
ISA
Israel Space Agency
Ministry of Science
and Technology
ISRAEL CELEBRATES SPACE
2013

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A Message from the Minister of Science and Technology

Human activity in space influences every aspect of our lives and functions as a force in the global economy. Transportation, communications, the banking industry and other industries rely on man-made satellites. Many countries around the globe maintain national space programs and are involved in research and the scientific exploration of space.

The State of Israel has a long history in space. By the 1960s, Israel had already established the National Committee for Space Research and Israeli scientists were involved in the study of the cosmos. The national space program, established in the early 1980s, led to numerous Israeli accomplishments.

The development of an independent space program in a small country like Israel is not insignificant. It required vision and the investment of significant resources. At the time that the Israeli space program was established, it represented vision and foresight – the belief that it was possible to create an impressive infrastructure in academic institutions and industry, enabling scientific research and technological development. Today, the Israeli space program is a success story, primarily in the area of miniaturization. However, the State of Israel cannot allow itself to lower its guard and rest on its laurels.

A national space program allows the State of Israel to maximize the only resources that stand at the country's disposal, in abundance: highly qualified manpower and a drive towards excellence. In order to maintain its advantage in space, the State of Israel must continue to develop centers of knowledge in the industrial sector and academic institutions, encouraging the innovation and entrepreneurship that are keys to success in an age of globalization and information.

The study of space attracts quality scientific and technological professionals, and the research conducted in this area has advanced Israeli science and technology. The Israel Space Agency, under the aegis of the Ministry, aims in the coming years to significantly increase the Government's investment in the civil space program, an area in which Israel is already viewed as a leading nation. The Ministry is advancing cooperative efforts with leading countries in space study, as well as with the business sector, and it intends to expand its circle of partnerships and projects.

Rabbi Professor Daniel Hershkowitz
Minister of Science and Technology

A Message from Israel's Space Agency Chairman

In the past decades, the world has witnessed a remarkable development in the areas of space research and exploration, and in the usage and application of space technologies for the benefit of mankind. Space applications provide vital information and services that advance science, the global economy and our security.

Space ignites the imagination and is an excellent means of engaging the public, especially the youth. Space encourages young people to educate themselves about scientific issues and encourages them to work professionally in the fields of science and technology. After all, the space sector creates and demands highly skilled people.

Israel benefits from a long and successful legacy in space, and for several decades, it has demonstrated its capabilities and expertise in space science and technology. Israel's accomplishments in this area have benefited the Israeli economy and industry, and have improved the economic welfare of its citizens.

When Israel's new national civil space program was adopted, its focus was the study of space utilization, in order to secure life on Earth and better understand the universe. Israel perceives space as a technological stimulus; a key to a modern society and an advanced information-based economy; and a resource attracting highly skilled professionals. Accordingly, Israel's Space Agency aspires to preserve and extend Israel's comparative advantages, and to place Israel amongst the elite of space-faring nations.

As part of the agency's efforts to achieve these goals, Israel aims to contribute and expand the scope of its multilateral cooperation in space. We hope to strengthen collaboration with partner countries.

Israel looks forward to cooperating with any space-faring nation, or emerging one, which shares the passion and dedication for space science and exploration, and for the peaceful usage of outer space for the benefit of the human race.

I am grateful to all who contribute to Israel's efforts in space, who are determined to preserve Israel at the forefront of the global space community.

Major Gen. (Ret.) Prof. Isaac Ben-Israel
Chairman, Israel Space Agency

About Israel Space Agency

Israel Space Agency (ISA), a part of Israel's Ministry of Science and Technology, coordinates and supervises the national civil space program. Its objectives include establishing national space policy, and developing external relations and collaborations with other space agencies. ISA also coordinates scientific research activity and space exploration initiatives that involve Israeli academic institutions and industries.

ISA activities emphasize the importance of research and development. The agency especially supports scientific R&D with real economic potential, such as the development of new, innovative and unique technologies.

The agency also strives to produce and manufacture new lines of products, to create and establish a new generation of scientists in the field of space science and exploration, and to support and encourage expansion and growth of related space industries.

