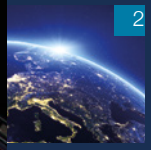
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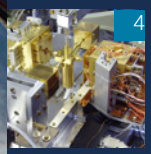
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THE FUTURA MISSION: DOING RESEARCH IN SPACE

Samantha Cristoforetti on the International Space Station

By the editorial staff in collaboration with the Italian Space Agency

On 23 November 2014 at 22:01 (Italian time) the Soyuz Expedition 42/43 launched. This was the start of FUTURA, the second long-term mission of the Italian Space Agency (ASI), involving Samantha Cristoforetti, European Space Agency (ESA) astronaut, and Captain in the Italian Air Force.

Born in 1977 and brought up in Malè in Val di Sole, Samantha is on board the International Space Station (ISS) as a Flight Engineer in the crew of the ISS 42/43 expedition. A Captain in the Italian Air Force, with over 500 hours of active flight time on six types of military aircraft, for this mission Samantha trained in the use of the ISS systems and the Russian Soyuz space shuttle, in robotics and in extra-vehicular activities, at the various training centers in the United States, Russia, Canada and Japan. Her travel companions on the Soyuz are the American Terry Virts and the Russian Anton Shkaplerov.

The FUTURA mission, assigned to the ASI by NASA, is the fruit of a collaboration between the ASI and ESA. It is the first mission for Samantha Cristoforetti, who has become the first Italian woman in space, and the seventh Italian astronaut to go into space, following Franco Malerba, Umberto Guidoni, Maurizio Cheli, Roberto Vittori, Paolo Nespoli and Luca Parmitano.

An astronaut, a researcher, and always willing to interact with space enthusiasts (on Twitter, as @AstroSamantha, and on the website Avamposto42), Samantha has become "the girl next door" who talks to us from space. But we should not forget that she is also a researcher in an exceptional scientific laboratory, the Space Station.

The FUTURA mission has a rich program of scientific research, using microgravity conditions to conduct experiments that are expected to produce benefits in terms of knowledge and technological innovation.

For this mission the ASI selected and developed nine Italian scientific and technological research projects to be undertaken during Samantha Cristoforetti's stay on board the Space Station, along with another project that is already underway on the Station, and has been collecting data for over three years.

The projects have been devised by Italian universities, research institutes, large companies and SMEs.

Five projects focus on various aspects of human physiology in conditions of weightlessness, and two will carry out biological analyses of cell samples in microgravity. The astronauts on board will also test a demonstrator for an automatic manufacturing process for the realization of 3D objects in zero gravity (3D printing), and a multifunction capsule machine for hot drinks, including real Italian espresso coffee.

FOR MORE INFORMATION

The experiments on the International Space Station
http://www.asi.it/it/news/gli_esperimenti_di_samantha

Vanessa Ravagni
is head of the Scientific Research and Technology Transfer Division of the University of Trento

SPACE RESEARCH TO IMPROVE THE QUALITY OF LIFE

From the European Mars missions to the space economy to technology transfer from space to Earth and from Earth to space. We talk with the president of the Italian Space Agency.

Vanessa Ravagni interviews Roberto Battiston, President of the Italian Space Agency.

President of the Italian Space Agency (ASI) since May 2014, Roberto Battison has for many years been involved in research in astrophysics and the physics of elementary particles in space. He is a full professor in the Department of Physics at the University of Trento, was formerly president of the Astroparticle Physics Commission of the Italian National Institute of Nuclear Physics (INFN), and was one of the people behind the establishment of the Trento Institute for Fundamental Physics and Applications (TIFPA).

Professor Battiston, space research seems to be going through a renaissance; it seems that everyone wants to invest in this field. Can you explain why this is?

An incredible number of things in our everyday lives depend on space: telecommunications, monitoring of the atmosphere and of the earth, and emergency management, just to name a few. Space is a synonym for progress, for improving the quality of life. Not investing in space means not believing in the future.

As president of the ASI, can you tell us what Italy's role is within international space research?

Italy plays a fundamental role in the international space scene as the third contributor to ESA (the European Space Agency), after France and Germany, and before Britain. In addition, it has close collaborative relationships with NASA and with emerging space programs, such as that of China.

What are the main projects that the Italian Space Agency is working on?

The ASI is involved in scientific research with the instrumentation that ESA launches into space, both to observe the Universe and to observe the Earth. These are programs that often last more than ten years, but that allow us to go beyond the current limits of our knowledge in sectors from astrophysics to planetology, cosmology, or the study of planetary systems belonging to other stars.

The recent Ministerial Council meeting in December 2014 approved three large projects in which Italy plays an important role: the new European launchers, including the Italian-made Vega-C; the extension of the Space Station to 2020; and the completion of two European missions that will land on Mars, the ExoMars project.

Can the research carried out for space exploration also have applications on Earth? Can it improve the quality of our lives?

