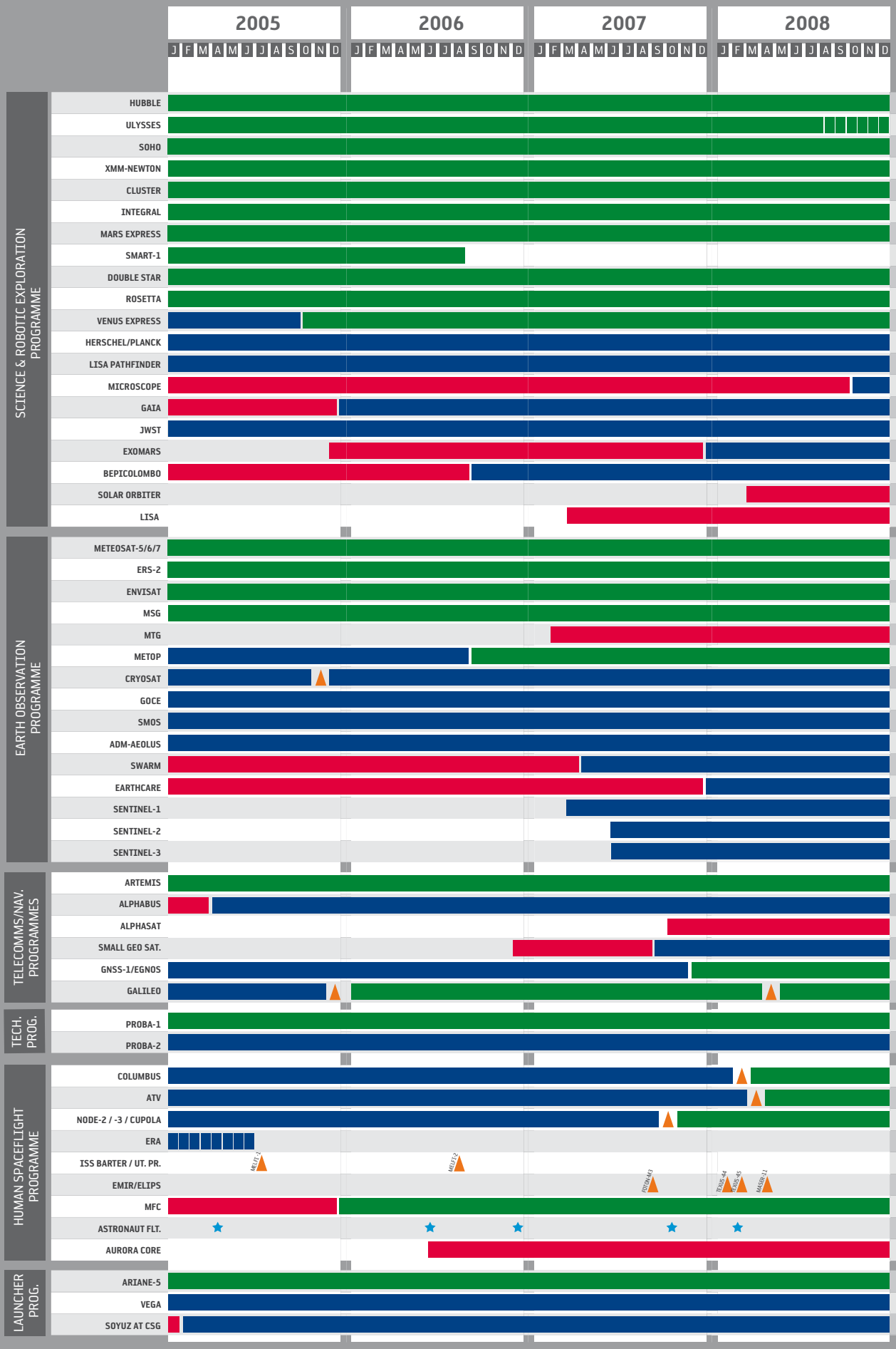
