CNES MAG

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SPACE ● INNOVATION ● SOCIETY

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FRANCE-GERMANY

TOGETHER IN SPACE

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CENTRE NATIONAL D'ÉTUDES SPATIALES

INSIDE

PARTNERS

Mentioned in this issue: p.06 DLR, the German space agency; p.08 GRGS, the French space geodesy research centre; p.09 MPE, the Max Planck Institute for Extraterrestrial Physics; p.10 JAXA, the Japan Aerospace Exploration Agency; p.11 CADMOS centre for the development of microgravity applications and space operations; p.18 MEDES space medicine and physiology institute; p.23 GFZ-Potsdam, the German research centre for geosciences; p.24 LRBA ballistic and aeronautics research laboratory; and the European Space Agency (ESA).

Cover: Citizen Press - The Noun Project

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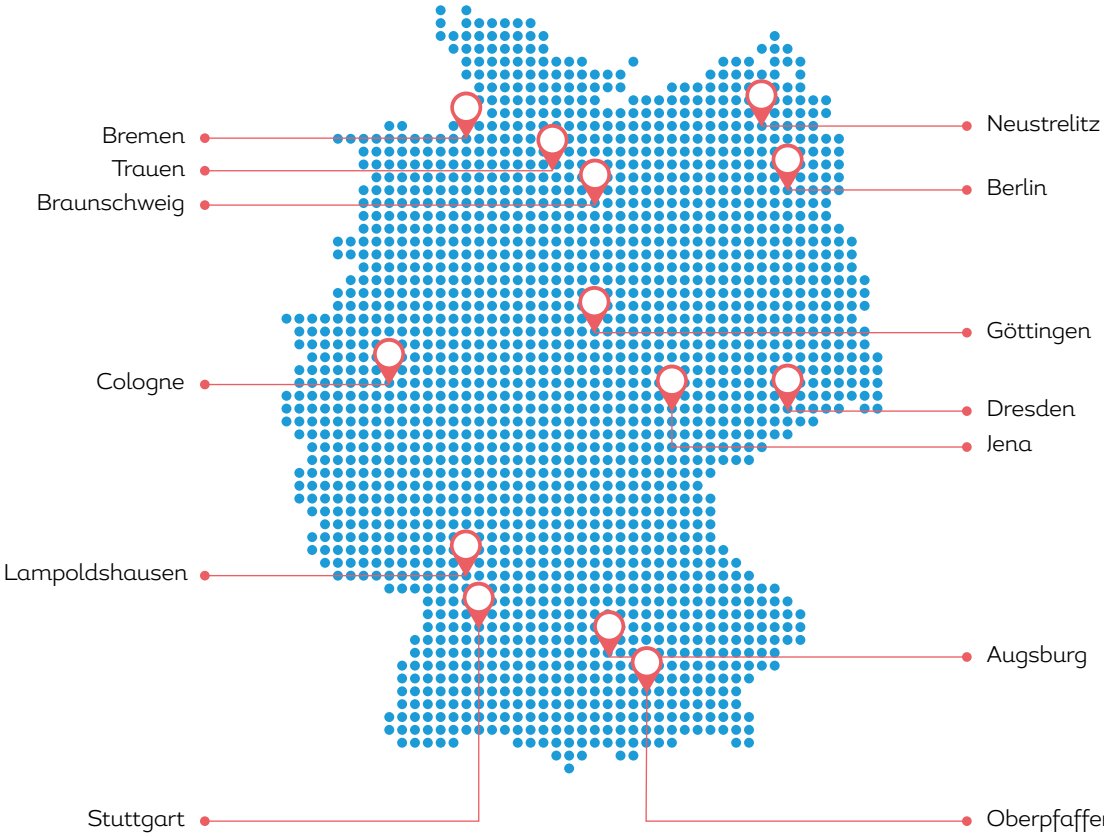
13 DLR DEDICATED SPACE FACILITIES



CONTRIBUTORS

ANNE THIESER

Formerly in charge of bilateral relations with Germany at CNES, Anne Thieser is well acquainted with her counterparts there, where she is held in the highest esteem. For this issue, she gave us access to her contacts to reveal the rich extent of these relations from the inside. Today, she continues to forge ties in her new post cultivating corporate partnerships within the agency's Communications Directorate.

JEAN-PHILIPPE ZEBUS

After occupying a number of posts in French Guiana, at the end of 2017 Jean-Philippe Zebus joined CNES's International Affairs team, where he coordinates bilateral relations with a portfolio of European nations. Consequently, he has taken over from Anne Thieser as the agency's Germany desk officer at Head Office. He is currently overseeing the drafting of an amendment to the French-German agreement encompassing studies for future launchers and propulsion systems.

EMMANUEL GRIMAULT

To accomplish the tricky mission of capturing pictures during tests for MASCOT with a helicopter, photographer Emmanuel Grimault was just the man for the job. He would only get one chance to take the shot, and he didn't miss it. He got some stunning photos in the field for Roundup and during anechoic chamber testing for the opening feature of CNES in Action.

MARIANNE QUILES

A graduate of the IEP political studies institute in Paris, Marianne Quiles has been writing for the trade press for over 20 years. With her sharp, open mind and natural curiosity, there's no subject she isn't willing to tackle. The Q&A section of the magazine has been her domain in recent issues. After Michel Cymes and Cédric Villani, this time she interviewed a woman of considerable stature while juggling between French, English and German.

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EDITORIAL

With the upcoming ILA 2018 air show taking place in Berlin from 25 to 29 April, CNES has decided to devote this issue of CNESMAG to French-German space cooperation. This event will provide a new opportunity to spotlight Europe's successful space programme and France and Germany's role as its two prime movers.
At the European Space Agency (ESA), at the European Commission and through bilateral channels, our excellent partnership has driven the development of programmes that are the envy of the world and spawned a world-class space industry. In the fields of launchers, science, Earth observation, telecommunications and defence, our two countries are moving forward together and leading the way for European nations. Our combined efforts have enabled such emblematic successes as Ariane, Rosetta-Philae, Galileo and Copernicus, and our involvement in operating the International Space Station.
But French-German space cooperation is above all focused on innovation, committed to the construction of Europe and the absolute necessity of extending our horizons. Sustained by this shared conviction, day by day, our two nations are working in concert to forge the future of spacefaring Europe.

JEAN-YVES LE GALL
CNES PRESIDENT

The City of Berlin seen from the Pleiades Earth-observing satellite.

TRADE SHOW

France at ILA 2018 in Berlin

Germany's equivalent to the Paris Air Show, ILA Berlin[1] is the world's oldest event of its kind. Organized by BDLI[2], the German aerospace industries association, it has been showcasing Germany's industrial, technological and aerospace expertise since 1909. For trade visitors, it's an opportunity to see new innovations and develop their international business. Confirming the excellent cooperation between the French and German national space agencies, France is guest of honour at this year's show where CNES will be present on the stand of its counterpart DLR (Deutsches Zentrum für Luft- und Raumfahrt). At the 2018 event, the agencies' close ties will be on display in such key domains as climate monitoring, launchers and space exploration. They will also be signing agreements on future launchers and disruptive innovation, pursuing the lines of cooperation set by President Emmanuel Macron and Chancellor Angela Merkel.

1. 25–29 April 2018, ExpoCenter Airport, Schönefeld
2. Bundesverband der Deutschen Luft- und Raumfahrtindustrie

ELYSÉE TREATY

A PLACE FOR SPACE

The Elysée Treaty marked the post-war reconciliation between France and Germany and furthered a certain idea of Europe. In signing the treaty on 22 January 1963, President Charles de Gaulle and Chancellor Konrad Adenauer were pursuing their visionary aim of "completely transforming relations between the two peoples". Fifty-five years later, on 22 January 2018, the two nations' current heads of state reaffirmed the solid friendship that has been built on the treaty's foundations. And they now want to amend the historic text to forge even closer ties in the fields of foreign policy, European defence, common security, climate and environmental monitoring and the digital economy—all areas where space is going to prove vital. The 2018 rework of the treaty confirms the pivotal role of French-German cooperation in implementing the 2015 Paris Agreement on climate and the commitments made at last year's One Planet Summit.

