautiful in its own way. We also went to Cancun, Mexico, and visited the three Mayan ruins of Chichien Itza, Uxmal, and Palenque — all so impressive.

After four and a half engrossing years at Mary-Jane and Joe's lab, we returned to Japan where I obtained a deputy research manager position (1993–1996) and then a research manager position (1996–1999) at the HSP (heat shock protein) Research Institute under the direction of Dr Takashi Yura, who had just retired from Kyoto University. After five and a half amazing years at Takashi's Institute, Dr Manabu Negishi offered me an associate professorship in his lab at the newly established Graduate School of Biostudies of Kyoto University (1999). After four fascinating years at Manabu's lab, I became a full professor at the Graduate School of Science of Kyoto University (2003). In this way my childhood dream was fulfilled.

Although I have changed laboratories every four or five years, I feel that I have finally settled down at my current institution. I have also changed experimental systems to meet new goals: from yeast to mammalian cells and then to mice, and seven years ago we also began to employ the medaka fish system. My ultimate goal is a comprehensive understanding of the biology, physiology and evolution of the UPR.

I like to watch various sports. Since junior high school I have practiced Kendo, a modern Japanese sport/martial art which uses a bamboo sword (shinai) and protective armour (bogu). Kendo is now widely practiced not only in Japan but also in many other countries around the world. I practiced Kendo in Dallas and instructed many Americans, and our Texas/Colorado team won the bronze medal in an All United States Kendo Federation Championship. My ranking in Kendo is now five (go-dan). I swing a wooden sword one hundred times every morning. I also instruct elementary school students once a week, with the goal of helping them achieve a sound mind in a sound body.

We have three children, our son Tomohide and daughters Megumi and Linna, all still teenagers who have to attend school and regrettably, with my wife Sachiko, are unable to attend the ceremony. To my great happiness, my eighty-five year old parents both enjoy robust health and I look forward to attending the ceremony with them.

Peter Walter
Laureate in Life Science and Medicine

Growing up in West Berlin, Germany, I spent numerous hours in my father's chemist shop, a drugstore where herbal medicines, chemicals and various household items were sold. This exposure — along with dabbling in the pyrotechnical adventures of mixing and igniting chemicals — fostered my early interest in the natural sciences. By age twelve, I knew that I wanted to be a chemist.

I began my study of chemistry in 1973 at the Free University of Berlin. Three years into the programme, a fellowship from the German Academic Exchange Service enabled me to study in the United States. I moved to Nashville, Tennessee, where I joined the chemistry department at Vanderbilt University as an international exchange student. My primary intent at the time was to immerse myself in the English language, which I never was particularly good at in school, yet I knew would be important in a research career. Working in the laboratory of Tom Harris on the biosynthetic pathway of a fungal alkaloid, I quickly discovered that American universities offered young students cutting-edge, hands-on research experiences and fostered their early development as independent researchers. I became hooked on this style of learning and graduated a year later from Vanderbilt University with a Master of Science degree in organic chemistry.

Rather than returning to Germany as originally planned, I applied to the graduate programme at the Rockefeller University in New York. After an initial rejection, I was admitted from the waiting list. From 1977 to 1981, I studied for my PhD degree with Günter Blobel, who later received the Nobel Prize. In the course of this work, I switched my field of study from chemistry to cell biology. I had become fascinated by the complexities that govern the inner workings of living cells. During my graduate work, I discovered the signal recognition particle, a universally conserved protein/RNA complex that enables proteins to become properly localized in cells. I remained in Blobel's group for two years, first as a postdoctoral fellow and then as an assistant professor. While in New York, I met Patricia Caldera, a native of Mexico and a chemistry graduate student at New York University. We later married and raised our two daughters, Gabriela and Sylvia.

In 1983, I joined the faculty of the Department of Biochemistry and Biophysics at the University of California at San Francisco, where I moved through the ranks and served as Department Chair from 2001 until 2008. In my laboratory at UCSF, we turned our attention to deciphering the pathways that cells use to regulate the abundance of their internal organelles. With a particular focus on the endoplasmic reticulum, the organelle in which many newly made proteins are assembled, my lab uncovered the "unfolded protein response", a complex cell-internal signalling network that adjusts the cell's protein folding capacity to demand. Regulating the abundance of the endoplasmic reticulum is a fundamental process for all eukaryotic cells, and it is a key determinant in a number of diseases, including cancer, diabetes, and neurodegenerative diseases. Most disease connections arise because the cell is programmed to die, rather than endangering the organism by making defective and potentially harmful proteins. My lab has identified the genes that are centrally involved in the unfolded protein response and deciphered their function in this crucial cell-internal communication pathway.