ISA's Vision:
Placing Israel among the top five leading countries in space science and technology, in areas in which Israel has relative advantages

ISA's Objectives:

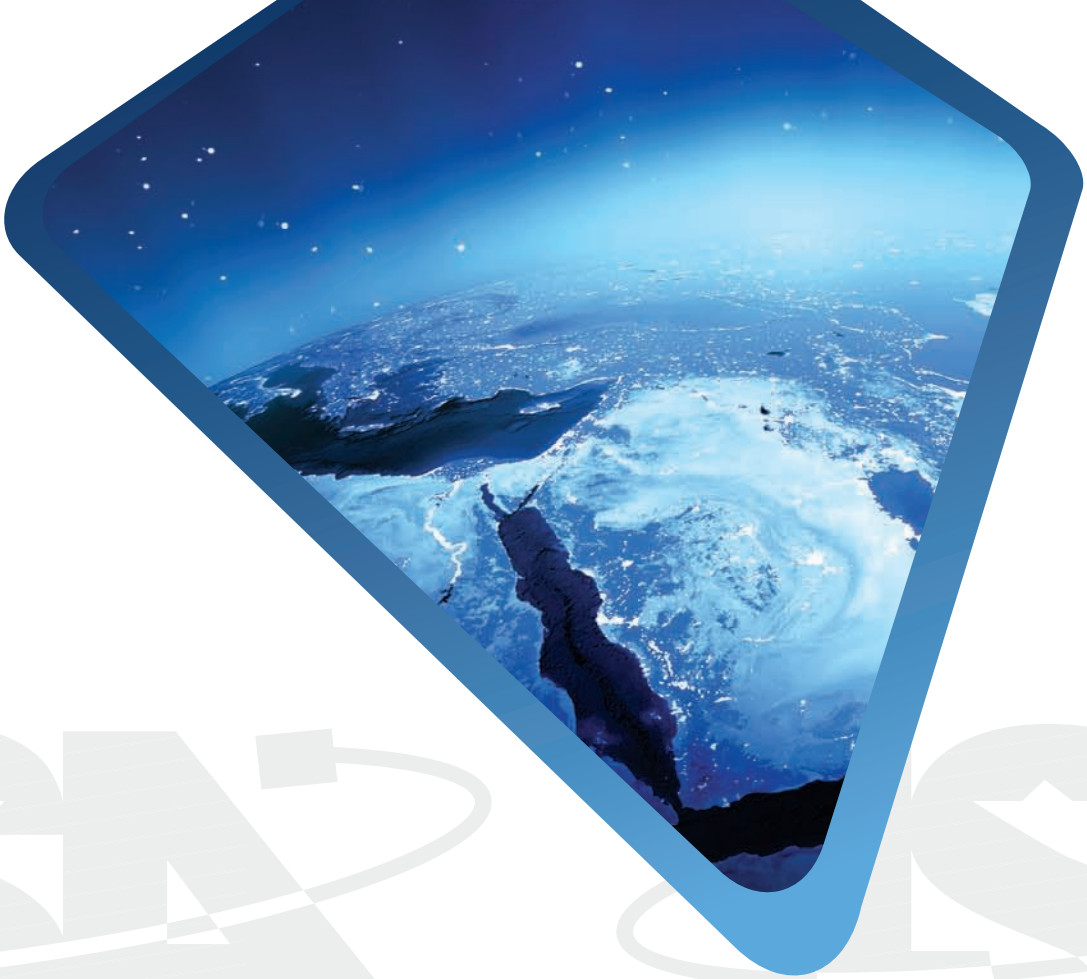
- Expanding its bilateral and multilateral cooperation in space
- Leading the global trend of miniaturization of space systems
- Establishing technologically advanced, national capabilities in areas in which Israel is relatively leading, especially remote sensing and micro-satellites, including developing the means of launching them into space
- Supporting community outreach and increasing public awareness, especially youth awareness

Israel's Space Activity: Background

Israel has a long and successful legacy in space, having developed robust and competitive space industries and applications.

Israel's space program was established in the early 1980s. Israel's prime target was, and still is, to continue building an extensive space infrastructure. Originally motivated by national-security needs and lack of resources, Israel is focused on miniaturization and developing national capabilities in the area of lightweight, small satellites of high resolution, remote sensing and communications, a field in which it is acknowledged as a world leader.