19

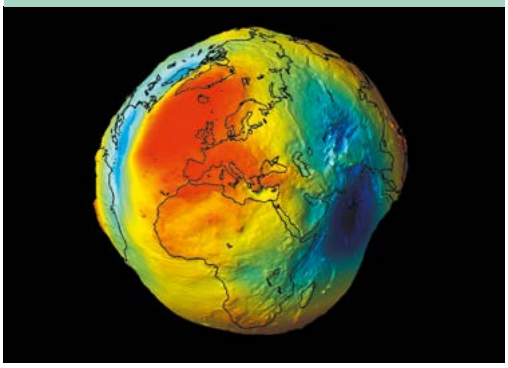
Since 2003, France-Germany joint cabinet meetings have been held in both nations, once or twice a year. The 19th such meeting took place on 13 July 2017 in Paris. The next one will be in Germany.

JOINT CABINET MEETING

SUMMITS SCALE NEW HEIGHTS

It was not until 2003 and the 40th anniversary of the Elysée Treaty that the first France-Germany summit meetings were instituted. While these summits cover a broad range of topics, space, on account of its geostrategic nature, is always on the agenda, driving decisions in priority sectors like climate monitoring, security and innovation. In line with the conclusions of the COP21 conference, ministers jointly approved the design and development phase for MERLIN[1] (see In Pictures, p. 17). In 2016 in Metz, the 18th French-German joint cabinet meeting renewed the amended framework agreement between CNES and DLR, while the 19th meeting reaffirmed the obvious need to tackle climate change and confirmed Germany's involvement in the development of France's third CSO[2] satellite.

1. MEthane Remote sensing LIdar missioN
2. Composante Spatiale Optique (Space Optical Component)



GEOSCIENCES

OF CHALLENGES AND MEN

People are what drive all partnerships. In 1973, it was a German geodesist working at CNES who sowed the first seeds of French-German collaboration in geoscience. Two years later, a first official cooperation agreement was signed and GRIM, the first-ever global model of Earth's gravity, was developed by GRGS, the French space geodesy research centre, and a German research institute[1]. Since 2000 and the launch of the CHAMP[2] satellite (see CNES in Action, p. 22), many more missions have been accomplished. Today, CNES and GFZ[1], the German research centre for geosciences, are continuing to work together on key challenges in geoscience, such as understanding the dynamics of the Earth system and its evolution, and forecasting extreme events. This partnership could also lead to innovative concepts for new miniaturized remote-sensing instruments. The two nations are also seeking big data solutions to cope with the exponential growth in the volumes of data they are now handling.

1. Successively TUM - Technische Universität München (Technical University of Munich), DGFI - Deutsches Geodätisches Forschungsinstitut Munich (German geodetic research institute) and then GFZ - GeoForschungsZentrum Potsdam.
2. CHAllenging Minisatellite Payload (DLR/GFZ), from which EIGEN models were generated.

PARABOLIC FLIGHTS

PLANTS IN HYPERGRAVITY

Does gravity affect plant behaviour? This is one of the questions the next campaign of parabolic flights dedicated to life sciences, set for 28 May to 7 June, could help to answer. The flights will essentially be carrying experiments led by ESA, CNES and DLR. In particular, a German-French study being pursued jointly by researchers at Fribourg University and Clermont-Ferrand University will be focusing on plant physio-biology. The first-of-its-kind experiment will observe changes in plant cells through a compact fluorescence microscope in a partial gravity environment rather than the usual microgravity conditions. Each parabola will alternate between phases of hypergravity and reduced gravity. The teams will concentrate their investigations on the interval between zero gravity and normal gravity, and then compare their results with ground or microgravity experiments.

ATHENA
SURVEYING THE HOT UNIVERSE

ESA's Athena mission is setting out to study the hot and energetic regions of the Universe. This X-ray space observatory is one of the large-class missions in the agency's Cosmic Vision science programme for 2015–2025. To probe and map these still poorly understood regions, Athena's telescope will be relying on new-generation mirrors. CNES and DLR are closely involved in the mission, through joint science groups working to define and continually refine the mirrors' specifications and expected performance. There are nine European countries working on Athena, but responsibility for the two focal instruments is shared equally between France and Germany.

14

Specific, concrete space cooperation agreements signed under the framework accord between France and Germany. They cover a range of areas, such as the International Charter on Space and Major Disasters, activated recently in the wake of the hurricanes that tore through the Caribbean.

H2020

The acronym for Horizon 2020, the research programme established by the European Union to boost its economic potential. France and Germany are working hand in hand to propose research projects to their European partners for an IOD/IOV[1] flight. The goal is to validate subsystems in the space environment and ultimately use them on future missions. The two nations are also proposing research work in the area of space access.

1. In-Orbit Demonstration/In-Orbit Validation

X

SVOM is a French-Chinese mission to hunt for gamma-ray bursts (GRBs), for which France is supplying an X- and gamma-ray camera called ECLAIRs and a low-energy X-ray telescope. The German Max Planck Institute for Extraterrestrial Physics (MPE) in Garching will conduct testing. CNES and MPE signed a memorandum of understanding in April 2017 fixing the framework for this partnership.

FRENCH-GERMAN ACCORDS 2013-2017

17 JUNE 2013

Cooperation agreement to develop and operate MASCOT for the Hayabusa2 mission

2 JUNE 2016

Framework agreement stepping up space cooperation between CNES and DLR

14 SEPTEMBER 2016

Specific cooperation agreement between CNES and DLR concerning the MERLIN project

19 APRIL 2017

Memorandum of understanding between CNES and the German Max Planck Institute for Extraterrestrial Physics (MPE) to contribute to the MXT and ECLAIRs instruments for the SVOM astronomy mission

20 JUNE 2017

Trilateral agreement between Japan's JAXA, DLR and CNES to work together on the Callisto project

VIDEO

MASCOT heading for asteroid Ryugu

Testing the link budget in March between the Hayabusa2 probe simulated by the helicopter and the scale 1 qualification model of the lander on the ground.

BALLOONS

EUROPE HAS PLENTY OF PUFF

Stratospheric balloons—one of CNES's domains of excellence—are riding on the tailwinds of the Horizon 2020 framework programme, under which the four-year HEMERA infrastructure research project begun in January has been selected by the European Commission. The project's priority is to develop the stratospheric balloon user community in Europe. HEMERA is also seeking to extend the scope of research, conceive new instruments and foster synergies between 13 partners from seven countries, with France and Sweden the project's main instigators[1]. Germany is involved through DLR, the University of Heidelberg and the University of Karlsruhe. CNES is coordinating the programme and sharing responsibility with Sweden for zero-pressure stratospheric balloon flights, as well as leading development. A European call for projects is set to be issued soon.

1. Norway, Canada, the United Kingdom and Italy are also partnering the project

MASCOT

ASTEROID DEAD AHEAD!

The small MASCOT lander has been stowed away since 2014 on Japan's Hayabusa2 probe, on a perilous mission to scout ahead for the probe designed to collect samples from the surface of asteroid Ryugu. DLR developed the lander and tested it in space conditions, while CNES provided its expertise in radiofrequency engineering, batteries and spaceflight dynamics. French and German experts have put the lander through its paces to avert any hitches and the mission's science team is now hoping to harvest 16 hours of data once it reaches its destination. They've also noted in their summer diaries the date at the end of July when mapping of Ryugu will start to determine MASCOT's landing site. The site, which will need to offer the right combination of science value and lowest risk to the lander, will be chosen on 14 August at a meeting bringing together CNES, DLR teams from Bremen, Cologne and Berlin, the Japan Aerospace Exploration Agency (JAXA) and mission scientists. MASCOT is scheduled to be deployed between 1 and 5 October.