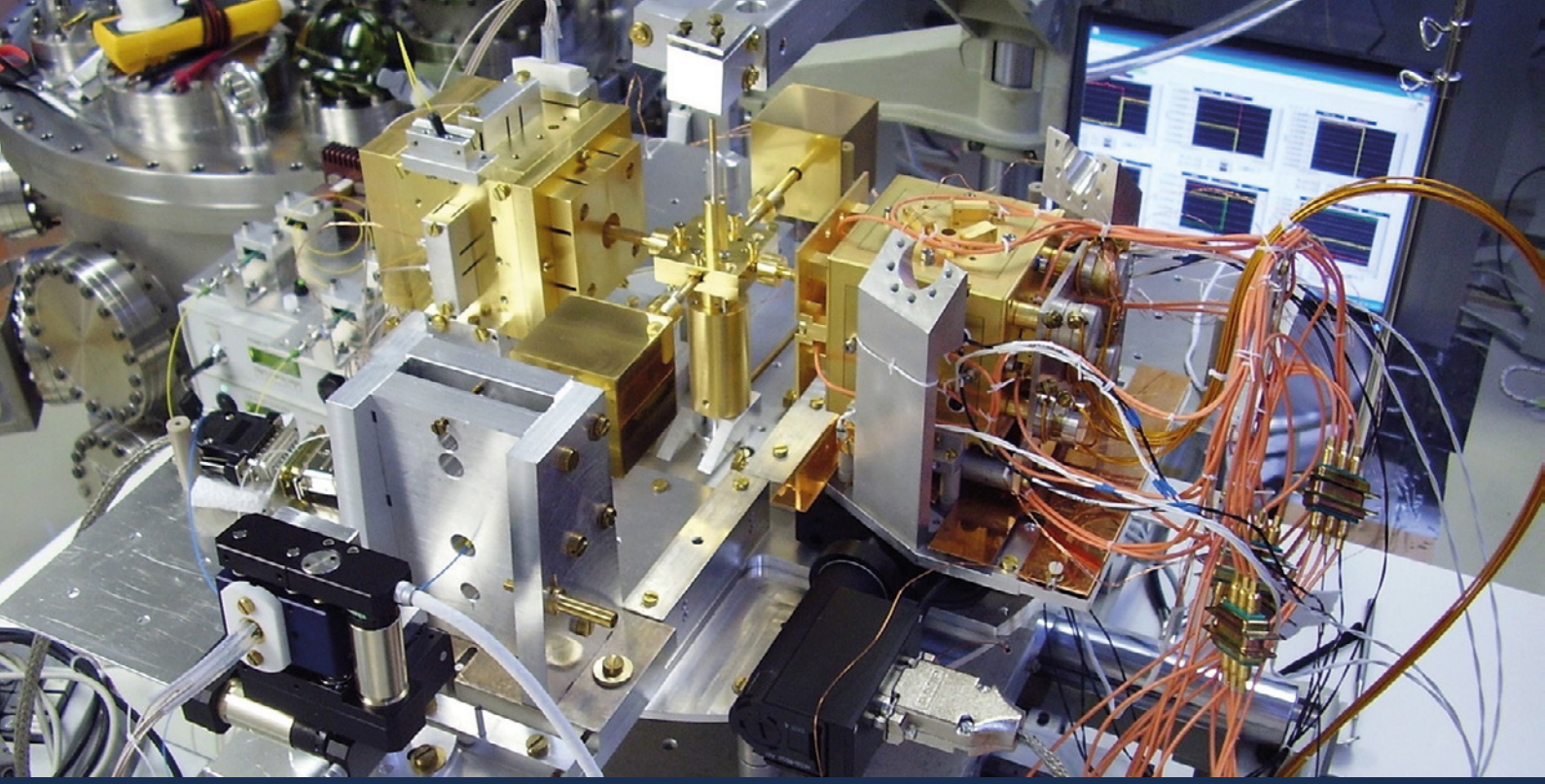
Space touches our daily lives in ways that we often don't even notice: satellite navigation is in everyday use, weather forecasts are increasingly accurate, and satellite observations of Earth offer countless applications, from protection against landslides to border controls, from supporting civil defense in emergency situations to the management of agricultural land. The study of climate change at both local and global levels would not be possible without satellite observations. All this contributes to improving the quality of life, helping us to manage and to mitigate the impact of humans on the planet.

Do you think there are real opportunities for researchers and companies to engage in technology transfer in this sector?

There is no doubt that space is a great opportunity for both research and business, both to develop the 'space economy' and to transfer to/from space those technologies that are useful for everyday life. An example of transfer from Earth to space is 3D printer technology, which could revolutionize the building of structures in space or on other planets. In contrast, an example of transfer of technology from space to Earth concerns techniques for treating diseases such as osteoporosis, through particular medicines and types of exercise.

FOR MORE INFORMATION

Italian Space Agency
http://www.asi.it/



LISTENING TO THE UNIVERSE THROUGH GRAVITATIONAL WAVES

The University of Trento's contribution to the LISA Pathfinder space mission. Launch date set for October 2.

by Stefano Vitale

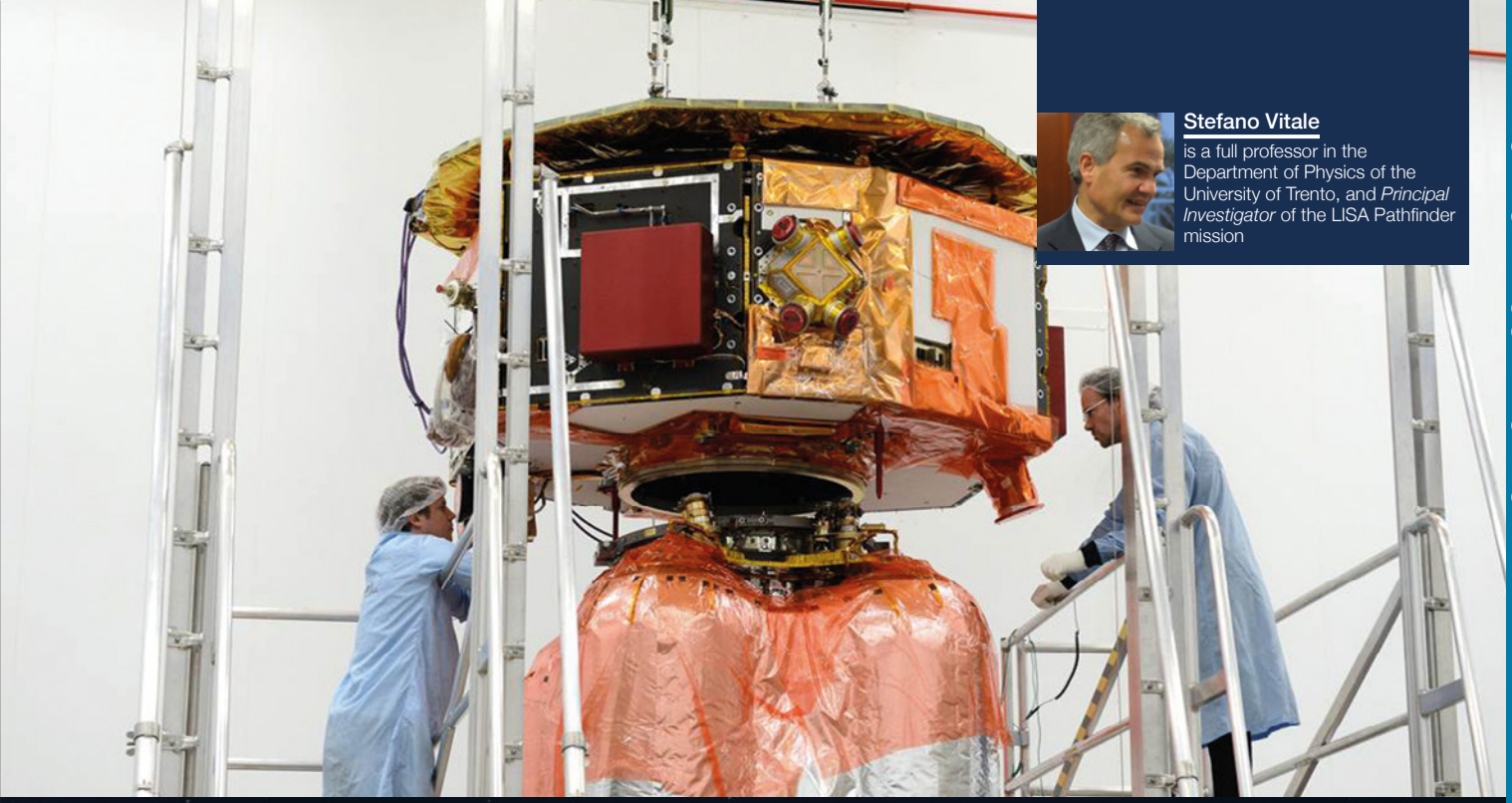
The force of gravity dominates the Universe. The motion of stars and galaxies, and the great cosmic cataclysms such as the Big Bang or black holes, where space and time disappear, are phenomena that are due to, or dominated by, gravity. Gravity acts at great distances. Although greatly lessened by distance, the gravity produced by very distant celestial bodies has an effect on us.