Based on this technological know-how, several Israeli groups are currently developing micro-satellites and nano-satellites for demonstrating and validating new technologies and technology spin-offs. An additional outcome of these activities is educational public outreach, inspiring young people to pursue their futures in the business of space.



Professor Yuval Neeman, the founder of ISA and its first chairman (1983-2005), was an elementary particle physicist who became one of the pioneering scientists in space research and astronomy in Israel. He established the Physics and Astronomy Department at Tel Aviv University, as well as the Institute for Space Research and the Observatory in Mitzpe Ramon. Professor Neeman served as Minister of Science from 1982 to 1984 and from 1990 to 1992.

A New National Civil Space Policy: 2012

In the last few years, Israel's space community underwent a long and comprehensive process of reevaluating its space-related objectives and policies. In November 2009, President Shimon Peres and Prime Minister Benjamin Netanyahu appointed a task force headed by Mr. Menachem Greenblum, Director General of the Ministry of Science and Technology, and Professor Isaac Ben Israel, Chairman of Israel's Space Agency. The purpose of the task force was to examine Israel's space program and recommend a framework for a new national space program.

The main objective of the task force was to focus on civil and scientific applications that would allow Israel to develop a greater industrial scale and competitive edge in the growing, global space market. The recommendations of the task force were adopted and implemented in 2012.

The main recommendations of the task force:

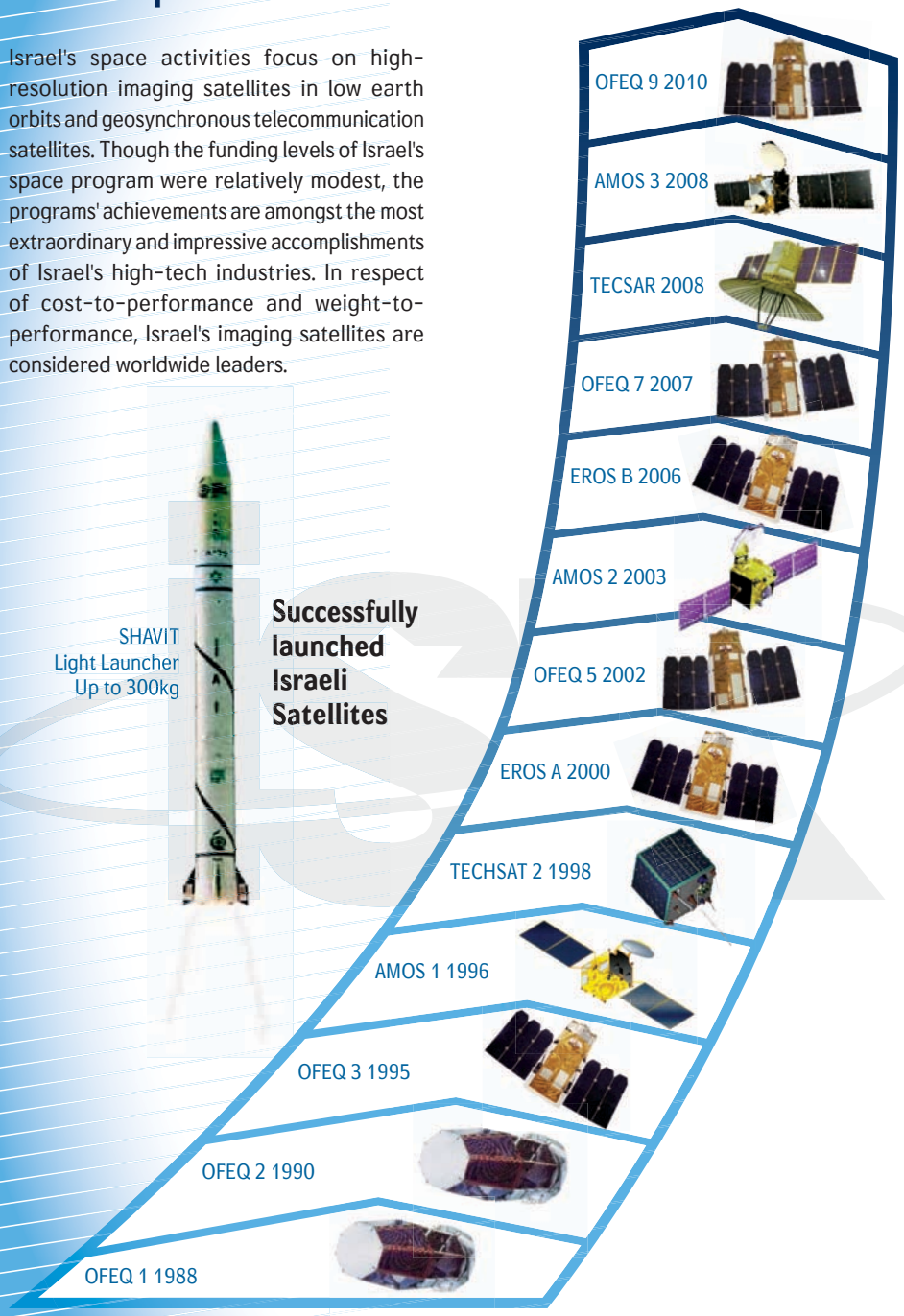
- Maintaining an Israeli presence in space for scientific, national and commercial uses.
- Ensuring that Israel is among the top five leading countries in the community of nations engaged in space science and space research technologies, in areas in which Israel has relative advantages.
- Significantly expanding local industries' competitiveness, and increasing the revenues of the global space market.
- Expanding Israel's bilateral and multilateral cooperation in space in order to provide business opportunities, upgrade foreign relations between partner countries in space science and exploration, and encourage the peaceful use of outer space for the benefit of the human race.
- Improving Israeli knowledge and upgrading its industrial infrastructure in R&D areas that are suggested for funding, such as: satellite miniaturization, remote sensing and communication; as well as in fundamental, basic and applied research.
- Strengthening the interrelationship between space research and applications, and Israeli society.