HEALTH

SPACE MEDICINE TAKES OFF WITH CARDIOLAB

In the 1990s, the Russian Mir space station accommodated two systems dedicated to cardiovascular research: Physiolab (CNES) and Medex (DLR). Today, the Cardiolab medical laboratory aboard the International Space Station (ISS) is one of the elements of the EPM[1] facility operated by CNES through the CADMOS centre for the development of microgravity applications and space operations. CNES has developed two sensors and the main processor of the Cardiomed unit to which instruments are connected, while DLR built most of the mobile measuring units. The design and scientific characteristics were defined by a group of French and German experts headed by a co-lead from each nation. In the field of space medicine, Cardiolab data are helping to mitigate the effects of microgravity on astronauts' cardiovascular systems. They are also providing keys for general practitioners to better understand cardiovascular complaints.

1. European Physiology Module

AFRICA

DEVELOPMENT THROUGH SPACE

Tackling poverty and inequalities in Africa was one of the stated ambitions of last year's G20 summit. Space has a role to play in aiding emerging countries in pursuit of this aim. French and German working groups are today conceiving bilateral space projects designed to lead actions identified by the G20 nations. The range of investigations is vast, spanning climate change, agriculture, water resource management, prevention of epidemics, healthcare and natural disasters to name a few. Currently in the study phase, proposals could be refined by the end of this year for approval by ministries and governments concerned.

DEFENCE

AVERTING ORBITAL COLLISIONS

Transmitting array of the Graves radar at Broye-lès-Pesme, near Dijon.

Space surveillance and tracking (SST) is an area where France and Germany have always concerted closely. On 16 April 2014, the European Parliament and Council decided to establish a framework for cooperation between France, Germany, Italy, Spain and the United Kingdom to improve detection and tracking of space objects in order to avert orbital collisions, the aim being to protect space services crucial to the security of the EU's citizens and economies. This decision led to the creation of the EU-SST Support Framework, which relies notably on France's Graves and Germany's Gestra sensors to provide a cataloguing and tracking capability unique in Europe. Germany and France are now seeking to strengthen this framework by bringing new countries into the consortium. EU-SST entered active service in July 2016.

#COMMUNITY

Every day, CNES engages with you on social networks and you share your thoughts and questions with us. Join the conversation!

@NATHJOU
#Communication, #espace, #vulgarisation boosting projects for @CNES

Mars, Mercury and also #astéroïde #Ryugu for @haya2e_jaxa with @CNES, @JAXA_en & @DLR_de

CNES and its partners heading for Mars and Mercury in 2018 | via @ouestfrance

@LECOCQ_DOM
VP Ecosystems & Communications at Air Liquide Hydrogen Energy WBU #energy #hydrogen #biogas #innovation #cleanenergy #mobility #cH2ange #FutureIsClean

When space inspires #innovation at @airliquidegroup! Fascinating debate with @FDarchis JYLeGall @CNES FdeWinne @esa & ASuchanek @DLR_de

@CLAUDIO GENNARO
Istituzioni e Politiche Spaziali @SIOItweet

Dr. Elachi "InSight mission in coop with @CNES and @DLR_en two months from now will help us understand better #Mars internal structure"

@JANWOERNER
Director General, European Space Agency @ESA. Tweets by my team (T) and me.

Direct return for @thom_astro to @ESA_EAC & @DLR_en's: envihab in Cologne - great pleasure to welcome him w/ @CNES pres JY Le Gall #Proxima

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Q & A

PASCALE EHRENFREUND

PROFESSOR PASCALE EHRENFREUND, CHAIR OF THE EXECUTIVE BOARD OF DLR, gives us the inside track on how the German space agency works and talks about innovation and space exploration, two key challenges for France and Germany in the years ahead.

DOES THE TERM "FRENCH-GERMAN COUPLE", OFTEN USED TO DESCRIBE OUR NATIONS' DIPLOMATIC RELATIONSHIP, ALSO APPLY TO SPACE?

Pascale Ehrenfreund: France and Germany are the two prime movers behind space policy and activities in Europe, contributing roughly half of the European Space Agency (ESA) budget. Our two nations are driving key decisions together and our voice is one that counts for our partners. However, there are some things we do differently. Germany's approach is specifically focused on science and technology research. DLR, the German aerospace agency, spans aeronautics, space, energy, transport, security and digital technologies. This organization is designed to ensure greater efficiency and foster synergies. The agency is thus working to develop science, industry and the economy. Historically, Germany has always been able to rely on an excellent space science and technology community in the fields of Earth observation, navigation, applications, astrophysics and planetary exploration, as well as in human spaceflight and microgravity science, as illustrated through the International Space Station. Last year, Thomas Pesquet's Proxima mission rekindled the French public's interest in human spaceflight, and we hope that France will continue to support this area.

IN FRANCE, CNES PLAYS A PIVOTAL ROLE SHAPING THE NATION'S SPACE POLICY. DOES DLR ENJOY THE SAME DEGREE OF INFLUENCE IN GERMANY?

P. E.: Yes, absolutely. DLR is overseen by the Federal Ministry of the Economy and Energy and employs 8,200 people, with 250 posted at the space agency. The federal government defines our space strategy and the agency executes it. A coordinator at the ministry—most often a secretary of state—has responsibility for aeronautics and space. Alongside its contributions to ESA, Germany also has its own national space programme with a yearly budget of €270 million, which is devoted to developing our capabilities and supporting academia and industry.

FOR THE ILA AIR SHOW IN BERLIN, DLR AND CNES ARE SHOWCASING THEIR JOINT PROJECTS TOGETHER. WHICH OF THESE PROJECTS IS THE MOST EMBLEMATIC OF THIS PARTNERSHIP IN YOUR VIEW?

P. E.: First of all, I'd like to say how delighted we are to have France as the partner nation for the upcoming ILA show. As for which projects are the most emblematic of our partnership, I'd have to say MERLIN, which is the result of our common desire to develop an innovative, pre-operational satellite for monitoring climate and greenhouse gases.

"GERMANY HAS ITS OWN NATIONAL SPACE PROGRAMME WITH A YEARLY BUDGET OF €270 MILLION, WHICH IS DEVOTED TO DEVELOPING OUR CAPABILITIES AND SUPPORTING ACADEMIA AND INDUSTRY."

This remote-sensing mission intends to measure and plot natural and anthropogenic cycles of methane (CH_4) fluxes in the atmosphere. It's a highly sophisticated mission designed to give us the big picture, as scientists think this gas has a big impact on global warming. I would also say the Japanese space agency's Hayabusa2 mission, which this autumn will be deploying the MASCOT lander—developed by DLR and carrying four instruments including an infrared spectrometer supplied by CNES—onto the surface of asteroid Ryugu and then collecting debris from the plume kicked up by its impact for analysis back on Earth. This is a C-type asteroid, that is, one likely to contain organic material. Germany, France and their ESA partners are also involved in the European Union's Copernicus Earth-observation programme designed to give Europe its own independent operational Earth remote-sensing capability. Copernicus will provide a synoptic picture of the status of our

"WITH THE RECENT SERIES OF LUNAR PROBES—FROM ESA, JAPAN, CHINA, INDIA AND THE USA—AND NEW LANDERS IN DEVELOPMENT, ESTABLISHING A LONG-TERM PRESENCE ON THE MOON IS BACK IN THE FRAME AND FUELLING DREAMS AGAIN."

PASCALE EHRENFREUND

PROFESSOR, CHAIR OF THE EXECUTIVE BOARD OF DLR

"OUR TWO NATIONS ARE DRIVING KEY DECISIONS TOGETHER AND OUR VOICE IS ONE THAT COUNTS FOR OUR PARTNERS."

planet and enable development of user services. So, there are plenty of big projects to keep us busy!

WHAT FORM CAN INNOVATION IN SPACE TAKE?

P. E.: DLR and CNES are jointly developing tools to boost innovation. The goal is to conceive differentiating technologies and invite space firms to develop new ones. And for that, it's important to pursue a dynamic approach to encourage an entrepreneurial spirit and attract young talent, as we're seeing in the United States with NewSpace[1]. Broadening the range of applications of space technologies will make space much more accessible and attractive.

AS CHAIR OF THE PANEL ON EXPLORATION (PEX) FOR THE COMMITTEE ON SPACE RESEARCH (COSPAR), WHAT CHALLENGES DO YOU SEE FACING SPACE EXPLORATION?

