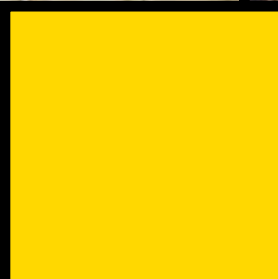


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**Spanish
women
in Space**



INTERVIEW
HÉCTOR SOCAS
*RESEARCHER AT THE INSTITUTE OF ASTROPHYSICS OF CANARY
ISLANDS AND DIRECTOR OF THE MUSEUM OF SCIENCE
AND THE COSMOS OF TENERIFE*

NEWSPACE
**ON COURSE FOR
THE SPACE LILIPUT**



THE HOLE IN THE OZONE LAYER OVER THE ANTARCTIC

IS ONE OF THE LARGEST AND DEEPEST IN
RECENT YEARS

Measurements taken from the **Copernicus Sentinel-5P** show that the hole in the ozone layer over the Antarctic this year is at one of the biggest and deepest levels recorded in recent years. A detailed analysis from the German aerospace centre indicates that the hole has reached its maximum size.

The size of the hole in the ozone layer fluctuates in a regular way. From August to October the hole does not increase in size, reaching its maximum between mid September and mid October. When the high temperatures in the stratosphere start to rise in the southern hemisphere the depletion of the ozone layer slows down, the polar vortex weakens and finally breaks, and by the end of December the levels of ozone return to normal.

Text: ESA, NASA, ESA.



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Space

Satellite opportunities and applications in the digital era

EDITORIAL

The world that lights up the decade of the 20s is a digital and connected one. According to reports from Cisco 52% of the world population – calculated at six billion – is now using Internet. There are 26 billion devices connected with the web and the average speed per user is about 50 Mbps. Global traffic has reached 195 Exabytes a month, a figure that's difficult for our minds to quantify. That is something like all the films made to date circulating around the web every two minutes.

The growth expected in the next few years is dizzying. Two thirds of the world's population will be using the Internet by around 2023. There will be 30 billion appliances, half of which will be machine to machine (M2M) connections. The digital revolution has come on the back of broadband, fibre and 4G (soon to be 5G), the appliances and mobile apps.

And where does the satellite fit in all of this? According to reports from Euroconsult, we can estimate that the rented capacity of satellites is some five Exabytes a month, half of which is for broadcasting video services. They are very modest figures. At the moment Space communications occupy a peripheral position in the dynamics of the digital transformation and are very focused on government sectors, defence and the rural environment. So, what's waiting for us?

The answer comes from various fronts:

- With new constellations: Space X, Oneweb, Amazon, Telesat, SES are planning to launch tens of thousands of low orbit satellites and that will catapult the capacity with sustained growth of 20% a year.
- The convergence of standards in 3GPP: with the coming of 5G a great diversity is envisaged from multiple perspectives, technologies, services and traffic types with the prospect of a future integration of satellites with 5G systems.
- And what we would like to highlight on this occasion, new uses, linked with the so-called “verticals” and also downstream apps.

The promise of 5G has three axes. An approved broadband (eMBB); massive communications between machines (mMTC) and ultra reliable low latency communication (uRLLC).

How do we transfer that promise to the satellite? Examples of eMBB via satellite that we can highlight are the delivery and download of software content over the air (FOTA / SOTA); the fixed backhaul to 5G networks where it is not feasible to deploy ground based communications, and the support and provision of mobile services in platforms such as vehicles, aircraft, ships and trains (ESIM).

On the mMTC scene, satellites already empower the monitoring and management of assets in remote settings and means of transport. Its capacities can be widened to manage a broad range of IoT appliances, both fixed and mobile.

With uRLLC, the considerable latency that is inherent with the distances of GEO satellites will be considerably reduced with the LEOs, although it will still be high for time critical apps where reaction is measured in a few milliseconds. However, the satellite will be very useful when it comes to enhancing key applications such as connecting with vehicles; for example thanks to the capacity of providing information in almost real time for watching traffic.

The success of generalization in the use of the satellite in the digital context will be tied to the growing availability of capacity provided by the new high throughput satellites (HTS) through millimetric bands and the LEO mega-constellations. But also in particular in the technological development of ground-based terminals, in terms of features and reduced size, weight, power and cost (SWaP-C). What is not new is the technological transition from traditional parabolic antennas- ideal still in fixed settings, and some mobile ones where volume is not a critical factor – to flat panel (or phase array) antennas, which are optimal for mobility with their low profile. Finally there are the electronically steered antennas (ESA), without mechanical components, which are still in their infancy if we look at their implementation in mass markets.

The structural conditions of the Space sector - technological, financial, regulatory and commercial – augur the development of downstream uses and applications. High value clients and sectors – governments, defence and corporations – will continue to be the biggest clients in the near future. But over the medium to long term they will cede to mass applications, which will necessarily be more integrated with the standards of the new digital and connected world.



Miguel
Ángel Díaz
CEO INSTER

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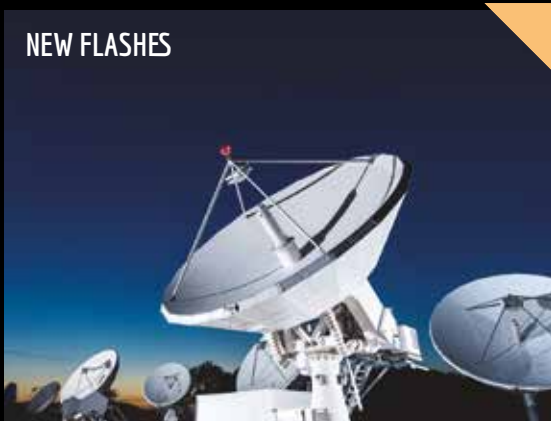


NEWSPACE

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NEW FLASHES



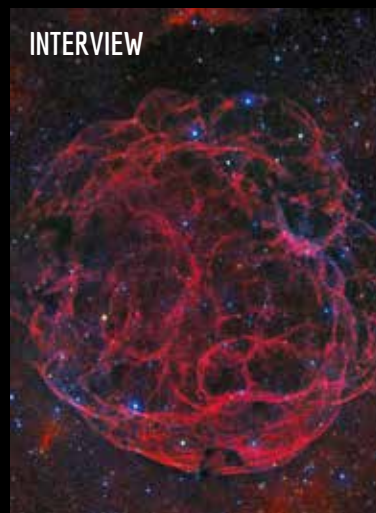
OPINION



FEATURE



INTERVIEW



INTERVIEW



NEW FLASHES



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Spanish women in space

Ever since pioneers like Mary Jackson (née Winston), a NASA aerospace engineer in the 1950s, and Valentina Tereshkova, the first female astronaut in the 1960s, entered the Space industry, breaking into what until then had been an exclusively male preserve, the presence of women in this sector has not stopped growing. Currently they represent 24% of all employees in Spain, with the same qualifications as the men, according to TEDAE's annual report on the Spanish Space industry. Their presence is normal at all levels of the production chain, from design to manufacturing, but also in the universities, as mission scientists; in public institutions such as Space agencies and even onboard the roc-

kets as astronauts. Today there are women working in the Space industry all around the world. It is no longer news that a female scientist, engineer, project director or minister is a fundamental link in a Space programme. While there is still plenty of room for achieving parity – the salary difference is estimated at 12.2% (according to a study by CEOE and PwC) – we can say that the Space industry has normalized gender differences.

In Spain there are many women who are members of scientific and commercial missions, from companies to institutions. We invite you to meet some of them.

MERCEDES RUIZ HARO

(SENER AEROESPACIAL)

Is... head of the department of systems, navigation and control at the Avionics and Advanced Systems division of SENER Aeroespacial. She is a technical aeronautics engineer with a major in propulsion, a Masters in satellite and Space technology, a higher industrial engineer majoring in energy technology and a Masters in business innovation, as well as having completed a Space programme at the International Space University.

Her work involves... supporting, coordinating and supervising the development of projects in the area, focusing on the field of aerospace systems, AOCS (attitude and orbit control system) and GNC (guidance, navigation and control). She is also a consultant on innovation and electric propulsion.



During her professional career... she has held a number of different positions at the company. She started out as an engineer working in the area of fluid dynamics (including experiments in parabolic flight) before moving on to become a propulsion and systems engineer for innovative Space missions such as SMART-OLEV and PRO-BA-3, director of projects, a member of the company's directorate of innovation and technology and then her current role as head of systems, navigation and control.

An interesting anecdote... "As a project director I have had the opportunity to start, in collaboration with the UC3M (University Carlos III of Madrid), a development line for a helicon source plasma engine. It is a disruptive technology in the area of electric propulsion for satellites which we are working on at the moment with the aim of marketing it from 2023 onwards.

She works in the Space sector because... "ever since I was small it has been a field I have been passionate about. As the years pass I have seen that it has much to offer: answers to scientific questions; crucial information for our day to day life, from observation of the Earth to communications and positioning and exploration..." She sees it as a means of contributing to society through science and engineering.

Mercedes believes that... we are living in an époque of much change, influenced by different factors, among them technology: "Space is a sector that is going to be key in the near future, such as infrastructure for many types of development, for economic growth... I believe that the next industrial revolution will come from Space".

MARTA ESCUDERO

(GTD)

Is... COO (Chief Operating Officer) for Space at the GTD group at international level. She graduated in physics.

Her work involves... coordinating the work of more than 100 male and female engineers who answer to her and are located in Spain, French Guiana, the United Kingdom and Germany. Their work represents the biggest proportion of billing for the GTD group.

During her professional career... She went into the Space sector following a brief spell as a professor of electronics and computer programmer on artificial vision projects and in the industrial sector. She joined the staff at GTD in 1989 as head of quality for its first aerospace projects. Soon after she became the company's head of Space with special emphasis on launchers.

An interesting anecdote... In the mid 1990s she was working on projects for France's

national centre of Space studies (CNES), located at the European Spaceport, making frequent journeys to French Guiana. One day she received a call from a client saying they had a serious problem: the launch control centre had to be ready in six months' time. After more than three years of development and many delays, the group that had been awarded the contract was not able to meet the requirements of the project or the schedule. And the client wanted to know if the team co-led by Marta would be capable of taking over the project and finishing it. Marta packed her bags and moved immediately to Kourou to guarantee the success of the project in the agreed six month time window.



She works in the Space sector because... it had always been her dream. "When the opportunity presented itself I grabbed it! And I am still benefiting from it and enjoying it every day."

Marta believes that... "Space is a sector that inspires us and pushes us to go beyond our limits. The projects we carry out urge us to improve, to develop new technologies, new concepts and fascinating new missions, all without room for error. And this improvement has a direct or indirect impact on the quality of life for all of society. Be it navigation, Earth observation, telecommunications, Space exploration.... All of this has an impact on the day to day life of people, even if they are not aware of it. And for those of us who are fortunate enough to work in the sector, Space inspires and pushes us to conquer new challenges and move beyond horizons that we once saw as unattainable."

MARÍA DEL MAR FERNANDEZ LISBONA (AIRBUS)

Is... Key Account Manager Space Spain for Airbus. An aerospace engineer with a Masters in industrial technology management, she has also taken a management development programme in general management and several courses of systems engineering and at the International Space University.

Her work involves... coordinating the Space sales team for Airbus in Spain, seeking out value added contracts. Close relations with the Spanish administration are fundamental for helping to increase budgets linked to Space activity, an area to which she dedicates much of her time.

During her professional career... she has undertaken various roles in a diverse range of departments, all at the same company



where she started work in 1989. They include head of programmes, viability studies and engineering management (on missions such as Minisat-01, ASCAT, ENVISAT, Meteosat Third Generation...) to being responsible for trade and institutional relations. Along the way she has also been head of the control department, commercial director of programmes for satellites and subsystems (S/S), and head of control in the financial department. She now heads the sales team in Spain for Space business.

An interesting anecdote...

when she was aide to the director of the PAZ satellite programme, she tells how she worked with many women. "As an example, the radar thermal grading team consisted of 10 people. All of them were women!"

She works in the Space sector because...

María del Mar dreamed of becoming an astronaut, and if that were not possible to take

part in the development of Space activity in Spain. As a matter of fact she applied for the first selection of candidates for future Spanish astronauts run by the European Space Agency (ESA) in 1990, but "when I applied I hadn't reached the required minimum age".

Maria del Mar highlights that... "since I joined in 1989 I have seen the whole Spanish Space sector grow in its capabilities. Spanish companies enjoy a lot of prestige on the international scene. Our engineers and operations personnel are highly valued for their knowledge and good work". As regards female participation, she thinks that "it has been growing since 1989, but lately we have seen less women studying for technical careers. At Airbus we are trying to promote the incorporation of women to take on jobs, collaborating in all the STEM (Science, Technology, Engineering, Maths) science educational initiatives that we can".