In particular, what reaches us, as a very weak quivering, travelling at the speed of light, are the violent changes in gravity due to the motion, equally violent, of large celestial bodies such as stars or even galaxies. These small vibrations of gravity, gravitational waves, were predicted by Einstein, and there have been indirect observations of the emissions of several celestial systems. However, these are so weak that we have not yet been able to detect them with any human-made instruments, despite the amount of effort and resources that have been applied.

Gravitational waves are the ideal messenger for observing the Universe. They pass undisturbed through any form of matter or energy; they are emitted by all bodies, visible or obscured; and they record the motion of these bodies and bring this information to us from the most remote depths of the Universe.

We can compare them to sound; they come from sources hidden behind other objects, like the sound of animals hidden in a forest, and they allow us to detect them, recognize them, estimate their distance and follow their movement. They come from sources that do not emit light, like sounds at night. **Listening to the Universe through gravitational waves promises a profound revolution in astrophysics, astronomy and cosmology, like those caused by the invention of the telescope or the radiotelescope.**

The principle of detection of gravitational waves is relatively simple. The waves exert gravitational forces in the form of a "tide". They behave like the gravity of the Moon, which pulls a little more on the parts of the Earth that are nearer, and a little less on those that are further away, giving the planet that characteristic 'rugby ball' deformation that we call a "tide". Gravitational waves tend to give any body a similar deformation, although much smaller, and oscillating in time with periods ranging from a fraction of a second to an hour, so considerably shorter than the six hours of the Earth tides. To detect gravitational waves, we need two bodies with a great distance between them (the greater the distance the better), such as two distant parts of the Earth. We then need to measure very precisely any variations in the distance between them.



Stefano Vitale
is a full professor in the Department of Physics of the University of Trento, and *Principal Investigator* of the LISA Pathfinder mission

In the space-borne detector we discuss below, the particles are two cubes of gold-platinum, weighing 2 kg each, and placed 1 million kilometers apart. The variations in this distance, due to gravitational waves, are expected to be tens of billionths of a millimeter.

Large terrestrial observatories have been developed over many years through international collaborations in Europe, the United States, and Japan. The most advanced is opening this year. **An important space-borne observatory, known as LISA, or more recently eLISA, orbiting around the Sun, has been in development for a number of years** by the European Space Agency (ESA). This will be the third in the series of important space missions planned by ESA. This year ESA will launch the LISA Pathfinder mission, developed over the last ten years, which aims to test in space the sophisticated instrumentation necessary for the observatory.

The mission was conceived by the team at the Experimental Gravitation Laboratory of the University of Trento, together with colleagues from the Max Planck Institute in Hannover. Trento also designed and guided the industrial development of an essential part of the instrumentation, the inertial sensors. These sensors constitute a sophisticated system whose principal aim is to suspend the above-mentioned two cubes of gold-platinum inside the satellites, first the LISA Pathfinder satellite, and then the eLISA satellite. They must be suspended so that they have no contact with the rest of the satellite, and their relative motion should be affected only by gravitational waves. To give a better idea, any force greater than a hundred billionths of a billionth of the weight that these two cubes would have on Earth, approximately the weight of a bacterium, would be an appreciable disturbance for LISA Pathfinder.

The role of Trento, carried out with the financial support of both the INFN, now represented in Trento by TIPFA, and the ASI, has earned the head of the laboratory the role of Principal Investigator of the entire mission.

LISA Pathfinder's launch date is scheduled for 2 October. The Trento scientists are working frenetically on the last tests and last operations before the launch. They are working even more intensely on the preparation of the operations of the mission itself, which will start next spring, after two months for the satellite to reach its interplanetary orbit, and will last around six months.

In contrast to what usually happens on scientific missions, for the LISA Pathfinder operations, given the great sophistication of the instrumentation, the Principal Investigator's team will be based at the Science Operation Center. The operations themselves have been designed in a collaboration between the scientific team, including ESA, the Trento group, and some tens of institutes in 7 countries in Europe, and in the United States.

If all goes well, at the end of the operations work will begin on the realization of eLISA, the era of gravitational astronomy will have begun, and we will finally be able to hear the concert of the sounds of the Universe. Stay tuned!