P. E.: European ministers with responsibility for space will be meeting at ESA level at the end of 2019, where Europe is expected to chart a new exploration roadmap. For example, the road ahead for the International Space Station is still unclear. After 2025, the United States seems to favour delegating low-Earth operations to the commercial sector, which would imply a new relationship with industry and also pave the way for exploration of the Moon and Mars. COSPAR supports a space exploration programme strongly rooted in science to further our understanding of planets, moons, smaller bodies in the solar system and the origin of life.

DO YOU SEE A SOCIAL DIMENSION IN THIS ENDEAVOUR?

P. E.: NASA's missions and SpaceX's exploits are attracting a lot of public attention, as are ESA missions like Mars Express, Rosetta and Proxima. Spaceflights by our astronauts Alexander Gerst and Thomas Pesquet serve not only to conduct scientific experiments, but also to educate people of all ages and inspire vocations among the young generations in Germany, France and all over Europe. With the recent series of lunar probes—from ESA, Japan, China, India and the USA—and new landers in development, establishing a long-term presence on the Moon is back in the frame and fuelling dreams again. Such spectacular missions will attract new talent to the fields of science and engineering, where more students are needed to innovate and move forward. They can look forward to working on a new generation of satellites and on research areas geared towards achieving sustainable development.

1. NewSpace, or entrepreneurial space, is the term applied to the emerging private space industry.

Profile

1990 : PhD in astrophysics

1991 : Post-doctoral researcher at CNES

1995 : Professor and research scientist for several ESA and NASA missions

2010 : Chair of Panel on Exploration (PEX) for the Committee on Space Research (COSPAR)

2013 : President of the Austrian Research Fund (FWF)

2015 : Chair of the Executive Board of DLR

PHILAE – INTREPID EXPLORER GETS SPECIAL TREATMENT

The teams at the Science Operations & Navigation Centre (SONC) in Toulouse and the Lander Control Centre (LCC) in Cologne are well used to shuttling between the two cities, as they worked closely together to watch over and handle Philae during its long-haul mission. Their collaboration was driven by the major technological challenges they had to face during its trickiest phases. The science programme sometimes called for concessions on both sides, but the French centre's flexibility made sure that Philae could keep doing science until its batteries finally ran out. The merger of two projects[1], which each partner would have found hard to fund alone, enabled this emblematic endeavour to be accomplished.

1. Champollion at CNES/JPL and RoLand at DLR

MERLIN – THE RIGHT BALANCE

The catalyst for the MERLIN mission was the disillusionment that followed the COP15 conference in 2009. Considering that the commitments made there didn't go far enough, Nicolas Sarkozy and Angela Merkel decided to pursue a path of bilateral cooperation. The result was a novel mission to measure concentrations of atmospheric methane, allying two concepts: an innovative space lidar developed by DLR and a spacecraft bus conceived by CNES. The recipe for this successful flagship technology collaboration is the recognition of skills and expertise on each side, equitable funding, shared responsibilities and joint exploitation of the mission's data.

2+2

Out of the €10 billion budget allocated to space by the ESA Ministerial Council in 2016, France and Germany signed up to fund €2 billion each.

Astronaut recruits

THE CAMPAIGN TO RECRUIT A NEW INTAKE OF EUROPEAN ASTRONAUTS, completed in 2009 by DLR and CNES's MEDES health subsidiary, was the most extensive ever undertaken, attracting 8,400 candidates. This was perhaps not surprising, as it was the first in 17 years. France and Germany jointly organized the selection process involving a battery of medical and psychological tests. Among those who made the grade was France's Thomas Pesquet, who subsequently spent six months from November 2016 to June 2017 on the ISS. Germany's Alexander Gerst is scheduled to follow in his footsteps from June to November this year (see Insights p. 35).

BEDREST

Preparing on the ground to adapt better when in space is the goal of bedrest campaigns simulating microgravity conditions. Tests are conducted either at MEDES in Toulouse or DLR in Cologne, supported by close collaboration between the French and German space agencies.

600

ECLAIR6 IS A CONSORTIUM OF 46 FIRMS led by Eiffage Civil Engineering working to build Ariane 6 ground support facilities in French Guiana, a programme costing some €600 million. The ELA4 launch complex is scheduled for delivery in July 2019 and the first Ariane 6 launch planned in 2020.

A300 A310

Over 17 years, the Airbus A300 Zero-G parabolic flight laboratory conducted 113 scientific flight campaigns and six microgravity initiation flights. In that time, it flew 13,000 parabolas, clocking up 80 cumulative hours of microgravity for the French (CNES), European (ESA) and German (DLR) space agencies. It flew its last mission in Germany on 3 November 2014, from Cologne/Bonn airport.
The Airbus A310 Zero-G, owned by Germany and part of its government fleet of aircraft, has since taken over the mantle. Today operated by CNES subsidiary Novespace, it has room for 40 research scientists or passengers and more than 200 m^3 of specially outfitted space.

A STRATEGIC PARTNERSHIP

FRANCE IS GUEST OF HONOUR AT THIS YEAR'S ILA AIR SHOW IN BERLIN, A MARK OF RECOGNITION REFLECTING ITS EXCELLENT PARTNERSHIP WITH GERMANY THAT HAS BEEN SERVING SCIENCE, TECHNOLOGY AND INNOVATION IN THE FIELD OF AEROSPACE FOR DECADES AND WILL CONTINUE TO DO SO IN THE FUTURE.

The Hayabusa2 probe and MASCOT lander will communicate with each other using a Japanese antenna. At the end of January, CNES organized a measurement campaign to refine the link budget calculations. A similar process was used for the Rosetta mission.

France and Germany are today the pillars of the European space programme that they were both instrumental in founding. In the 1960s, the two nations realized they must join forces to guarantee Europe's independent space launch capability and keep pace with the two space superpowers, the United States and the Soviet Union. At the time, CNES had just been formed—in 1961—and aerospace activities in Germany were still being managed under the banner of the Modellversuchsanstalt für Aerodynamik aerodynamics research institute founded in 1907 (see Timeline p. 28-29). On 29 February 1964, the two nations brought into being ELDO[1] and tasked it with developing launch vehicles. Shortly afterwards, on 23 March 1964, they formed ESRO[2], its counterpart for construction of satellites.

SYMPHONIE LAYS FIRST STONE OF SPACEFARING EUROPE

The first bilateral programmes followed not long behind and French-German space cooperation got started in earnest with Rubis n°3 in 1966 and Dial in 1970. But it was Symphonie in 1974 that would be remembered as the first really substantive result of this nascent effort. This telecommunications satellite came out of the merger of two experimental projects, Saros-2 for France and Olympia for Germany, after the signature of an intergovernmental accord on 6 June 1967. By positioning the French-German tandem in the telecommunications market segment, the first commercial application of the space era, Symphonie thus also paved the way for live satellite TV broadcasting.

Encouraged by this success, France and Germany put their full weight behind the creation in 1975 of the European Space Agency (ESA), combining ELDO and ESRO. The purpose of the new agency was clear: to coordinate the technical, financial and scientific resources of member states to enable programmes that would have been too ambitious for any country to take on alone (see Philae, In Pictures p. 16).

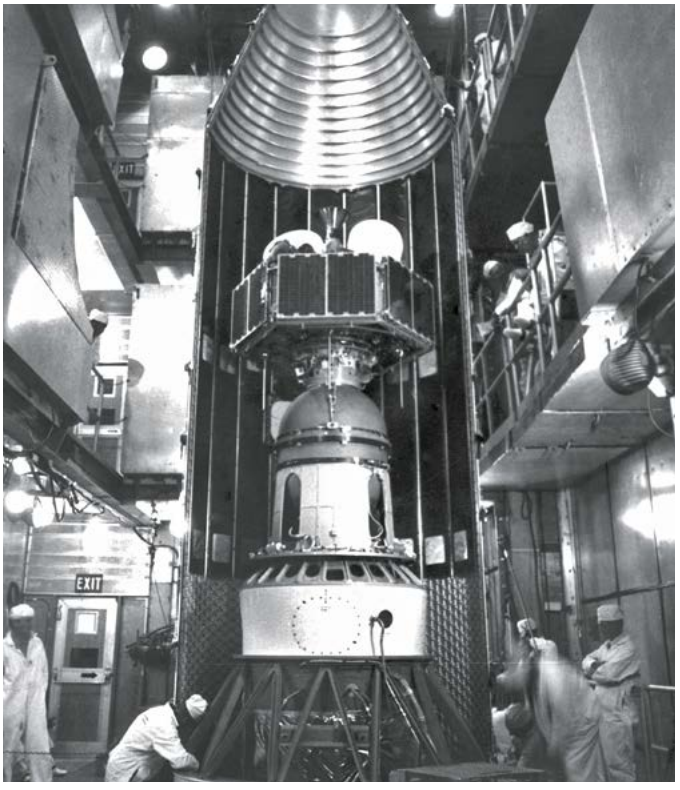
8,200

Jobs

at DLR. Seven new institutes recently joined the 33 already operating within Germany's space agency at 20 sites, 13 of which are focused on space (see map p. 3).