MÓNICA ALONSO MARTIN-SAUCEDA (AIRBUS)

Is... a technician in the cabling department at Airbus. She is an accounting technician and has taken specialist courses run by the European Space Agency (ESA).

Her work involves... the making of cables for satellites and launch adaptors, as well as running electrical tests for the continuity and insulation of those cables.

During her professional career ... she has spent most of her working life in the same area. She started working at a sub-contracting company for EADS- CASA-Espacio (now part of the Airbus group), where she stayed for 13 years before joining Airbus.

An interesting anecdote... Mónica recalls one of the most striking experiences in her

career as being a journey to Turín (Italy), to carry out the cabling and testing for a satellite that was under biological protection: "We had to dress in a similar way to the specialists who treat cases of ebola. We were totally shielded and our protection equipment could not touch the floor. The cleaning conditions inside the room were extreme, even the floor was cleaned by hand."

She works in the Space

sector because... "ever since I was small I was attracted by subjects connected with astronauts and crewed spaceships." And in her case, it came through her family as her father spent all his working life in the Space sector.

Mónica sees it as necessary... to get the sector known at an early age (in primary and secondary schools) among girls, to increase

its visibility in the technological world, especially in workshops. "So that it's not just a few – one or two per class – who prepare to work in this sector at middle and higher levels. And that there is the same visibility – with female presence – for the work carried out in workshops, and that we are not just a few." In that way, she underscores, Space is a job with a future.



ISABEL FERNÁNDEZ- PEÑA IZQUIERDO (CRISA)

Is... a graduate in law and administration and management of companies (ADE) and is now head of the Commercial & Contracts department at CRISA

Her work involves... leading a team of five people and being in charge of the coordination and management of offers. Her tasks include the coordination of the offer, drawing up the costing and payment plans, checking of the contract and identifying of risks, the preparation of internal documents for approval of the offer, and negotiations with the client up to the signing of the contract. Her work extends into the actual execution of the contract, taking charge of the actual hand-over for the start of the project and the management of the contract. "At the moment I am leading the negotiations for the operating contract for the Ariane 6 for the different CRISA equipment that goes aboard the launcher. It is a fundamental contract for CRISA."

During her professional career... she started out as an intern in the marketing department at telecoms company Movistar.

"On finishing that I joined CRISA to cover for a maternity leave in the contracts department. Then I moved on to the financial department and after two years returned to contracts as head of section. Gradually I took on more responsibilities in management and coordination of offers until I reached the post I now occupy."

An interesting anecdote... "I remember the time we had to take an offer by hand to Brazil. This was because the process for getting the necessary administrative authorizations for bidding in that country could be greater than the actual bidding period so we decided to ensure the delivery. Another anecdote that comes to mind occurred during the contract negotiations for the sequential electronics for the PB phase of the Ariane 5 programme. After several months, the negotiations were concluded and I was going skiing. However, at the last minute they had to be restarted, meaning I had to spend several days shut up in an apartment until we were finally able to sign."

She works in the Space sector because... "I got into the world of Space by chance as

what attracted me initially was working in an international environment, negotiating complex contracts with clients whose needs are mixed and diverse, all over the world. Little by little I started to realize just how exciting this sector is, with developments based on science and their later application to our daily lives. Each programme has its own peculiarities. There is a lot of research work to do and each team is set up ad-hoc, which makes the task a challenge but also very enjoyable. I think Spain has some great professionals in this field and it is a great honour to work alongside them".



Isabel highlights that... "one of the biggest challenges that faces us in Space in recent years is in making the industry more competitive at the same time as carrying out ever more complex technological developments. The Space sector is evolving very quickly and we are going through a period of change, opening up the way in some very competitive and completely different export markets that we know about, supported by the European Space Agency

CAROLINA LÓPEZ DE EGEA GÓMEZ (ARQUIMEA)

Is... a graduate in environmental sciences and Head of QA/PA and procurement at ARQUIMEA

Her work involves... guaranteeing that everything functions as it should, and that people are comfortable in their work, because what we are doing is fully under control and we are among the best in knowing how to do it.



tant and head of quality in various sectors. (Among them I have audited the factory of (snack maker) Risi, yes, the ones who make Risetos). All that experience has brought me to where I am now, to the space where I have found my place".

An interesting anecdote... "A funny one is when a job has no quality controls and things happen like sending a box of peppers to a wind farm instead of the box of screws they needed to repair a wind turbine".

She works in the Space sector because... "When I went for my first interview I didn't think they would pick me. I didn't know what

awaited me and above all I didn't imagine that I would fall in love with it. To start with it was difficult because although I was an expert in quality there were, for example, many technical terms that I have had to learn."

Carolina highlights that... "this sector is wonderful. It is incredible to be able to work in the future, with your teams helping the world to keep advancing - helping to control and mitigate climate change, to give support to meteorology, to enable people, even if they are far away, to communicate..."

IRENE GONZÁLEZ (THALES ALENIA SPACE)

Is... a graduate in law with a Máster in human resources (HR) management and organization and a certificate in coaching for executives and teams. She is now HR Manager for Thales Alenia Space in Spain.

Her work involves... for the last five years leading an HR team in different areas.

During her professional career ... "I have learnt – and keep on learning – much about the world of Space. At the same time I can bring in my experience of working in other industries as when it is relating to people it is not very different. Over the years, working with different groups, I have come to realize that doctors, biologists, engineers... all of them have similar difficulties, challenges, motivations and illusions".



An interesting anecdote ... "I started my professional career as a lawyer and after two years of legal practice I decided to redirect myself into what is my true vocation – dealing with people. That's how I set out on the path of human resources, where I have now spent most of my professional life. I have carried out different positions in various multinational companies, mainly ones like HR Business Partner in pharmaceutical and medical technology companies.

She works in the Space sector because ... "Space is culturally something magic. It awakens our curiosity to learn about what is out there, our origins. Having a part in developing the equipment that goes aboard spaceships has its romantic side, equipment that is launched into Space and has to function. There is no possibility to repair it as it will never return, yet it helps us to improve our knowledge of the

planet that we live on and what surrounds us, so that we are able to have a better future. It is a sector with highly qualified professionals, one that is very demanding and one where I can find great work opportunities in what, as I said before, is my great passion – the development of people".

Irene highlights that... "Depending on the jobs that we are recruiting for, it's necessary to have some specific technical knowledge. But what we most value are skills like communication, global vision, the ability to work in a team and the capacity to learn. The world is changing ever more rapidly and we have to be capable of adapting ourselves and even anticipating these changes. That is why it is no longer enough to be a big expert in something. We need people who seek continual improvement, are fast thinking and want to go far. I see it as an exciting sector that will surely have a very relevant role in the coming years.

OLGA ALBERT (TELESPAZIO)

Is... a graduate in chemistry from the University of Barcelona in 1990 and is now Director of Business for Geo-information and Satellite Operations for downstream / business at Telespazio

Her work involves ... "responsibility for carrying out of all the projects (time limits, quality and costs), and at accounting level for the results of the company, for its income and its gross margins. Also among my tasks is supporting the pre-sale technician in preparing offers and the management control and reporting of operational activities, both internal and within the group".



Madrid, the chance of switching to a company in Barcelona as head of map production emerged. This time, more for personal reasons, I decided to accept the challenge. The company, a Catalan one with 20 people to start with, is dedicated to map making and the development of geo-information systems. It has grown over the years to become what is now Telespazio Ibérica, with a current staff of 140 people. First came a merger with a company called Teledetección from Madrid and later the purchase of both by the Telespazio group in 2008. My career has followed a parallel path. After cartography I passed on to the applications development team, then became product manager and finally the head of global operations".

An interesting anecdote... "I have to give enormous thanks to the various people who have shown belief in me at certain times and pushed me to take on new jobs. I remember especially the day when someone recommended that I should do an MBA as part of my training process. With two small daughters

and an already considerable workload I sincerely didn't see myself as being capable of doing it. Fortunately my boss ignored my reluctance and kept insisting. Without this differential it would have been difficult for me to have got to where I am today. I believe that at times we need that push and a certain dose of confidence to advance, and that is something that I try to pass on to my collaborators."

She works in the Space sector because ... "you could say that the Space sector is something that I found along the way. The takeover by Telespazio has provided me with great opportunities. Firstly, there is the fact of belonging to an international group, which changes your perspectives on the way of working and widens your reach as far as possible personal projects go. It also provided a differential factor between the sectors in which I found myself and the Space sector, where the options of investment, new business models, the high level of globalization of services and markets in constant evolution give shape to a setting that is very different in its activities at business level and for its management."

MAR LÓPEZ COTARELO (CRISA)

Is... a graduate in physics from the Universidad Autónoma de Madrid, where she specialized in the solid state theory. She took an industrial course at the Universidad Politécnica de Madrid (UPM) which was targeted at training professionals to develop new production technologies among small and medium size companies (SMEs) in Madrid. Her specific training in Space came with a grant from the ESA to participate in the International Space University's summer programme in 1995.

Her work involves ... heading up market intelligence and voice based client services for Space equipment. That involves analyzing the impact of market trends in Space equipment, checking on the feedback from customers with the goal of identifying the strategic decisions and taking necessary actions to ensure business growth. She works closely with the rest of the sales and strategy team, in particular with those in charge of export accounts, the product portfolio and the operational marketing team. She also coordinates communications and ethics compliance for Crisa.

Her first job was... at the European Space Agency (ESA's), Space Research and Technology Centre (ESTEC) in the Netherlands where she stayed for nine years. For the first three she focused on research and development in the field of electronic component radiation, in particular with processors and programmable logic components. Later she joined the department of microgravity as head of product assurance and programme security. While there she worked on projects for Spacelab missions, Russia's MIR space station, a Russian programme for retrievable satellites and for the International Space Station. On returning to Spain, she joined the quality department at Crisa, initially as head of the quality engineering section and later as deputy director. Five years ago she decided on a career change

to the sales and strategy department, taking up the post she still holds today.

An interesting anecdote... involved the first launch campaign in which she participated with ESA. "It was in Russia, and due to various delays I ended up spending my Christmas holidays between Moscow, where our laboratory was located, and Plesetsk, the launch site. It was snowing and -24C". The team was made up of Dutch, French, Italians, Germans, Americans, with Mar as the sole Spanish representative. It was her first campaign in Russia and they had to learn and solve many things on the job. One of the most pleasing aspects was working alongside Russian engineers and scientists while they carried out the preparation and final integration of the satellite's equipment.

Why does she work in Space? "Without doubt, for the emotion. According to my father, when I was little I said that I wanted to work for NASA, although to be honest I don't remember saying that. What I do remember is always having a big interest in subjects connected with Space. I think that is because like many others of my generation as children we watched the arrival of Man on the Moon on television. When



I finished my studies the opportunity arose to work at ESA. I didn't have to think about it for a moment and went to Holland. That's now quite a few years ago and I can safely say that I have never felt bored in this job. Projects are always a challenge as each programme is different. You can be doing science or developing applications for Earth observation, navigation or telecoms that we all make use of in our daily lives. As we normally work in international teams with a lot of motivation, each person brings a very relevant added value to the project we are engaged in."

Mar thinks... "The Spanish Space sector is very competitive when up against companies from other countries, with a specific characteristic that I feel it is important to highlight here. That is the large number of

women who work here in Space compared with the numbers employed in foreign companies in this sector and in other areas of technology. It has been that way for many years and, as a matter of fact, was one of the things that most grabbed my attention when I started working for Crisa. We women are employed in all areas of the company, from the workshop to finance and engineering, and at all levels of responsibility".

"The Spanish Space sector is very competitive when up against companies from other countries, with a specific characteristic that I feel it is important to highlight here".

Ma DOLORES SABAU GRAZIATI (INTA)

Is... a graduate in physics from the Universidad Complutense de Madrid in 1972. She did her doctorate in physics with a speciality in Space astrophysics at the Universidad Central de Barcelona in 1990, carrying out pre-doctoral studies at L'Institut d'Astrophysique de Paris (IAP, +CNRS) where she again specialized in astrophysics. Later she went on to do post doctoral studies at the Istituto di Astrofisica e Planetologia Spaziali (INAF-IAPS) in Rome, her introduction to the world of multi range astrophysics as applied to the study of the universe's heat and energy. After a brief spell at the electronics R&D division of Estándar Eléctrica S.A. (1973-1974), she returned to the Universidad Complutense de Madrid to begin her research career in the astrophysics department. Her lines of investigation broadened out towards theoretic astrophysics as a result of a collaboration with the Institut d'Astrophysique de Paris in which she got involved in firmly maths-based work in the field of stellar atmospheres.