Israel's Space Activities and Assets

Israel's space activities focus on high-resolution imaging satellites in low earth orbits and geosynchronous telecommunication satellites. Though the funding levels of Israel's space program were relatively modest, the programs' achievements are amongst the most extraordinary and impressive accomplishments of Israel's high-tech industries. In respect of cost-to-performance and weight-to-performance, Israel's imaging satellites are considered worldwide leaders.

SHAVIT
Light Launcher
Up to 300kg

Successfully launched Israeli Satellites



Israel Space Agency's International Relations

As a long-standing spacefaring nation, Israel policy is that cooperation in space is an efficient means of contributing to and promoting global progress.

Israel is also motivated to engage in international cooperation in space to leverage the budgets allocated for space R&D and allow Israel to manifest its relative strengths (especially in miniaturization), provides business opportunities and upgrades foreign relations between partner countries.

Moreover, Israel believes that collaboration between countries presents an excellent opportunity to learn and assimilate diverse experiences, methodologies and standards. It enables us to better understand cultural nuances, and opens the door to further understanding and tolerance between peoples and nations.

Israel looks forward to cooperating with all spacefaring nations including countries with emerging space programs, which share the passion and dedication for space science, exploration, and the peaceful usage of outer space for the benefit of the human race.

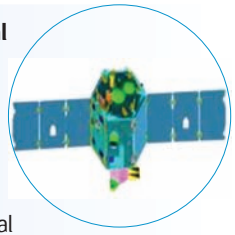
Israel is open to the exchange of ideas, and is interested in jointly cooperating on issues such as space systems and sub-systems, the ground segment, space exploration and space science.

Shimon Peres, President of the State of Israel

"Space, is the bridge between countries"

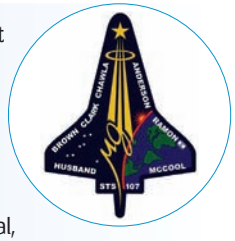
International Cooperation: Noteworthy Projects

Israel is part of numerous significant projects that require extensive international cooperation with space programs around the world.



The **VENμS Project:** a joint project with the French Space Agency – **Centre national d'études spatiales** (CNES). The project involves joint development and cooperation in launching the Vegetation and Environment Monitoring New Micro-Satellite (VENμS) Mission. The project was mutually initiated by ISA and French Space Agency (CNES), and a Memorandum of Understanding (MOU) was signed in 2005. The scientific objective of VENμS is to provide data for scientific studies that focus on how to monitor, analyze and model land surfaces, given the influences of environmental factors and human activities. To accomplish this objective, VENμS will take high resolution and super-spectral images of predefined sites of interest on the surface of the Earth every two days. The technological objective of VENμS is to demonstrate technology and test hardware (specifically, electrical propulsion systems) in order to display accurate autonomous orbit control. The VENμS platform is being jointly built by Israel Aerospace Industries (IAI) and Rafael, while the Israeli company Elbit Systems Electro-optics – Elop was selected by CNES to develop the electro-optical payload. The scientific missions of the project were defined and will be conducted by Ben-Gurion University and the Center for Biosphere Studies from Space in France.