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REMOTE SENSING AND RADAR: FROM PLANETARY EXPLORATION TO EARTH OBSERVATION

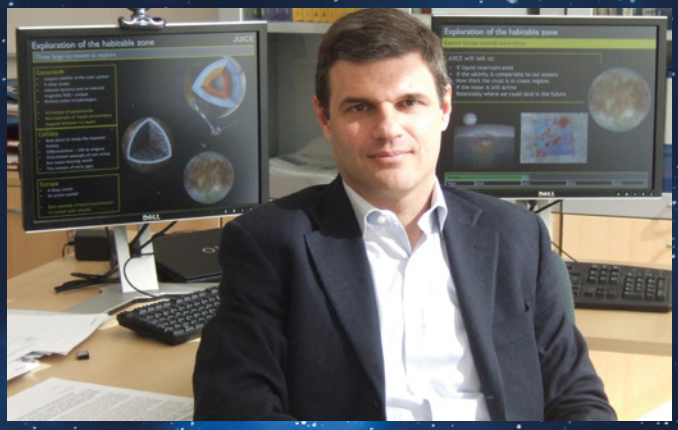
From the search for life in space to the monitoring of the environment, of natural resources and of anthropic activity on Earth. The research activity of the university's Remote Sensing Laboratory.

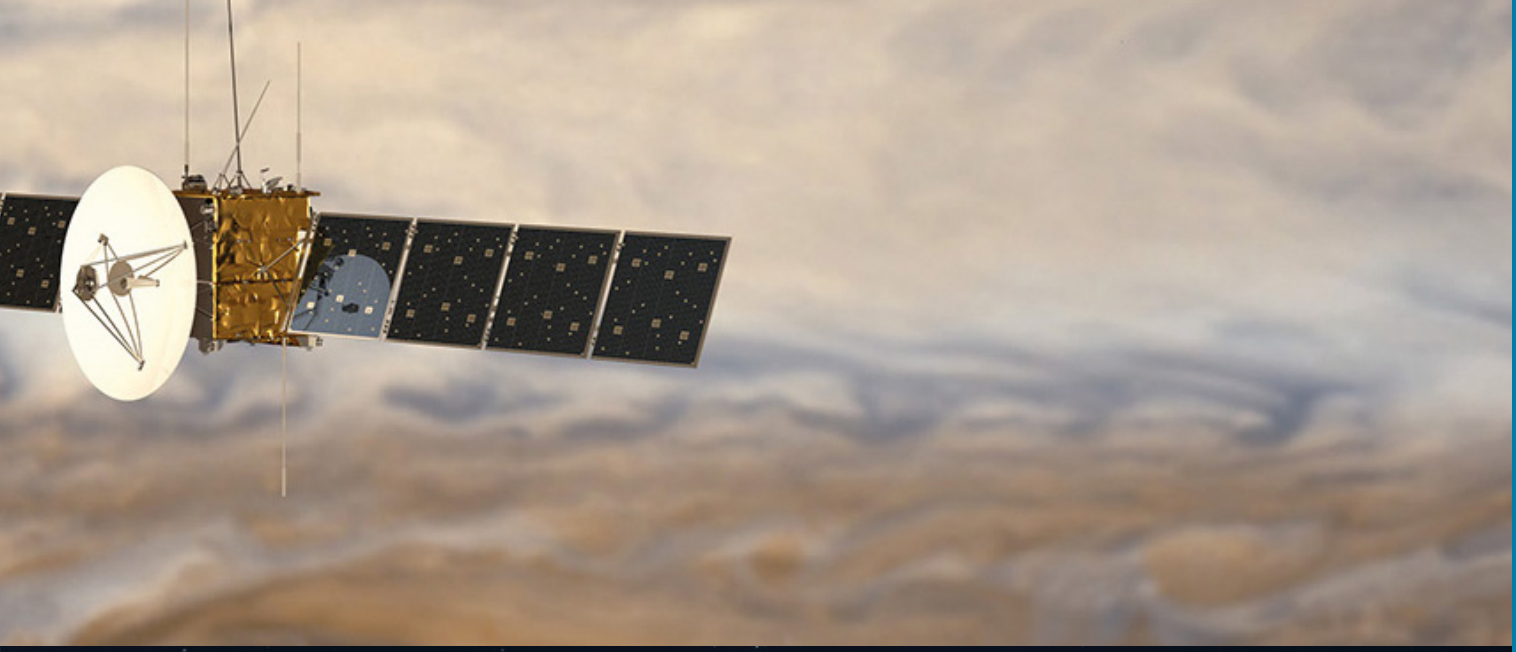
Paola Fusi interviews Lorenzo Bruzzone

The Remote Sensing Laboratory (RSLab) of the Department of Information Engineering and Computer Science (DISI) of the University of Trento has carried out research activity on space technology and systems since 1999. These activities focus on remote sensing and radar systems, addressing both missions for Solar System exploration and Earth Observation. The laboratory, directed by Lorenzo Bruzzone, full professor of Telecommunications at DISI, has attained a high level of international visibility both for the results and the high level of scientific recognition it has achieved, as well as for its leadership in major international projects and in space missions.

In the context of Solar System exploration, Prof. Bruzzone is the Principal Investigator of the space radar RIME (Radar for Icy Moon Exploration), which is one of the most important payloads of the European Space Agency's (ESA) JUICE mission to search for traces of life on the icy moons of Jupiter. RIME will have the capability to measure from space what is happening beneath the surface of the icy moons, up to a depth of around 9 kilometers. RIME will be built in Italy with some of its subsystems supplied by NASA's Jet Propulsion Laboratory.

In the area of Earth Observation, RSLab plays a major role in a large number of international projects aimed at developing innovative systems and automatic data analysis techniques for information extraction from the huge quantity of data produced by the large network of satellites that orbit the planet. Among the most important activities we mention RSLab's major role in ESA's Big Data initiatives, and the various projects on the development of next-generation systems for emergency management (e.g. for earthquakes and floods) and for environmental monitoring.





Professor Bruzzone, what does your research involve?

Our research focuses on developing remote sensing and radar systems and the related techniques for the automatic extraction of information from the data. The technology can be used in different ways: the sensors can be mounted either on satellites travelling through the solar system to study the planets and other celestial bodies, or on satellites that remain in orbit around the Earth and allow us to observe our planet.

