CNES MAG

EN FR

SPACE ● INNOVATION ● SOCIETY

#68
May 2016

COOPERATION

A GLOBAL AMBITION

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CENTRE NATIONAL D'ÉTUDES SPATIALES

INSIDE

NOTE
In issue n°67, we omitted the © GIM Smart Geo Insights copyright for the Pleiades image used to track polio vaccination campaigns in Nigeria (p. 26). To make up for our omission, we've posted an in-depth article (in French) about this most original application that you can view at https://entreprises.cnes.fr/fr/pleiades-a-lassaut-de-la-polio

PARTNERS

Space agency partners mentioned in this issue with whom CNES is pursuing cooperation programmes: p.08 AEM (Mexico); p.10/27 NASA (United States); p.10 JAXA (Japan); p.07 ISRO (India); p.08 AGEOS (Gabon); p.09 SANSA (South Africa); p.10/34 DLR (Germany); p.11 CNSA (China); p.34 KARI (South Korea).

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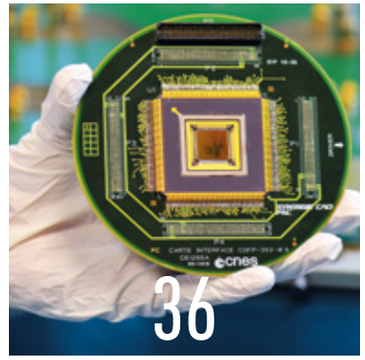

CONTRIBUTORS

JEAN-PASCAL LE FRANC
CNES's Deputy Director of Planning and International Relations moved into diplomatic relations straight after graduating from the Ecole Centrale de Paris. Today, working with the agency's teams, he is behind every cooperation agreement that CNES signs. For this issue, he took us behind the scenes of international relations.

DONATO GIORGI
In charge of CNES's European and International Affairs team, Donato Giorgi worked with various European institutions before joining France's permanent representation to the European Union as attaché for space affairs. He therefore has plenty of expert insight into what's at stake in space for Europe.

LÉONARD DUPOND
Once his talent had been spotted by publishing house Seuil Jeunesse at the end of his graphic arts studies, Léonard's career as an illustrator was off to a roaring start. His style imposes a very tight range of colours. We gave him carte blanche to illustrate the CNES IN ACTION section of this issue.

SÉBASTIEN GODEFROY
From the age of 18, Sébastien has always seen photography as a pretext to reach out to others. From his pictures for the Fondation Abbé Pierre for the homeless to his current project depicting people living in poverty, the human touch permeates all of his work. For us, he did a photo shoot with CNES President Jean-Yves Le Gall.

CNES MAG

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EDITORIAL

Throughout this year we will be celebrating the 50th anniversary of French-Russian space cooperation, retracing the history of this emblematic partnership that started with the Soviet Union and in the process sketching out the key diplomatic shifts the space sector has seen. In the international arena, CNES has always sought to adopt a global perspective by making cooperation central to its strategy. As an undisputed expert in its field with unique competencies, CNES has been behind many fine successes in space. Within Europe's space programme, of course, notably with Galileo, Copernicus and Ariane 6, and also through fruitful bilateral collaborations like the development of MERLIN with Germany and climate-monitoring satellites with India. And this is a trend that is set to continue, as no fewer than 12 agreements were signed last year alone—a string of successes that are extending the global reach of France and its space industry. A number of international events this year—among them the ILA Berlin Air Show in early June and the Toulouse Space Show in late June, where India will be the guest of honour—will also offer opportunities to showcase CNES's dynamic cooperation efforts.

MARIE-CLAUDE SALOMÉ
CNES DIRECTOR OF COMMUNICATIONS

FRENCH-RUSSIAN COOPERATION

A half century of cordial relations

This year marks the 50th anniversary of the first space cooperation agreement between France and the former Soviet Union. A fresco and a bilingual film will be touring throughout the year, turning the spotlight on science missions and Soyuz in Guiana. Commemorations will culminate in November with ESA's Proxima mission, on which French astronaut Thomas Pesquet will be flying to the ISS. It was of course Russia that enabled France to join the human spaceflight club, giving five French cosmonauts the chance to experience this unique adventure. Among them was Claudie Haigneré, the first French woman to fly in space, seen here returning from the Andromède mission in 2001.

From left: Francisco Javier Mendieta (AEM), Wu Yanhua (CNSA), Jan Wörner (ESA), AS Kiran Kumar (ISRO), Charles Bolden (NASA), Jean-Yves Le Gall (CNES), Shizuo Yamamoto (IAXA), Alain Ratier (Eumetsat).

NEW DELHI

A DECLARATION OF SUBSTANCE

Following on from the COP 21 climate conference in Paris last December, the heads of the world's leading space agencies came together in New Delhi at the 10th Asia-Pacific Remote Sensing Symposium (APRS), where on 3 April they approved the principles of a joint declaration. Underlining the vital role of satellites in studying and preserving Earth's climate, this declaration calls for evolving space-based operational tools combining in-situ measurements and increased computing resources. To this end, space agencies will need to develop new technologies to be flown in space and encourage their research communities to devise new models. The declaration emphasizes cooperation to cross-calibrate instruments and cross-validate their measurements with a view to achieving an independent international system for estimating global emissions based on internationally accepted data. Through this declaration, the space agencies present at APRS committed to establishing a global framework for this purpose.

+50%

The velocity boost from Earth's rotation near the equator generates a "slingshot" effect to optimize launch performance. Since late 2011, Soyuz has been operating from French Guiana, where it can offer 50% more lift capacity than at its other base in Baikonur.

INDIA

NEW CLIMATE AGREEMENT

Artist's impression of the Megha-Tropiques satellite.

Climate has been central to CNES and ISRO's[1] joint efforts over the last 15 years, the two agencies having launched two ocean-observing missions together, Megha-Tropiques in 2011 and SARAL-AltiKa in 2013, which have spawned a series of operational applications. Both missions quickly achieved measurable results for India's environment policy, notably aiding water resource management and monsoon forecasting. This cooperation is now set to continue with a new agreement signed at the end of last year to develop a third joint climate-monitoring satellite that will also carry an Argos-4 instrument.
This new mission, dubbed Oceansat, will use CNES-developed infrared technologies to map heat exchanges at Earth's surface and will be launched in 2018.

1. Indian Space Research Organisation.

GABON

CNES BEHIND NEW COMPETENCY CENTRE

The pioneers remember clearing the site with machetes for the first launcher tracking station in Libreville, in 1986. In the intervening 30 years, CNES has worked constantly with Gabon and the inception in 2010 of AGEOS[1], the Gabonese space agency, further strengthened these ties. In a country 90% covered by equatorial rainforest, AGEOS is using SPOT imagery to support the REDD+[2] programme. The Gabonese agency significantly boosted its image-acquisition capacity last year with the opening of a new receiving station for its SEAS[3] Gabon satellite-based environmental monitoring project, through which it will keep track of its seaboard. And with the bilateral framework agreement signed last December, CNES is committed to helping AGEOS develop its activities, by providing imagery from the Sentinel and Pleiades satellites and encouraging exchanges of expertise.