In 1985... she joined the scientific groups of the Comisión Nacional de Investigación del Espacio (CNIE) a partner of the Instituto Nacional de Técnica Aeroespacial (INTA) where she worked on basic research in the field of stellar astrophysics. In 1987, after CONIE was dissolved by the Science Act of 1986, she was given a contract by INTA where she collaborated on the establishment of the Laboratorio de Astrofísica Espacial y Física Fundamental (LAEFF), the Space sciences division and the payload office which she pushed for and headed up from the start. It eventually became the Department of Payloads and Space Sciences which today is one of the most prestigious at INTA and of which she was director for 10 years. When her contract ended in 2019 she was named Científica Ad

Honorem INTA, not just the first woman but the first person to receive the distinction. Since then she has carried on with her Space science research work while also working as an adviser to the board of INTA.

A highly active, thoughtful, curious and persevering person, most of her long professional life has been dedicated to Space. She feels privileged for having been able to carry out basic and applied research, contributing to complex and innovative technological developments, setting up new lines of Space research, and in particular for being able to create groups of highly capable and internationally-renowned scientists and technologists.



Over the last three decades, María Dolores Sabau and her research teams, in their permanent search for the perfect interaction between science and Space technology to best reach their objectives, have participated in many of the most important scientific Space missions, both national and international, especially through the ESA. In doing so, they have pushed national prestige out to the limits of the Cosmos as they try to unravel its secrets. They have gone out to meet it and landed on a distant comet as they attempt to ascertain how our solar system and perhaps life itself came about. They have visited the surface of Mars for the second time and recently set course for the Sun, our nearest star, as part of the most ambitious solar mission ever undertaken. She has been IP/NTA for several of these missions (IBIS/Integral, OSIRIS/Rosetta, ASIM).

As a result of... her high level of participation in Space projects she maintains an excellent and fluid relationship with the private Space sector as well as the state research agency (Agencia Estatal de Investigación). The agency has co-sponsored many of her team's projects and she in turn has frequently advised them on scientific Space projects, including being assistant manager for the second National Space Plan. She has

had numerous scientific articles published in prestigious specialist international magazines. She is also a founder member of the European Astronomical Society (1992), a member of the International Astronomical Union since 1993 and a member of the Spanish Society of Astronomy since 1990. In recognition of her work she has received the Cruz al Mérito Aeronáutico cross (2005), and been named Científica Ad Honorem INTA (March 2019) and Reservista de Honor (Honoured Reservist) in the science category by the Ministry of Defence (March 2020).

Maria Dolores points out that... at the start of her career as a researcher there were very few women working on Space programmes, even at international level. She believes that the steady and unstoppable incorporation of women into the sector's activities is very positive, given that women tend to be more conciliatory, tend towards team work, are more sensitive towards other people, and have greater resilience, bravery and firmness in decision making. She thinks they are usually more motivated in reaching their goals than in the power in doing so.

She defends... equal opportunities especially in training, as that is the basis for the professional development of any person. She does not believe in female quotas, and in fact sees them as prejudicial. All women, just like men, should be there on their merits; because they are the best. One of her biggest sources of pride is having headed a department that was close to parity - 45% were women and all of them, just like the men, were valued for their talent, potential, professionalism and their contribution to results. She says she has never felt discriminated against for being a woman, although she recognizes that the road has not always been an easy one.

Married with five children and a grandmother of 11, she never wanted to relegate her role as mother and has always tried to balance her maternal obligations with her professional responsibilities. That has obliged her to dedicate many hours to both and to make

the most of them, each time setting her priorities and frequently having to forego things. "You always have doubts about whether you have done the best thing. Balancing things is not easy, but neither is it impossible." She believes that in the end the balance between family, professional and personal life has been positive.

A piece of advice to women... starting out in any aspect of the Space sector. "I would tell them that first of all they should prepare themselves well, don't miss out on opportunities and pinpoint big and clear objectives and be ready to achieve them. Often there are no more limitations than those we put on ourselves."

MÓNICA LÓPEZ (CDTI)

Is... A master's graduate (2002) in remote sensing and geographical information systems from the University of Paris, completing her studies as a higher agricultural engineer at the Universidad Politécnica in Madrid.

Currently she is the Spanish delegate to the European Space Agency's Earth Observation programme and the Spanish representative on the Copernicus Committee of the European Commission.

She has always worked in areas connected with remote sensing and Earth observation. She started her professional career in France with Spot Image, a company dedicated to the marketing of satellite imagery, carrying out market studies for environmental and agricultural products. After several years working in the private sector as a specialist in remote sensing she joined the CDTI (Spain's Centre for the Development of Industrial Technology) where she has now worked for 15 years.

At the CDTI she has been involved in Space programmes for Earth observation at both national and international level. She began by working on the national mission, Ingenio, interacting with users on defining the aims of the mission. Ingenio was an optical Earth observation satellite, targeted principally at map making, the management of natural resources, agriculture and the monitoring of natural disasters. Later she became part of the Spanish delegation to ESA on the Earth Observation committee and is currently also Spain's



representative on the European Commission's Copernicus committee. Copernicus is the most important Earth observation operational programme to be developed until now in Europe in the area of environment and security. The CDTI, as well as carrying out the traditional tasks related with contributing to ESA programmes and the management of industrial returns also plays an active part in the promotion of the Copernicus programme, through the setting up of work groups, seminars, etc, with the objective of spreading the benefits of the programmes to potential users.

She works in the Space sector because...

"When I finished my university studies the opportunity arose to finish them with a Masters in remote sensing." This training gave her a global vision of how the data provided by Space systems could be applied to aiding the management and monitoring of the Earth's resources, a field that fascinated her. Since then she has tried to steer her professional career towards the development of activities in this area.

Mónica highlights... the importance of having good interaction between the developers of Space systems, scientists and the end users, given that the goal is to develop innovative systems that provide reliable data to cover the needs of the users and, in doing so, serve to strengthen Spanish industry.

ESTEL CARDELLACH GALÍ (ICEE-CSIC)

Is... a physics graduate from the Autonomous University of Barcelona (UAB, 1997) who was awarded a doctorate at the Department of Signal Theory and Communications at the Polytechnic University of Catalonia (UPC, 2002), with an investigation carried out at the Institute of Space Studies of Catalonia (IEEC).

Currently she is... a distinguished researcher for the Spanish National Research Council (CSIC), carrying out work at the Institute of Space Sciences (ICE-CSIC). Her objective is to develop new techniques in remote sensing based on opportunistic signals. That means reusing signals transmitted by other satellite systems for the purposes of Earth observation. This helps keep down costs, enables them to be carried aboard small satellites and provides new capabilities for advancing scientific knowledge on highly relevant subjects such as climate change, meteorology, hydrology and oceanography.



Most of her efforts revolve around signals sent out by navigation satellites (for example GPS, or generically GNSS) such as detailing intense atmospheric precipitation, tropical cyclone winds, the marine altimetry of polar ice, the detection of inundated areas in wetlands that are hidden by dense vegetation, etc. She also looks at extending these techniques to other types of signal (such as communications and television via satellite).

The core of her work... is the scientific use of opportunistic signals transmitted from satellites. Her doctoral thesis was the first in Europe (running in sequence with the first in the USA) to investigate the use of satellite navigation signals (GNSS) to extract information on oceanic winds. NASA now has a constellation of satellites that carries out this concept (CYGNSS). On finishing her thesis she was awarded a post-doctoral research posting – financed by NASA and

managed by the USA's National Science Foundation – at the NASA/Jet Propulsion Laboratory (JPL) in Pasadena, California. There she continued investigating remote sensing techniques with GNSS (2002-2003). From the American west coast she moved to the east (to Cambridge, Massachusetts), where she carried out post-doctoral research into measuring tectonic movements through GPS at the Center for Astrophysics (CfA) at Harvard University and the Smithsonian Institution (2003-2005). She then returned to Spain, to the IEEC with a Juan de la Cierva grant (2005-2007) and then to the ICE-CSIC with a Ramón y Cajal contract.

In the context of her research... she has undertaken a plethora of experiments to test out the techniques she has worked on.

Apart from the results, these have produced a pile of anecdotes and bizarre memories, ranging from the nervousness of having to carry a NASA receiver to Sicily for stratospheric balloon flights to surviving on ripe strawberries while driving a motor-home along the California coast. They also included getting air sick while handling complex instruments on the light planes used by the Cartographic Institute of Catalonia and getting 'lost' at a military canteen on a French airfield.

Among her scientific achievements, one of those that makes her most proud is having designed a new concept for measuring intense atmospheric precipitation through GNSS polarimetry. It was demonstrated successfully in a unique experiment on board Hisdesat's PAZ satellite. She has also reached agreements with the NOAA (the US National Oceanic and Atmospheric Administration) to distribute data from the experiment to meteorological services around the world, which has been carried out without interruption since autumn 2019.

She works in the Space sector because... it is a privileged place for observing and getting a better understanding of the different inter-linking phenomena that dictate the

behaviour of our planet. It is also an area where it is expensive to operate. "Finding solutions that cut costs while increasing and optimizing the capabilities of observing and understanding our world is the challenge that motivates me to work in this sector."

Text: Oihana Casas, Guillermo Cayado and Araceli Serrano.

"It's a privileged place for observing and getting a better understanding of the different inter-linking phenomena that dictate the behavior of our planet"



Javier Cacho

Satellites revolutionized polar exploration

A little over 100 years ago two groups of men competed to be the first to reach the heart of Antarctica, the geographic South Pole. The story is well known: the Norwegian team led by Roald Amundsen achieved its goal, while the British one, under the command of Captain

Scott, managed to reach the mythical point but perished on its return journey, only a short distance from a base where their companions awaited them. Unaware of the tragedy that was befalling Scott and his team, they could do nothing to go out and find them.

Just a few years later the ship that carried Shackleton's expedition to the Antarctic became trapped in ice, which ended up crushing and sinking it. Those aboard were forced to trek across the surface of a frozen sea that each day threatened to engulf them. For almost two years the rest of the world knew nothing about what had happened to them and therefore did not know where to go to find them.

The two stories touched the world and have become part of collective imagination. Hundreds of books have been written about Captain Scott, while in the case of Shackleton his determination to save his men turned him into the archetypal leader. His behaviour is studied in many university business schools.

But these two adventures would not be remembered if the protagonists had been able to rely on a telephone connected with a satellite, one that

would have enabled them to call for help.

POLAR EXPLORATION IS NOT WHAT IT USED TO BE

In the last few decades technology has revolutionized all fields of human activity: agriculture, industry, services and even our personal habits. Polar exploration is no exception to this trend. If we look at the equipment that was used during the so-called Heroic Age of Polar Exploration (a period extending from the last years of the 19th century to the first decades of the 20th) the changes were substantial.

Furs for clothes have been replaced by new materials that are lighter and more comfortable, ones that allow the skin to breathe and insulate better against the wind and the cold. The large, heavy wooden sleds and metal skates have given way to others of

plastic that are far lighter and ultra resistant. The monotony of meals that consisted solely of pemmican- the polar food par excellence, has yielded to freeze dried products that offer as much variety as a restaurant. We can carry on listing the significant changes in tents, sleeping bags, boots and gloves.

Javier Cacho is a scientist and communicator. An expert on the history of polar exploration, he has written such popular books as "Amundsen-Scott, la Carrera al Polo Sur" (The Race to the South Pole) and "Shackleton, el indomable" (the indomitable).

Despite the advantages that each and all of these advances brought to the explorer, none of them has been as significant as that offered by satellites. Clothes may be more comfortable, sleds and skis lighter, and the food much more varied and nutritious and all these new developments have made it easier to face up to the hard climatic conditions of the polar regions. But nothing has brought such a substantial advance as that provided by the Space sector.

While the maps of that era were full of blank spaces – that's to say unexplored or little known territory – for some years now satellite images have enabled us to know in detail the difficulties and dangers that explorers are going to find. This helps them seek out alternative, safer routes.

Explorers in those days had to fix the coordinates of the place where they were by using a sextant to take measurements from the Sun, as long as it wasn't hidden by clouds. Later on, usually after they had set up camp, they had to convert these measurements to find their latitude and longitude, enabling them to locate their position on the map. That took them two hours of tedious mathematical calculations with trigonometry tables, keeping them awake when they needed to sleep to recharge their batteries.

Nowadays, on the other hand, a simple GPS enables them to know immediately where they are without worrying whether the Sun is hidden behind clouds, down to the nearest metre. The same system guides them along routes established by their predecessors, even enabling them to walk blind if in fog or a blizzard.

If these advances, along with a few others, are important, there is one that represents a completely new dimension, telecommunications.



STAYING IN CONTACT

During the Heroic Age of Polar Exploration, when a ship left port it severed its umbilical cord with the world. It disappeared completely, as if it had entered another dimension, only returning when it came back to port. The crew's families, friends and sponsors didn't know how the expedition was going, just as they didn't know what was happening in their country or the rest of the world.