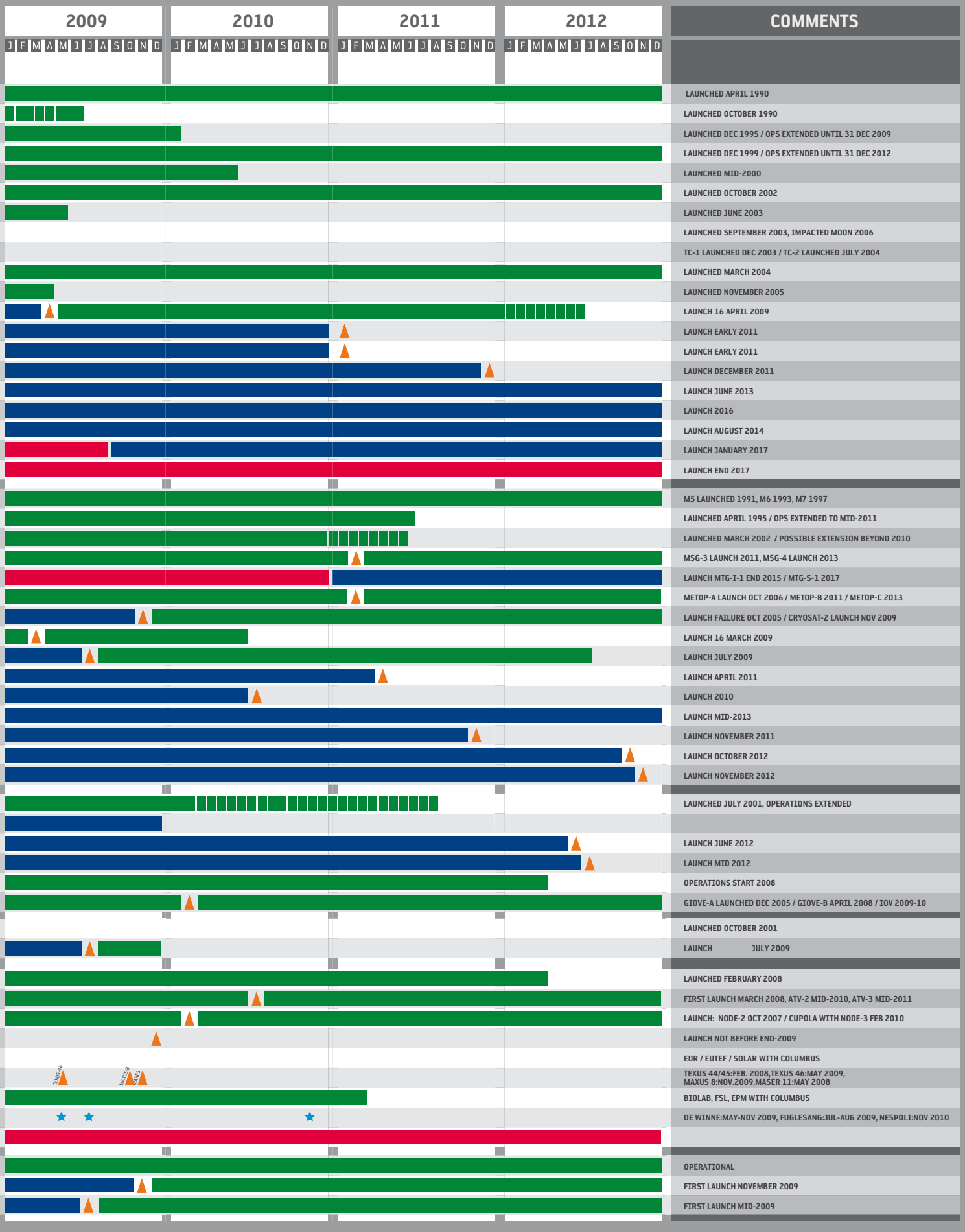
→ PROGRAMMES IN PROGRESS