1. Agence Gabonaise d'Etudes et d'Observations Spatiales.
2 Reducing Emissions from Deforestation and forest Degradation.
3 Surveillance Environnementale Assistée par Satellite.

MOROCCO

COP 22 IN SIGHT

More than just a postcard tourist destination, Morocco is playing a driving role in Africa's economy. As it is also in tune with environmental issues, it will be hosting the COP 22 from 7-18 November, a gathering it has already hosted before for the COP 7 in Marrakesh in 2001. CNES will be providing support and is already working with Morocco's Royal Centre for Remote Sensing (CRTS) and Royal Centre for Space Studies and Research (CRERS) on applications for agriculture, water management and oceanography.

MEXICO

ENGINEERS ON THE TEAM

The Mexican engineer set to join the science ballooning team at the Toulouse Space Centre on 1 June will have company, as a colleague from the National Autonomous University of Mexico (UNAM) has been working there since 1 September 2015. This successful cooperation is combining expertise to develop and qualify a satellite-based telemetry and telecommand system. The Mexican engineers are being hosted under the specific agreement signed last June at the Paris Air Show with AEM, the Mexican space agency.

SOUTH AFRICA

ALL-NEW RECEIVING STATION

Receiving stations are the key element connecting a satellite and its control centre. In 1984, CNES erected such a station to track Ariane launches in Hartebeesthoek, South Africa. Along with Aussaguel-Issus outside Toulouse and Kourou in French Guiana, Hartebeesthoek is the station most used to position satellites and keep them on station for CNES and its partners. For the Cormoran[1] project to sustain this network, a new station is set to replace the one in service since 1984. The building is now finished and the antenna is undergoing validation. All that remains is to qualify the station within the network for it to start operating later this year. SANSA[2] will be involved in operating it alongside tele-operations from Toulouse.

1. COnsolidation et Renouvellement des MOyens Réseaux et des ANtennes.
2 South African National Space Agency.

40

companies are working at the CSG, reflecting ESA's geographic return principle. They form UEBS, the launch base employers' confederation.

€5.3 BILLION

ESA's 2016 budget, up 18.4% on the previous year, coming chiefly from the contributions of its 22 member states and European funding for the Galileo and Copernicus programmes. With €844.5 million, France—through CNES—is the leading contributor with Germany.

23 OFFICES AND SUBSIDIARIES

Created in 1985, CLS, a subsidiary of CNES, Ifremer and investment firm Ardian, supplies value-added satellite-based products and solutions for environmental monitoring, sustainable resource management and maritime security. Last year, 70% of its revenues came from export markets in 60 countries. It has 23 offices and subsidiaries around the world serving 25,000 customers.

BUILDING SPACEFARING EUROPE

28 APRIL 1960

The Council of Europe tasks the Committee of Ministers with studying the possibility of creating a European space research agency.

MARCH 1962 TO MAY 1963

The CECLES/ELDO, CERES/ESRO and ECST organizations are created to develop and build European launchers.

MARCH 1970

The Aigrain report deems a national space policy unachievable and advocates European cooperation.

30 MAY 1975

The European Space Agency (ESA) is formed to federate Europe's space efforts. It today has 22 member states, including Switzerland and Norway from outside the European Union.

2004

Framework agreement between the EU and ESA laying down guidelines and procedures for relations between the two institutions.

1 DECEMBER 2009

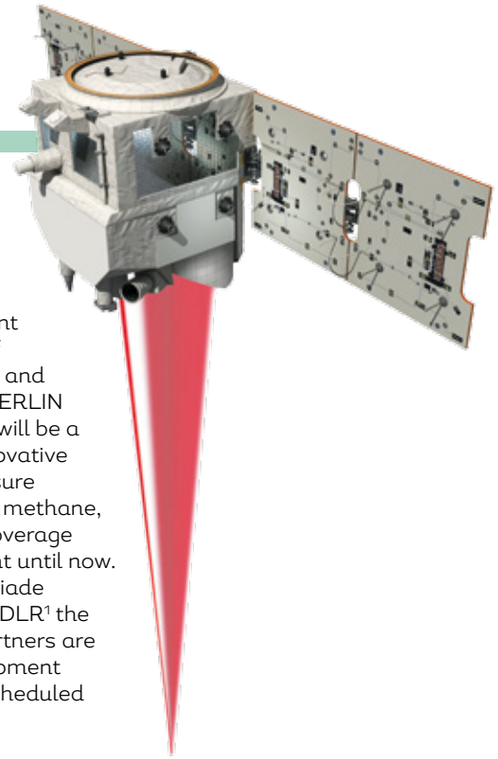
The Treaty of Lisbon comes into force, giving the EU an explicit shared competency in space policy.

UNITED STATES

SWOT DRIVING A TECHNOLOGICAL REVOLUTION

Jason is the flagship series of altimetry satellites conceived by NASA and CNES (see Materials p.27). Responsibility for operations has now been transferred to NOAA[1] and Eumetsat, the U.S. and European operational agencies, and the two partner space agencies are refocusing on their original mission to innovate. French-US teams are now readying Jason's successor with SWOT, built around KaRin, a high-tech interferometric altimeter designed to give oceanographers more detailed data on the surface topography of oceans and coastal waters, and on the levels of lakes, rivers and other freshwater sources. Pilot sites have already been chosen to test the technologies. SWOT is receiving funding under France's PIA future investment programme, as well as from the United Kingdom and Canada. It is currently in the study phase on both sides of the Atlantic and is expected to launch in 2021.

1. National Oceanic and Atmospheric Administration.



GERMANY

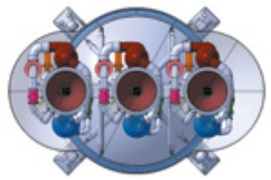
MERLIN SET TO BREAK METHANE'S SPELL

Methane is known to be a potent greenhouse gas. In the wake of the COP 21 conference, France and Germany are developing the MERLIN programme together. MERLIN will be a small satellite packed with innovative technologies designed to measure atmospheric concentrations of methane, including over regions where coverage has been sparse or non-existent until now. CNES is supplying the new Myriade Evolutions spacecraft bus and DLR[1] the active lidar sensor. The two partners are expected to green-light development shortly in Berlin, with launch scheduled in 2020.

1. German space agency

JAPAN

CALLISTO TO DEVELOP REUSABLE LAUNCH VEHICLE



As our modern throwaway society is increasingly called into question, engineers dream of building reusable spacecraft. JAXA[1] and CNES have joined forces on the Callisto programme, which is studying a demonstrator concept intended to pave the way for the launchers of the future. The task facing them is a hard one, calling for innovative technologies and design. The teams began the first phase of the project in November last year, involving cross-analysis of different reuse concepts and scenarios. From October, CNES will be starting talks with the German space agency DLR, JAXA's partner, on the possibility of a three-way collaboration. For the time being, the first test of the demonstrator is set for 2019.

1. Japan Aerospace eXploration Agency.

CHINA

TRACKING GAMMA-RAY BURSTS

CNSA[1] and CNES are seeking to step up their cooperation through the SVOM astrophysics mission (Space Variable Objects Monitor). SVOM will look for gamma-ray bursts (GRBs) generated by exploding massive stars and from the merger of compact objects like neutron stars and black holes. The satellite will be capable of detecting the faintest GRBs and then repointing within minutes to observe them with narrow-field telescopes. The mission is expected to detect some 200 GRBs. Launch is scheduled for 2021.