The **SHALOM Project:** a joint project with the Italian Space Agency – **Agenzia Spaziale Italiana** (ASI). The project involves hyperspectral satellites, to be mutually developed, manufactured, launched and operated for the purpose of advancing interpreting services that will be provided by the Israeli and Italian industries. The first stage of the project is aimed at launching a hyperspectral satellite operative in the VIS/NIR/SWIR range, the spatial resolution of which is 10 meters. Additionally, an air-borne hyperspectral demonstrator, which is operative in the range of thermal infrared, is also to be developed in the first stage of the project. Based on the results of the flight tests of this demonstrator, both parties will make a decision with regard to continuing to the second stage: developing and launching a hyperspectral satellite that is operative in the thermal range. Phase A of the project was initiated in April 2012.

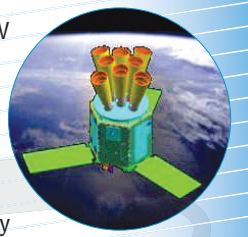


The **MEIDEX** (Mediterranean Israel Dust Experiment) **Project:** a joint project with the National Aeronautics and Space Administration (**NASA**) that studies the Mediterranean region and its influence on the weather and climate. In particular, the study focused on the transport of mineral dust in the atmosphere over the Mediterranean Sea and the tropical Atlantic Ocean. The project included remote as well as in situ measurements of light scattering by desert aerosol particles in six wavelengths starting from near UV to solar IR. A large number of international, scientific collaborations had been set up in the context of this experiment. The experiment was one of the main missions of Israel's Astronaut Col. Ilan Ramon, and was carried out on the NASA STS-107 Columbia Shuttle Mission in January 2003.

Leading Satellite and Science Projects

The following is an overview of Israel's future leading science projects in space:

SAMSON – Space Autonomous Mission of Swarming & geolocating Nano-Satellites: a project conducted by the Asher Space Research Institute (ASRI) of the Technion, which will include three nano-satellites in formation flying in a mission to demonstrate high precision geo-location of civilian signals from the ground, e.g., for rescue purposes. The project is expected to launch in 2015.
SAMSON will demonstrate and implement Technion-developed formation-flying algorithms using an innovative nano-satellite propulsion system. Based on Technion student projects, it will be designed and built by Technion students with significant contributions from partners in the industry, namely, Israel Aerospace Industries (IAI), RAFAEL Advanced Defense Systems Ltd., Elbit Systems Ltd. and SPACEALIST Ltd.



LIMSAT – Less is More: a small space mission designed to carry out a wide-filed UV transient survey. The project is being implemented by the Weizmann Institute of Science, Israel Aircraft Industries (IAI) and Elbit Systems Electro-optics – Elop in collaboration with NASA AMES and CALTECH. It brings together academia, industry and government.
LIMSAT will be injected into a Low Earth Orbit using a low-cost platform with SB-SAT terminal, carrying a UV camera payload to detect and locate low energy X-ray bursts as precursors for supernova events, and to examine their time evolvement in the UV spectrum.

Space IL: a project aims to successfully launch, fly and land a robotic spacecraft on the moon, operate the spacecraft across the lunar surface, and transmit video, images, and data back to Earth. The spacecraft of choice is a micro-satellite carrying the Israeli flag. Through this project, Israel would become the third nation to land on the Moon.
Space IL is a non-profit organization established by a multidisciplinary team of Israeli space enthusiasts to compete with privately-funded space teams in the Google Lunar X Prize. The Google Lunar X Prize is a global race of lunar exploration, offering the largest international incentive prize of all time: a total of $30 million.
The Space IL team consists of over 100 staff members including Israel's most revered space experts. The Space IL team is driven to advance Israel's scientific and technological fields and reinvigorate Israel as a start-up nation, by undertaking a challenging task that will ignite the imagination of the country's young generation. Space IL is determined to push ingenuity further than ever before.