The remote sensing and radar instruments currently available can acquire images from space (at a distance of hundreds of kilometers) with a level of detail in the order of tens of centimeters. This allows us to deal with problems related to environmental monitoring, land monitoring and the analysis of anthropic activities at both global and local scales.

Who are the people involved?

This work involves researchers (at various levels), along with PhD students, and researchers from other universities, who often spend periods as visiting scientists at our laboratories. There is also a close collaboration with Fondazione Bruno Kessler (FBK).

What are your goals for the next few years?

We have several goals. On the planetary exploration side, the next few years will be crucial as we will be developing RIME, which needs to be ready in 2020 so that it can then be launched towards the Jovian system in 2022. Studies on other radars for the exploration of the solar system are in progress, and these could result in the participation to new missions. On the Earth Observation side, the challenge is to define and develop new systems to better exploit the huge amount of data provided by the satellites currently in orbit, and to integrate these data with those acquired by aerial and UAV sensors to define new services.

How do you think these issues will have an effect on everyday life, or on businesses?

This is not a niche activity. The benefits of our research are immediate and very concrete, and they affect also the Trentino region. In fact, in collaboration with the Autonomous Province of Trento, we are developing pilot projects for services based on aerial/satellite remote sensing to support the mapping and management of forests, the monitoring of crops, and the mapping of snow cover. Such projects open the way to a new generation of tools for land management and monitoring, capable to regularly provide very detailed information on a large scale. Thus the space research is at the service of the most concrete needs of public authorities and citizens.

Do you collaborate with partners or companies on these issues?

Our main partners are the space agencies (in particular ESA, ASI and NASA), with which we have various collaboration activities. At ESA we also have important roles in prestigious scientific Advisory Boards. Then there are partnerships with universities, research centers and the main international companies in the sector. Working with companies is essential to transform the research output into innovative services.

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THE STUDY OF COMETS AND THE ORIGIN OF LIFE

The University of Trento's contribution to the Rosetta Mission

by Mariolino De Cecco

I've been involved in the Rosetta Mission since my PhD studies. My experience is not really a typical example as usually universities deal with the 'concept' side, while companies in the aerospace sector develop the hardware for the flight. In our case we designed, assembled, and tested both the qualification and the flight prototypes.

This applied research and technological transfer project initially involved a group of researchers at the University of Padua, and then my part of the project continued at the University of Trento. Since I've been at the University of Trento, **I've been working on updating the software for the calibration and verification of the shutter mechanism. This is the real heart of both telescopes that make up OSIRIS**, which is the main experiment of Rosetta, and consists of two telescopes, a wide-field telescope to observe the coma of the comet, and a narrow-field telescope to observe the nucleus. The OSIRIS experiment also saw the involvement of a medium-sized Italian company, Lika Electronics, in the production of components (high resolution optical encoders) that previously were made only in the United States, in France or in Japan.

What is Rosetta? Defined as a 'cornerstone mission', Rosetta is one of the most ambitious undertakings of the European Space Agency (ESA). **The objective of the mission is to reveal the many mysteries that still surround comets**, in the same way that the Rosetta stone, thanks to the French archeologist Champollion, allowed us to decipher the Egyptian hieroglyphs in 1816. Comets are primordial bodies resulting from physical and chemical processes that occurred during the formation of the Solar System. They have remained more or less uncontaminated due to their great distance from the Sun. It is believed that much of the water in the Earth's oceans could have been left by the many comets that hit our planet during its early years, and that the pre-biotic elements that favored the development of life could have been brought to Earth by comets. The study of comets is therefore crucial for the understanding of many of the things that are still unknown about our origins. So we are not talking about immediate practical outcomes such as those from missions related to systems orbiting the Earth, which allow us to locate our position, monitor soil conditions, or create defense structures (to name just a few examples).

Rosetta is looking at the origins of life, and as yet we do not know what concrete impact this will have on everyday life. Many of the advances and scientific conquests that have had an impact on our history did not come about through a direct approach, but through wider and more ambitious objectives that are a greater driving force for innovation. Space research is among these.

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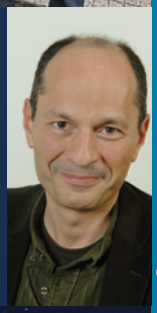
SYNERGIES, BASIC RESEARCH AND INDUSTRIAL APPLICATIONS

The Trento Institute for Fundamental Physics and Applications (TIFPA): an important point of reference also for space research

Marinella Daidone interviews Marco Durante, the director of TIFPA



You can't talk about space research in Trento without mentioning the Trento Institute for Fundamental Physics and Applications (TIFPA), created in 2013 by the National Institute of Nuclear Physics (INFN), the University of Trento, Fondazione Bruno Kessler (FBK) and the Autonomous Province of Trento (particularly APSS, its health services agency).

To understand the work that is going on in this field, we spoke to the new Director of TIFPA, Marco Durante, an international expert in medical physics and in radiation protection in space, and Director of the Biophysics Department at GSI Helmholtz Center in Darmstadt (Germany).

Professor Durante, can you explain what TIFPA does?

TIFPA carries out basic and applied physics research. It is a highly innovative research center, which means generating synergies between the partners (INFN, the University of Trento, FBK and APSS) and creating a channel through which basic research can lead to practical applications.

Can you tell us about the research group?

TIFPA has a small group of permanent staff, but orbiting around this group are about 100 INFN associates based at the University, and researchers at FBK and APSS who are interested in the applications of nuclear physics.

What are the main space research projects that you are working on?

TIFPA runs, in conjunction with the University of Trento and FBK, highly important experiments in space physics, such as LISA Pathfinder and AMS-2. In addition, together with APSS, we are developing a cosmic radiation simulator in the Proton Therapy Center, which will be used to design the shields on the spacecraft and to study the effects of radiation on astronauts and on electronic equipment during space flight.

We have just witnessed the tragedy in Nepal. In the future will it be possible to monitor earthquakes from space?

The Limadou experiment that we are working on is exploring this possibility. TIFPA is building the detector that will be installed on a Chinese satellite. The hypothesis is that intense flows of electrons at high altitude are linked to intense earthquakes.

More generally, how can space research have benefits for everyday life?