Since 1997, I have been an investigator with the Howard Hughes Medical Institute. Currently, I am the 2016 President-Elect of the American Society of Cell Biology and an elected member of several scientific societies such as the German Academy of Natural Scientists Leopoldina, the US National Academy of Sciences, the American Association for Arts and Science, and the European Molecular Biology Organization. I co-author the textbooks *Molecular Biology of the Cell* and *Essential Cell Biology,* two of the world's most widely used works in molecular cell biology. Among the various awards I have received are the Eli Lilly Award in Biological Chemistry, the Passano Award, the Wiley Prize in Biomedical Sciences, the Stein & Moore Award, the Gairdner Award, the E B Wilson Medal, the Otto Warburg Medal, the Jung Prize, and the Ehrlich and Darmstaedter Prize.

I have always been a strong advocate of the value of basic, curiosity-driven research to society. Personally, I would consider it a crowning highlight of my career if some aspects of the basic knowledge that we have accumulated over the years are translated into a tangible benefit for mankind. It is important to realize, none of the tremendous opportunities that we now hold in our hands were obvious when we started on our journey; they only emerged gradually as we playfully and fervently followed the turns of our meandering and serendipitous path. I am grateful to have the honor of walking along this path with the outstanding and courageous young scientists who joined my lab.

Professor Peter C Sarnak

Member of the Board of Adjudicators

Chairman of the Selection Committee for the Prize in Mathematical Sciences

Professor Peter C Sarnak is currently the Eugene Higgins Professor of Mathematics at Princeton University and Professor of the Institute for Advanced Study.

He has made major contributions to number theory, and to questions in analysis motivated by number theory. His interest in mathematics is wide-ranging, and his research focuses on the theory of zeta functions and automorphic forms with applications to number theory, combinatorics, and mathematical physics.

Professor Sarnak received his PhD from Stanford University in 1980. In the same year, he became Assistant Professor of Courant Institute of Mathematical Sciences of New York University and an Associate Professor in 1983. In 1987 he moved to Stanford University. He joined Princeton University as Professor in 1991, became the Henry Burchard Fine Professor of Mathematics in 1995 and the Chair of the Department of Mathematics from 1996 to 1999. From 2001 to 2005, he was Professor of Courant Institute of Mathematical Sciences of New York University.

He has received many awards, including the Frank Nelson Cole Prize, American Mathematical Society (2005) and Levi L Conant Prize, AMS (2003). He was elected as a Member of the US National Academy of Sciences and Fellow of the Royal Society of London in 2002.

The Prize in Mathematical Sciences 2014

George Lusztig

**for his fundamental contributions to algebra,
algebraic geometry, and representation theory,
and for weaving these subjects together
to solve old problems and reveal
beautiful new connections.**

An Essay on the Prize in
Mathematical Sciences 2014

For more than two hundred years, symmetry groups have been at the centre of mathematics and its applications: in Fourier's work on the heat equation in the early 1800s; in the work of Weyl and Wigner on quantum mechanics in the early 1900s; and in the approach to number theory created by Artin and Chevalley. These classical works show that answers to almost any question involving a symmetry group lie in understanding its realizations as a group of linear transformations, that is, in terms of its *representations*.

Lusztig's work has completely transformed our understanding of representation theory, providing complete and precise answers to fundamental questions that were understood before only in very special cases. What he has done has advanced all of the mathematics where symmetry groups play a role: from Langlands' programme for understanding automorphic forms in number theory, to classical problems of harmonic analysis on real Lie groups.

Here are some hints of the ideas at the heart of Lusztig's work. The most basic symmetry group in mathematics is GL(n), the group of invertible $n \times n$ matrices. (The entries in the matrices will be different in different problems.) One of the most important invariants of a matrix is the collection of its n eigenvalues. The eigenvalues do not come with an ordering, so they can be rearranged using the permutation group S_n (consisting of the $n!$ permutations of $(1, 2, \ldots, n)$). A consequence (understood already in the nineteenth century) is that some of the properties of the (large and complicated) group GL(n) can be encoded by the (smaller and simpler) group S_n.

All permutations of $(1, \ldots, n)$ may be built up from n–1 "simple transpositions": the permutations s_i that exchange i with i+1, and leave everything else alone. For example, we can reverse the order of (1, 2, 3) by first exchanging the 1 and the 2, then exchanging the 2 and the 3, and finally exchanging the 1 and the 2 again:

$(1,2,3) \to (2,1,3) \to (3,1,2) \to (3,2,1)$.