status at end December 2008


2005
2006
2007
2008
J F M A M J J A S O N D
SCIENCE & ROBOTIC EXPLORATION PROGRAMME
HUBBLE
ULYSSES
SOHO
XMM-NEWTON
CLUSTER
INTEGRAL
MARS EXPRESS
SMART-1
DOUBLE STAR
ROSETTA
VENUS EXPRESS
HERSCHEL/PLANCK
LISA PATHFINDER
MICROSCOPE
GAIA
JWST
EXOMARS
BEPICOLOMBO
SOLAR ORBITER
LISA
EARTH OBSERVATION PROGRAMME
METEOSAT-5/6/7
ERS-2
ENVISAT
MSG
MTG
METOP
CRYOSAT
GOCE
SMOS
ADM-AEOLUS
SWARM
EARTHCARE
SENTINEL-1
SENTINEL-2
SENTINEL-3
TELECOMMS/NAV. PROGRAMMES
ARTEMIS
ALPHABUS
ALPHASAT
SMALL GEO SAT.
GNSS-1/EGNOS
GALILEO
TECH. PROG.
PROBA-1
PROBA-2
HUMAN SPACEFLIGHT PROGRAMME
COLUMBUS
ATV
NODE-2 / -3 / CUPOLA
ERA
ISS BARTER / UT. PR.
MELIT-2
MELIT-2
EMIR/ELIPS
FOTON-M3
TEXUS-44
TEXUS-45
MASER-11
MFC
ASTRONAUT FLT.
AURORA CORE
LAUNCHER PROG.
ARIANE-5
VEGA
SOYUZ AT CSG


2009
2010
2011
2012
J F M A M J J A S O N D
COMMENTS
LAUNCHED APRIL 1990
LAUNCHED OCTOBER 1990
LAUNCHED DEC 1995 / OPS EXTENDED UNTIL 31 DEC 2009
LAUNCHED DEC 1999 / OPS EXTENDED UNTIL 31 DEC 2012
LAUNCHED MID-2000
LAUNCHED OCTOBER 2002
LAUNCHED JUNE 2003
LAUNCHED SEPTEMBER 2003, IMPACTED MOON 2006
TC-1 LAUNCHED DEC 2003 / TC-2 LAUNCHED JULY 2004
LAUNCHED MARCH 2004
LAUNCHED NOVEMBER 2005
LAUNCH 16 APRIL 2009
LAUNCH EARLY 2011
LAUNCH EARLY 2011
LAUNCH DECEMBER 2011
LAUNCH JUNE 2013
LAUNCH 2016
LAUNCH AUGUST 2014
LAUNCH JANUARY 2017
LAUNCH END 2017
M5 LAUNCHED 1991, M6 1993, M7 1997
LAUNCHED APRIL 1995 / OPS EXTENDED TO MID-2011
LAUNCHED MARCH 2002 / POSSIBLE EXTENSION BEYOND 2010
MSG-3 LAUNCH 2011, MSG-4 LAUNCH 2013
LAUNCH MTG-I-1 END 2015 / MTG-S-1 2017
METOP-A LAUNCH OCT 2006 / METOP-B 2011 / METOP-C 2013
LAUNCH FAILURE OCT 2005 / CRYOSAT-2 LAUNCH NOV 2009
LAUNCH 16 MARCH 2009
LAUNCH JULY 2009
LAUNCH APRIL 2011
LAUNCH 2010
LAUNCH MID-2013
LAUNCH NOVEMBER 2011
LAUNCH OCTOBER 2012
LAUNCH NOVEMBER 2012
LAUNCHED JULY 2001, OPERATIONS EXTENDED
LAUNCH JUNE 2012
LAUNCH MID 2012
OPERATIONS START 2008
GIOVE-A LAUNCHED DEC 2005 / GIOVE-B APRIL 2008 / IOV 2009-10
LAUNCHED OCTOBER 2001
LAUNCH JULY 2009
LAUNCHED FEBRUARY 2008
FIRST LAUNCH MARCH 2008, ATV-2 MID-2010, ATV-3 MID-2011
LAUNCH: NODE-2 OCT 2007 / CUPOLA WITH NODE-3 FEB 2010
LAUNCH NOT BEFORE END-2009
EDR / EUTEF / SOLAR WITH COLUMBUS
TEXUS-46
MAXUS-9
MASER
TEXUS 44/45:FEB. 2008,TEXUS 46:MAY 2009,
MAXUS 8:NOV.2009,MASER 11:MAY 2008
BIOLAB, FSL, EPM WITH COLUMBUS
DE WINNE:MAY-NOV 2009, FUGLESANG:JUL-AUG 2009, NESPOLI:NOV 2010
OPERATIONAL
FIRST LAUNCH NOVEMBER 2009
FIRST LAUNCH MID-2009
DEFINITION PHASE
MAIN DEVELOPMENT PHASE
OPERATIONS
STORAGE
ADDITIONAL LIFE POSSIBLE
LAUNCH/READY FOR LAUNCH
ASTRONAUT FLIGHT