1. China National Space Administration.

IAF

REACH OUT AND TOUCH

The International Astronautical Federation (IAF) counts 300 member organizations and communities, representing 66 countries. CNES President Jean-Yves Le Gall is the current IAF President. Serving its motto—Connecting @ll space people—he wants IAF to reach out to all space players, "*emerging space nations, new entrants from the Internet sphere and young generations.*"

VIDEO

[+]

WWW.CNES.FR

COSPAS-SARSAT

SAVING LIVES AROUND THE GLOBE

There may be no such thing as zero risk, but the Cospas-Sarsat intergovernmental organization can be counted on to come to the rescue in an emergency. In 1988, Canada, France, the United States and Russia formally founded the satellite-based search-and-rescue system designed to respond to distress calls anywhere in the world. For the past 30 years, the four partner nations have operated the system under the authority of the Cospas-Sarsat Council, of which France recently took over the rotating chair. But the Secretariat[1] remains the linchpin of this international programme. The same simple procedure applies to shipowners, airlines and hikers alike, who must register their emergency locator beacon. Once a beacon is activated, it sets off a sequence of transmissions from the Cospas-Sarsat satellites to ground stations and control centres, which then dispatch emergency-response teams closest to the location of the distress call. Cospas-Sarsat today federates 40 nations and two organizations. The constellation currently comprises satellites in low Earth orbit (LEOSAR) and geostationary orbit (GEOSAR), and is set to incorporate satellites in medium-Earth orbit (MEOSAR) for even faster response.

1. The Secretariat is the administrative body of the International Cospas-Sarsat Programme. Its mission is to assist the Council in the implementation of all its functions.

40,000

Human lives saved since Cospas-Sarsat entered service, in response to more than 11,000 distress calls around the globe.

#COMMUNITY

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

@ COPERNICUSEU
The European Earth Observation Programme

Congratulations! @EUMETSAT, @NOAA, @NASA and @CNES and @SpaceX ! #Jason3 will soon provide ocean data for the #CopernicusEU programme.

@ SCT MÉXICO
Secretaría de Comunicaciones y Transportes.

La @AEM_mx y la @CNES apoyarán a los universitarios de #Chihuahua para transitar de lo aeronáutico a lo espacial.

@ KIRAN MAZUMDAR SHAW
Chairman and Managing Director of Biocon, India's largest Biotechnology company

Great news as @isro and @CNES join hands to develop Mars Lander #SpaceCollaboration

@ TIMMINS BALLOON BASE
World's only mid-latitude stratospheric balloon launch base; A cooperative effort between the Canadian & French Space Agencies and the City of Timmins

Sad day today, said good-bye to @CNES and @csa_asc people yesterday. Next scheduled campaign is 2018. Already looking forward to it!!

CNES'S ONLINE GUIDEBOOK

To understand CNES's strategy and see how it works with its partners at a glance, we've put together an interactive guidebook for you. Get the lowdown on the agency's budget, strategy and collaborations!
> http://corporate.cnes.fr

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Q & A

JEAN-YVES LE GALL

IS A FIRM BELIEVER IN FRANCE'S SPECIAL ROLE IN THE INTERNATIONAL SPACE ARENA.
With the emergence of new players, spinoffs for the nation's industry and the continuing construction of Europe's space effort, CNES's President advocates a resolutely go-ahead approach to international relations.

VIDEO

See who's partnering us in the space adventure.

CNES SIGNED NO FEWER THAN 12 AGREEMENTS IN 2015, WITH PARTNERS LIKE THE UNITED ARAB EMIRATES, MEXICO AND SOUTH KOREA. HOW IS 2016 SHAPING UP IN INTERNATIONAL RELATIONS?

Jean-Yves Le Gall: The success of our programmes has made CNES a go-to partner all over the world. This year we'll be sustaining our momentum, even if the priority is to implement agreements already signed. The COP 21 climate conference rekindled interest in space and at the start of April we brought together the heads of the main space agencies in New Delhi to follow up on the Paris Agreement. We all share the belief that space should be a reflex response when tackling climate issues. It is satellites that have revealed climbing global temperatures and the mean rise in sea level of 3.2 millimetres a year. Today, several programmes, including MERLIN and MicroCarb developed by CNES, are working together to measure greenhouse gas emissions and ensure effective implementation of the COP 21 Agreement. Satellite sentinels are useful in this sense to international organizations and individual nations, as they are the only way to measure efforts being deployed to curb emissions.

WHAT PLACE DOES CNES RESERVE FOR EMERGING SPACE POWERS IN ITS COOPERATION POLICY?

JYLG: The geography of the space sector is shifting. The United States is of course still our premier international partner through the Mars exploration and oceanography programmes. Then we have India, with two joint satellites in orbit, Megha-Tropiques and SARAL-AltiKa, and a new agreement signed in January. We're also developing two satellites with China, CFOSat and SVOM, and we're pursuing our historic ties with Russia and Japan. But the world space order has changed and we're also developing closer relations with new players like the United Arab Emirates, Mexico and South Korea, sowing the seeds of future win-win agreements.

WHAT HAS CHANGED IN INTERNATIONAL COOPERATION IN RECENT DECADES?

JYLG: The end of the Cold War had a significant impact on our cooperation policy. CNES could never have considered operating Soyuz in Guiana in the Soviet era. The international arena is being reshaped around new emerging nations and the might of the United States that has given birth to NewSpace. That's why we're having constantly to adapt, and as a French public institution we're able to project a relatively neutral position and forge ties around the globe. It's kind of become our trademark.

YOU OFTEN SAY THAT POTENTIAL PARTNERS SHOULD 'THINK FRANCE' AS A REFLEX RESPONSE. HOW CAN CNES HELP TO ACHIEVE THAT?

JYLG: By maintaining a high profile and communicating about our accomplishments and infrastructures. Our Toulouse Space Centre has developed expertise found nowhere else in the world. We're up there with the best of them and we need to tell people that. That's why I strive to bring foreign delegations to Toulouse, like recently Sweden's King and Queen and the Indian Prime Minister. Visitors never fail to be impressed.

DO CNES'S INTERNATIONAL ACTIVITIES HAVE A SPINOFF EFFECT ON FRANCE'S SPACE INDUSTRY?

JYLG: Our goal is for our international partners to turn to French industry when looking for contractors. They already do in the domain of Earth observation and this has spawned a whole ecosystem around CNES in Toulouse. Our industry has achieved remarkable success in this particularly vibrant market,

"THE WORLD SPACE ORDER HAS CHANGED AND WE ARE DEVELOPING CLOSER RELATIONS WITH NEW PLAYERS, SOWING THE SEEDS OF FUTURE WIN-WIN AGREEMENTS."

JEAN-YVES LE GALL

CNES PRESIDENT

"THE SUCCESS OF OUR PROGRAMMES HAS MADE CNES A GO-TO PARTNER ALL OVER THE WORLD."

in North and South America, North Africa, the Middle East and Central Asia. Another prolific sector is telecommunications. Through the government's PIA future investment programme, we helped French industry to get a foothold in electric propulsion, with the result that after a dip in 2013, numerous orders were booked in 2014 and 2015. This confirms our vocation to drive innovation for jobs.