MEMORABLE SUCCESSES

Half a century on, the will to keep moving forward is as strong as ever. "*France and Germany are still the pillars of Europe's space programme today, providing more than 50% of space funding for both civil and military efforts*," notes CNES's Jean-François Dupuis, space advisor at the French Embassy in Germany (see Horizons p. 32). Fourteen successive agreements between CNES and DLR were finally consolidated under a framework accord in 2002, committing both countries over the long term to large-scale endeavours like the ISS and Mars exploration. With the world first achieved by the Rosetta/Philae mission, the two space agencies found themselves at the forefront of cometary exploration,



The first Symphonie satellite is stowed inside the fairing of the Thor-Delta launcher that lifted off on 19 December 1974 from Florida.

History in the making: German Chancellor Konrad Adenauer and French President Charles de Gaulle sign the treaty sealing France and Germany's friendship on 22 January 1963 at the Elysée Palace in Paris.

reaching a pinnacle of technology and science. Today, the MASCOT lander is set to follow in its footsteps (see Roundup p. 10). CNES's engineering focus is mirrored by the scientific prowess of DLR and the members of the Helmholtz community encompassing big research organizations working on space, energy and health.

NEW CHALLENGES AHEAD

Climate monitoring, with the increased tracking of greenhouse gases, and industry, to which both nations have pinned their colours, are the two new challenges now to be met. But the high-flying tandem is also contributing to applications programmes with other partners like ESA and the European Commission for Copernicus, Eumetsat for meteorology and GSA[3] for Galileo. In the international arena, CNES and DLR are showing a united front as often as possible, as will be the case at major events such as ILA Berlin or the next International Astronautical Congress (IAC) in Bremen this October. The focus there will be very much on innovation, and technology spin-offs are expected to spawn new markets.

€37

The yearly per capita budget that France devotes to civil space, putting it second only to the United States. Germany has a budget of €20 per capita, per year.

1. European Launcher Development Organization
2. European Space Research Organization
3. European GNSS Agency

EARTH OBSERVATION
LEADING THE WAY ON CLIMATE MONITORING

Yesterday with CHAMP and today with MERLIN and Copernicus, France and Germany have played a pivotal role in advancing our understanding of climate. It all began at a time when climate issues were still a long way down the global agenda...

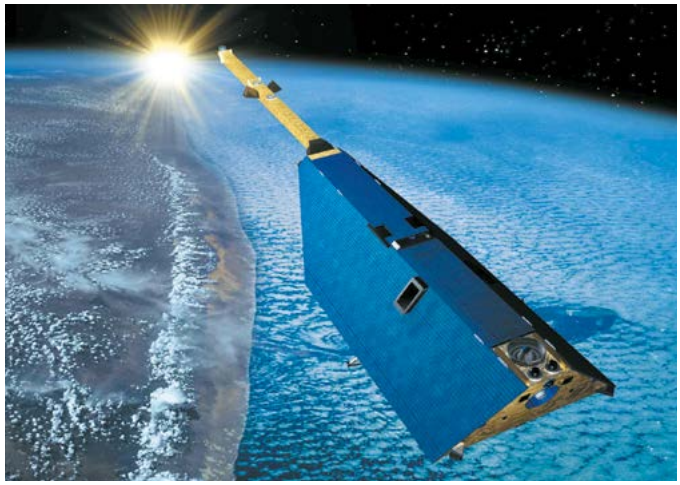
In 1995, when CNES joined the CHAMP mission proposed by GFZ[1], climate change was barely a blip on our radar screens. CHAMP (see Roundup p. 8) nevertheless signalled a first step towards climate monitoring from space, today a domain of crucial importance. "*Changes in Earth's gravity field over several decades are indicators of climate variations*," says Pascale Ultré-Guérard, CNES's Deputy Director of Planning, International Relations and Quality. A clear picture of the gravity field also enables more precise tracking of sea level, another key indicator of climate change... In this sense, CHAMP was a pathfinder for the later GOCE[2] (1999) and GRACE[3] (2002) missions.

MONITORING EXPERTS

French-German cooperation in the field of climate science has since extended its horizons even further to monitoring of greenhouse gases. CNES and DLR have thus joined forces to conceive the MERLIN satellite mission designed to quantify atmospheric methane concentrations (see In Pictures p. 17). In strategic, financial and technological terms, this programme is pretty close to perfect. MERLIN will be the first mission to fly a lidar in space, with France supplying the spacecraft

The East Frisian peninsula in Northwest Germany, viewed by the Sentinel-2B satellite.

bus and Germany the innovative lidar concept—another example of French and German teams drawing on their reciprocal technology advances (see Horizons p. 31). The two space agencies are also leading contributors to the European Union's Copernicus programme. MERLIN data will complement those collected by the fleet of Sentinel satellites to fuel operational environmental geoinformation services. But there is still a long way to go. "*Only highly sophisticated satellites will be able to measure and identify anthropogenic greenhouse gas emissions from each large city or group of industrial facilities*," noted Frédérique Vidal, France's Minister for Higher Education, Research and Innovation, at the dinner for heads of space agencies organized last December in Paris (see below).



The CHAMP satellite measured Earth's gravity and magnetic fields with great precision over a period of more than 10 years.

NEW HOPE SPRINGS FROM SPACE CLIMATE OBSERVATORY

Outside the operational sphere, CNES and DLR have pressed hard to influence decisions. No major international climate gathering—Mexico, New Delhi, Paris, Marrakesh—goes by without the two leading agencies of spacefaring Europe making their voices heard, as they did on 11 December 2017 at the dinner at CNES in Paris for the heads of 25 space agencies on the eve of the One Planet Summit, organized at the initiative of President Emmanuel Macron two years after the COP21 conference. The aim of this gathering was to give substance to the Paris Declaration. Germany was a key supporter of this concrete resolution to set up a Space Climate Observatory (SCO) that will pool climate data acquired from space, in particular to keep track of essential climate variables (ECVs). This observatory will apply a policy of free and open access to data for the international scientific community.

1. Deutsches GeoForschungsZentrum – Potsdam, the German research centre for geosciences
2. Gravity and Ocean Circulation Explorer
3. Gravity Recovery And Climate Experiment

COMET

EXTENSIVE AIRBORNE CAMPAIGN TO TRACK METHANE

Atmospheric concentrations of methane are currently the subject of several studies. In Germany, numerous scientists are supporting DLR's CoMet airborne campaign for which the HALO[1] aircraft, a research platform flying a CHARM-F[2] lidar instrument, is set to measure concentrations in an air column of 15 kilometres. At the same time, CNES will be mobilizing the SAFIRE fleet's Falcon 20 to collect profiles of concentrations of carbon dioxide, methane and carbon monoxide from the surface to an altitude of 11 kilometres. Lastly, a balloon-borne AirCore instrument will measure gas concentrations in situ from 0 to 30 kilometres. The indicators archived, compiled and compared from these French and German survey campaigns will join the corpus of data available to the international scientific community and mark the first step in validating future space missions like MERLIN (see In Pictures p. 17).

1. *High Altitude* and LOng range research *aircraft*
2. CO_2 and CH_4 Atmospheric *Remote* Monitoring - Flugzeug

Aerial view of the ELA4 construction site at the Guiana Space Centre.