Elementary results from linear algebra provide a beautiful decomposition of GL(n) into pieces labelled by permutations; these are essentially the *Schubert varieties* for GL(n). The piece labelled by the trivial permutation consists of the upper triangular matrices, where all problems of linear algebra are easy. The piece labeled by the simple transposition s_i consists of matrices with a single nonzero entry below the diagonal, in column i and row (i+1). As the permutation gets larger, the corresponding matrices become less and less upper triangular, and the corresponding Schubert variety gets more and more complicated.

A first theme in Lusztig's work is that the algebraic subtleties of representation theory correspond perfectly to the topological and geometric subtleties of Schubert varieties. Although this idea is foreshadowed in earlier works, such as that of Borel and Weil in the 1950s on representations of compact groups, Lusztig's results have revolutionized the field. Mathematicians talk about *geometric* representation theory to distinguish what is possible now from its antecedents.

Representations are complicated, as are the Schubert varieties to which Lusztig's work relates them. A second theme in his work is the creation of combinatorial tools — easy to describe, but almost without precedent in mathematics — to describe in fantastic detail the topology and geometry of Schubert varieties. This theme begins in a 1979 paper with David Kazhdan, and continues through Lusztig's most recent work. The idea is to build complicated Schubert varieties from simpler ones exactly as complicated permutations are built from simpler ones, by multiplication of simple transpositions. This description of permutations has been studied in combinatorics for more than a hundred years, but Lusztig's ideas have opened whole new fields of investigation for them.

A third theme in Lusztig's work is the new field of quantum groups, introduced by Vladimir Drinfeld in the 1980s. Lusztig has said that the test of a new theory is whether you can use it to answer questions that were asked before the new theory existed. He has made quantum groups pass that test in a number of amazing ways. For example, his theory of canonical bases (which can be introduced only using quantum groups) allowed him to extend the classical theory of "totally positive matrices" from $GL(n)$ to all reductive groups.

There is much more to say about Lusztig's work: on modular representation theory, on affine Hecke algebras, and on p-adic groups, for instance. He has touched widely separated parts of mathematics, reshaping them and knitting them together. He has built new bridges from representation theory to combinatorics and algebraic geometry, solving classical problems in those disciplines and creating exciting new ones. This is a remarkable career, as exciting to watch today as it was at the beginning more than forty years ago.

George Lusztig
Laureate in Mathematical Sciences

I was born in 1946 in Timisoara, Romania. Both my parents were accountants and at home we spoke Hungarian (I learned Romanian at age 3 when I went to kindergarten). My wife, Gongqin Li, was born in Wuhan, China and trained as a mathematician but now works on software development. I have two daughters from my previous marriage: Irene (born in 1974) and Tamar (born in 1982).

I attended elementary school and high school in Timisoara. In 7th grade my favorite subject was chemistry but in 8th grade (1960), after some moderate success in the mathematics Olympiad, I began to spend most of my time solving mathematics problems from a mathematics magazine for high school students and decided to be a mathematician. During my last two years of high school I met Maria Neumann, a professor at the University of Timisoara, who lent me some books on Foundations of Geometry and Non-Euclidean Geometry which we would discuss in our meetings. I think that these discussions were very good for my mathematical development.

When I finished high school (1963), I went to Bucharest and enrolled as a student in the Department of Mathematics at the University of Bucharest. The teacher who most influenced me during the Bucharest years (1963–1968) was Kostake Teleman who was a member of a well-known mathematical family. I attended his course on Linear Algebra, based on Artin's book Geometric Algebra, and his course on Differential Geometry, which was his main area of expertise. I also attended his more advanced courses: one on the Gelfand–Naimark theory of induced representations (in which I learned about flag manifolds) and one on the Atiyah–Singer index theorem. Both of these were very important for my development.

In 1968 I graduated from Bucharest University and got a job as an assistant in the University of Timisoara but stayed there for only six months. In the summer of 1968, I attended a summer school in pseudodifferential operators in Stresa, Italy, where I met I M Singer. I told him that I had been invited to the University of Warwick for a special term in dynamical systems but that I was really more interested in index theory. He suggested that while in England I should meet M F Atiyah. This I did, and after one month at Warwick, Atiyah arranged for me to go to Oxford. When I first met Atiyah, he explained to me a problem on the semicharacteristic of a closed $4k + 1$ manifold which he was just discussing with Singer. After several weeks I found a solution to that problem. During my two-month stay at Oxford I also proved some results on the constancy of the holomorphic Lefschetz number in a circle action which Atiyah then used in his work with Hirzebruch on the vanishing of the A-roof genus. Before leaving Oxford I received an invitation from the Institute for Advanced Study, Princeton, NJ, based on the recommendation of Atiyah who was about to move there.