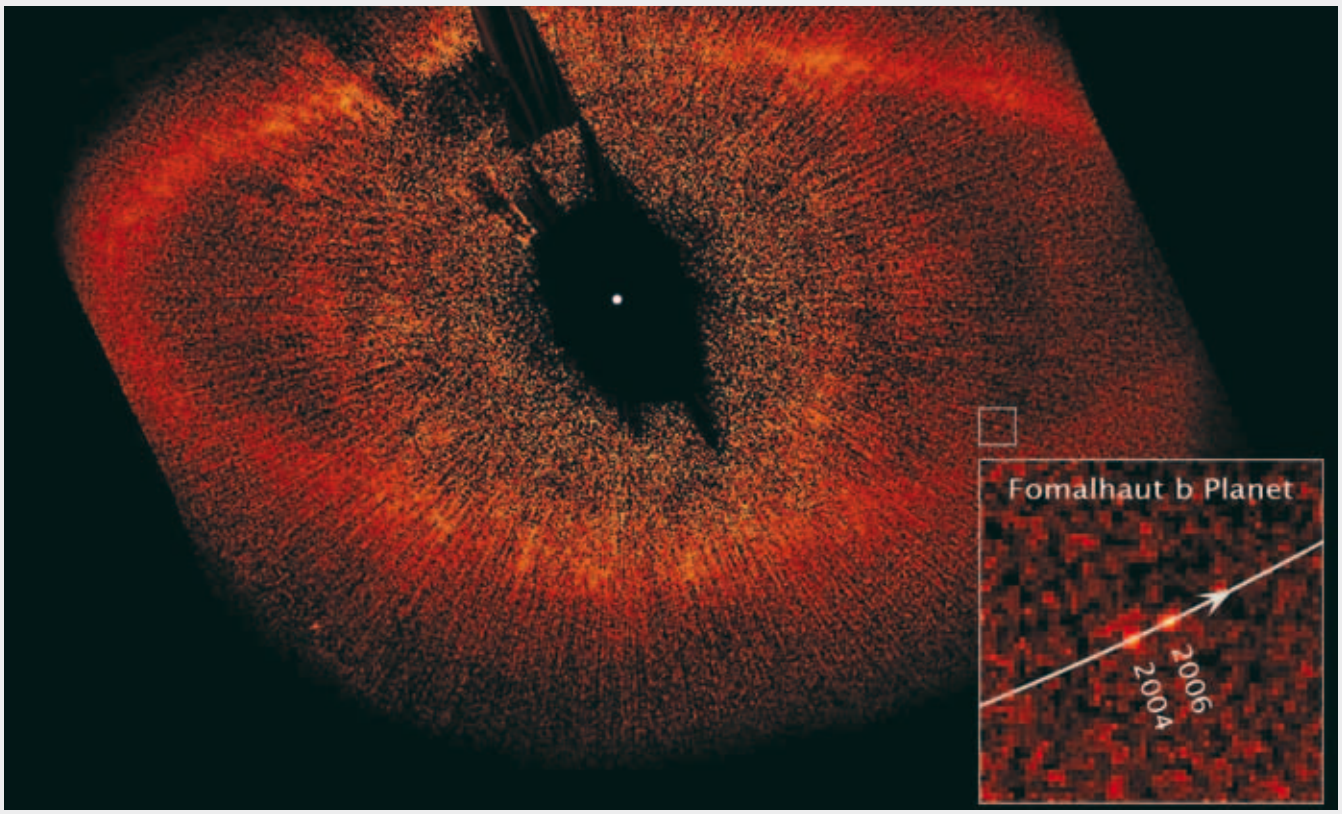
→ HUBBLE SPACE TELESCOPE

The NASA/ESA Hubble Space Telescope is back in business. Science operations were resumed on 25 October 2008, four weeks after a problem with the science data formatter took the spacecraft into a 'safe mode'. Just a couple of days after Hubble was brought back online, it photographed an intriguing target: a pair of gravitationally interacting galaxies called Arp 147 in the constellation of Cetus, more than 400 million light-years from Earth.