LAUNCHERS **EXPLOITS** AT ALL STAGES

France and Germany had worked together on launchers from the outset, but it was with the Ariane series that their partnership really came into its own. Today, this domain is one of the best illustrations of their collaboration, driven by the constant pursuit of excellence.

In 1945, 123 German engineers recruited by the French Ministry of Armaments joined the LRBA ballistic and aeronautics research laboratory in Vernon, west of Paris, bringing with them the missile expertise acquired during the Second World War. These guidance and propulsion specialists also brought the benefit of their experience working within the French teams that would later develop the nation's space launch capability—an initially unlikely pairing that is still going strong today on the back of Ariane's remarkable run of success.

ARIANE 6, THE PRODIGY

With Ariane 6, "*cooperation is stepping up a gear and the French-German partnership is instrumental in inventing Europe's future launchers*," confirms Jérôme Vila, in charge of innovation at CNES's Launch Vehicles Directorate (DLA). France is overseeing the new launcher's development and the architecture of its engines through CNES, while Germany's know-how is key to conceiving its upper stages in Bremen. Germany is also providing its engineering excellence at the remarkably equipped facilities of DLR's propulsion research centre in Lampoldshausen, now de facto one of Europe's chief centres for launcher engine and stage testing. This is where Ariane 6's engines are currently being put through their paces and where the upper stage will shortly be hooked up to its test stand. DLR has the huge advantage of being a government space agency that also encompasses other value-added high-tech sectors such as automotive engineering, energy, transport and digital technologies (see Timeline p. 28-29). It is thus fuelling technology spin-offs and cross-fertilization for the benefit of space systems.

SIGHTS ON THE FUTURE

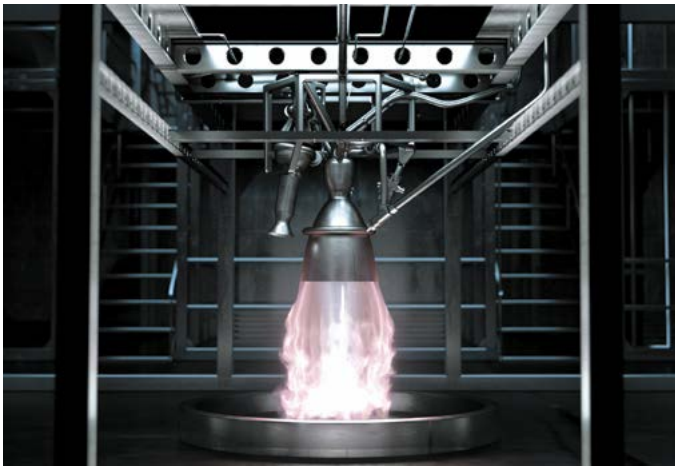
French-German cooperation on launchers is also looking further ahead, as the two nations set their sights on the reusable generations of launchers planned to replace Ariane 6 after 2030. For the Callisto experimental reusable vehicle set to make its maiden flight in 2020 (see Materials p. 27), France and Germany are working in close partnership to keep pace in the competitive world launch market. Callisto's goal is to test key technologies required for reusability and pave the way for future generations of Ariane. They are also driving another futuristic programme called Prometheus, now under the banner of ESA, to develop a demonstrator of a low-cost reusable engine running on liquid oxygen and methane. The joint technology roadmap that CNES and DLR have been working from in this area for several months now is a strong indication of their shared sense of purpose.

6,000

In the case of Ariane 6, 'heavy metallurgy' is not just a figurative expression. The mobile gantry being built by SEH is a massive structure weighing 6,000 tonnes and standing 90 metres tall, while the umbilical tower to be erected by MT Mechatronics will rise to a height of 66 metres.

ELA4 AND GERMAN METALLURGY PROWESS

Heavy metallurgy is another flagship German industry contributing to the construction of Ariane 6's future ELA4 launch pad. The Eclair6 consortium led by Eiffage has been tasked with building the launch infrastructures, for which several major contracts have been awarded to German firms. Among them, Eiffage Metal's German subsidiary SEH is erecting the mobile gantry (see In Figures p. 18). Another historic partner of the Guiana Space Centre, MT Mechatronics, based in Mainz, is supplying the launch table, which it has already delivered, and the mobile transporter systems that will ferry stages to the launch site. This firm will also be building the umbilical tower and flame trench. The German teams from Actemium and Cegelec Space have been working at the Kourou launch base for more than 50 years. For ELA4, Actemium Cegelec Gmbh is supplying and installing some 70% of conventional fluid lines and control consoles. Last but not least, Ariane Group, the launcher prime contractor from conception to commercialization, is none other than a French-German firm born out of the merger of Airbus and Safran in 2014.



The Prometheus engine.

INNOVATION PAVING THE WAY FORWARD

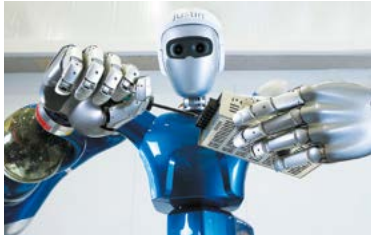
Europe's leadership position is no longer enough to keep pace in today's fiercely competitive global environment, where France and Germany are banking on innovation to stay ahead.

In domains as diverse as communication, navigation, climate monitoring and security, space is set to become a 'Swiss Army knife' for boosting nations' competitiveness in the international arena while meeting an ever-growing range of social needs. And for the two nations behind the birth of Europe's space programme, innovation is the name of the game. On 1 February in Berlin, CNES President Jean-Yves Le Gall and Pascale Ehrenfreund, Chair of the Executive Board of DLR, reaffirmed the importance of stepping up their cooperation in space innovation, in line with the will that President Emmanuel Macron and Chancellor Angela Merkel expressed on 22 January for France and Germany to become world leaders in disruptive innovation. This intention is already being pursued through demonstrator projects like Prometheus and Callisto, but to succeed it will require technology spin-off to move up a gear. Here, Germany can rely on the Helmholtz Association of which DLR is a member alongside other research institutes providing the potential to achieve this. CNES, meanwhile, is playing its part by giving strong support to start-ups and industry, and initiatives are springing up on both sides of the Rhine. In 2015, DLR launched the first European INNOspace Masters competition to encourage new ideas, and the AIF industry association (see box) in France set priorities to help small- and medium-sized industries to take up new technology tools.

AIF

FUTURE INDUSTRY ALLIANCE

The AIF[1] future industry alliance is a non-profit association that helps firms to adopt new production technologies, apply new ways of working and acquire new skills. It starts with a diagnosis co-funded by local authorities *"to identify firms' weaknesses and give them the keys to become more competitive,"* explains Tahar Melliti, the association's chief executive. AIF also supports training and refresher courses for employees working



in innovative sectors like cobotics[2], additive manufacturing, augmented or virtual reality and big data. *"Space is obviously a part of what we do,"* confirms Tahar Melliti, and the European dimension is not neglected. A common baseline architecture is also in development to define digital standards covering all industrial phases from conception and development through to production and commercialization.

1. Alliance Industrie du Futur
2. The use of 'collaborative robots' designed to interact with human operators

LEARN MORE:
HTTP://WWW.INDUSTRIE-DUFUTUR.ORG/

SPACE RECYCLING

WOULD A REUSABLE LAUNCHER MAKE SENSE FOR EUROPE? To answer that question, the Callisto project is developing a small proof-of-concept vehicle about 12 metres tall capable of flying to an altitude of 35 kilometres and then returning to land near its launch site—a true technical challenge that France and Germany are setting out to meet together. *"As a conceptor of complete launch systems, CNES is in charge of the launch vehicle and supplying the flight software as well as the launch base in French Guiana. DLR, which has already proved its prowess in aerodynamics and landing systems on the Philae lander, is building the retractable legs that will absorb the shock on landing, as well as the flight control surfaces to guide the vehicle as it re-enters the atmosphere,"* says Pascal Tatiossian, CNES's Callisto project leader. The first flight is planned late in 2020.