BIG SPACE PROJECTS IN THE UNITED STATES ARE NOW MOST OFTEN PRIVATELY FUNDED. HOW DO YOU VIEW THIS PARADIGM SHIFT?

JYLG: We hear a lot about private funding in the United States, but the federal government is still providing backing on a massive scale. NASA's budget for 2016 is equivalent to last year's plus the entire budget of CNES, an increase of $2 billion. But here in Europe we often do just as well with far fewer resources, and sometimes better! Working with ESA, we controlled the Philae lander from Toulouse. With NASA and its Curiosity rover, we're driving on the surface of Mars. And we've created world leaders in launch vehicles, Earth observation and services. For example, our subsidiary CLS, which is celebrating its 30th year in business this year, is going from strength to strength.

HOW CAN CNES HELP TO BUILD SPACEFARING EUROPE?

JYLG: We're ESA's chief partner and its main contributor with Germany. Since the Treaty of Lisbon, the European Union has acquired a shared competency for space and established two major programmes with Galileo and Copernicus. Here again, CNES is leading the way. Galileo is a wholly European geolocation system conceived mostly in Toulouse and CNES is working with GSA, the European GNSS Agency set up by Brussels, to operate it. For Copernicus, CNES has designed the PEPS Sentinel Product Exploitation Platform to provide free access to data. It's now up to us to make these two programmes a success.

THE NEXT ESA COUNCIL MEETING WILL BE BRINGING TOGETHER EUROPE'S SPACE MINISTERS AT THE END OF THE YEAR IN LUCERNE. WHAT CAN WE EXPECT TO COME OUT OF THIS MEETING?

JYLG: The 2014 ESA Council meeting took the historic decisions, on CNES's recommendation, to immediately engage development of Ariane 6 and increase funding for operations on the International Space Station. First of all, this year's meeting must confirm those decisions. It will then need to specify Europe's contribution to the next phase of ExoMars, its major Mars exploration programme, and look at remote-sensing and telecommunications satellites. These are all projects in which the French space community is very active.

Profile

2013: CNES President
2007: Chairman & CEO of Arianespace
2001: CEO of Arianespace
1998: Chairman & CEO of Starsem
1996: Deputy Director General of CNES
1993: CEO of Novespace
1988: Advisor to the Minister for Post, Telecommunications and Space
1981: Research scientist at CNRS, the French national scientific research centre

A HISTORIC AGREEMENT

In 2005, the news that Soyuz was coming to French Guiana took the world by storm. Negotiations were eased by the longstanding ties between France and Russia initiated by President Charles de Gaulle in 1966, and the Russian space agency signed an agreement with CNES and ESA to build a pad for its legendary launcher at the Guiana Space Centre. With Soyuz's arrival in Sinnamary, ESA rounded out is range of launch services to complement Ariane 5. After the gargantuan construction project to ready the pad, the first Soyuz lifted off from the equatorial launch base on 21 October 2011, sending aloft the first two satellites of the Galileo constellation.

IN PICTURES

INTO THE WILD

CNES was looking for somewhere to stage its large stratospheric balloon flights and likely candidates in France were few and far between. At the same time, Canadian firms and universities were looking to test new technologies on zero-pressure stratospheric balloons. CNES's expertise in this domain and the vast expanses of Ontario therefore provided the perfect match. Timmins proved the ideal location for a new base where the agency's ballooning teams were able to conduct the Strato-Sciences campaigns in 2014 and 2015, and the Canadians were able to fly their experiments. The next flights are planned in 2018.

160

Regions of interest around the world that Venμs will be watching over. Combining high spatial resolution with frequent revisits, this mission will collect data on plant growth and other terrestrial processes impacted by environmental and human factors. Venμs is a joint mission of France and Israel.

NEW MILITARY SATELLITE MAKES THREE

With MUSIS, Belgium, Germany, Greece, Italy, Spain and France are planning the replacement of their current reconnaissance satellites[1]. This joint project will comprise an optical space component (CSO), for which France is the lead nation, and two radar components from Germany and Italy. France had previously launched construction in 2010 of two identical satellites to fulfil complementary missions in separate orbits. A cooperation agreement signed with Germany in 2015 has now brought this number up to three, with the goal of boosting the performance of Helios 2 with better resolution and a significant increase in daily imaging capacity.

1. Helios, Pleiades, SAR-Lupe and COSMO-SkyMed.

1 in 5

INTERNATIONAL COOPERATION IS IN RESEARCH SCIENTISTS' DNA. What matters most is science value, so pooling of expertise, experience and results is a must. That's why CNES conducts most of its science missions with international partners and data are most often made available to the wider scientific community, for example through data and service hubs. This emphasis on collaboration is also reflected in the fact that nearly one in five doctoral and post-doctoral CNES grantees comes from abroad, plus the international symposia the agency organizes and attends, like the 41st COSPAR Scientific Assembly set to take place from 30 July to 7 August in Istanbul, Turkey.

Antennas

Natal, Libreville, Jeju, Lucknow... This network of downrange ground antennas retrieves information on launcher health and status up to orbit injection. Dotted around the globe along the launcher's flight path, their data are centralized and interpreted in real time. CNES's Ground Developments Sub-directorate is tasked with deploying this network and employs its diplomatic talents in negotiating the intergovernmental accords authorizing the construction of a station or leasing of an existing antenna. The downrange tracking network currently comprises 17 stations providing coverage for all missions.

COOPERATION

MOVING FORWARD TOGETHER

IN A CHANGING INTERNATIONAL LANDSCAPE, CNES HAS FORGED LASTING RELATIONSHIPS WITH PARTNERS ALL OVER THE WORLD FOR MORE THAN 50 YEARS. AS A GO-TO PARTNER, IT IS HELPING TO MAKE 'THINK FRANCE' A REFLEX RESPONSE AND THUS CONTRIBUTING TO THE SUCCESS OF SPACEFARING EUROPE. BEHIND THE POOLING OF KNOW-HOW AND RESOURCES ARE THE MEN AND WOMEN WORKING TOGETHER TO ACHIEVE SHARED GOALS.

By definition, diplomacy is what matters above all in international relations. This is especially so in space, which is clearly a strategic domain given its civil and military aspects. So, when CNES looks to forge ties with foreign partners, it naturally calls on France's extensive diplomatic network, the third largest in the world behind those of the United States and China.

PARTNERSHIPS FROM ALL QUARTERS

With CNES responsible for implementing France's space policy, the government is itself behind many contacts, notably with nations that are a priority of its foreign policy. In today's global economy, French industry may also draw the agency's attention to possible opportunities where it sees new momentum being created. And nations looking to benefit from France's expertise to develop their own space policy may even seek contacts directly. As Jean-Pascal Le Franc, CNES's Deputy Director of Planning and International Relations, points out, *"France has an excellent reputation in space around the globe, which is why our cooperation proposals are usually well received by partners, and in many cases they actively seek our assistance."*

4

CNES currently has four advisors representing the agency abroad (outside Europe) and assisting ambassadors on space matters.