In 1969 I went to work with Atiyah at the Institute for Advanced Study, Princeton, NJ, and stayed there for two years. Since I did not have a PhD, at the end of the first year I asked W Browder whether I could get a PhD from Princeton University based on a paper on Novikov's higher signatures that I had just completed. He said yes, and in 1971 I received my PhD.

Meanwhile, I became very interested in the representation theory of finite algebraic groups. In 1971 I received an offer of a lectureship from the University of Warwick, UK, which I accepted, due in part to the presence there of J A Green from whom I hoped to learn about representation theory. In the first few years at Warwick I had a collaboration with R Carter which helped me to better understand reductive groups. Also, I succeeded in finding a construction of discrete series for GL(n) over a finite field for which previously only the characters were known (by the work of Green).

In the spring of 1974, during a visit to IHES, I started a joint work with P Deligne in which we constructed the generic irreducible representations of reductive groups over a finite field using the étale cohomology of certain algebraic varieties; this was completed in the spring of 1975. Around the middle of 1974 I was promoted to Professor at the University of Warwick and spent the next few years trying to classify all irreducible representations of reductive groups over a finite field.

In 1978 I became a professor at MIT where I continue to be today. Around 1980, after my joint work with Kazhdan, intersection cohomology became one of my main tools. I have used this tool very often, in particular in the theory of character sheaves which I started to develop in the 1980s and I am still concerned with today, and also in the theory of canonical bases arising from quantum groups which I started to develop around 1990.

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* Professor Yue-Man Yeung

* Mrs Mona Shaw

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* Professor Samuel Sai-Ming Sun

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Mona Shaw

Mona Shaw, wife of Sir Run Run Shaw, is Chairperson of The Sir Run Run Shaw Charitable Trust, The Shaw Foundation Hong Kong Limited and The Shaw Prize Foundation. A native of Shanghai, China, she is an established figure in the Hong Kong media and entertainment industry and Chairperson of the Shaw Group of Companies. She was Deputy Chairperson and Managing Director of Television Broadcasts Limited until her resignation in March 2012, and is now a Non-Executive Director of the company.

Council Member

Professor Chen-Ning Yang

Professor Chen-Ning Yang, an eminent physicist, was Albert Einstein Professor of Physics at the State University of New York at Stony Brook until his retirement in 1999. He has been Distinguished Professor-at-large at The Chinese University of Hong Kong since 1986 and Professor at Tsinghua University, Beijing, since 1998.

Professor Yang received many awards: Nobel Prize in Physics (1957), Rumford Prize (1980), US National Medal of Science (1986), Benjamin Franklin Medal (1993), Bower Award (1994) and King Faisal Prize (2001). He is a Member of the Chinese Academy of Sciences, the Academia Sinica in Taiwan, the US Academy of Sciences, the Royal Society of London, the Russian Academy of Sciences and the Japan Academy.

Since receiving his PhD from the University of Chicago in 1948, he has made great impacts in both abstract theory and phenomenological analysis in modern physics.

Council Member

Professor Kenneth Young

Professor Kenneth Young is a theoretical physicist, and is Master of CW Chu College and Professor of Physics at The Chinese University of Hong Kong. He pursued studies at the California Institute of Technology, USA, 1965–1972, and obtained a BS in Physics (1969) and a PhD in Physics and Mathematics (1972). He joined The Chinese University of Hong Kong in 1973, where he has held the position of Chairman, Department of Physics and later Dean, Faculty of Science, Dean of the Graduate School and Pro-Vice-Chancellor. He was elected a Fellow of the American Physical Society in 1999 and a Member of the International Eurasian Academy of Sciences in 2004. He was also a Member of the University Grants Committee, HKSAR and Chairman of its Research Grants Council. He served as Secretary and then Vice-President of the Association of Asia Pacific Physical Societies. His research interests include elementary particles, field theory, high energy phenomenology, dissipative systems and especially their eigenfunction representation and application to optics, gravitational waves and other open systems.

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Professor Pak-Chung Ching

Professor Pak-Chung Ching is Pro-Vice-Chancellor/Vice-President, Director of Shun Hing Institute of Advanced Engineering and Professor of Electronic Engineering of The Chinese University of Hong Kong. He received his Bachelor in Engineering (First Class Honours) and PhD degrees from the University of Liverpool, UK, in 1977 and 1981 respectively. Professor Ching is a Fellow of IEEE, IEE, HKIE and HKAES. He is Chairman of the Hong Kong Council for Testing and Certification, Chairman of the Veterinary Board of Hong Kong and Member of the Steering Committee on Innovation and Technology. He also sits on the boards of a number of research and development organizations in Hong Kong. Professor Ching was awarded the IEEE Third Millennium Award in 2000, and the HKIE Hall of Fame and the Bronze Bauhinia Star by the Government of HKSAR in 2010. His research interests include adaptive digital signal processing, time delay estimation and target localization, blind signal estimation and separation, automatic speech recognition, speaker identification/verification and speech synthesis, and advanced signal processing techniques for wireless communications.