DNA

INCEPTION

DIFFERENT **ORIGINS**

CNES's inception in 1961 met a geostrategic need to give France a structure designed to assure the nation's independent space launch capability. It is a government agency whose remit spans five strategic domains: access to space, science, Earth observation, telecommunications and defence. DLR began life back in 1907 as an aerodynamic research centre, since when it has evolved into its present form (1997) as both a research centre and government space agency encompassing not only space but also aeronautics, transport, energy, digital technologies and security.

COOPERATION

NATURALLY **COMPLEMENTARY**

CNES is focused on systems engineering, programme and project management and technology development in partnership with industry. As such, it delegates responsibility for research. DLR, on the other hand, belongs to a scientific community of 40 institutes and is fully oriented towards research. Both agencies work to rationalize, harmonize and provide a legal footing for joint projects. CNES is thus able to contract out to DLR or one of its research institutes. In 2016, the two space agencies renewed their framework agreement and extended it to closer cooperation with the European Union, in addition to their collaboration with ESA.

CNES AND DLR'S MISSION IS TO EXECUTE NATIONAL SPACE POLICY. WHILE THEY MAY NOT BE ORGANIZED IN THE SAME WAY, THEIR SPECIFIC DIFFERENCES COMPLEMENT ONE ANOTHER FOR EUROPE'S BENEFIT.

EXCHANGE

RIGOROUS **PROCEDURES**

Combining strengths and sharing costs are vital in today's competitive world. As a result, most space programmes are bilateral or multilateral endeavours, underpinned by well-established protocols (see p. 9). The terms and conditions —scope of cooperation, programme duration, funding, etc.—are set out in letters of intent, memoranda and framework agreements. For example, 20 technical agreements were signed for the Symphonie programme between 1969 and 1978. The bilateral framework agreement signed by CNES and DLR in 2002 encompassed 14 cooperation agreements.

TEAMS

THE HUMAN **FACTOR**

New technologies may have transformed the way we communicate, but they can't replace the human factor that cements any relationship of trust. While CNES has representatives to mediate with its partner nations (see Horizons p. 32), a lot of teamwork takes place on the ground, with integrated project teams being dispatched where needed. At CNES's Launch Vehicles Directorate (DLA), for example, ESA, DLR and CNES personnel are working side by side in a richly stimulating environment. For them, cultural barriers are a thing of the past.

JULIA WEMBACHER

Modelling and computation engineer at the Guiana Space Centre's environment and ground range safety department

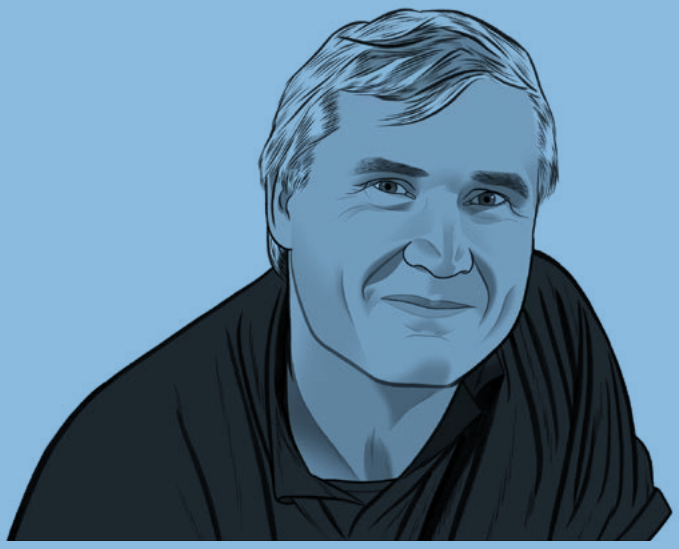
"I love working with people of different nationalities..."

For young engineer Julia Wembacher, the Guiana Space Centre (CSG) is the "*perfect combination of a stunning natural environment and a really exciting job.*" Born in Germany, Julia, 27, joined CNES in August 2017. Since then, she's been calculating the risks on the ground, should a major incident occur. **Hailing from a tiny village in the Bavarian Alps, Julie discovered the CSG on a visit** organized by the European Space Agency, her then employer in the Netherlands. It was love at first sight. She applied and 10 months later was packing her bags for Kourou. "*I love working with people of different nationalities...*" To begin with, she didn't speak a word of French, but she's been working in the language for nine months now, helped by three hours of classes a week and the constant contact with her colleagues, mostly French. "*Making friends has been really easy,*" she says. So much so that Julia spends much of her free time with colleagues, recently taking part in the Space Marathon! But it's not all been such a breeze. ***"Here, everything's really bureaucratic. All this paperwork is so French!"*** she laughs. ***"But I'm getting used to it.*** *When I arrived, I was put on a fast track to learn about the base and all the standards for drafting documents.*" As a non-French European, Julia's on an 18-month contract. Now halfway through, she's looking at various options. "*I love it here, but I'd also like to apply to NASA or go back to the Netherlands.*" She misses her loved ones and the great museums. ***"Here, it's not better or worse, just different. Every day's an adventure.*** *Right now, I'm discovering the carnival, it's like wow!*" Julia also enjoys the excursions into the rainforest and sampling Creole cuisine. "*I'm really going to miss all this. My job as well. Readying for a launch—that's amazing!*"

JEAN-FRANÇOIS DUPUIS

CNES's Berlin correspondent

"There's a vital federal dimension here..."



Space advisor Jean-François Dupuis is a French Berliner! "*I represent CNES in Germany*," he says. "*As a diplomat,* ***I report to the French Ambassador and work for the French government with special responsibility for French-German relations in space.***" After stints at CNES's Launch Vehicles Directorate, Stratospheric Balloons Department and the Guiana Space Centre, he arrived at the German space agency DLR in 1999. He was appointed Science and Technology Advisor to the French Embassy in Germany in 2004 and set up CNES's Berlin office in 2009. He's the **official point of contact for government, members of parliament, the science community, industry and other French stakeholders interested in forging space partnerships with their neighbours across the Rhine.** Part of his role is to explain the differences between the two countries. "*There's a vital federal dimension here—you negotiate with Berlin, but also with the governments of each of the Länder, or federal states, involved in the cooperation. Dealing with the right person is crucially important!*" Another defining feature is that **industry and competitiveness take precedence in any political decisions, which means that German space strategy is closely tied to industrial policy.** For this reason, DLR—which is a scientific organization, with its space agency and research institutes—is overseen by the Ministry of Economy and Energy, not the Ministry of Research.[1] For Jean-François Dupuis, "*CNES and DLR are highly complementary in terms of their structures and how they operate, so it's quite natural they should work together.*" Our expert says he's "*in his element*" in this eminent context. "*I love my home, CNES. I love the complexity of political negotiations in an international environment. And I really appreciate the German way of life and the people here, with their sense of culture, technology and tradition.*"

1. In France, CNES is overseen by the Ministry of Research and the Ministry of Defence.

GERHARD EHRET

Co-Principal Investigator for the MERLIN science mission at DLR

"I've enjoyed close working relations with French scientists for over 30 years!"

The highly anticipated French-German MERLIN mission, currently scheduled to be orbited in 2021, will measure methane concentrations in Earth's atmosphere and identify methane emission sources. Under this close partnership, CNES is building the satellite platform, which will carry the DLR remote-sensing instrument, based on a revolutionary new lidar technique. *"By measuring the laser light reflected by a surface, it allows highly precise measurement of greenhouse gas molecules in the atmosphere,"* says **Dr Gerhard Ehret, who joined DLR in 1986, specializing in Earth laser remote sensing.** Today head of the Lidar department at DLR's Institute for Atmospheric Physics, he started by *"going to see what French scientists were doing in this field". "I've enjoyed close working relations with them for over 30 years,"* he continues. Located in Oberpfaffenhofen, this branch of DLR builds airborne lidar-based instruments to support the development of future missions. Co-Principal Investigator **for the MERLIN science mission, the Institute is about to conduct the CoMet measurement campaign using its CHARM-F airborne demonstrator.** The purpose of this campaign is to *"prove everything works properly, identify any possible technical improvements and provide a training opportunity for scientists using this new type of data."* Since MERLIN data will be used by laboratories on both sides of the border, the two countries are also sharing the ground segment. To align advances and prepare for the integration phases, French and German scientists meet twice a year, sometimes in France, other times in Germany. An active member of these committees, Gerhard Ehret says he's *"highly impressed by the professionalism of CNES and the scientists on the French side—especially when I see what they can do with lidar data in terms of climate models. It's a great experience!"*

Jacques Arnould,
science historian
and theologian,
CNES ethics officer.