Space research has always been a catalyst for applications on the ground. There are a huge number of examples, but if we limit ourselves to TIFPA we can see that Limadou could improve our ability to predict seismic events, and research on space radiation could help cancer treatments with proton beams.

How can technology transfer be encouraged in this sector? Could small and medium-sized companies become involved?

This is the aim of TIFPA, to close the gap between basic research and industrial application.

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FROM TRENTO TO PASADENA: PAOLO BELLUTTA TELLS HIS STORY

First a degree in physics at the University of Trento, then a job at the Jet Propulsion Laboratory, now a member of NASA's Mars Exploration Rover mission.

Lino Giusti interviews Paolo Bellutta

Paolo Bellutta graduated in physics at the University of Trento in 1981 and is now a member of the Mars Exploration Rover mission at NASA. We caught up with him in Pasadena in California to ask him about his amazing adventure.

How did it all start? Where did the desire to work at NASA come from?

When I started working I wasn't thinking about this field at all. Space was a faraway place, fascinating, but not a sector to consider working in. But a series of intermediate choices, almost by chance, have led me to this career. In 1998 I answered an advertisement for a job at the Jet Propulsion Laboratory (JPL) and soon found myself in Pasadena, California. JPL was a very sought-after destination and I didn't think I had much chance. It was a long hard road, but it gave me a lot of experience, and it was very satisfying resolving problems, and that was maybe what helped me carry on.

Did you ever think it would be difficult to get to that point, coming from a small town in the Alps?

It was such a distant goal that I didn't even really consider it. I was born right at the beginning of the conquest of space, and the first shaky black and white images on TV showed events that were far away from my own world. Even now I sometimes ask myself if I am really doing this job. Maybe, as I was born in Rovereto, my fate was already decided.

What struck you most, in terms of research, when you made the big leap from Italy to the United States?

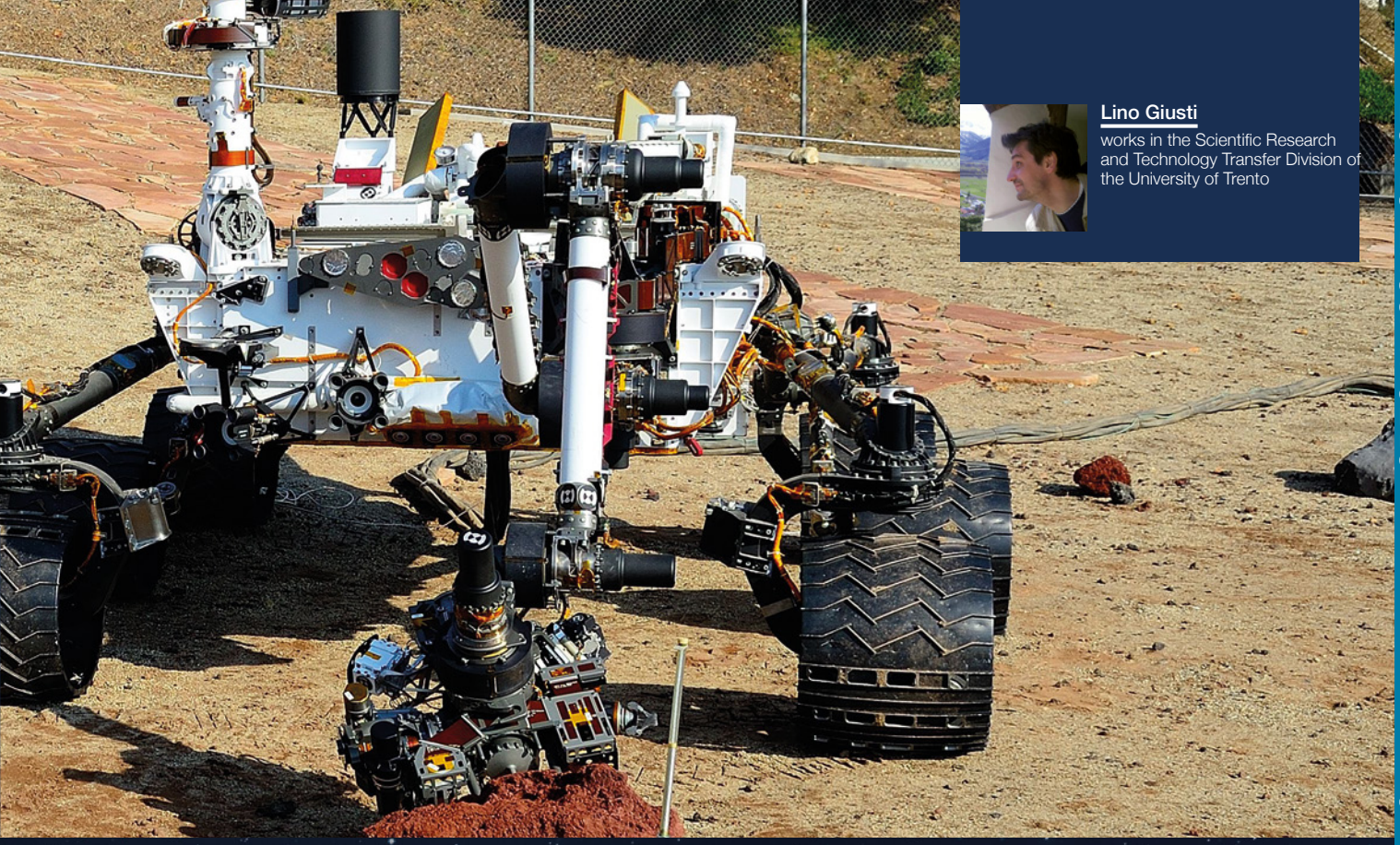
The most noticeable thing was definitely the availability of resources, both human and in terms of equipment and funds. But the main thing is the determination with which people work, sometimes at the expense of creativity. It's a stereotype, but we Italians try to resolve problems in the simplest way, sometimes bypassing the traditional methods. This often results in more elegant and innovative solutions.

What advice would you give to a young researcher, on the basis of your experience at the highest levels of space research?