With the arrival of the wireless telegraph and then the radio, things started to change a little. As the equipment was big and heavy it could not be used by the explorers on their treks, but at least it enabled their base to keep in contact with the rest of the

planet. No longer were they so isolated.

While telephone communications spread right around the planet in the 20th century, enabling people to talk by phone to the most out of the way places, things didn't move so quickly in the polar regions. The first time I went to the Antarctic, in the 1980s, I communicated with my family via radiotelegraph, using Morse code. Alternatively you could use radio stations, which were a considerable improvement, although if anyone connected to that frequency they could listen in to your conversation. Fortunately, with the proliferation of satellite networks, it was all set to change.

Now it is inconceivable that a group of explorers would leave their base to

“A phone call from Captain Scott would have enabled people to go to his team’s rescue”



go deep into the frozen continent without taking a satellite phone, as well as GPS and a radio beacon. They can communicate at any hour with their operations base to tell them about their movements or any difficulties they have had. Every night they can talk with their families, calming their mutual worries. They will receive daily weather forecasts to help plan their activities the following day. And if anybody falls ill, telemedicine allows them to send vials to a specialist to receive an assessment.

If this were not enough, if an accident occurs they can give the exact position as to where they can be found. Even if the communications systems break down and there’s an emergency they only have to activate the ra-

dio beacon and the COSPAS-SARSAT network will receive their call for help and activate a rescue operation.

THE ADVENTURE HAS ONLY JUST BEGUN

Clearly it is not possible to take an instrument from our era back to the past. But if we could do it, a phone call from Captain Scott would have enabled people to go to his team’s rescue. As a matter of fact, a support group had been waiting for them for several days, 20 kilometres from the point where they died. The story of Shackleton could also have been very different. A radio beacon on his ship would have alerted people of the tragedy that was taking place and sparked a rescue operation.

We cannot travel in time or change history. What happened to those explorers and the way they confronted adversity will always be an example to follow. Each era has its own technology, which in part configures our challenges as a group. Stories such as those of Scott and Shackleton in the polar regions may never be repeated, but the curiosity for penetrating the unknown and the human being’s spirit for overcoming adversity is the same. We need to find another place to deploy the thirst for adventure that we carry in our genes. That place is the solar system and even the universe. The adventure continues.

"IT WOULD BE BORING IF WE GOT TO KNOW IT ALL. AND SCIENTISTS WOULD BE LEFT WITHOUT ANY WORK. HUMAN BEINGS NEED TO EXPLORE AND DISCOVER"

W From a process engineering point of view one could see my work as turning coffee into scientific articles"

INTERVIEW

Héctor Socas

Researcher at the Institute of Astrophysics of
Canary Islands and director of the Museum of
Science and the Cosmos of Tenerife

HOW WOULD YOU DEFINE THE IAC?

It is an international research centre whose objectives are: 1) the advance of human knowledge about the Universe and our place in it; 2) promoting the development of new technologies and transferring them to society; 3) spreading scientific knowledge and culture; 4) protecting world heritage, which involves the sky over the Canary Islands; and 5) operating the international observatories in the Canary Islands.

WHAT ARE THE FUNCTIONS OF THE INSTITUTE AND WHAT DO YOU LIKE MOST ABOUT YOUR JOB?

I am a scientific researcher. From a process engineering point of view one could see my work as turning coffee into scientific articles. Of course the work of a researcher also takes on other aspects such as managing groups and resources within the framework of research projects, leading doctoral theses and dissemination. What I like best is, without doubt, the initial phases of any research work, when you come up against new problems and have to explore ways of handling them.

TELL US WHAT DAILY LIFE AT IAC IS LIKE

There are many types of different jobs, depending on the posts. At IAC there are people who work in engineering, graphic design, scientific communication, administration, etc. In my case, the day to day of a researcher is fundamentally office work. Many people have a rather romantic vision of an astronomer as someone who spends the day isolated on a mountain top peering through a telescope, but the reality is very different. Professional telescopes are very much in demand from researchers all round the world and the competition for getting access at observation times is very tough. Every year the selection committee receives many observation proposals and assigns times to the different groups in relation with how interesting they regard their projects. In the end, what interests both the observatory and the owners of the telescopes is that they make optimum use of them and make as many advances as possible. Most astronomers are going to see something

like that once a year or on very few occasions, some almost never. It typically takes several months to prepare a good observation proposal, which includes calculations that demonstrate what they aim to observe is viable with the instrumentation requested. And after an observation, analyzing all the data and reaching scientific results usually takes about a year, sometimes several years. In my case, most of my time is spent developing and applying numerical codes, computer programs that make calculations with which we can extract information from the data. An important part of the time is also spent on other tasks, such as writing research articles, preparing conferences, meetings with colleagues, reading up specialized literature and, in many cases, work linked to management, writing reports etc. Some colleagues also dedicate time to disseminating their work or teaching in universities.

TELL US ABOUT THE ADVANTAGES OF THE CANARY ISLANDS COMPARED WITH OTHER REGIONS FOR AN INSTITUTE LIKE YOURS

The natural conditions in the Canary Islands make it an optimum site for astronomical observations. The presence of high mountains in the middle of the ocean, which have a stabilizing effect, and the continual blowing of trade winds make for slopes where you find a high percentage of clear nights in a year. They are protected by a sea of clouds from artificial lights and have an extraordinarily stable atmosphere. I believe the IAC has been an example to follow in that it has not only limited itself to exploiting a natural resource but used that resource as a lever for training a generation of first rate researchers to promote the development of a cutting edge research centre.

CAN ALL THE STARS HAVE PLANETS?

We don't know if all the stars have planets but it seems planets are very abundant and that they can be found with all types of stars. Among the major challenges of astrophysics over the next decades will be understanding the distribution of planets around the different types of star and defining the atmospheres of those closest to us.

6. - What are optical communications?

They involve using light to transmit information. Today we can use fibre optics for sending a shaft of light between far flung points. As light has a frequency much greater than radio waves, you can send much more information per second. You can also use lasers for wireless communications, with hardly any losses. Given that the photons that make up light are quantum systems that are relatively easy to manipulate, we can carry out quantum interlinking operations between different photons for developing new systems of security guaranteed cryptography and communications. IAC has done some long distance quantum interlinking experiments between the Canary Islands of Tenerife and La Palma. These have enabled us to verify the predictions of the



Supernova remnant:
Image Credit: Daniel López/ Alfred Rosenberg (IAC)

theories and to carry out studies connected with these technologies that we will likely be seeing as commonplace in the future.

COULD THERE BE DIFFERENT SYSTEMS TO OURS IN THE UNIVERSE WITH ANOTHER ARROW OF TIME OR WITHOUT SPECIFIC TIME?

According to our current theories, no. But of course we have no guaranties that they are correct, to the point where one can give an absolute answer. There are theories that speak of this type of situation but normally they revolve around "other universes" and in the context of very speculative ideas, without any evidence that substantiates them.

COULD DARK MATTER CONSIST OF ROCKS?

Almost certainly, no. There are different signs and evidence that points to dark matter not interacting with life or with ordinary matter. Most of these clues come from cosmology. The current cosmological model sits perfectly with the observations that have been made and this model assumes the same quantity of dark matter that is me-

asured in the galaxies. If dark matter were made up of atoms, then there wouldn't have been enough time in the history of the universe to form the structures and the distribution of the galaxies that we see today. There are almost 10 similar arguments that point to a dark matter without interaction with ordinary matter and always in the proportion of approximately 80%-20%.

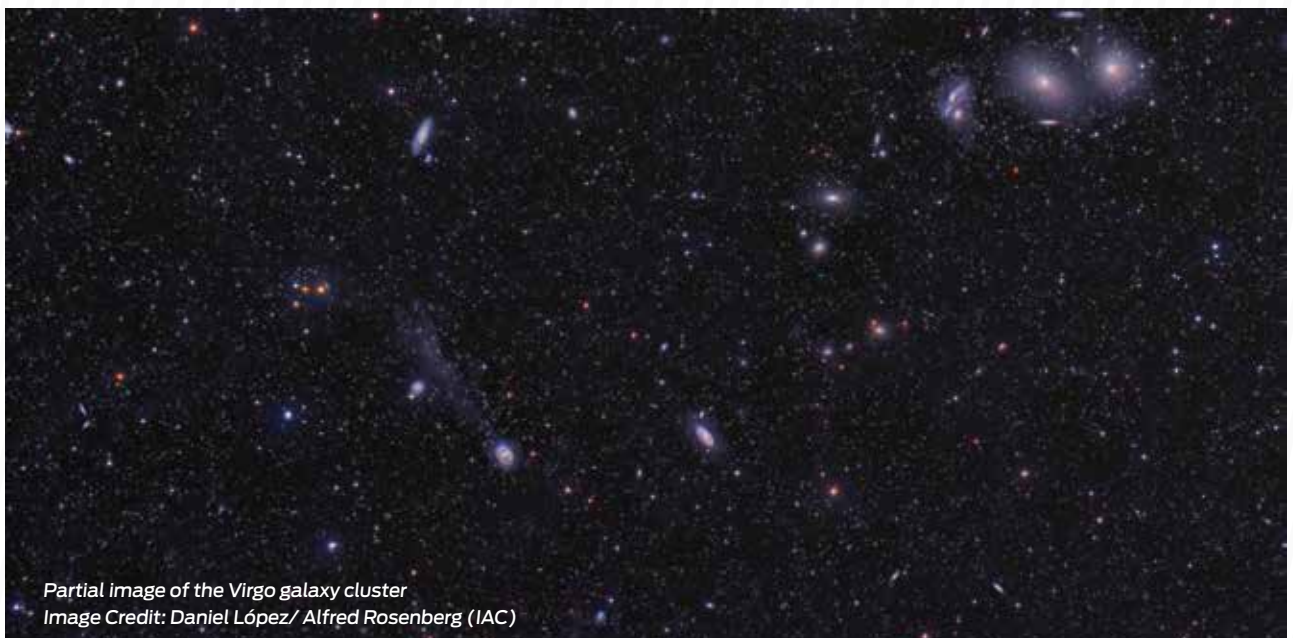
WOULD SCIENCE BE BORING IF ALL OUR THEORIES WERE CORRECT FROM THE START?

Douglas Adams said in "The hitchhiker's guide to the galaxy" that there's a theory that if one day we learn all there is to know about the Universe it would change immediately to become something completely different and indecipherable. He also said that, according to another theory, this had already happened. Yes, it would be boring if we got to know it all. And scientists would be left without any work. Human beings need to explore and discover.

IS THERE LIFE IN ANOTHER PART OF THE UNIVERSE? ON MARS COULD THERE BE LIFE IF WE LOOK IN THE RIGHT PLACE?, AND ON THE MOON?

We have no sure answers to these questions. But, based on the little we do know, I can dare to speculate. To the first question I would say almost certainly, yes, although it could be so far away that we never get to find it. As for Mars, it's a possibility. In the past it was even more habitable than Earth. It once had a dense and warm atmosphere, with oceans and rivers of liquid water. It's possible that it could have developed some form of life that was later extinguished when the planet changed and turned into the wasteland that it is today. It is also possible that some sort of residual microbe life could have survived in the subsoil. On the Moon, it doesn't seem very likely. But we really know so little about astrobiology that it's difficult to take anything for granted.

W The natural conditions in the Canary Islands make it an optimum site for astronomical observations"



ON COURSE FOR THE SPACE LILIPUT

The search for new ways to democratize the commercialization of Space is constant, versatile, and suggestive and is generating a climate of confidence for the development of innovative ways of accessing Space.

Thanks to the reduction in costs of electrical components it is now possible to build small satellites that are fuelling progress in the low earth orbit. These provide for connectivity capacity for the whole world, the use and exploitation of Earth observation data and access to cheaper launchers such as those proposed for the Space X, Rocket Lab and PDL Systems.

The users of these systems are many and varied, spread out among universities, governments, entrepreneurs, researchers, operators of critical infrastructure and all sorts of companies. We are talking about small satellites, miniature at times, that are transforming the Space industry and bringing it closer to society.

Satellites with a weight of between 1 and 10 kgs are known as nano satellites. They comprise: CubeSats, Pocket-Qubes, TubeSats, SunCubes, ThinSats and pico satellites (non standard). Let's analyze some recent figures from the European nano satellite database

to get a better idea of the market they cover (<https://www.nanosats.eu/#figures>):

- Nanosats launched: 1,417
- CubeSats launched: 1,302
- CubeSats interplanetary: 2
- Nanosats destroyed at launch: 93
- Maximum of nanosats on one launcher: 103
- Countries with nanosats: 68
- Companies in the database: 518
- Forecast: Nearly 2,500 nanosats will be launched in the next six years.