HOW COOPERATION WORKS

Once an opportunity is detected, CNES puts together a protocol mission with the aid of the diplomatic network to meet the main space players in the country in question. If this mission confirms the country's interest, the first step in establishing formal cooperation is the drafting of a letter of intent. The international relations team at CNES's Head Office then sketches out the scope of future cooperation, in accordance with each party's skills and know-how. The next step is a framework agreement outlining its precise contours and limits. "We're obviously very attentive to any risks of transferring strategic expertise," says Jean-Pascal Le Franc. Such formal arrangements remain the key to achieving balanced cooperation in which there are mutual benefits while preserving the interests of both sides. The pinnacle of successful space cooperation is obviously a joint mission, guaranteeing good visibility and direct scientific or economic spinoffs. But cooperation may also encompass a whole range of lower-profile activities like exchanges of personnel, academic collaboration, hosting of PhD students or the organization of symposia.

CNES'S FOREIGN CORRESPONDENTS

In the case of a longstanding partnership in space or one deemed of special importance, CNES seconds a space advisor to France's embassy in the country in question. CNES's four foreign ambassadors tell us what it's like to work in cultures often markedly different to our own.

PODCAST

[+]

WWW.CNES.FR

PIERRE-HENRI PISANI, Tokyo

"There are at least two sides to space in Japan: the advanced technology side geared towards specific strategic and scientific requirements, the clearest illustration being in hazard management; and the cultural side, since the Japanese are big fans of animation for whom artistic creation fuels their dreams. As a result, each satellite has a dual identity, one technical before launch and one symbolic once in orbit. After launch, a satellite is given a new name that's arrived at after a carefully considered and reasoned process. It's hard to get close to the Japanese in everyday life. While this does help to gain a better insight into Japanese society, it never completely unveils all of its mysteries."

ELISABETH MOUSSINE-POUCHKINE, Moscow

"Space affairs are in the news every day and there's no sign of interest in space waning in the written press! The same goes for commemorations. This country is still living on its glorious space past. Although space isn't affected by the sanctions and counter-sanctions arising out of the current political climate between the EU and Russia, I do feel the impacts in my job. I'm finding it hard to meet our Russian partners. Indeed, we don't meet at the Russian space agency but in more neutral places."

MATHIEU WEISS, Bangalore

"India's youth are as enthusiastic about space as football fans supporting their favourite teams. They know the names of all of the space agency's top managers and dream of joining it one day. Since the 1960s, space has become part of the population's daily life. With their Hindu culture, Indians have focused on space serving society rather than projecting power. They're never in the office before 10 in the morning, as they take their time over breakfast and meditate. But they dine there in the evening. They're flexible and innovative, less standards-driven than us. Indeed, Indians and Californians both see NewSpace as a simpler and cheaper way of doing things in space."

NORBERT PALUCH, Washington D.C.

"While space doesn't seem to be a hot topic in the presidential election primaries, what strikes me is the key role of Congress in this area. Representing CNES in Washington involves making contacts with a whole range of players in the space community, from think tanks and associations to federal government representatives and agencies. Not a week goes by without me being invited to some event or other. I'm happy to report that in a country well aware of the power it wields, CNES and its engineers enjoy a good reputation!"

50 YEARS OF SPACE COOPERATION

CNES has strived since its inception to forge international partnerships, achieving some fine successes along the way. Today, it is looking to extend its cooperation efforts to new players and lay the groundwork for the future while leveraging the agency's and French industry's expertise.

For France, space was never going to be a solo effort. From the outset, in 1959, the Research Committee that was the forerunner of CNES focused its attention on two avenues to be explored: the interdisciplinary nature of space research and the possibility of finding international partners, materialized in 1961 by the signature of a first agreement with NASA. This agreement provided for a satellite project and training of French personnel in the United States. In 1962, looking to assure France's strict independence, President Charles de Gaulle's government created CNES and gave it the task of shaping the nation's space policy. The fledgling agency thus played an active part in establishing Europe's nascent space programme, for which Ariane would be the standard bearer. One 'space giant' followed the other, and in 1966 CNES signed a technical, scientific and economic cooperation agreement with the Soviet Union, paving the way for French astronauts to fly in space and marking the start of an extraordinary human adventure. Later, France would extend its partnership to other big space players, like Japan in 1980. Further afield, the two 'housemates' aboard the International Space Station (ISS) were busy turning the scientific observatory into an exceptional orbital research laboratory and a fine example of international cooperation that today federates 15 partner nations.

The Moon landing in 1969 opened eyes to the potential of space and CNES continued to fulfil its research mission with verve, working on a series of Mars, operational oceanography, climatology and astronomy missions within the framework of ESA. In the words of Jean-Pascal Le Franc, CNES's Deputy Director of Planning and International Relations, "*international cooperation with the world's leading space agencies is in CNES's DNA.*"

12

Cooperation agreements with China, Greece, India, Italy, Japan, Kazakhstan, Mexico, Morocco, Poland, Singapore and South Korea were signed in 2015 alone.

NEW ERA, NEW CHALLENGES

Last year CNES signed 12 agreements with international partners around the globe. One of the reasons for such a profusion of partnerships is that many nations, inspired by the careers in space their elders have embraced, are now grasping the importance of space applications to development policies. Be it in mapping, telecommunications, agriculture, environmental monitoring or civil protection, the field of applications is vast and the requirements huge. Another factor behind the emergence of new space powers is easier access to space being driven by entrepreneurs investing in the sector and bringing radically new approaches. As a result, legacy players are having to adapt. "*Such partnerships benefit both sides,*" says Jean-Pascal Le Franc. "*While these nations need our experience to get started, in return we're able to keep abreast of new developments that can turn out to be great sources of inspiration.*"

Among the emerging space powers, China and India naturally stand out due to the scale of their space ambitions, having now moved on from their initial goal of supporting development to exploration of the solar system. CNES has longstanding partnership ties with India, both in propulsion and satellites, and has been working for ten years now with China, with whom two satellites are in development.

Besides CNES itself, the nation's industrial base clearly has everything to gain from such cooperation. "*If our partners get to know our industry's unique competencies and know-how through CNES, then everyone gains from that,*" affirms Jean-Pascal Le Franc. "*As the national space agency, it's our duty to do all we can to encourage our partners to turn to France when they're looking to pursue their development.*"

LOGOS

COOPERATION IN PICTURES

MAKING SPACEFARING EUROPE A REALITY

Whether with the European Space Agency (ESA), the European Union or other nation states, opportunities for cooperation in space have been on the rise in Europe in recent years. For CNES, this represents a great chance to showcase its expertise.

European space cooperation was born out of the heady days of the construction of Europe and has been built on the premise that nothing of substance could be achieved without pooling skills and resources. The first concrete efforts to initiate European space cooperation emerged in the mid-1960s and were later pulled together in 1975 under the banner of the European Space Agency (ESA). Since then, ESA has constantly been cited as an example to follow, achieving fine successes such as Ariane and world firsts like landing on the surface of a comet. However, Europe and the world have moved on a great deal since 1975. The Berlin Wall has come down, East-West relations are no longer as fraught as they once were and restrictions on the use of a good number of space assets have been relaxed. The best example of this is no doubt the opening to civil applications of satellite positioning systems initially designed by and for the military. At the same time, as the satellite telecommunications market has reached maturity, the intergovernmental organizations of the early years have become private companies. In the process, space has become a key driver of economic growth and is no longer simply a symbol of sovereignty.