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Professor Wai-Yee Chan

Professor Wai-Yee Chan is Professor of Biomedical Sciences and Director of School of Biomedical Sciences, The Chinese University of Hong Kong (CUHK), Hong Kong. Professor Chan obtained his BSc (First Class Honours) from CUHK in 1974 and PhD from the University of Florida, Gainesville, Florida, USA in 1977. Prior to assuming his current position in June of 2009, he was Professor of Pediatrics, Georgetown University, Washington, DC, and Head and Principal Investigator, Section on Developmental Genomics, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, USA. His expertise is in developmental genomics and molecular genetics of endocrine disorders. He received the 1988 Merrick Award for Outstanding Biomedical Research and the 2008 Presidential Award from the Association of Chinese Geneticists in America. He serves on the editorial boards of a number of international scientific journals and on review panels of regional and international research funding agencies.

THE SHAW PRIZE 邵逸夫獎

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Professor Reinhard Genzel

Astronomy Committee

Professor Reinhard Genzel, born in 1952 in Germany, is the Director and Scientific Member at the Max Planck Institute for Extraterrestrial Physics, Garching, Germany, Honorary Professor at the Ludwig Maximilian University, Munich since 1988 and Full Professor of Physics, UC Berkeley since 1999.

He received his PhD from the University of Bonn in 1978. He was a Postdoctoral Fellow at Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts (1978–1980), an Associate Professor of Physics and Associate Research Astronomer at Space Sciences Laboratory (1981–1985) and a Full Professor of Physics at UC Berkeley (1985–1986).

Professor Genzel received many awards, including Newton Lacy Pierce Prize (1986), Leibniz Prize (1990), Janssen Prize (2000), Balzan Prize (2003), Petrie Prize (2005), the Shaw Prize in Astronomy (2008), Jansky Prize (2010), Karl Schwarzschild Medal (2011), Crafoord Prize in Astronomy (2012) and Tycho Brahe Prize (2012).

He is a Member of the European Academy of Sciences, the German Academy of Natural Sciences Leopoldina, the Bavarian Academy of Sciences. He is also a Foreign Member/Foreign Corresponding Member/Associate of the Academy of Sciences of France, the US National Academy of Sciences, the Royal Spanish Academy, and the Royal Society of London.

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Professor
Douglas N C Lin

Astronomy Committee

Professor Douglas Lin is the Founding Director of the Kavli Institute for Astronomy and Astrophysics at Peking University and Professor of Astronomy and Astrophysics at the University of California, Santa Cruz.

He obtained his PhD at the Institute of Astronomy, Cambridge University. He held post-doctoral fellowships at Cambridge and Harvard University. He joined the faculty at the Department of Astronomy and Astrophysics, University of California, Santa Cruz in 1979, became a Full Professor in 1985, served as its Chair in 1998, and was elected as a Distinguished Faculty in 2009. For his research, he has won awards from the US, Germany, UK, and Russia. He was elected to the American Academy of Arts and Sciences in 2002 and an Honorary Fellow of the Royal Astronomical Society in 2010.

He is the author or co-author of over 200 research papers, mainly on astrophysics and planetary sciences and several science articles for the general public. He has frequent television and newspaper interviews and lectures widely, and has held visiting professorships at many universities around the world.

Selection Committee Member

Professor
Ramesh Narayan

Astronomy Committee

Professor Ramesh Narayan is the Thomas Dudley Cabot Professor of the Natural Sciences at Harvard University.

Professor Narayan received a BSc in Physics from Madras University (1971), and an MSc (1973) and a PhD (1979) from Bangalore University. After a few years as a Research Scientist at the Raman Research Institute, Bangalore, he went in 1983 to Caltech, where he was a Senior Research Fellow. He joined the faculty at the University of Arizona in 1985, and moved to Harvard University in 1991.

Professor Narayan has carried out research in a number of areas of theoretical astrophysics, including accretion disks, gravitational lensing, gamma-ray bursts, neutron stars and black holes.

Professor Narayan is a Fellow of the Royal Society (London), a Fellow of the American Association for the Advancement of Science, and a Member of the US National Academy of Sciences.