Nanosats launches



WHAT IS A CUBESAT?

Its origins are strange. Engineers Jordi Puig-Suari from Spain and Robert Twiggs from the United States designed some small cube-shaped satellites at the end of the 1980s to help in teaching their students. By 2003 they had started out on their Space adventure, supported by universities and governments. Emerging from this background of education and university, CubeSats constitute a major technological leap that has revolutionized Space. They are made from standard cubic units, (1U), measuring 10cmx10cmx10cm and the number depends on the mission. Usually it is between 2 and 12 (1.5U, 2U, 3U, 6U), with a weight of between 1 and 10 kgs. They are fitted with solar panels, a camera, batteries, transmitters, sensors, small drivers etc. This way it is possible to have them ready to jump into Space in just one or two years, with a variety of payloads and a working life of up to 10 years.

That enables costs to be reduced for both manufacturing and launching, as they can travel into Space along with other missions in the additional cargo space that is available on rockets. They are packed into containers and are ejected into Space at the push of a button, using a spring system. A similar technique is used to deploy CubeSats from the International Space Station (ISS), from the Japanese module, Kibo.

Currently they are used in tasks such as remote sensing, communications, geopositioning, climatology, greenhouse gas emissions, agricultural controls, etc, but now they have started out on an interplanetary adventure, reaching the Moon, Mars and other distant places.

SOME OF THE MISSIONS

In the last five to 10 years the European Space Agency (ESA) has become involved in promoting the construction of Cu-

beSats and successfully participated in some missions.

Some of the interesting ones include: The HERA mission, scheduled for launch in 2024, is ESA's contribution to the international collaboration on Asteroid Impact and Assessment (AIDA). NASA's DART impactor will hit the moon of a system of binary asteroids called Didymos. Hera will observe the effects of this to enable the study of this type of asteroid deviation. Its objectives are to: demonstrate technology in interplanetary Space, investigate mitigation techniques on objects close to Earth and gather new knowledge about the evolution of the solar system. Hera will be accompanied by two CubeSat explorers of six units, which will give European scientists their first opportunity of operating CubeSats in Space.

Through the Fly element of its general technological support programme, ESA is developing the Miniaturized Asteroid Remote Geophysical Observer (M-ARGO). The concept of M-ARGO was explored for the first time at ESA's design installations through a discovery and preparation study. Planned for launch in 2023, the mission will test the potential of miniaturized technology for minimizing the costs of Space exploration.

The two unit Sunstorm CubeSat (from the Finnish Reaktor space laboratory with the payload from a Finnish-British consortium) will be launched in 2021 to demonstrate a highly miniaturized X ray flux monitor technology (XFM) for monitoring and forecasting climate in Space.

OTHER PROJECTS

NASA is carrying out an extensive technological programme for small spaceships, as well as a launch initiative for CubeSats. Previous CubeSats selected have studied objects close to Earth, Space

climate and the Earth's atmosphere among others.

Starting from 2018, NASA launched its first pair of CubeSats designed for deep Space: Mars Cube One or MarCO. Both satellites were carried aboard the rocket that launched InSight, NASA's latest landing module for Mars. The MarCO CubeSats tracked InSight on its cruise through Space, each of them transmitting data to Earth when the landing module entered the Martian atmosphere.

GTOSat is another CubeSat mission – of 6U – under development and scheduled for 2021. It is targeted at opening up the way for high fidelity and capacity CubeSat constellations and missions beyond Low Earth Orbit (LEO). It will study the dynamic radiation belts of the Earth, acting as a follow-up mission to NASA's Van Allen Probes, and demonstrate the potential usefulness of small satellites both for science and the monitoring of Space climate. While several earlier CubeSats have studied the radiation belts of the LEO, GTOSat will be launched into a low inclination geostationary transfer orbit (GTO) for studying directly the number of particles trapped in the nucleus.

The CubeSats launched from the ISS use the Japanese Kibo module. The Japanese Space Agency has worked with the United Nations Office of Outer Space Affairs (UNOOSA) to start up Kibo-CUBE, a project that offers developing countries the opportunity to deploy their own CubeSats from the ISS.

“ Nearly 2,500 nanosats will be launched in the next six years”





Towards a New Era of Exploration

- For the last 30 years the Hubble telescope has fundamentally changed our understanding of the cosmos, and its story
- After the Voyager spacecrafts, Cassini offers new data on Enceladus, one of Saturn Icy Moons. To be followed by the discoveries that Juice and Europa Clipper missions will bring us on Jupiter's icy moons.
- We keep learning about Mars, awaiting for ExoMars and Perseverance.
- New cargo and crew transportation vehicles help us get ready for the challenges of the Moon and Mars exploration programs as they pave the way towards the emerging space-economy.

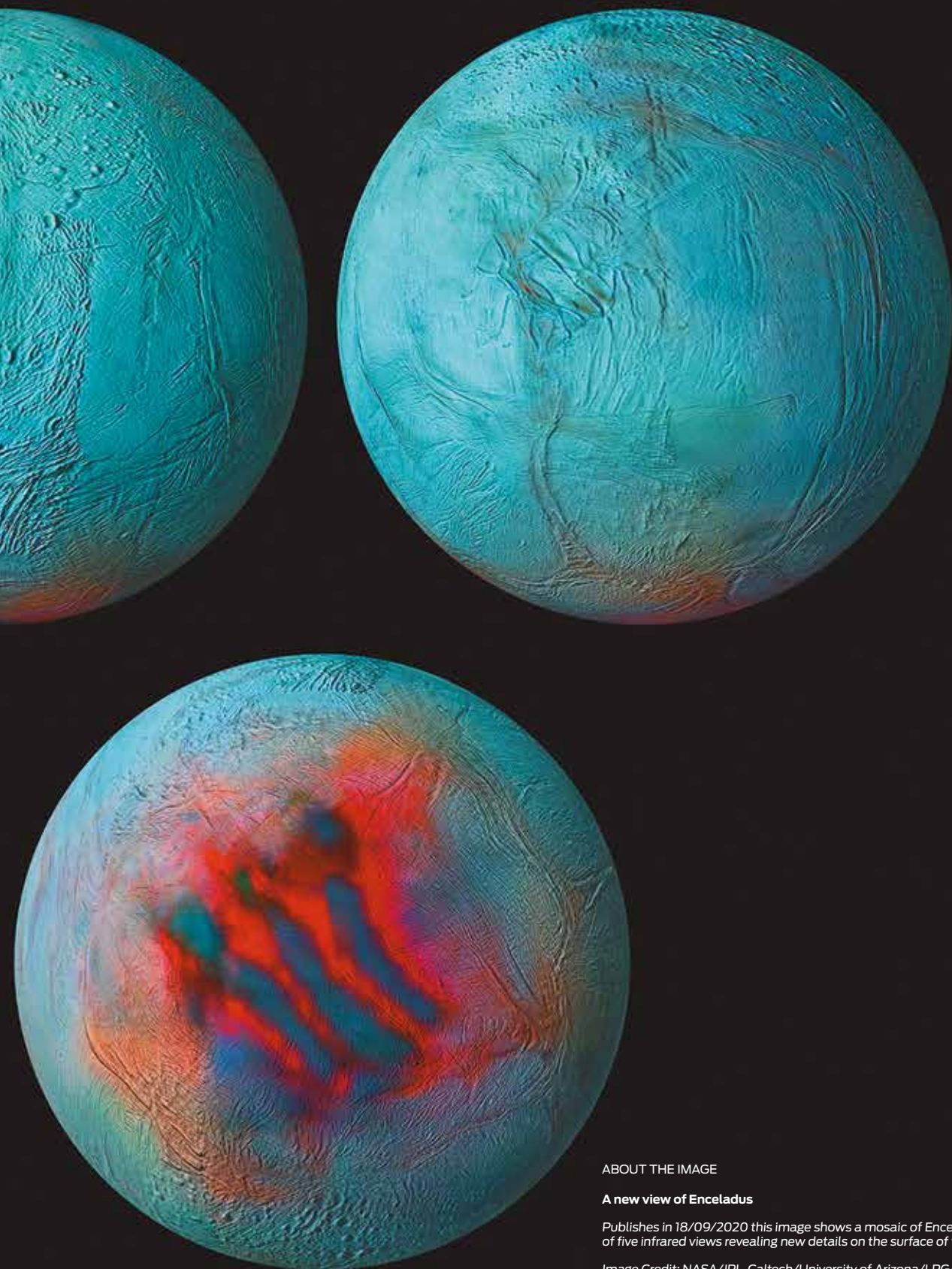
ABOUT THE IMAGE

Tapestry of Blazing Starbirth

The portrait features the giant nebula NGC 2014 and its neighbour NGC 2020 which together form part of a vast star-forming region in the Large Magellanic Cloud (Hubble 30th Anniversary)

Image Credit: NASA, ESA, and STScI





ABOUT THE IMAGE

A new view of Enceladus

Published in 18/09/2020 this image shows a mosaic of Enceladus composed of five infrared views revealing new details on the surface of this moon.

Image Credit: NASA/JPL-Caltech/University of Arizona/LPG/CNRS/University of Nantes/Space Science Institute

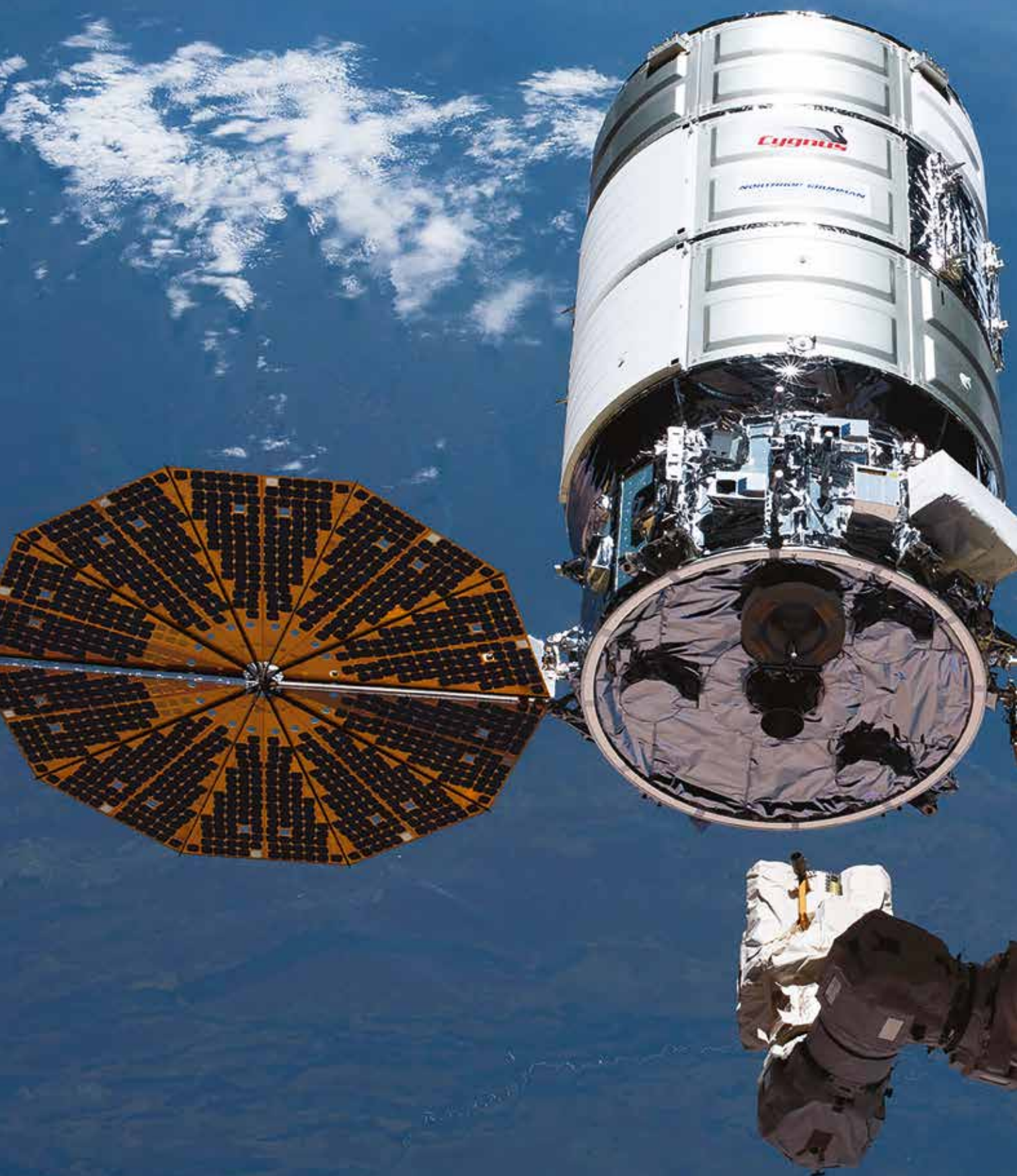


ABOUT THE IMAGE

Dune fields in Mars' Green Crater

The image, taken on 27 April 2020 shows part of an impact crater located inside the larger Green Crater in the Argyre quadrangle in the southern hemisphere of Mars.