SPACE AS A SHARED COMPETENCE

In this promising context and to develop the growth potential of space applications, the European Union began 15 years ago to take a closer interest in space with its flagship Galileo and GMES programmes (the latter has since been renamed Copernicus), and it has acquired a shared competence in space since the Treaty of Lisbon came into effect in 2009. What this means is that the EU is today a key space player in Europe, with its own policies and programmes. As France's national space agency and with the current array of competent stakeholders in Europe, CNES believes in exploiting expertise where it is to be found. "*ESA offers its technical competencies and ability to manage large-scale research and development programmes, while the European Commission provides a political and strategic dimension, and the potential to federate Europe's long-term needs,*" says Donato Giorgi, who heads CNES's international affairs team. "*Bilateral cooperation between national agencies is necessary to respond to specific needs and develop skills that aren't available elsewhere. The important thing is that all the pieces of the puzzle fall into place to project a positive image of spacefaring Europe that reflects its efficiency and expertise.*"

4

Nations

Between them, France, Germany, Italy and the United Kingdom are contributing more than 72% of funding for ESA's mandatory and optional programmes this year.

GERMANY

A KEY PARTNER

As a pivotal element of Europe, the French-German partnership plays an equally vital role in structuring its space activities.
French-German relations in space have never been better. The recent joint cabinet meeting offered the chance to recall the two nations' shared priorities, particularly in the field of launchers. Since a first framework agreement signed in 2002, soon to be renewed, there has been a plethora of bilateral initiatives with no fewer than 15 cooperation agreements in a range of areas from launcher propulsion to solar system exploration (with the MASCOT lander for Hayabusa 2) and Earth observation. In the latter domain, the forthcoming ILA Berlin Air Show will provide the opportunity to officially announce the go-ahead for the MERLIN satellite (see Roundup p.10). France and Germany also converged their positions at the previous ESA Ministerial Council meeting in 2014, Germany increasing its contribution to the Ariane 6 and Vega C development programme to 23%, up from 18% previously on Ariane 5. "*The political classes in France and Germany agree on the strategic and industrial importance of space,*" says Jean-François Dupuis, CNES's space advisor at the French Embassy in Berlin since 2004. "*This helps to converge points of view and build an enduring consensus that serves the interests of both sides.*"

FRENCH GUIANA
A SPACE CENTRE AT THE CROSSROADS OF NATIONS

With operators from Europe and Russia, and space agencies and satellite customers from around the world, the Guiana Space Centre brings together teams from all horizons and different cultures, working together towards a common goal.

VIDEO
[+]
WWW.CNES.FR

The Guiana Space Centre (CSG) is a high-performance facility sustained by the combined know-how of some 1,700 employees from all over Europe. While French is the official language, you will often hear Italian, German, Spanish and local Creole. And with the arrival of Soyuz, the CSG and the neighbouring town of Sinnamary have been playing host to Russians since 2008. So there are now two major space nations working together on the base, learning from each other's very different ways of doing things. Added to the mix in this multilingual environment are the cosmopolitan satellite preparation teams, who talk in Japanese, English, Indian, Argentine Spanish, Portuguese and Malaysian, and it's not uncommon to hear a French Canadian accent. Sari-wearing Indians work alongside their American counterparts in shorts in the payload preparation buildings. The payload support managers with whom they are in closest contact are all agreed on one thing: when you're working towards the same goal of launching a satellite, language is not an obstacle to understanding. The methods may not always be identical, but the attention paid to the satellites and operational safety is the same. "*When everyone gets together to talk during a campaign, we have the whole world sitting around the table*," says Tony Guillaume, Director of Operations (DDO) at the CSG. Such gatherings are a great opportunity to discover the sometimes surprising facets of other cultures. "*Hindus are probably the most surprising*," says Guillaume. "*They look at you and say 'yes' while shaking their head from left to right… so we think 'was that a yes or a no'?*" They are also amongst the most sociable, as no preparation of an Indian satellite is complete without an 'Indian Day', a moment of cultural and culinary exchange not to be missed! That's how life goes down at the CSG, a unique spot of culture on Earth with its eyes on space.

FRENCH EXCELLENCE IN ALTIMETRY

IN THE 1990s, CNES AND NASA INITIATED A SERIES OF SATELLITE ALTIMETRY MISSIONS that would reveal the tiniest variations in the topography of the oceans. The concept, based on continuously bouncing a radar signal off the ocean surface, laid the foundation for operational space oceanography. Since TOPEX/Poseidon and its successors in the Jason family, global sea level can be ascertained with near-millimetre accuracy. Today, satellite altimetry is a domain where CNES excels, delivering data on current velocity and direction, wave height and wind speed. In 2021, the SWOT[1] mission will be carrying a new interferometric altimeter offering a resolution that will further improve measurements of the level of continental surface waters and oceans, including in coastal waters.

1. Surface Water Ocean Topography.

Jason-3 in the anechoic chamber at Thales Alenia Space.

LUCERNE

FUNDING

RESOURCES / SCIENTIFIC PROGRAMME

ESA's member states will be approving funding for the agency's mandatory activities over the period covering 2017-2021.
This is the budget line that funds ESA's flagship mandatory scientific programme, behind such world firsts as the Rosetta comet-chasing mission.

PERFORMANCE

LAUNCHERS

There will be a lot on the agenda for launchers, with Ariane 5 and Vega operations support, preparations for the future and operations at Europe's spaceport for 2017-2021. Ariane 6 is not expected to be a focus of discussions, since the key milestone for Europe's future launch vehicle will be at the end of September, with the review designed to confirm the programme is on track to meet its performance and cost objectives.

TWO YEARS AFTER LUXEMBOURG, THE EUROPEAN SPACE AGENCY COUNCIL IS SET TO MEET AT MINISTERIAL LEVEL IN DECEMBER IN SWITZERLAND. SOME BIG DECISIONS ARE AWAITED AT THIS IMPORTANT EVENT IN THE AGENCY'S CALENDAR.

EXPLORATION

HUMAN SPACEFLIGHT / ROBOTIC EXPLORATION

The European partners on the International Space Station (ISS) are already committed to continuing their participation until 2020 and will have to decide on whether to extend it to 2024. Europe will also naturally need to determine what activities to pursue there and what it envisions post-ISS.
Concerning robotic exploration, ExoMars 2018—the second phase of the ExoMars programme—will no doubt be a key topic. Member states will be asked to specify Europe's funding contribution for the next key stage in Mars exploration.

INNOVATION

TELECOMMUNICATIONS / EARTH OBSERVATION

The future of satellite telecommunications will be an important topic, with the competitiveness of Europe's prime contractors and equipment suppliers at stake. With the emergence of NewSpace, support for innovation through targeted developments will be crucial. Lastly, a new phase of the Earth observation programme will enable new and innovative science missions to be pursued, notably in the field of climate change monitoring, as well as nurturing development of new applications.

SUSMITA MOHANTY

CEO of Earth2Orbit

"If you love what you do and just go for it, no one can stop you!"

