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This report, drawn up by CNES in collaboration with the French space science community, provides highlights on space science in France since the 40th COSPAR General Assembly in 2014, in the fields of Earth Observation, Universe Sciences, as well as Condensed Matter and Life Sciences in Microgravity. The two years which followed the Scientific Prospective Seminar in La Rochelle have been rich in programmatic decisions and noteworthy scientific results: CNES has been strongly involved in the space component of the COP21, especially through the French-German MERLIN project, which will monitor methane in Earth's atmosphere, and the start of the MICROCARB mission, dedicated to measuring atmospheric carbon dioxide. The 2014-2015 period was also marked by prominent scientific results obtained by the European probe ROSETTA and the lander PHILAE about the origin of the Solar System and comets. PHILAE's acrobatic landing on comet Churyumov-Gerasimenko captured media and public attention in France, Europe and worldwide.

In the Universe Sciences field, planetology has seen many important developments. For the small Solar System bodies – besides PHILAE and ROSETTA – France is participating in an asteroid sample return mission, with the lander MASCOT, launched in 2014 aboard Japan's HAYABUSA2 spacecraft. Mars is still a top priority of the national community and the subject of three ongoing missions. They are MARS EXPRESS (ESA), NASA's CURIOSITY rover – the operations of the CHEMCAM and SAM instruments are planned from the Toulouse space center – and EXOMARS 2016, successfully launched in March 2016. The missions under development are INSIGHT (NASA, 2018), whose main instrument SEIS will be provided by France; and MARS2020 (NASA), the successor of CURIOSITY, which will carry the SUPERCAM camera. Over the past two years, the VENUS EXPRESS operations ended, but ESA's large-class JUICE mission (Jupiter ICy moons) was selected and has been supported by France from the outset.

Milestones in Fundamental Physics in Space include the cold atom clock PHARAO, which was developed by CNES, delivered to ESA and which is awaiting launch to the International Space Station. After the launch of LISA PATHFINDER, MICROSCOPE was successfully launched on April 25, 2016, to test the equivalence principle.

In Solar and Plasma Physics, the exploitation of the SOHO and CLUSTER missions is ongoing, while BEPICOLOMBO and SOLAR ORBITER are under development. France contributes to the instruments of NASA's MMS mission which was launched in March 2015 and has begun delivering initial results.

In Astronomy-Astrophysics, the PLANCK Collaboration published in 2015 cosmic microwave background polarization maps, result of a considerable data analysis effort. The success of French and European cosmology is expected to continue with EUCLID, under development by ESA. As for high energy, the Franco-Chinese mission SVOM is being developed and is to be launched in 2021. The French teams are also involved in ESA's future large X-ray observatory ATHENA, and CNES will be responsible for one of the two instruments. GAIA data are being exploited. Lastly, CNES supports the French scientific contribution to ESA's exoplanet missions, CHEOPS and PLATO.



Cospar 2016

Since May 2015, a new aircraft from the CNES subsidiary Novespace allows the French and European scientific community to conduct experiments in microgravity during parabolic flight campaigns. There are many scientific themes involved such as neuroscience, the physics of granular matter and various technology experiments. CNES supports the MEDES Space Clinic and its dry immersion study. It also supports several French teams involved in experiments installed on the International Space Station, or under development. One of them, DECLIC, is the result of a cooperation with NASA. The instrument was returned to Earth owing to a failure; it has been fixed and should soon be back in the ISS.

In Life Sciences, the experiments in development are the BION-M2 mission in collaboration with Russia for monitoring the blood pressure of mice, and the CARDIOSPACE device in partnership with China.

In Earth Observation, the space component of the Copernicus European program has been implemented since the launch of the first SENTINEL missions (SENTINEL 1A and 1B, 2A and 3A). CNES is involved at different levels in this operational program and provides data to national actors via the PEPS platform. It is also worth mentioning that the altimetry mission JASON3, in partnership CNES/EUMETSAT/NASA/NOAA, was successfully launched. It will be the altimetry reference mission of Copernicus.

CNES supports the exploitation and, in some cases, the operations of a dozen missions, most of which are part of an international partnership: they are CALIPSO, JASON2, IASI on METOP A and B, SMOS, CRYOSAT, MEGHA-TROPIQUES, PLEIADES 1A and 1B, ALTIKA/SARAL, SWARM. The implementation of four data and service centers for space-based and in situ data distribution and valorization is almost complete. The Theia Land Data Center is operational, whereas the Atmosphere (AERIS), Solid Earth (Form@Ter) and Ocean (Odatis) Data Centers should be made official in 2016. These data centers are set up by CNES in partnership with other national research organizations. They operate as a network, linked to the European structure.

In 2015, to contribute to the preparation of the COP21, CNES has implemented various actions to highlight the role of space in the fight against climate change; they are still ongoing in 2016.

The VEN μ S mission in cooperation with Israel, CFOSAT with China, and SWOT with NASA, are in development. The implementation of the IASI-NG program was signed with EUMETSAT in February 2015. It will involve three identical instruments on the future METOP-SG platforms, with both operational and research goals. As to ESA's Earth Explorer program, the BIOMASS mission – proposed by the French community – was confirmed in 2015, and the FLEX mission was chosen as the Earth Explorer 8.

In the wake of the Scientific Prospective Seminar in La Rochelle, several phase 0 studies are under way to go forward with top-priority scientific issues. The three selected Phase A studies involve a balloon-borne study of the exchanges between lower stratosphere and upper troposphere, a thermal infrared Earth observation project currently under discussion with India, and finally a geostationary ocean color instrument.

Let us conclude with the progress made by the CNES balloon program. After the qualification of the Timmins site in Canada, two successful open stratospheric balloon campaigns took place in 2014 and 2015, including atmospheric science experiments as well as the PILOT experiment for the measurement of interstellar dust polarization.