Image Credit: ESA/ExoMars/CaSSIS





ABOUT THE IMAGE

Cygnus Cargo Spacecraft at the ISS

The U.S. Cygnus space freighter is pictured as the Canadarm2 robotic arm, reaches out to grapple the 12th Cygnus resupply ship sent to the ISS. (November 4, 2019).

Image Credit: NASA

TEDAE MEMBER COMPANIES EARNED SPAIN 20.63 BILLION EUROS IN 2019

Auditors KPMG have drawn up a report for TEDAE on the economic and social impact of the Defence, Security, Aeronautics and Space industries on the Spanish economy, one that showed that they contributed 20.63 billion Euros to the country's GDP in 2019. It also highlighted that the industries have grown exponentially over the past 10 years and that in 2019 they accumulated more than 14 billion in billing. The figures demonstrate that the industries represented by TEDAE have an ever growing and more relevant presence in the national GDP (1.7% in 2019).

ECONOMIC IMPACT

The Defence, Aeronautics, Security and Space industries play a fundamental role in economic growth and recuperation in the medium term. They are an economic motor that generates wealth thanks to their supply chain, as it also has the capacity to give an impulse to other sectors of the economy. That is reflected in the figures for 2019, a year in which the indirect effect on other economic sectors rose to approximately 7 billion Euros and the induced amount – thanks to salaries and the repercussion on other

related industrial sectors - reached over three billion Euros.

GENERATING EMPLOYMENT

As for generating work, more than 200,000 people have a job related with the aeronautics sector, between direct, indirect and induced labour. What is more, they are quality jobs, given that the average gross salary in the industries represented by TEDAE is 42,854 Euros a year, 83% higher than the national average. That is key in attracting and retaining talent and maintaining industrial competitiveness.

RESEARCH AND DEVELOPMENT

The high investment in R+D is also reflected in the KPMG report. Member companies of TEDAE are at the forefront of investigation, even ahead of other leading sectors such as pharmaceuticals and vehicles.

In 2019, the Defence, Aeronautics, Security and Space industries were one of the main motors of innovation and development in Spain, with direct activity estimated to be worth some 1.12 billion Euros. But when you add in the tractor coefficient that generates a total of over 2 billion Euros invested in R+D+i.

Investment in projects connected with the aeronautics industry has a big impact on society and maintaining

it is key for Spain to be a benchmark country in innovation. Innovation is a key lever for maintaining the competitiveness of the country.

FISCAL IMPACT

The report also records the taxes levied from member companies of TEDAE. In 2019 they rose to 2.5 billion Euros, equivalent to 1.19% of the the national tax take. To that can be added the corresponding income tax paid by employees working in quality jobs created through the aeronautical industry and company taxes.

With these figures, Ricardo Martí Fluxá, president of TEDAE, believes that Spain needs to promote these industries more. "We are far from what we should represent in the GDP of a country that has an ambition to progress. What is needed is a national strategy to strengthen those sectors that generate more wealth in both productivity and pay".

Begoña Cristeto, the partner responsible for vehicles and industry at KPMG, says the study highlights why the industries represented by TEDAE are strategic for Spain in the creation of quality jobs and their contribution to R+D+i. And at a key moment for attracting European funding, how the report will be a tool that will help government bodies to understand the social and economic impact of TEDAE's sectors when making decisions.

Main Space variables

	Military Space	Civil Space	Total Space
Turnover (in 000s of Euros)	171.667	795.366	967.033
Contribution to GDP	0,03%	0,11%	0,13%
Total multiplier	2,39	1,97	2,04
Jobs	1.071	15.831	16.903
Investment in R+D+i (in 000s of Euros)	2.488	164.585	167.072

UNITED ARAB EMIRATES TO ORBIT MARS

THE UNITED ARAB EMIRATES (UAE) launched its first Space probe, called Hope, to Mars last July.

It was taken up by a Japanese H2-A rocket from the Space centre on the island of Tanegashima and is due to reach its destination in February 2021, coinciding with the 50th anniversary of the formation of the UAE.

NASA's Deep Space Antenna at Robledo de Chavela (Madrid province) is part of the ESA network that is in contact with the probe.

With this mission, The United Arab Emirates aims to join the group of countries that have so far reached the red planet.

It is among those countries that took advantage of the window of opportunity that opened between July and August for the launch. At that time the distance between Mars and Earth was

only 55 million kilometres, compared with the average of 225 million kilometres.

Hope will orbit the planet for at least three years in an unusual trajectory that will take it as close as 20,000 kilometres from the planet's surface before moving out to 40,000 kilometres. That will enable it to obtain images of the complete planet and its atmosphere, observing its daily changes, while also getting closer imagery.

The objective of the mission is to throw light on what caused Mars to lose most of the atmosphere that once protected it at some point in its history, turning it into the frozen desert that we know today.

Hope will study how energy moves through its atmosphere throughout a day over all the seasons, combing the dust in suspension that has so much influence on Mars' climate and temperature.

It will also analyze the behaviour of the neutral atoms of hydrogen and

oxygen in the upper part of the atmosphere, which it is believed could have played an important role in the erosion of the atmosphere.

To do this, it carries a visible and ultraviolet light camera with two spectrometers, one infra red and the other ultraviolet. All the data it collects will be published immediately so that other countries can access it.

Hope will also be able to facilitate communication between rovers on the Martian surface and Earth.

The project forms part of the Emirates' efforts to develop a diversified economic model based on knowledge, with which they want to attract talent and encourage careers.

The probe has been designed and built in the USA with the participation of professionals and students from the Emirates. The scientific goals have also been established with US help from NASA's Mars Exploration Program Analysis Group (MEPAG).

AT



PERSEVERANCE: SPANISH TECHNOLOGY ON ITS WAY TO MARS AGAIN

NASA'S ROVER PERSEVERANCE

is on its way to Mars to study the planet's climate and geological structure and to seek traces of microbiotic life that could have lived there in the past. To do this it is relying on the support of highly advanced technology from Spanish Space companies like Airbus Defence&Space, Crisa (Airbus D&S), Alter Technology Tüv Nord and Sener Aeroespacial, as well as the Centre for Astrobiology (CAB), INTA, the University of Alcalá, the Polytechnic University of Catalonia, the Microelectronics Institute of Seville, the Rocasolano Institute of Physical Chemistry and the University of the Basque Country. The rover vehicle will also be collec-

ting samples of sediments and rocks and storing them for a possible trip to Earth on a later mission.

Perseverance took off on 30 July from the Cape Canaveral air force base in the United States aboard an Atlas V launcher, the start of a voyage that will deliver it to Mars on 18 February 2021.

It will do so in the ancient Jezero crater, a place of special interest because it is believed that thousands of years ago it hosted a large lake in which microbiotic life could have lived.

To descend to the planet in a specific spot, Perseverance has its own landing and navigation systems. These enable it to identify its position and correct its course while in the air.

It also has an onboard laboratory for studying the process of entry, descent and landing on Mars, a key factor in the safety of future crewed missions to the planet.

Once it has landed, the autonomous power system will enable the rover to

move around without waiting for instructions from scientists on Earth.

It will then start its exploration with the aid of seven different scientific instruments. One of these is the Mars Environmental Dynamics Analyzer (MEDA) which has been completely designed and built in Spain. On top of this the high gain antenna the rover carries to communicate with the orbiting spaceship and send out data is also entirely Spanish made and the most advanced in the world.

The Centre for the Development of Industrial Technology (CDTI) has collaborated in the funding of the project and managing relations with NASA while the Ministry of Science, Innovation and Universities has also contributed funds.

Other key instruments for the mission will be the Sherlock scanner for detecting organic material through the Raman technique and luminescence, and the PIXL system for measuring the composition of rocks and soil.

Both systems will enable mapping of organic material, the chemical composition and texture to a level far higher than any other vehicle that has been to Mars before.

In another development, the Moxie experiment will look at generating oxygen from carbon dioxide, which will also be a big step forward for future missions.

The rover is equipped with a small helicopter called Ingenuity, which will be the first aircraft in history to fly on an extra-terrestrial planet.

Weighing just 1.8 kgs, it has four blades fixed to two 1.2 metre long shafts, which will revolve at a speed of around 2,400 revolutions per minute, eight times faster than those of a standard helicopter.

With these it will aim to fly in an atmosphere with a density equivalent to 1% of what we have on Earth, a third of our gravity and temperatures of some 90 degrees Celsius below zero.

Antonio Tovar



GRAVITATIONAL WAVE DETECTORS

PUT KNOWN ASTROPHYSICS INTO DOUBT

THE GRAVITATIONAL WAVE detectors at the Virgo (Europe) and Ligo (United States) observatories have made a surprising discovery. They have identified a compact object with a very unusual mass, of between 2.5 and five times that of the Sun, generating big questions and putting into doubt what is known about astrophysics.

Until now observations had left a gap between these two magnitudes that were considered to be too small to be a black hole and too big to be a neutron star.

But on 14 August 2019, the two detectors recorded a movement in the

fabric of space time generated 800 million years ago by an object that merged with a black hole measuring 23 solar masses and which ended up creating a black hole some 25 times bigger than the mass of the Sun.

The object that collided with that black hole would have had the amazing mass of around 2.6 times that of the Sun, which leaves scientists wondering if it could be the heaviest neutron star detected so far or the lightest black hole discovered so far.

Another surprise was the difference between the two objects that collided, one being approximately nine

times the size of the other.

After detecting this event, the Virgo and Ligo observatories launched an alert to the whole astronomy community to comb through, as they have done on other occasions, the zone from which the wave came, to see if they could detect any more flashes or signs.

However, in this case none of them were able to register signals in the radio electronic spectrum. News of the discovery was published last June in the magazine, *The Astrophysical Journal Letters*.

CHAIN OF SUCCESSSES AND DISCOVERIES

AFTER THIS SURPRISING FIND, last October the Virgo and Ligo network announced that in the third period of observation that was carried out between April and October 2019, they had registered no less than 39 events in which gravitational waves were generated.

Most of them corresponded with black hole fusions, although the characteristics of some of them "question the established models of astrophysics and open up new scenarios" say scientists from the Virgo observatory.

Among the detections were 36 fusions of black holes, a possible fusion between a binary system of neutron stars and two systems that were probably composed of a black hole and a neutron star.

The publication gives for the first time a "complete image of the extraordinary number of signals from gravitational waves and their sources, a quantity of observations and data on the physics of a black hole that it would have been difficult for us to imagine just a few years ago", the researchers stressed.

The existence of gravitational waves, which had been foreseen by Einstein, could not be proven until 2015.

The rapid increase in the number of detections has been possible thanks to significant improvements in the instruments used compared with those of previous observation periods. Among these improvements is an increase in the power of lasers, better mirrors and especially the use of quantum squeezing technology.

ESA IS LOOKING FOR NEW IDEAS AND WANTS TO HEAR WHAT YOU HAVE TO OFFER

THE ESA WANTS to hear some new ideas and has opened a competition that enables anyone who wants to propose new types of mission to be carried out in the future.

Secondary schools, research centres and companies are all welcome to send in their ideas, but this time the agency also wants to pay attention to proposals from members of the public with a scientific spirit.

To pass on your ideas you only have to enter the agency's Open Space Innovation Platform (OSIP), where you will find all the necessary information.

For the agency's director general, Jan Wöerner, "it is the moment to

sow the seeds of the next missions and Space projects. On this occasion we are probing the knowledge, competitiveness and creativity of the industry, academic and scientific centres to identify the best ideas beyond our own planning".

The reach of future Space missions is practically infinite and could be outside the ESA's current framework, but will always have to fit in with the agency's assigned mandate.

They could focus, for example, in resolving a particular scientific question, looking at the world from another perspective, or looking at new ways to access Space.

New technology can also be the basis of a mission, as is the case with the Biomass Earth Explorer mission that will map out all the Earth's trees through an innovative P-band synthetic aperture radar system.

New operating methods could also be tested, such as the double sate-

llite Proba-3. This will carry out precision formation flights to create an artificial eclipse in orbit and in doing so be able to improve observation of the Sun's corona.

Some missions are aimed at setting up services from Space, as happens with ESA's telecoms missions. The recent launch of the ESAIL micro satellite is a good example. It uses identification signals emitted automatically by ships as the basis of a global maritime tracking service.