Then it was announced in November that Hubble had taken the first visible-light image of a planet circling another star. Estimated to be no more than three times Jupiter's mass, the planet Fomalhaut b orbits the bright southern star Fomalhaut, located 25 light-years away in the constellation Piscis Australis.

Fomalhaut has been a candidate for planet-hunting ever since an excess of dust was discovered around the star in the early 1980s by the US-UK-Dutch IRAS satellite. In 2004, Hubble confirmed that a large dust belt surrounded the star and astronomers later proposed that dust ring is being 'gravitationally modified' by a planet between the star and the ring's inner edge.

This image of galaxy pair Arp 147 was taken on 27–28 October 2008 by the Hubble Space Telescope (NASA/ESA/M. Livio, STScI)



The newly discovered planet, Fomalhaut b, taken with the Hubble Advanced Camera for Surveys. Inset, the planet's position during observations made in 2004 and 2006. The white dot in the centre marks the star's location, and the surrounding region is black because the Advanced Camera's coronagraph was used to block out the star's bright glare so that the dim planet could be seen (NASA/ESA/P. Kalas, Univ. of California, Berkeley)

More Hubble images showed that an object was moving along a path around the star and was therefore gravitationally bound to it. Fomalhaut b was confirmed as a real astrophysical object. Now, Hubble has photographed the planet as a point source of light lying over 2 billion km inside the ring's inner edge.

The planet is about 15 billion km from the star, or about 10 times the distance of the planet Saturn from our Sun. The planet's upper-mass limit is constrained by the appearance of the Fomalhaut ring. If the planet were much more massive, it would distort the ring, and the effect would be observable in the ring's structure. Astronomers have calculated that Fomalhaut b completes an orbit around its parent star every 872 years.

The planet is brighter than expected for an object of three Jupiter masses. One possibility is that it has a huge Saturn-like ring of ice and dust reflecting starlight. The ring might eventually coalesce to form moons. The ring's estimated size is comparable to the region around Jupiter that is filled with the orbits of the four largest satellites.

Artist impression of the planet orbiting Fomalhaut (ESA/NASA/L. Calcada, ESO for STScI)

→ ULYSSES

Ulysses continues to return useful science data at the time of writing, indicating that the adopted strategy of 'fuel bleeding', described in the last Bulletin, is still effective in preventing freezing of the remaining hydrazine. The Ulysses Science Working Team met for the 60th and last time in mid-November. Although the spacecraft is still operational, it was decided that this would be the final official SWT meeting given the imminent end of the mission.

The unexpected longevity of the spacecraft is making it possible to obtain unique, high-latitude data to help characterise the solar wind during the present solar minimum, which is unusually long. Even though the Sun remains largely quiescent, the inclination of its magnetic equator with respect to the rotational equator is currently larger than normally observed at solar minimum. This in turn is allowing Ulysses, which was located at 32° North solar latitude on 1 January, to investigate in detail the boundary between 'fast wind' from the northern pole and 'slower wind' from the region around the Sun's magnetic equator.

→ CASSINI/HUYGENS

After concentrating on Enceladus in 2008, Cassini is focusing on Titan for a while, although additional low-altitude Enceladus flybys, directly through the plumes ejected from its south pole, are planned during the latter part of the Cassini Equinox Mission. In November 2008, the Visual Infrared Mapping Spectrometer instrument, using a special imaging mode, obtained the highest possible resolution images (about 1 km) near and around the Huygens landing site. This may help to shed new light on the odd rotation state of Titan's icy crust discovered by the radar observations. In late December, the first altimetry profile over a lake was obtained by radar over 'Lake Ontario', the southern lake containing ethane liquid that was identified in early 2008 using infrared spectroscopy.

→ XMM-NEWTON

On 18 October 2008 ESA lost contact with XMM-Newton while it was approaching perigee passage and communicating normally with the Santiago ground station in Chile. After several unsuccessful attempts to recover the spacecraft, the problem was still present even when other ESA ground stations were used. This confirmed that the loss of contact was related to either an onboard problem or a catastrophic event in orbit. On 20 October images of the track of XMM-Newton against the night sky, taken by amateur astronomers from Germany's Starkenburg observatory, showed that the satellite was still in one piece.