Today there is an incredible amount of competition for work, so it's even more important to be versatile and well-prepared than when I started 30 years ago. Trying to broaden your horizons offers a wider range of job possibilities and makes you a more attractive prospect. Knowledge about a particular problem is important, but that can be learnt on the job.

Which space project has involved and excited you most, and what did that give you?

Definitely the project that has excited me most in the last 11 years is the Mars Exploration Rover Project, with its two rovers, Spirit and Opportunity. They have been my gateway to space and to Mars. Understanding how these missions are run, the choices that are made from a scientific and technological point of view, is fascinating. These rovers are like prosthetics that extend my abilities and give me access to another world. I'm not the only one who thinks this way. We often find ourselves gesticulating to imagine how the vehicles



Lino Giusti
works in the Scientific Research and Technology Transfer Division of the University of Trento

work on Mars, in such a vivid way that we associate characteristics to the rovers, which, like all exploration ships, are thought of as female. Spirit was difficult to manage, always requiring our attention. Opportunity, however, has been always successful in everything. Curiosity is very complex, with a thermonuclear tail and a 10 megawatt laser. Exploring another planet, seeing new places every day makes me think of how explorers in previous centuries felt when they arrived in new parts of our planet, and what happened afterwards.

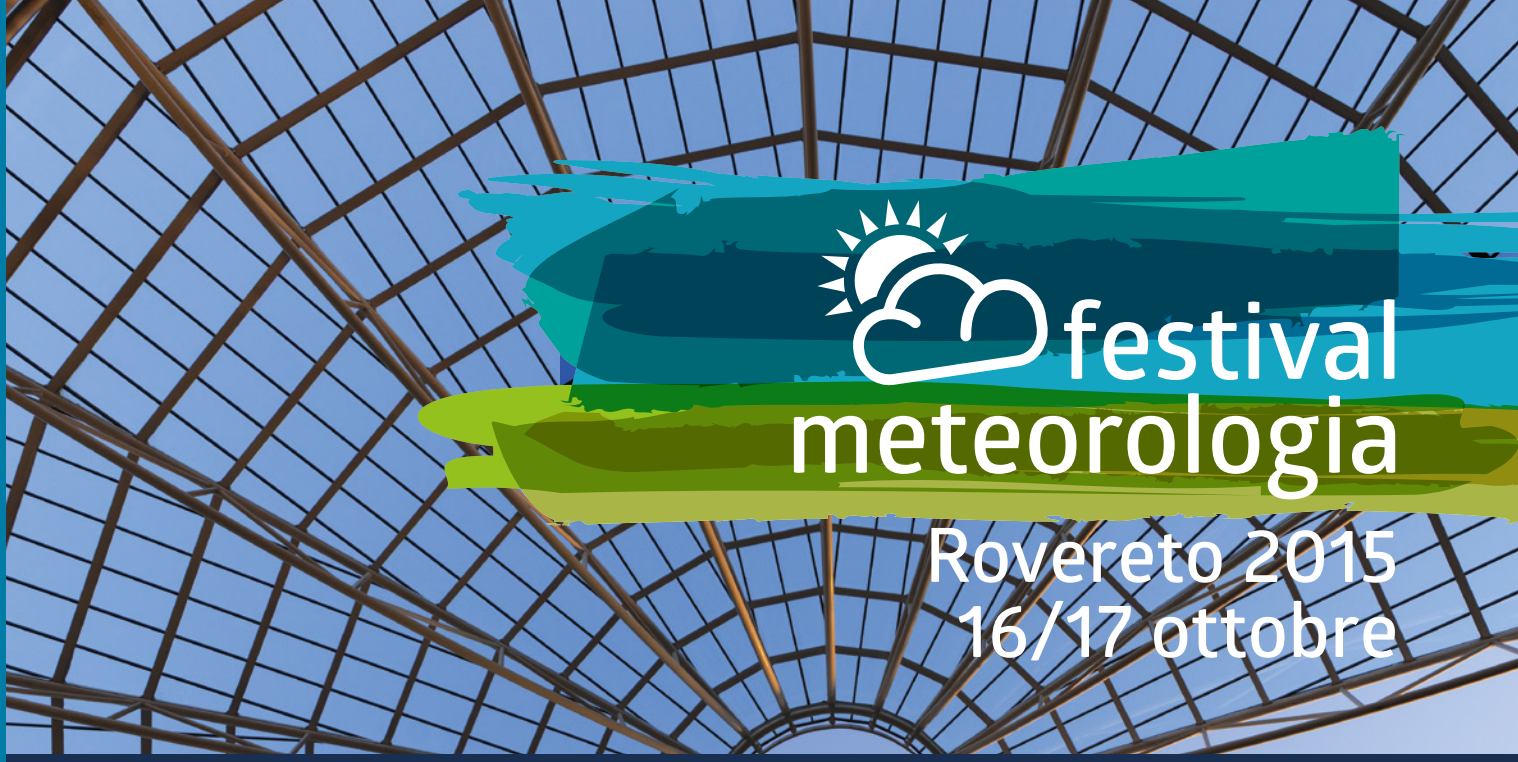
From your viewpoint working in the field, what will change in our everyday lives in the next few years thanks to space research and the technology that develops around it?

There's no doubt that in the last 20-25 years the Internet has changed everyday life radically, and robotics will be the next technology to change our lives. Robotics meaning mechanical systems controlled by systems that interact with the environment, not as humanoids we'll see in the street. The transport industry will be the first to be visibly changed. Already there are cars that can park by themselves or that warn the driver of potential dangers, or even take control and correct the speed or the steering on the highway. In the not too distant future I imagine small vehicles that can carry one or two people without human assistance, giving freedom of movement also to people with disabilities. We will have reconfigurable heavy vehicles, which can transport different quantities of goods, making distribution centers superfluous.

Automatic-driving-only streets are not far away, and will reduce accidents and traffic jams. Our grandchildren will probably consider driving licenses as something exotic, not something essential. Air and train transport will also be robotized. Already many airports have people-moving systems that are totally robotized, and the most recent aircraft operate completely autonomously for most of the flight. In the skies we will see an ever-increasing number of small vehicles for the transport of small quantities of material, instead of express couriers.