Selection Committee Member

Professor
Adam G Riess

Astronomy Committee

Professor Adam G Riess is a Professor of Physics and Astronomy at Johns Hopkins University and a Staff Astronomer at the Space Telescope Science Institute. He received his bachelor's degree from MIT in 1992 in Physics and his PhD from Harvard in 1996. He leads the Higher-Z SN Search program, which uses the Hubble Space Telescope to discover distant supernovae. In 1998, he led the study for the High-Z Supernova Search Team which first reported evidence that the Universe is accelerating. Science Magazine named this the 1998 "Breakthrough of the Year."

In 1999 Professor Riess received the Trumpler Award from the ASP, the Bok Prize from Harvard University in 2001, the Warner Prize from the AAS in 2003 and the Sackler Prize in 2004. In 2006, he shared the Shaw Prize in Astronomy with Professors Schmidt and Perlmutter and the 2007 Gruber Prize with members of the High-Z team and the Supernova Cosmology Project. Professor Riess won a MacArthur Fellowship in 2008, was elected to the US National Academy of Sciences in 2009 and received the Einstein Medal in 2011. Last but not least, he was awarded the Nobel Prize in Physics 2011 together with Professor Saul Perlmutter and Professor Brian Schmidt.

Selection Committee Member

Professor
Bruce A Beutler

Life Science and Medicine Committee

Professor Bruce A Beutler is a Regental Professor and Director of the Center for the Genetics of Host Defense at UT Southwestern Medical Center in Dallas, Texas. He received his medical training at the University of Chicago, graduating in 1981. As a postdoctoral fellow at The Rockefeller University (1983–1986), he isolated mouse tumor necrosis factor (TNF) and discovered its importance as a mediator of inflammation. Subsequently, at UT Southwestern, he analyzed mammalian responses to bacterial lipopolysaccharide. This work culminated in the identification of Toll-like receptors as key sensors of the innate immune system, used to detect infection. In further studies, Professor Beutler employed a forward genetic strategy to elucidate many aspects of mammalian immunity.

He has received numerous awards for his work including the Balzan Prize (2007), the Albany Medical Center Prize (2009), the Shaw Prize (2011), and election to both the US National Academy of Sciences and the Institute of Medicine (2008). In 2011, he shared the Nobel Prize in Physiology or Medicine for "discoveries concerning the activation of innate immunity".

Selection Committee Member

Professor Günter Blobel

Life Science and Medicine Committee

Born in Germany, Professor Günter Blobel earned an MD degree from Tübingen, Germany and a PhD degree in Oncology from Madison, Wisconsin. Following postdoctoral training, he became Full Professor of Cell Biology at Rockefeller University in New York in 1976. Since 1986 he is also Investigator of the Howard Hughes Medical Institute. He received numerous awards, among them the 1993 Lasker Award and the 1999 Nobel Prize in Medicine. He donated the entire proceeds of the Nobel Prize of one million USD to the reconstruction of the Frauenkirche and the Synagogue in Dresden, Germany. His research has focused on how proteins translocate across or integrate into membranes and on bidirectional traffic between the cytoplasm and the nucleus. A recent research objective is to piece together the atomic structure of the 100 MDalton nuclear pore complex by crystallographic and cryo electron microscopic analyses.

Selection Committee Member

**Professor
Franz-Ulrich Hartl**

*Life Science and
Medicine Committee*

Professor Franz-Ulrich Hartl is a Director at the Max Planck Institute of Biochemistry in Martinsried, Germany. After completing his medical studies he earned a D med degree in Biochemistry from the University of Heidelberg and then worked as postdoctoral fellow and group leader at the University of Munich. From 1991 to 1997 he was a Professor at Memorial Sloan-Kettering Cancer Center in New York where he was appointed HHMI Investigator in 1994. Professor Hartl's laboratory has elucidated the role of molecular chaperones in protein folding and discovered that the chaperonins — a class of ATP-driven chaperones — function as nano-cages for single protein molecules to fold unimpaired by aggregation. His recent research has focused on understanding the mechanisms underlying the toxicity of protein misfolding in neurodegenerative disease.

Among Professor Hartl's honors are the Gairdner International Award, the Louisa Gross Horwitz Prize, The Rosenstiel Award, The Wiley Prize, the Albert Lasker Award for Basic Medical Research, the Heineken Prize and the Shaw Prize in Life Science and Medicine. He was elected as a Foreign Associate of the US National Academy of Sciences in 2011.