Leading Satellite and Science Projects

Inklajn1: a joint venture of Israel's Nano-Satellite Association (INSA), Israel Aerospace Industries (IAI) and Israel's Amateur Radio Club (IARC), will be a test platform for CubeSat, a type of nano-satellite that is very small size and weighs no more than 10 kilograms. The CubeSat standard was developed at California Polytechnic University (CalPoly) and Stanford University in 1999, to enable universities worldwide to design and build research satellites for space science and exploration.

Inklajn1 is designed to validate new hardware for space usage, thus leveraging this educational platform for commercial use. Among the new hardware tested on this satellite one might find electronic power distribution combined with deployable solar panels (providing up to four times more energy), new batteries, satellite control algorithms, a new small GPS and an atomic clock.

The goal of the satellite is to space-prove this low-cost hardware, which can be later used for large-scale satellites, by testing it in space for a long duration – thus reducing the risk involved in integrating this new hardware and software for the first time.

This satellite also provides an educational platform for high school students studying at the Herzliya Science Center in Herzliya, Israel. The Herzliya Science Center's space educational program is fully integrated with the program, including satellite design and testing.

Professor Yuval Neeman, the founder of ISA and its first chairman:

> "Israel does not have natural resources. Therefore, the essence of its economy, social development and – most of all – security needs, derive from its only resource: highly qualified manpower in science and technology. No wonder we have joined the 'club' of spacefaring nations by taking action."

An Israeli Astronaut

In the mid-1990s, as part of a cooperation agreement between the Israel Space Agency and NASA, it was decided to send an Israeli astronaut on a NASA mission. Colonel Ilan Ramon was chosen to be the first of Israel's astronauts to go to space, opening the door for others after him.

Ramon went into space aboard the Space Shuttle Columbia on STS-107, in 2003. During his two weeks in space, he performed a number of scientific experiments, including Israeli experiments. Most of the findings, which were delivered before the loss of the shuttle, contributed directly to technological innovation and scientific progress.

Ramon's participation in the NASA mission symbolized, in a profound way, the closeness between NASA and ISA. In addition, Ramon was a source of excitement and inspiration for the Israeli people.

Colonel Ilan Ramon

Israel's first astronaut, Colonel Ilan Ramon, was lost on the STS-107 NASA Columbia tragedy on February 1, 2003, together with the mission's crew members:

- Rick D. Husband, Commander
- William C. McCool, Pilot
- Michael P. Anderson, Payload Commander
- David M. Brown, Mission Specialist 1
- Kalpana Chawla, Mission Specialist 2
- Laurel Blair Salton Clark, Mission Specialist 4

Ilan Ramon International annual Space Conference

The Ilan Ramon annual International Space Conference is a living tribute to Israel's first astronaut, the late Colonel Ilan Ramon, and the entire STS-107 crew.
Since 2006, the conference is held annually in conjunction with the Fisher Brothers Institute for Air & Space Strategic Studies. The conference is the main event that brings together Israel's space community and international peers, drawing global prominent and distinguished scientists, heads of space agencies, space industries and many others.

Israel: A Start-Up Nation

Israel is a leader of R&D and high-tech, with global technological innovations and advancements, scientific discoveries in all of its diversity, and internationally recognized universities and research centers.

A national space program fits well with Israel's ethos of being a knowledge-based society, rooted in innovation and entrepreneurship. Technology and innovation have been primary catalysts of Israel's economy from the early days of the state. The acknowledgment that Israel will always remain quantitatively disadvantaged (compared to its neighbors) pushed Israeli decision-makers to base Israel's national security concepts and national economy on the principle of "quality over quantity," giving foremost priority to science and technology. National investments in science and technology have thus been perceived as central factors in the power balance equation between Israel and neighboring Arab countries. For this reason, Israel has invested significant effort over the years to promote scientific research and technological know-how, including space.

In the last few decades, Israel was graded globally at the list the top of in scientific, space and physics publications, especially for its excellent quality, originality and applicability.

Israel has seven research universities with applicable results and implementation: The Weizmann Institute of Science, Tel Aviv University, the Technion – Israel Institute of Technology, Ben-Gurion University of the Negev, the Hebrew University of Jerusalem, Haifa University and Bar-Ilan University.