We mustn't be caught off-guard. India is an established space power with a growing list of achievements, from the Moon to Mars, its own space observatory and now the Indian Regional Navigation Satellite System (IRNSS), completed in April. This we know, yet it's hard not to be astonished by the energy and enthusiasm of Susmita Mohanty, CEO of Earth2Orbit (E2O). **A space industry insider, she has founded three NewSpace companies on three continents.** Her interests include aerospace architecture, which is the focus of San Francisco-based LSG[1], and the democratization of interpreted satellite imagery, the main activity of E2O in Bangalore, her latest enterprise. She's passionate about innovation and the many ways it can be applied to NewSpace, from launchers, robotic exploration and satellite construction to spatial data analysis for mobile applications. **Not averse to risk, she's a firm believer in the revolutionary potential of this movement. "*What happened with commercial aviation in the 20th century will be applied to commercial space travel in the 21st century*,"** she says. "*Beyond orbital and suborbital flights, these companies will be exploring other ideas, like space elevators, orbital laboratories and extraterrestrial mineral exploration.*" If Susmita Mohanty has made her mark in a predominantly male world, it's thanks to her forceful personality, passion for space and ability to make her own path, far from hierarchical constraints and political powers. "*Regardless of gender, if you love what you do and just go for it, no one can stop you!*" India is now home to a myriad of small, agile space companies, offering a diverse array of resources and quick to invent.

1. Liquifer Systems Group.

YANNICK MELLIER

Astrophysicist and Euclid Consortium Lead

"A European mission driven by passion and reason..."

Yannick Mellier is just as enthusiastic today as he was aged 10, when he first looked through a telescope and discovered Saturn. Since those formative years, his universe has taken on a whole new dimension. At the helm of an international consortium, he's readying for the scientific exploitation of Euclid. **In 2020, this ESA mission will begin compiling a 3D map of hundreds of millions of galaxies to explain why the Universe is expanding at an accelerating rate.** As an astrophysicist at the IAP astrophysics institute in Paris, Yannick Mellier has toured the world's telescopes, from Chile to Hawaii. His work on gravitational lensing has won him international acclaim and his appointment as Euclid Consortium Lead. "*It's a huge responsibility and a real opportunity*," he says. Even if it means taking time out from fundamental physics to focus more on management. "*I'm not principal investigator for the mission, so I'm on management duty!*" Some 14 European nations and NASA are united in a common cause. That's 900 members, 1,280 people, 125 laboratories and a host of different approaches to coordinate. "*We also need to accommodate the specific culture of each nation.*" But it's a fantastic adventure: "*The teams are passionate and have put aside their individual ways of doing things in the name of science. They're combining passion with reason, and we're moving forward. The importance of this mission has really boosted me!*" The research scientist is mindful of Euclid's significance and the value of CNES's unfailing support. **"*For me, CNES has been a positive influence in my life since my student days in Toulouse.*"** For Euclid, the agency's role has been "*decisive, supporting our efforts from the selection phase to the organization and design of the mission*," he concludes. The Euclid mission was originally a French project and was chosen in 2011 from 50 proposals as the M2 mission in ESA's Cosmic Vision programme.

HORIZONS

GREG SKOMAL

Biologist at the Massachusetts Division of Marine Fisheries

"French-US synergy embodied in Argos has revolutionized species conservation..."

His world is the ocean, but space also plays a major role. Greg Skomal is a seasoned seafarer, talented photographer and renowned biologist. His work centres on the study of highly migratory fish species, including shark, tuna and billfish. "*I want to know where they go over broad and fine spatial and temporal scales and how this is related to their natural history,*" he says. ***"My goal is to generate enough species-specific information to implement conservation measures for sustainability."*** He's also enthusiastic about space technologies. As head of research into great white sharks, he was one of the first scientists to use the Argos system. "*It gives us a number of tools. Without Argos geopositioning and data transmission, our ability to track animals would be severely limited. Tagged animals are tracked in real time, or through the transmission of archived data.* ***The evolution of tag technology has changed the way we study animal movements and has led to remarkable discoveries for a number of species."*** Greg Skomal appreciates the working relations he has with CLS[1] America. Established in 1986, CLS America is a subsidiary of CLS France and serves as a data centre. "*They meet all our Argos needs, providing the satellite-linked platforms, all our data and routine technical support.*" The tireless champion of marine species also appreciates the effectiveness of French-US cooperation: Argos is a highly practical result of collaboration between the National Oceanic and Atmospheric Administration (NOAA) and CNES. ***"The synergy of American and French cooperation expands the scope of services offered by the company and creates greater and more effective service coverage,"*** he concludes. "*It's creating real added value for an increasing number of applications.*"

1. Collecte Localisation Satellites.

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

ETHICS CORNER

JACQUES **ARNOULD**

HELLO, EARTH HERE!

What if the space community's efforts to foster cooperation between nations were driven, at least in part, by the holistic view of Earth and humanity offered by space?

Before 1957 and Sputnik 1, things were a lot simpler here on good old-fashioned Earth. As natural constraints and the ebbs and flows of history dictated, humanity spread out into cities, nations and cultures, learning to manage its differences and divisions by walls and borders, or by bridges and tunnels, depending on its mood. Later, when humans first set foot on the Moon, rumours would abound that the only man-made object visible from there was the Great Wall of China. When humanity entered the space age with a bang, a surprise was waiting. Viewed from space, human partitions seemed rather insignificant, even when imposed by vast ocean expanses or mountain relief. In less than an hour, any satellite or astronaut could fully circle the planet, without having to lift a barrier or scale a topographic obstacle. From the vantage point of space, Earth and its inhabitants suddenly seemed less divided than the atmosphere of a Cold War would suggest.

NEW SENSE OF PLANETARY RESPONSIBILITY

It's hardly surprising, then, that Yuri Gagarin and his successors should be officially appointed as "envoys of humanity". Never before in its history had it occurred to humans to bestow such a planetary title and responsibility. And hardly surprising that space, which begins where our atmosphere fades, should be legally subject to the ambitious principles of non-appropriation, peaceful use and the common good. I would like to believe that these lofty ideals aren't solely the result of some political calculation, but were at least partly inspired by this extraordinary vision of Earth from space.

ASPIRATIONS WITHOUT BORDERS

I would also like to believe that the same applies to the cooperation initiatives between states as they plan and implement the ambitious space programmes of tomorrow. Pursued with such visionary boldness and persistence, they cannot be driven by political, strategic, technical or economic necessity alone. To accomplish such audacious endeavours, I'm convinced that this discovery of Earth and ourselves, viewed by satellites and through the windows of crewed spacecraft, must have been an influence and inspiration. And what we've discovered isn't a uniform planet, or a homogenized humanity, but rather, richly coloured mosaics. And maybe a planet that would simply say, in the course of a radio conversation with the stars: "Hello, Earth here!"

AIR SHOW

FRENCH-GERMAN COOPERATION ON THE PROGRAMME

This year's ILA Berlin Air Show takes place from 1 to 4 June. CNES will have a dedicated area inside the huge stand of DLR, the German aerospace centre, reflecting the vitality of French-German cooperation. It will feature scale models of the future Ariane 6 launcher and the Microscope fundamental physics satellite launched on 25 April, as well as latest developments on the MERLIN programme.