We will have to prepare for retraining the personnel involved, as most of these jobs will disappear, but this is a problem that is going to increasingly affect our society. The evolution of technology is much faster than social evolution and the students of today will be working in jobs that have not yet been invented.

FOR MORE INFORMATION
Mars Exploration Rover mission
http://mars.nasa.gov/mer/home/
Photo credits: Marco and Paolo Bellutta



IN THE NEXT ISSUE OF KNOWTRANSFER: FESTIVALMETEOROLOGIA

Don't miss the first edition in Rovereto on October 16 and 17

After space, meteorology. The next issue of KnowTransfer will be devoted to the first edition of the Festivalmeteorologia, which will take place in Rovereto on 16 and 17 October, and to the scientific and technological research and knowledge transfer that revolve around this sector.

The Festivalmeteorologia is a unique occasion for the different sectors of Italian meteorology to meet, interact and share their knowledge. **The event gathers together the operators of institutional and private meteorological services, professionals and companies in the field, researchers, users of meteorological services and products**, and meteorology enthusiasts, as well as teachers and schools of all levels, and the general public. Meteorology has an increasing presence in our everyday lives; we consult the weather forecast on a daily basis to plan our activities and make a variety of decisions.

The core of the Festival will be a rich program of scientific and technical talks that will spark debate on current issues related to meteorology. An exhibition of meteorological instrumentation and services, and a varied program of cultural and recreational activities related to the topic, will contribute to putting a spotlight on meteorology and on the profound and pervasive influence of the weather on everyday activities.

"With the Festivalmeteorologia", explains the chair of the scientific committee, Dino Zardi of the University of Trento, "we want to contribute to the diffusion and consolidation of a basic general knowledge about meteorology, currently lacking in Italy, but increasingly necessary to understand and interpret the huge amount of meteorological information published in the various media. In this respect, the Festival will be a unique opportunity for exchange between the different actors in the area of Italian meteorology."

But are space research and meteorology so far apart? We asked Professor Zardi. "On the contrary, they are very strongly linked; you just have to think of the enormous benefit that meteorology has had from the development of atmospheric observation satellites, which are now an integral part not just of weather forecasting, but also of advanced research. It's no coincidence that we will have the honor of the presence, amongst the speakers at the Festival, of Professor Roberto Battiston, president of the Italian Space Agency."

See the program on the Festival website or follow us on Facebook.

CONTACTS
Festivalmeteorologia 2015
For information: info@festivalmeteorologia.it
For companies who wish to participate (exhibition area): aziende@festivalmeteorologia.it
www.festivalmeteorologia.it

KNOW**TRANSFER 12**

Technology and knowledge connecting university and business

We would like to thank the Italian Space Agency (ASI) for their help in producing this issue.

We would also like to thank:
NASA - National Aeronautics and Space Administration
ESA - European Space Agency
TIFPA - Trento Institute for Fundamental Physics and Applications

In this issue

1 THE FUTURA MISSION: DOING RESEARCH IN SPACE

Samantha Cristoforetti on the International Space Station

The FUTURA mission has a rich program of scientific research, using microgravity conditions to conduct experiments that are expected to produce benefits in terms of knowledge and technological innovation.

By the editorial staff in collaboration with the Italian Space Agency

2 SPACE RESEARCH TO IMPROVE THE QUALITY OF LIFE

From the European Mars missions, to the space economy, to technology transfer from space to Earth and from Earth to space. We talk with the president of the Italian Space Agency.

An incredible number of things in our everyday lives depend on space: telecommunications, monitoring of the atmosphere and of the earth, and emergency management, just to name a few. Space is a synonym for progress, for improving the quality of life. Not investing in space means not believing in the future.

Vanessa Ravagni interviews Roberto Battiston, President of the Italian Space Agency.

4 LISTENING TO THE UNIVERSE THROUGH GRAVITATIONAL WAVES

The University of Trento's contribution to the LISA Pathfinder space mission. Launch date set for October 2.

The mission was conceived by the team at the Experimental Gravitation Laboratory of the University of Trento, together with colleagues from the Max Planck Institute in Hannover. Trento also designed and guided the industrial development of an essential part of the instrumentation, the inertial sensors.

By Stefano Vitale

6 REMOTE SENSING AND RADAR: FROM PLANETARY EXPLORATION TO EARTH OBSERVATIONS

From the search for elementary forms of life in space to the monitoring of the environment, of natural resources and of anthropic activity on Earth. The research activity of the university's Remote Sensing Laboratory.

The space radar RIME (Radar for Icy Moon Exploration) will have a leading role in the European Space Agency's (ESA) JUICE mission to search for traces of life on the icy moons of Jupiter. RIME will be built in Italy, under the guidance of Lorenzo Bruzzone, with some of its subsystems supplied by NASA's Jet Propulsion Laboratory.

Paola Fusi interviews Lorenzo Bruzzone

8 THE STUDY OF COMETS AND THE ORIGIN OF LIFE

The University of Trento's contribution to the Rosetta Mission

The objective of the mission is to reveal the many mysteries that still surround comets, in the same way that the Rosetta stone, thanks to the French archeologist Champollion, allowed us to decipher the Egyptian hieroglyphs in 1816.

by Mariolino De Cecco

9 SYNERGIES, BASIC RESEARCH AND INDUSTRIAL APPLICATIONS

The Trento Institute for Fundamental Physics and Applications (TIFPA): an important point of reference also for space research

TIFPA carries out basic and applied physics research. It is a highly innovative research center, which means generating synergies between the partners (INFN, the University of Trento, FBK and APSS) and creating a channel through which basic research can lead to practical applications.

Marinella Daidone interviews Marco Durante, the director of TIFPA

10 FROM TRENTO TO PASADENA: PAOLO BELLUTTA TELLS HIS STORY

First a degree in physics at the University of Trento, then a job at the Jet Propulsion Laboratory, now a member of NASA's Mars Exploration Rover mission.

"These rovers are like prosthetics that extend my abilities and give me access to another world. Exploring another planet, seeing new places every day makes me think of how explorers in previous centuries felt when they arrived in new parts of our planet, and what happened afterwards."

Lino Giusti interviews Paolo Bellutta

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See the program at www. festivalmeteorologia.it or follow the event on Facebook.