Shimon Peres, President of the State of Israel

"In the past, we had a pioneer of land; now we need a pioneer of science…. I see Ilan as an excellent pioneer of science."

Areas of Space Research & Development in Israel

Space Activites in Israel – Science

Geophysics & planetary sciences

- Astronomy
- Astrophysics
- Astrodynamics
- Cosmology
- Planetary studies
- Comet & Asteroid studies
- Interplanetary dust
- Plasma physics
- General relativity
- Atmospheric studies, Meteorology, climatology and Ionosphere studies

Life Sciences

- Biology in zero-gravity
- Organic molecule formation in space
- Beginning of life in the universe

Geo Science

- Earth resource studies
- Arid zone research
- Environmental studies
- Geodynamics

Space Activites in Israel – Technolgy

Space Segment-bus

- Design
- Structure
- Materials for space
- Thermal design and control
- Energy
- Solar panels
- Communication
- Propulsion
- Satellite trajectories
- Stabilization, Attitude and Orbital Control
- Navigation
- Nano Satellites & Nano Constellations

Payloads

- Earth & Deep Space Observation
- Electro-optical (UV, Vis, VNIR, IR) high resolution panchromatic, multispectral, superspectral & hyperspectral imaging systems
- SAR high resolution imaging systems
- Detectors
- Telecommunication: digital payloads

Ground Segment

- Mission planning
- Tasking, Command & Control
- Tracking, Telemetry & Communication
- In orbit house-keeping
- Data reception, processing, exploitation & dissemination

Launch

- Launcher carrier
- Multi-stage launcher
- Guidance & control
- Propulsion
- Materials.

Space Activites in Israel – Commercial services, Value added products & applications

Communication services

- Satellite communication data relay services
- Ground communication networks & services

Geo- Spatial information services

- Commercial Remote Sensing Services (CRSS)
- Imagery exploitation tools and services
- Mapping (Cartography, Photogrammetry, GIS & Visualization) tools and services

Community Outreach

The Ministry of Science and Technology supports several community outreach initiatives, commemorating Col. Ilan Ramon.

One of ISA's missions is to increase awareness among Israeli youth with regard to the importance of space exploration and space technology, in order to encourage future specialization in the exact sciences. Consequently, ISA makes a special effort to interest the Israeli public in space science and technology, especially youngsters. It supports various community outreach projects.

In addition, the Ministry supports a variety of activities to commemorate Ilan Ramon. Among those activities: The Ramon Doctoral and Post-Doctoral Scholarship, the International Space University Summer Program Scholarship for Students, Ramon's Breakthrough Competition for Young Entrepreneurs, Ramon's Award for Excellence, Volunteering and Leadership for High School Students, and other competitions and exhibitions.

Ilan Ramon, First Israeli Astranaut

"Children and youth are drawn to the space being far away, not clear, completely different from life on Earth, difficult to achieve, stimulates the imagination and unknown. Who of us isn't drawn to the unknown?.... children and youth are the future of development and progress in space research, mainly because they are open to new ideas, creative and are not captivated in prejudices. That's why they are so important to our future in space."

Israel's Space Agency Staff

Professor Isaac Ben Israel, ISA Chairman

Professor Ben Israel studied mathematics, physics and philosophy at Tel Aviv University. As Major General, Professor Ben Israel served as the director of the Defense R&D Directorate in the IMOD (Israel Ministry of Defense) between 1998 and 2002. In 2002, Professor Ben Israel joined Tel Aviv University, where he heads the graduate program for security studies. He was a member of the 17th Knesset (Parliament) between June 2007 and February 2009.

Menachem Kidron, ISA Director General

Menachem Kidron obtained a degree in chemical engineering at the Technion – Israel Institute of Technology. He has held a number of positions at Rafael Advanced Defense Systems Ltd., including: Director General of the Space Directorate, Executive VP and Director General of the Manor Technologies Division, Head of the Manor Directorate, Director of propulsion systems, system engineer of solid rockets motors, section head for R&D of propellants for solid rocket motors, and engineer for R&D of solid rockets motors. Mr. Kidron has taken a sabbatical at Stanford University, California and City University, New York.

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