+ WWW.ILA-BERLIN.COM

CINEMA

FRANCE-KOREA ON THE BIG SCREEN

From May 2016, the Cité de l'Espace in Toulouse is celebrating French-South Korean cooperation with an exhibition of Korean satellite imagery and a film produced by the Korea Aerospace Research Institute (KARI). In the autumn, it will put on an exhibition in South Korea on satellites and water cycle management, in association with the Toulouse natural history museum. The exhibition is produced in partnership with CNES, the French national weather service Météo France, CLS, Mercator Ocean, LEGOS and CESBIO.

COMMEMORATIVE BOOK

50 YEARS OF FRENCH-USSR/ RUSSIAN COOPERATION

In this retrospective on 50 years of French cooperation in space with the former USSR and Russia, the French space history institute (IFHE) talks to the people involved about the scientific, technological and human aspects of this unique adventure, from the first lunar and Venus missions to the new Soyuz launch facility in Kourou and France's first astronaut.

50 ans de coopération spatiale France-URSS/Russie, Published by Tessier & Ashpool – 400 pages – €49.50

TOULOUSE SPACE SHOW

SPOTLIGHTS INDIA

The Toulouse Space Show is a major global forum dedicated to advances in space infrastructure, technologies and applications. This year's event takes place from 28 to 30 June, with India as guest of honour. Some 2,000 European and international attendees are expected. Topics covered will include geospatial intelligence, innovation and disruptive approaches and the links between space applications and the digital economy. The 28 June round table on "International cooperation and capacity building" will focus on the views and expectations of newly involved countries.

+ TOULOUSESPACESHOW.EU/TSS16

VIDEO [+] WWW.CNES.FR

TECHNOLOGY

ACTINSPACE, ACT III

For its third edition, ActInSpace® is going global! 28 cities in 14 countries are involved in the event, which uses space-related challenges to foster entrepreneurship and innovation. Participants form teams to solve one of 50 challenges, which consist in finding everyday uses for space technologies.

Organized by CNES, ESA and the ESA BIC Sud France business incubation centre, the 24-hour competition takes place on 20 and 21 May. The French final will be held on 28 June, followed by the international final on 29 June at the Toulouse Space Show. First prize is a flight on the Airbus Zero-G aircraft.

+ ACTINSPACE.ORG

DIARY

16-20 MAY 2016
SpaceOps
Daejeon, South Korea
www.spaceops2016.org

10-15 JULY 2016
IGARSS
Beijing, China
www.igarss2016.org

1-3 SEPTEMBER 2016
Bangalore Space Expo
Bengaluru, India

26-30 SEPTEMBER 2016
IAC
Guadalajara, Mexico
www.iafastro.org/iac-2016-registration-is-open

3-6 APRIL 2017
Space Symposium
Colorado, United States
www.spacesymposium.org

QUICK TAKES

#History - 13 chapters for 13 days when the French forged a nation, combining the eloquence of a historian and experience of a politician. Hervé Gaymard offers an original take on these key moments in France's history, including a chapter on 21 July 1969. CNES is mentioned, through its current and future programmes

Bonheurs et Grandeur – Ces journées où les Français ont été heureux by Hervé Gaymard, Published by Perrin – 2015 – 500 pages – €23

#International magazine Issue 45 of *Prospective Spatiale* is all about the evolutions and revolutions of the space adventure. Senior figures offer comment and insight on the new players in the sector and their impact over the last decade in terms of new practices and consumption patterns.

Prospective spatiale – Quarterly bilingual magazine – Issue 45 – €17.50

#Forum - Since its inception in 1984, the Space Symposium has become the premier US space policy and programme forum, with over 10,000 participants in recent years. Increasingly international, it's a must-attend event for space agencies, civil and military institutions and private-sector players from multiple spacefaring nations. CNES was there in April and is already looking forward to 2017!

LASER ANALYSIS

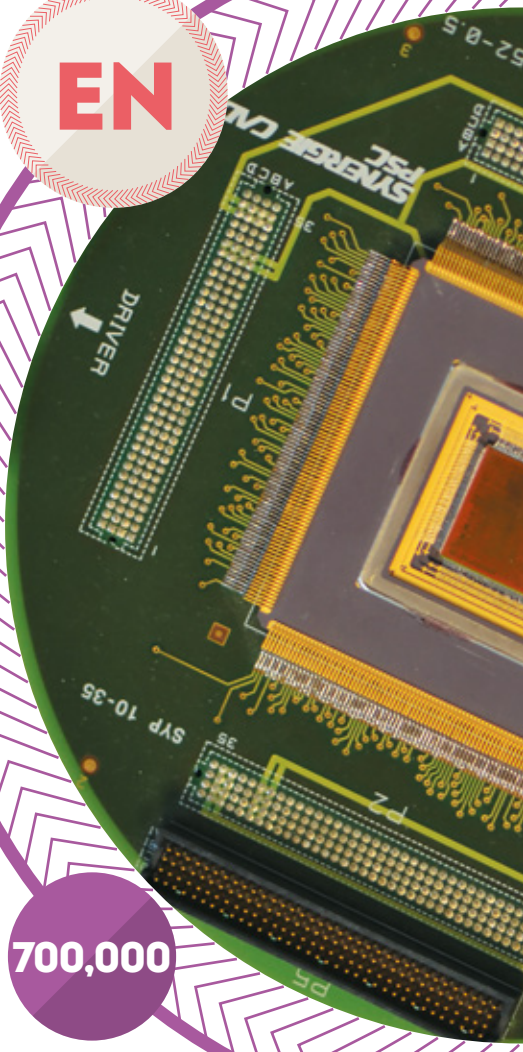
FRANCE AND SINGAPORE WORKING SIDE BY SIDE

France and Singapore are working together to develop a laser-analysis technique for inspecting microelectronic components, a process that could also be used in other sectors.

Laser analysis has brought Toulouse closer to Singapore since CNES started joint research work in this area with Nanyang Technological University (NTU). Together, the two partners are looking for hidden flaws in microelectronic components where the nanometric feature sizes make analysis a complex task. The work they are doing at the Toulouse Space Centre holds out hope for finding effective solutions. *"The effects of radiation and component ageing in space are one area we're focusing on,"* says Francis Pressecq, who heads CNES's component testing department. In Europe, research labs with the capability to combine research with operational projects are a rare breed. On the other side of the globe in Singapore, PhD student Chua Chung Tah was also studying radiation effects induced by lasers in microelectronic components at NTU. Through the Merlion[1] programme, he was able to come and work at CNES. Laboratory tests have confirmed that lasers could be the ideal solution to complement traditional inspection techniques, which are too random. A laser beam can be injected into a component at very fine resolution, causing a temporary perturbing effect that reveals the tiniest flaws. If it proves effective on space technologies, laser analysis could also be transposed to other sectors like the nuclear and aviation industries. Security applications like secure payments or ID cards use the same techniques and could therefore benefit from advances achieved through this research work.

1. Merlion is a Hubert Curien Partnership programme managed by the French institute in Singapore (IFS) that provides funding for visiting research scientists.

EN



700,000

The magnification obtained by CNES using high-performance instruments to reveal flaws in microcircuits.