Selection Committee Member

Professor Tony Hunter

Life Science and Medicine Committee

Professor Tony Hunter was born in Ashford, Kent, England. He received his BA in 1965 from the University of Cambridge, and his PhD in 1969 for work on mammalian protein synthesis under Asher Korner in the Department of Biochemistry, University of Cambridge. He was a Research Fellow in the Department from 1968 to 1971, and a Postdoctoral Fellow at the Salk Institute from 1971 to 1973 working under Walter Eckhart on polyoma virus DNA replication. He rejoined the Salk Institute as an Assistant Professor in 1975 in the Molecular and Cell Biology Laboratory, where he is currently the Renato Dulbecco Chair in Cancer Research and Director of the Salk Institute Cancer Center.

In 1979, he discovered that polyomavirus middle T antigen and the RSV v-Src oncoprotein both exhibit a previously unknown protein kinase activity that phosphorylates tyrosine. He has spent most of the last thirty years studying protein kinases and phosphatases, and the role of protein phosphorylation in cell growth, the cell cycle, and cancer.

He has received many awards for his work on tyrosine phosphorylation. He is a Fellow of the Royal Society of London, an Associate Member of EMBO, a Member of the US National Academy of Sciences, the Institute of Medicine, and the American Philosophical Society.

Selection Committee Member

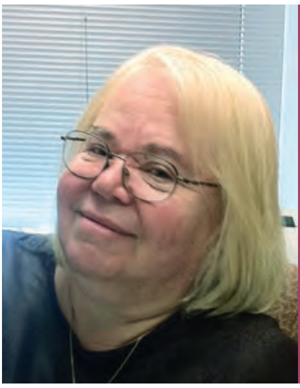
Professor
Robert J Lefkowitz

Life Science and
Medicine Committee

Professor Robert J Lefkowitz, MD is James B Duke Professor of Medicine and Professor of Biochemistry at the Duke University Medical Center. He has been an Investigator of the Howard Hughes Medical Institute since 1976. He has received numerous awards and honors for his research, including the National Medal of Science, the Shaw Prize, the Albany Prize, and the 2012 Nobel Prize in Chemistry. He was elected to the US National Academy of Sciences in 1988, the American Academy of Arts and Sciences in 1983, and the Institute of Medicine in 1994.

He is best known for his studies of G protein coupled receptors, a field which he has pioneered for more than forty-five years.

Selection Committee Member



**Professor
Eve E Marder**

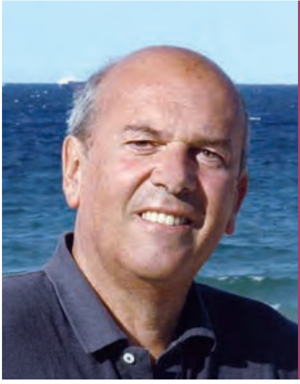
*Life Science and
Medicine Committee*

Professor Eve E Marder received her PhD from UCSD in 1974 and did postdoctoral work at the Ecole Normale Superieure, Paris. She is the Beinfield Professor of Neuroscience and Head of the Division of Science at Brandeis University. In the year 2007–2008, she served as President of the Society for Neuroscience, USA.

Her honours include membership in the US National Academy of Sciences, the American Academy of Arts and Sciences, the Salpeter Award from WIN, the Gerard Prize from the SfN, the George A Miller Award from the Cognitive Neuroscience Society, the Karl Spenser Lashley Prize from the American Philosophical Society, an Honorary Doctorate from Bowdoin College, and the 2013 Gruber Prize in Neuroscience. She serves on the NIH Director's BRAIN Working Group.

Professor Marder's studies in the dynamics of small neural circuits was instrumental in demonstrating that neuronal circuits are not "hard-wired" but can be reconfigured by neuromodulatory neurons and substances. Her lab pioneered studies of homeostatic regulation of intrinsic membrane properties, and stimulated work on the mechanisms by which brains remain stable while allowing for change during development and learning. Professor Marder now studies how similar network performance can arise from different sets of underlying network parameters, opening up rigorous studies of the variations in individual brains of normal healthy animals.

Selection Committee Member



Professor Corrado De Concini

Mathematical Sciences Committee

Professor Corrado De Concini was born in Roma, Italy, in 1949. He got his Laurea in Matematica at La Sapienza, Università di Roma in 1971 and his PhD at Warwick University under the direction of G Lusztig.

After having been a professor at the Universities of Pisa, Roma Tor Vergata and at the Scuola Normale Superiore of Pisa, he is currently a Professor of Algebra at the Università La Sapienza in Roma.

Professor De Concini is mainly an algebraist. He has worked on the study of the so-called wonderful compactifications of semisimple groups and symmetric varieties, the Schottky problem, hyperplane arrangements, and, recently, on the determination of the values of the index for transversally elliptic operators.