Smaller missions tend to be the most experimental, as is the case of the CubeSat ones, carried out with containers the size of a box of 10 cubic centimeters and above. The journey of twin CubeSats to test rendezvous and coupling manoeuvres in Space and the PRETTY Project, which uses reflected signals from navigation satellites to collect details of the Earth's environment, are two such cases.

MISSIONS FOR TODAY AND TOMORROW

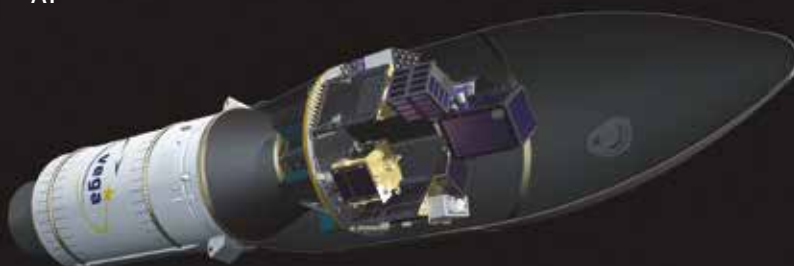
ESA HAS ROBUST plans for each of its areas of activity, as well as a long term one that covers the next 10 years. Nearly of all its current missions and programmes were drawn up, studied and prepared as part of the agency's preparation elements, where all the mission concepts are born.

Approximately every three years the future missions to be carried out are decided by ESA's Interministerial Council. This follows a preparation element meeting, one of ESA's basic activities for supporting informed decisions with studies.

These mission studies provide a resumé of all that is needed to make it viable ahead of carrying out a detailed design plan.

AT

"The reach of future Space missions is practically infinite and could be outside the ESA's current framework"



FUENTE: ESA



"The first image to be captured was a stellar field centered on HD 70843, a white star situated 150 light years away"

FOLLOWING ITS LAUNCH on 18 December last year, the Cheops (Characterising Exoplanet Satellite) uncovered the cap on its telescope six weeks later, "opening the eyes" of a mission aimed at observing stars known to have exoplanets circling them and which could host some sort of life.

It is a mission with a strong Spanish influence, given national companies represent seven of the 24 European participants. They are GMV, Iberespacio, Sener Aeroespacial, CRISA, Inventia Kinetics, and HV Sistemas with Airbus España as the lead con-

tractor. And while the initial operations and telemetry of the launch were tracked from the ESA station at Kiruna (Sweden), the centre of operations and ground support from which the satellite is now controlled is located at the INTA installations at Torrejón de Ardoz (Madrid province). The first image to be captured was a stellar field centered on HD 70843, a white star situated 150 light years away, which enabled the tracking team to check that the mission was working to perfection.

Fortunately, getting Cheops into service was not affected by the health

CHEOPS, A YEAR STUDYING EXOPLANETS

crisis caused by the corona virus, thanks to the social distancing measures and restrictions on movement introduced in Europe to avoid the expansion of the virus. The ground segment started to function very quickly, allowing for complete automation of the process of getting the satellite into service, which kept the impact of the crisis to a minimum.

Cheops' first discovery was a gigantic gassy planet which was named WASP-189 b. It is one of the hottest ones discovered to date and is situated 20 times nearer to its star than the Earth is to the Sun. The satellite watched as the exoplanet moved around its star, providing information on its size and density.

Cheops has another two and a half years of operational life ahead of it, to keep characterizing the numerous exoplanets and helping scientists to deepen their knowledge of the secrets of the universe and reveal further information on what is beyond Earth.

Begoña Franco

JOSEF ASCHBACHER, NEW DIRECTOR GENERAL OF ESA FROM JULY

THE ESA COUNCIL ratified at its meeting on 17 December the appointment of Austria's Josef Aschbacher, currently director of Earth Observation at the agency, as its new Director General.

Aschbacher studied at the University of Innsbruck, from where he graduated with a Masters and a doctorate in natural science. He began his working life as a scientific researcher at the university's Institute of Meteorology and Geophysics and has three decades of experience at the ESA,

the European Commission, the Austrian Space Agency, the Asian Institute of Technology and the University of Innsbruck. In 2016 he was named ESA's programme director for Earth Observation.

The mandate of his predecessor Johann-Dietrich Wöerner finishes in June 2021 and it will be then that Aschbacher takes over as director general.

The ratification finalized a selection process led by Sweden's Anna Rathsman, director general of her country's national space agency, which saw a list of highly qualified candidates that included Spain's Minister of Science and Technology, Pedro Duque; Christian Hauglie-Hanssen, director general of Norway's space



agency, and Italian astrophysicist Simonetta Di Pippo. [BF](#)

UPM'S CUBESAT, THE BEST TEST PLATFORM IN THE SPACE INDUSTRY

The Universidad Politécnica de Madrid put its UPMSat-2 satellite into Space in September 2020.

Its aim is to demonstrate different technologies in orbit and, at the same time, to take advantage of the development and operation of the system for training its students.

As such it serves as a low cost platform for testing the equipment of Spanish companies that it carries aboard, as a prelude to their commercialization.

Among these is a miniaturized thermal switch made by IberEspacio, an experimental high sensitivity magne-

tometer designed by Bartington and a system for monitoring the effects of radiation developed by TecnoBit and Strast.

The UPMSat-2 project has cost a total of 2.5 million euros (approximately one million on its development and 1.5 million for its launch aboard a Vega rocket) and has been funded by the European Commission's Horizon 2020 programme.

Weighing around 50 kgs, the CubeSat has a useful life of two years. It has taken seven years to build and involved the participation of 70 of the university's students.

It will orbit at a speed of seven kilometres per second at an altitude of 500 kilometres, communicating via a tracking station on the university campus at Montegancedo.

The launch date was originally scheduled for September 2019, but the date had to be put back because of problems, firstly with the Vega launcher and later because of adverse weather and Covid-19. It finally went into Space on 2 September 2020 local time in Kourú, French Guiana (3 September in Spain).

The CubeSat went up with 53 other micro-, nano- and cubesat satellites, which were put into orbit with the aid of a new dispenser called the Small Spacecraft Mission Service (SSMS).

AT

"The UPMSat-2 project has cost a total of 2.5 million euros (approximately one million on its development and 1.5 million for its launch aboard a Vega rocket)"



FIRST DATA FROM THE SOLAR ORBITER

ESA AND NASA'S Solar Orbiter is enabling us to study the Sun as never before and providing the closest images ever taken of the surface of the star.

The probe was launched into Space on 10 February 2020 and is equipped with six remote detection instruments (telescopes) and four instruments that survey the area around the spacecraft.

With the data collected through these two types of instruments, scientists can study how solar wind is generated, rains of charged particles, etc. and then how they reach the spacecraft.

It is a mission with a major Spanish contribution which is already providing images and uncovering some very interesting phenomena.

It has led to tracing the first map of the Sun's magnetic field without human participation and carried out from Space thanks to the onboard magnetometer, the development of which was co-led by Spain.

The magnetic field is responsible for much of the Sun's activity, from the spots that form on its surface to the storms and the solar wind.

The camera that provides Extreme Ultraviolet Imagery (EUI) has already shown mini eruptions, known as campfires that some people are linking with the flares that can be seen from Earth, although millions if not thousands of millions of times much smaller.

These campfires could also contribute to the heating up of the Sun's corona, the outermost layer of the Sun's atmosphere which extends millions of kilometres into outer Space and has a temperature above one million degrees Celsius, far warmer than the surface of the Star itself. These phenomena have

been studied for decades and are regarded as the 'holy grail' of solar physics.

Another of the instruments on the Solar Orbiter is the Polarimetric and Helioseismic Imager (PHI) camera that is carrying out high resolution images of the lines of the magnetic field on the surface of the Sun. For the first time it is also able to collect data from the dark side of the Sun.

On its long journey to the inner solar system, the probe will reach a point just 42 million kilometres from the star, almost a quarter of the distance between the Sun and the Earth.

The data collected will start to be published within 90 days in an effort to make the mission as open as pos-

sible for the scientific community as a whole. It will be archived at ESA's European Space Astronomy Centre (ESAC) in Madrid.

TEDAE member Space companies taking part in the Solar Orbiter mission are: Airbus Defence and Space España, Alter Technology Tüv Nord, Crisa (Airbus D&S), GMV, GTD, Senner Aeroespacial and Thales Alenia Space España.

"On its long journey to the inner solar system, the probe will reach a point just 42 million kilometres from the star"



ROLAND GARROS RECYCLES WITH SPACE TECHNOLOGY

ON 20 SEPTEMBER the French Open tennis championship got out under way at the Roland Garros stadium with a technology developed for use by ESA astronauts to save drinking water on long haul missions.

It meant the water used by the players to shower could be reused thanks to a system fitted to the WC systems in the dressing rooms.

The origin of the system goes back to the Micro-Ecological Life Support System Alternative (MELiSSA) programme which, over the last three decades, has developed advanced systems to support the living conditions and recycling on crewed missions.

These days missions to the International Space Station receive supplies from Earth, but this sort of support will not be viable when astronauts venture into the depths of Space.

As an alternative, the ESA is developing life support systems, configured in a closed circuit, so that future missions can count on oxygen, water and food supplies.

The MELiSSA programme consists of projects being developed all around Europe and in Canada by companies and universities, among them the Universidad Autónoma de Barcelona.

In 2009 the programme took a major step forward with the inauguration at the Universidad Autónoma of a pilot plant for MELiSSA, an herme-

tic multi compartment system for detailing and testing different biological processes that will enable crews to keep comfortable for months.

Much of the technology developed for MELiSSA has already been used for different spin-offs.

French company FIRMUS focused on the treatment, purification and separation of recycled and waste water, developing land-based systems for recycling of so-called 'grey' waters which are those that can be used for domestic uses.

Meanwhile the Monaco-based company FGWRS took charge of marketing the system, the Full/Firmus Grey Water Recycling System.

The goal is to conserve drinkable water by recycling 80% of these 'grey' waters for reuse in cisterns, washing machines and for other domestic tasks.

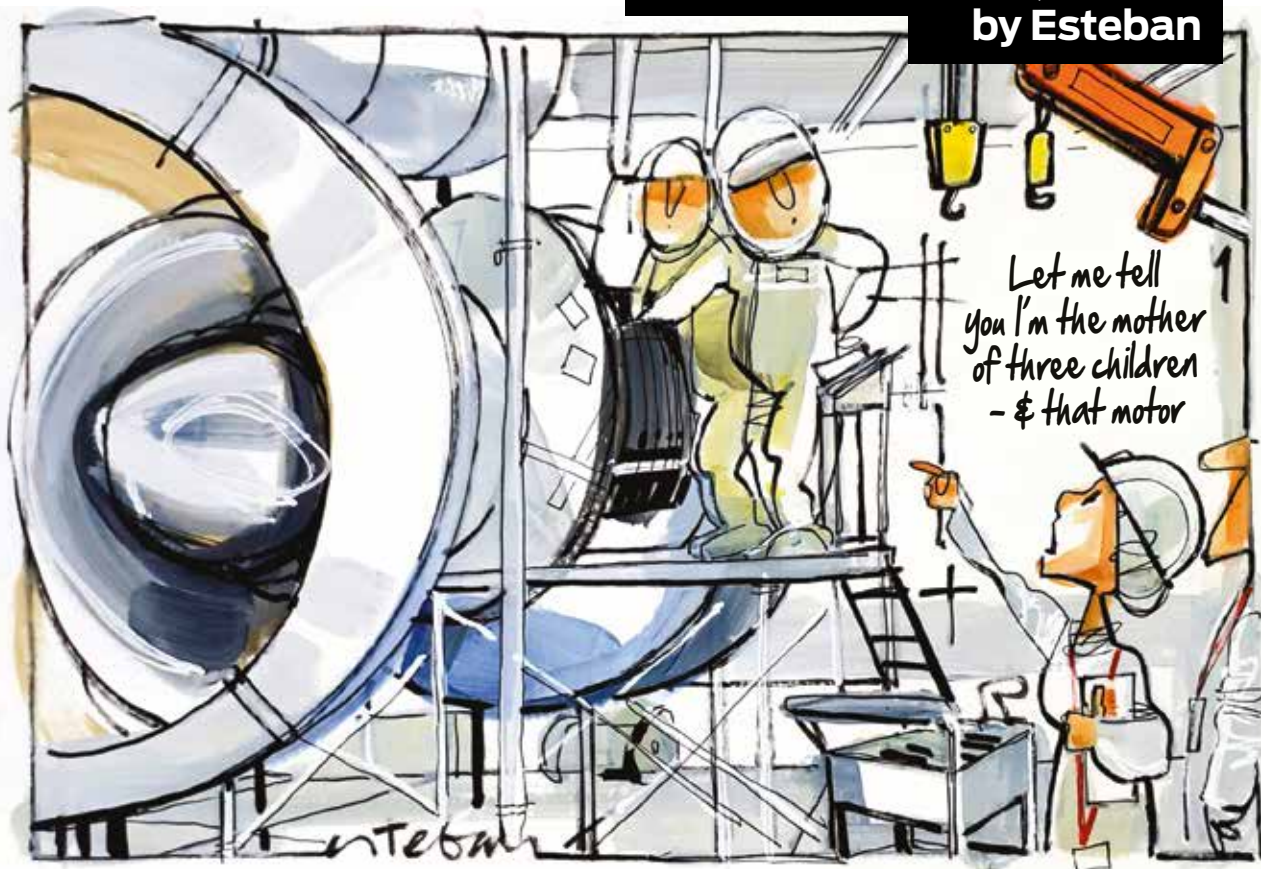
Over the last 15 years this technology has been used continually, without problems, in one of the most remote areas of the world – at the Franco-Italian Concordia research station, which is situated at an altitude of 3,200 metres, 1,100 kilometres inland from the coast of Antarctica.