ETHICS CORNER

JACQUES **ARNOULD**

THE EAGLE **AND THE ROOSTER**

There's no denying the existence of borders between our countries. But one way we can transcend them is through cooperation, exemplified by the many collaborative initiatives between Germany and France in space.

What does it matter to me if the Gallic Rooster is inspired by the grotesque theatrical creatures of Aeschylus and Aristophanes, like the misshapen hippalektruon or 'horse-cockerel', rather than the elegant Pegasus of mythology? After all, when Lucian of Samosata wrote Menippus's imaginary lunar voyage, he was poking fun at the philosophers of his day. And what does it matter if Lucian gave his hero one wing of an eagle and one of a vulture, so he might succeed where Icarus failed, which is simply a question of means? The stated goal from the very introduction of this satirically titled 'true story' is to demonstrate the benefits of gaining some vertical perspective and thinking freely, as much as it is about experience. From the Moon, once his eyesight had adjusted—no doubt for the better—he could contemplate the spectacle of Earth and its inhabitants. Nothing other, mused Menippus with a smile on his return to Greece, than the appearance of a "*community of ants*", an absurd play, an absolute cacophony. And Lucian didn't stop there with his cynical mockery: "*the people who amused me, however, were those who dispute about boundaries… the widest-acred of them all, methought, was the proud cultivator of an Epicurean atom.*" Has the world changed since Lucian's day, back in the second century? Well, yes, it has, and we shouldn't hesitate to mock the mocker.

A SPACE OF FRIENDSHIP

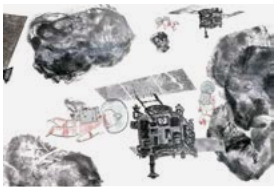
I wonder what Lucian would make today of this surprising alliance of Eagle and Rooster, the emblematic, totemic symbols of Germany and France. He'd probably find it funny, such was his school of thought. But again, what does it matter to me? I only know that our two countries, whose common border (whatever Menippus's astronaut-successors may think) is clearly visible from space, just like the border between the two Koreas and many other territories on the surface of our planet, have managed —not without toil and effort, difficulties and failures— to move beyond simply glaring at each other across the blue line of the Vosges, or worse. Space has been, and still is, one of the places where the good terms between us have been fostered.

I'm the child of a homeland our two countries have fought over. I'm also a child of Gagarin, Armstrong and Aldrin. Thanks to them, and their European colleagues, I've not only dreamt of stars—I've also seen a starry flag flying over some amazing cooperations. So, how can we not celebrate our joint initiatives, past, present and future, which don't ignore the borders between people but offer a way to transcend them and work together!

DIALOGUES

CELEBRATING FRENCH-GERMAN PARTNERSHIP

CNES's Observatoire de l'Espace has produced a deluxe box set of three booklets about the close links France and Germany have fostered in space over decades. A story of technologies, countries and people, *Dialogues* looks at all the themes explored by the two nations from 1966 to today. Thirty 'snapshots' with short commentaries present the key highlights of an extraordinary adventure, led by two countries determined to realize the dream of a spacefaring Europe. With a preface by CNES President Jean-Yves Le Gall and Johann-Dietrich Wörner, former Chair of DLR's Executive Board, it also includes a longer section entitled *Contakt*, with historical and esthetic analysis, plus a richly documented chapter on the Symphonie programme.



MASCOT

IAC 2018

Each year, space specialists from around the globe converge for the International Astronautical Congress (IAC). Some 5,000 are expected at IAC 2018, which takes place in Bremen, Germany, 1–5 October. CNES will be sending a delegation of engineers and showcasing its programmes with a stand highlighting French-German cooperation. As it happens, IAC 2018 coincides with the MASCOT lander's final descent onto asteroid Ryugu, three years after Philae touched down on comet 'Chury'. Part of Japan's Hayabusa2 asteroid sample return mission, led by JAXA, MASCOT is another prime example of French-German cooperation. To mark the occasion, the three agencies are planning a special event at the Congress.

ILA BERLIN

CNES OUT IN FORCE

At this year's ILA Berlin air show, CNES will again be present alongside DLR to promote the excellence of their cooperation. The 2018 event is a chance to showcase on their joint stand the Callisto mini-launcher and for the first time a full-scale model of the MERLIN satellite, outside the Space pavilion. Such models usually prove very popular with the visiting public during the open days at the weekend. CNES and DLR will also sign a bilateral agreement on space innovation at the event.

150,000

ILA Berlin will host 1,000 exhibitors from 37 countries and 150,000 visitors over five days. It's chiefly aimed at industry professionals, with two hugely popular public days at the end.

Alexander Gerst in the Cupola during his first stay aboard the ISS.

INTERNATIONAL SPACE STATION

A GERMAN AT THE HELM

In June, Dr Alexander Gerst of Germany will head to the International Space Station (ISS) for a six-month mission. A volcanologist and geophysicist, the ESA astronaut did a tour on the ISS in 2014. This year, he'll pursue tests and ESA research programmes, which typically span several missions. He'll likely work on the MARES system, designed to study muscle wasting, and plasma crystals in weightlessness. He'll also take part in various experiments performed by ISS partners. In the second half of his mission, Alexander–known for his outstanding professionalism and interpersonal skills–will be the second European[1] to command the station. He says he's *"honoured and eager to contribute to one of humanity's greatest adventures–discovering new horizons!"*

1. The first was Frank De Winne in 2009.

AGENDA

25-29 APRIL 2018
ILA Berlin Air Show
Berlin ExpoCenter Airport, Germany

1-5 OCTOBER 2018
69th International Astronautical Congress
Bremen, Germany

EDUCATION

GLOBE

Germany is one of France's closest partners on the GLOBE[1] international science and education programme, which gives young people the chance to use new technologies and space data to better understand and protect the environment. Some 25,000 schools in 119 countries are involved, including 609 in Germany and 112 in France. Germany was one of the first European countries to sign up to GLOBE, followed by France in 2004. Since then, CNES has worked with education officials in Germany, with a growing emphasis on interaction between classes and exchange visits. And the interaction continues today with a large-scale European campaign to measure air quality.

1. Global Learning and Observations to Benefit the Environment

ACTINSPACE COMPETING ACROSS BORDERS

Seeking to stoke young people's entrepreneurial spirit, ActInSpace is showing year after year that space technology spin-off can create new businesses. Buoyed by its success, this competition initiated by CNES is now widening its net and forging a new type of partnership with Germany.

ActInSpace gives participants 24 hours working in teams to solve a challenge set by CNES or its partners. Its goal is to get them using space data for applications for which they were not originally intended. The winners can then apply to CNES for a licence to exploit a patent and develop a new business on terms suited to a start-up, and the business can join the ESA BIC incubator network.

QUID PRO QUO

This hackathon started out on a small scale in five French cities in 2014, but by 2016 it had extended its reach to Europe, hosted by 24 cities, among them Darmstadt. This year, Munich has joined 71 other participating cities around the world. CNES provides each city with the elements needed to organize the competition and delegates operational aspects to the Aerospace Valley competitiveness cluster, based in Toulouse. For Munich, the AZO cluster, Aerospace Valley's German counterpart, is taking care of the operational side of things. AZO is also managing the three other large-scale European space competitions focused on GNSS technologies (Galileo), Copernicus data and space exploration. For Didier Lapierre, in charge of spin-off and technology transfer at CNES, "*this partnership enables ActInSpace candidates to be pointed towards the right competition for them in terms of funding and support. It's a quid pro quo arrangement between CNES and a German competitiveness cluster whereby we can also invite Germany to host this competition, which is a great source of innovation.*"

12

Start-ups,
one German, were formed as a result of the 2016 ActInSpace hackathon. Six more are in the process of being created.