He is a Member of the Accademia dei Lincei, of the Accademia delle Scienze detta dei XL and of the Istituto Lombardo. He received the gold medal of the Accademia dei XL and the Caccioppoli Prize in Mathematics. He has been a speaker at the International Congress of Mathematics (Berkeley 1986) and at the European Congress of Mathematics (Paris 1990).

Selection Committee Member

**Professor
W Timothy Gowers**

*Mathematical Sciences
Committee*

Professor Timothy Gowers was born in Marlborough, England, in 1963. From 1973 to 1976 he was a chorister in the choir of King's College, Cambridge, after which he went as a scholar to Eton College. He studied mathematics at Trinity College, Cambridge, where he also did his PhD, under the supervision of Bèla Bollobàs. In 1989 he became a research fellow at Trinity, moving to University College London two years later as a Lecturer. In 1995 he returned to Cambridge, and Trinity, where he was first a Lecturer and then a Professor. He is currently a Royal Society Research Professor and also holder of the Rouse Ball Chair in Mathematics. In the early part of his career he solved some old problems in Banach space theory, including two of Banach himself. He then discovered the first quantitative proof of Szèmèrèdi's theorem and has subsequently worked in additive combinatorics. For this work he was awarded a Fields Medal in 1998.

Selection Committee Member

Professor
John W Morgan

Mathematical Sciences Committee

Professor John W Morgan is a Professor of Mathematics and Director of the Simons Center for Geometry and Physics at Stony Brook University. His work is in the areas of geometry and topology. He has concentrated study of manifolds and smooth algebraic varieties. His most recent work includes a book, joint with Gang Tian, explaining in detail the proof of the Poincaŕe Conjecture.

Professor Morgan received his PhD from Rice University in 1969. He was an instructor at Princeton from 1969 to 1972, an Assistant Professor at MIT from 1972 to 1974, and was Associate Professor and then Professor at Columbia University from 1974 to 2009. In 2009, he joined Stony Brook University.

His awards include the Levi L Conant Prize of the AMS (2009). He is a Member of the AMS, a Fellow of the AMS (2013), and a Member of the US National Academy of Sciences.

Selection Committee Member

**Professor
David A Vogan, Jr**

*Mathematical Sciences
Committee*

Professor David A Vogan, Jr is Professor of Mathematics at the Massachusetts Institute of Technology, and President of the American Mathematical Society.

His work concerns representations of Lie groups, particularly unitary representations. Since 2003 he has worked with Jeff Adams' group "Atlas of Lie groups and representations" looking for light that computers can shed on these questions.

He received the BA and SM degrees from the University of Chicago in 1974, and the PhD from MIT in 1976 under the direction of Bertram Kostant. He continued as an Instructor at MIT, and a Member of the Institute for Advanced Study, before joining the MIT mathematics faculty in 1979. He served as Head of the department from 1999 to 2004.

In 2011, he received the AMS Levi L Conant Prize. He was elected as a Fellow of the American Academy of Arts and Sciences and a Member of the US National Academy of Sciences.

THE SHAW PRIZE 邵逸夫獎

Presenter

Ms
Do Do Cheng

Award-winning Actress
Versatile TV Performer
Programme Host

Award-winning actress, versatile TV performer and programme host Ms Do Do Cheng has starred in many TVB classic dramas and won film awards, local and international. Her hosting of the Hong Kong version of "The Weakest Link" and starring in Television Broadcasts Limited's (TVB) sit-com "War of the Genders" became talk-of-the-town. Ms Cheng's success in hosting the TVB gameshow on legal knowledge "Justice for All" brought her career to a new height. She also hosted the 2008 Beijing Olympics for TVB and has been one of the presenters for the Shaw Prize Award Presentation Ceremony since its inception in 2004.

Presenter

Mr
Leon Ko

Theatre and Film Composer

Mr Leon Ko received a Richard Rodgers Development Award in the US for his musical "Heading East". His musical "Takeaway" was the first major British Chinese musical to premiere in London in 2011. His music for the movie "Perhaps Love" won him a Golden Horse Award and a Hong Kong Film Award. His song "Ding Feng Bo" for the movie "The Last Tycoon" won Best Original Film Song at the recent 32nd Hong Kong Film Awards. For the stage, he received five Best Score awards for his musicals in Hong Kong. He was the musical director of Jacky Cheung's 2004 world tour of "Snow, Wolf, Lake". Recent works include music for the play "Tonnochy" in Hong Kong. Besides music, Mr Ko launched "Time In A Bottle", the first-ever perfume bottle exhibition in Hong Kong in 2010, showcasing the artistry of vintage bottles in the context of theatre. Mr Ko is currently a council member of the Hong Kong Arts Development Council.

Special Acknowledgement

(Airlines in alphabetical order)

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