The station is operated by France's Polar Institute Paul-Emilie Victor (IPEV) and Italy's Programa Nazionale di Riccerche in Antartide (PNRA), and has played a key part in the long term validation of the system.

The system used at the French Open last year will be used again at future editions of the competition. Other innovations will also be incorporated, such as the recuperation of the calories from grey waters to save water and energy at the same time.

The perfecting of regenerative systems to support life in Space is a task that is seen in the MELiSSA system as a continual long-term effort. So far it has generated hundreds of published articles, patents and spin-offs in related areas with the preparation of foods, and the purification of water and microbe life.

As in the IEE, nowhere
by Esteban



140,000 kms from Earth and even here
I can feel the look of my wife's mother...!





THALES ALENIA SPACE SPAIN TO PARTICIPATE IN NASA VIPER MISSION

The VIPER lunar rover, which from 2023 will explore the south pole of the Moon in search for water ice, will be able to communicate directly with the Earth thanks to the technology provided by Thales Alenia Space Spain. The water (and the oxygen it contains) are essential to establish a sustainable human presence on the Moon within NASA's Artemis program, as well as a valuable propellant for future space exploration missions.

ELECNOR DEIMOS OUTSTANDING ROLE IN NEW COPERNICUS MISSIONS

Elecnor Deimos will carry out mission analysis and re-entry analysis tasks for the CHIME mission whose objective is to map the Earth's surface with hyper-spectral images. It will also develop the ground processor prototype and the performance simulator for the CIMR and LSTM missions and will participate in the end-to-end simulator for the CO2M mission. CIMR mission will monitor the sea ice concentration, LSTM the Earth's surface temperature and CO2M the CO2 particles and plumes.



MIURA 1 QUALIFICATION CAMPAIGN OF THE FLIGHT ENGINE VERSION (TEPREL-B)

PLD Space successfully achieved a 180 seconds test of the MIURA 1 liquid rocket engine. This test is an increased duration test (x1.5 MIURA 1 powered flight time) of the TEPREL-B engine, developed by the company, focused on demonstrating the engine's endurance and reliability. This test is a key milestone for the engine qualification process.





CRISA WILL DELIVER HALO'S POWER SUBSYSTEM

HALO is the Habitation Module of Orbital Lunar Gateway, an international space station initiative lead by NASA, ESA and JAXA, whose objective is to reach the Moon by 2024. These power electronics are based on their state-of-the-art GHPP standard (Generic High Power Packaging), a flexible and modular system that ensures maintenance for manned missions. This same concept has been selected as baseline for other Gateway elements, demonstrating Crisa's leadership in power electronics in the international scene.

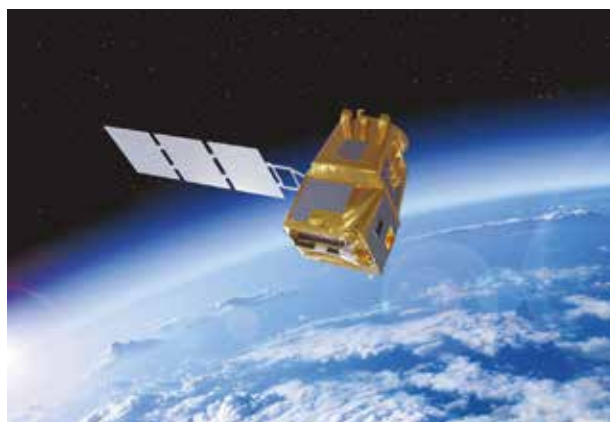
RAPID EMERGENCY MANAGEMENT

Since 2019, Telespazio Ibérica has been participating in the Copernicus program's emergency management service, financed by the European Commission and consisting of the rapid and on-demand provision of geospatial information to strengthen emergency response in the event of a natural disaster. The service is based on the acquisition, processing and analysis of satellite images, geospatial vector and raster data, as well as social networks when relevant. The contract, granted by the Joint Research Center, will be effective for the next four years.



AIRBUS MADRID: MAIN CONTRACTOR FOR THE LSTM MISSION

LSTM is a new generation Copernicus satellite that will monitor the Earth's surface temperature globally and continuously. In particular, this mission will respond to the needs of European farmers to make agricultural production on individual farms more sustainable. Being selected to lead the first Copernicus mission awarded to a Spanish company demonstrates the trust that ESA has in Airbus Spain as an experienced and reliable partner for its main missions.



NEW ANDOYA'S LAUNCH CONTROL SYSTEM DEVELOPED BY GTD

Since January 2020, GTD is working in the Andøya Space Port (ASP) building a Launch Control System who will provide real-time track processing and flight-safety information for its projected small launcher's launch base.

With this new System, ASP will improve the spaceport launch operations improving:

- Flight-Safety; Enable Launch criteria, Flight-safety criteria, Command Flight Termination.
- Launch Vehicle Tracking; displaying radar and telemetry tracking information
- Countdown control.
- Record acquired data for analysis, replay, incident investigation and operator training.



ARQUIMEA REACTS COMPLETE SUCCESSFULLY THE LAUNCH OF THE ESAIL SATELLITE

On September 3, the ESAIL microsatellite was launched and put into orbit, a mission promoted by ESA for the detection and tracking of ship traffic throughout the Earth. ARQUIMEA has been the supplier of HDRM mechanisms

(Hold-Down and Release Mechanisms) for holding and releasing the satellite's solar panels. This is the second successful flight mission and ratifies the TRL9 level of this technology.



TECNALIA PARTICIPATES IN THE DEVELOPMENT OF AN APPLICATION TO QUANTIFY MAXIMUM POTENTIAL DEPLOYMENT OF GREEN ROOFS THROUGH COPERNICUS

The CURE project (Copernicus for Urban Resilience in Europe)- funded under the European Union's Horizon 2020 programme- will provide the means to cope with the EO data under-exploitation in the domain of sustainable and resilient urbanization. CURE synergistically exploits the Copernicus Core Services and develops an umbrella cross-cutting application for urban resilience in DIAS, consisting of individual cross-cutting applications for climate change adaptation/mitigation, energy and economy, as well as healthy cities and social environments, at several European cities.



DAS COORDINATES H2020 SPACE PHLEXSAT PROJECT

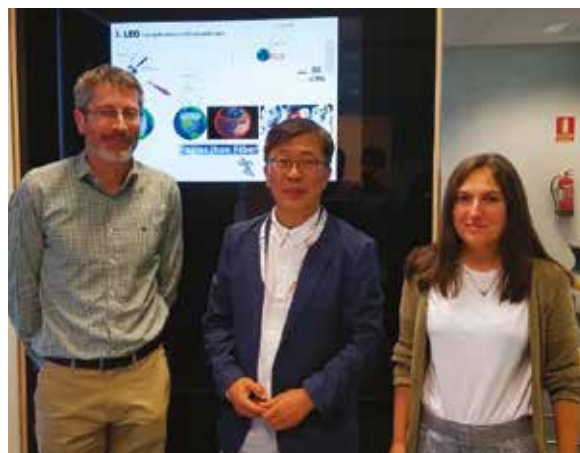
PHLEXSAT "Photo-Digital Channelizer for Flexible Digital High Throughput Satellites" main objective is the definition, design, manufacturing, assembly, and test to TRL5 of a photonic digital payload demonstrator. PhLEXSAT team, comprised by MDA, Axenic. Fraunhofer HHI, Argotech and Eutel-

sat, will take the next step in achieving the paradigm of the full-flexible Tbps-class payload by synergically mixing of Q/V bands, photonics and digital on-board processing within a new concept of photodigital flexible channelizer, leveraging DAS proprietary photonics technology and products.



INSTER WILL DEVELOP A LEO TERMINAL IN A BILATERAL PROJECT SPAIN - KOREA

The CDTI and its Korean counterpart KIAT have approved the grants for the joint development of a new generation communications terminal for the LEO low-orbit satellite constellations, which will be carried out by INSTER and the company ASAT with the support of the technological center ETRI. Inster will be responsible for the design of the antenna, electronically steerable, and ASAT of the modem. The functional demonstrator will be launched in late 2022.





SENER AEROESPACIAL DELIVERS THE OPTICAL CORRECTOR FOR THE WEAVE INSTRUMENT OF THE WILLIAM HERSCHEL TELESCOPE

The Instituto de Astrofísica de Canarias (IAC) and the Isaac Newton Group of Telescopes (ING) have accepted delivery from SENER Aeroespacial of the Prime Focus Corrector (PFC) for the WEAVE Multi-object spectrograph of the William Herschel Telescope (WHT), located on the island of La Palma (Canary Islands, Spain). SENER Aeroespacial was responsible for the detailed design, procurement of components and mechanical integration and verification of the WEAVE optical corrector.

TECNOBIT-GRUPO OESÍA WILL SUPPLY ELECTRONICS FOR THE 2 NEW SPAINSAT NG SATELLITES DRA ANTENNAS

Tecnobit has signed a contract of 6.79 M€ with Airbus Defense and Space for the supply of radio frequency control and distribution electronics for the 2 new SPAINSAT NG satellites, which AIRBUS develops for the operator Hisdesat Strategic Services. SPAINSAT NG, promoted by the Ministry of Defense, will allow Spain to increase communications capacity based on latest dual use technology.



THE MARQUESS OF ANTELLA DONATES 1000 MASKS TO THE CHILDREN OF THE ELEMENTARY SCHOOL OF

Álvaro Sánchez García de Viedma Marquess of Antella, and CEO of Integrasy, software company within the satellite industry, contributes to the fight against COVID-19, by donating 1000 masks to the Michelet school, located in the town of Antella, Italy, and inviting other nobles and businessmen to take similar actions, where corresponds. After having suffered the virus severely, Álvaro wanted to strengthen the security and health of the school



HISPASAT PROMOTES THE ROLE OF SATELLITES IN THE 5G ECOSYSTEM

The operator has joined 3GPP, the body that is leading the standardisation of 5G technology. Satellites are due to play an important role in the implementation of 5G to guarantee its rollout regardless of geographical location. Their global coverage

and speed of deployment will complement terrestrial networks in various scenarios, from connecting people and objects in remote rural areas to providing connectivity services on planes, ships, cars and trains.



ACQUISITION OF THE XTAR-EUR SATELLITE

Hispasat is the owner and it is positioned at 29° East, providing X-band coverage in an extensive geographical region that ranges from eastern Brazil and the Atlantic Ocean, in Europe, Africa, the Middle East and Southeast Asia to the east of Singapore. It will streamline satellite operations, maintain high service standards, and optimize solutions for clients such as the Spanish Ministry of Defense, the United States Department of Defense (DoD), and other government and European clients.



GMV IMPROVES EUTELSAT'S TELECOMMUNICATIONS SERVICE QUALITY

EUTELSAT has chosen GMV to develop a new system (IRIS) to check the signal quality and analyze the telecommunications service of its whole fleet. IRIS will also process data furnished by remote measuring units, previously configured according to a plan generated by IRIS. EUTELSAT has decided to replace the existing system by a more modern and scalable solution to meet users' present and future needs.



CONSULTING FOR THE PROPER SELECTION OF COMPONENTS

Alter Technology has created a virtual platform (CPSA) to provide consultancy services related to electronic components during the early phase of space missions included in the ESA Science Programme.

The platform allows a fluid exchange of information between users, ESA and Alter Technology, which will advise on the design and selection of the components and on the evaluation of new technologies or specific tests to anticipate, detect and solve possible problems at such an early stage of the missions.



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2º Espacio

Women in Space

THE SPACE FLIGHT
ON COURSE FOR
NEWSPACE

INTERVIEW
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