On 21 October the more powerful ESA 35 m ground station at New Norcia (Western Australia) was pointed in the direction of XMM-Newton using a special radio-science mode. A weak signal was detected from the spacecraft, helping confirm suspicions that the antenna switch was stuck in an intermediate position. A spacecraft emergency was declared

and support requested from NASA's Deep Space Network Goldstone antenna. Owing to its location, Goldstone provides visibility of the spacecraft when it is very close to Earth, allowing a higher signal power at the spacecraft. Commands were sent to move the antenna switch back to its last working position and, finally, full radio contact with the spacecraft was re-established using the 15 m ground station at Villafranca on 22 October. Following the recovery, it was confirmed that there had been no degradation of any of the instruments while the spacecraft was out of communications.

A multi-wavelength study of NGC 346 combining X-ray, infrared and visible light captured by XMM-Newton, Spitzer and the ESO's New Technology Telescope has been carried out.

NGC 346/N66 is a star-forming region in the Small Magellanic Cloud. Evidence for at least two different events of triggered star formation was found. An arc-like nebular feature, north of the central bright OB stellar association, is characterised by a high concentration of emission-line stars and young stellar objects, as well as embedded sources seen as infrared emission peaks that coincide with young compact clusters of low-mass pre-main-sequence stars. All these objects indicate that the northern arc of N66 encompasses the most current star formation event in the region. This evidence suggests that this star formation is the product of a different mechanism than that in the general area of the association, triggered by a wind-driven expanding H II region (or bubble) blown by a massive supernova a few million years ago.

Star forming in the Small Magellanic Cloud
(D.A. Gouliermis)

→ CLUSTER

Cluster constellation phasing and attitude manoeuvres were performed in November 2008 to form a 10 000 km tetrahedron in the solar wind. Starting in mid-April, the configuration will be changed to have the spacecraft close together in the auroral zone.

The flight control and science operations teams have started to prepare the short eclipse season. The season will be the longest experienced by Cluster with four eclipses (one on each spacecraft) every 2.5 days from 25 February 2009 up to 15 May 2009. Cluster 2 will have enough battery power to keep the payload switched on. Cluster 4 will have to switch off its payload during the eclipses, and Clusters 1 and 3, being in decoder-only mode, will switch their payloads off and on a few hours before and after the eclipses.

Cluster results were published reporting a new estimation of the amount of plasma leaving the Earth ionosphere, called 'ionospheric outflows', using electric field instruments. The method used is based on 'perturbations' of the electric field probes by ion outflows that create a wake near the spacecraft and give a spurious electric field. This spurious electric field can be used to estimate the ion outflow, at around 10^{26} /s.

→ DOUBLE STAR

Contact with Double Star TC2 could not be re-established in November or December. The Chinese operations teams are investigating what could be the problem and are regularly trying to contact the spacecraft. EPOS (RAL), who operate the two European instruments (PEACE and FGM) will continue to prepare commands until end January and then will wait a recovery of the spacecraft before restarting operations after the next eclipse season.

→ INTEGRAL

Integral operations continue smoothly with the spacecraft, instruments and ground segment all performing nominally.

The global properties of all gamma-ray bursts (GRBs) detected by Integral have been determined, and the rate over the whole sky is about 1400 per year above the trigger threshold of the IBIS hard X-ray/soft gamma-ray telescope on board. Many GRBs exhibit a 'spectral lag', i.e. a time delay between the arrival of the high-energy (50–300 keV) and low-energy (25–50 keV) photons. The spectral lag was measured for 28 Integral GRBs and two groups were identified in the lag distribution, one with short lags (< 0.75 s) and the other with longer lags. The long-lag GRBs all have low peak fluxes – close to the IBIS sensitivity limit – and have faint optical and X-ray afterglows. They are observed preferentially from the direction of the 'supergalactic' plane, tracing nearby clusters of galaxies and the local large-scale structure of the Universe.

The rate of the low luminosity GRBs is estimated to be about 25% of all events related to core collapse supernovae of Type Ibc. If they are indeed intrinsically under-luminous local events, they could vastly outnumber classical GRBs.

→ MARS EXPRESS

Following a late discovery of a potentially dangerous Phobos flyby in late December 2008, a strategy was implemented to change the flyby into a safe one. From the end of November to mid-December, the spacecraft went through solar conjunction and, except for a number of radio science measurements to study the solar corona, no further scientific observations were possible. The spacecraft exited from solar conjunction on 21 December 2008.

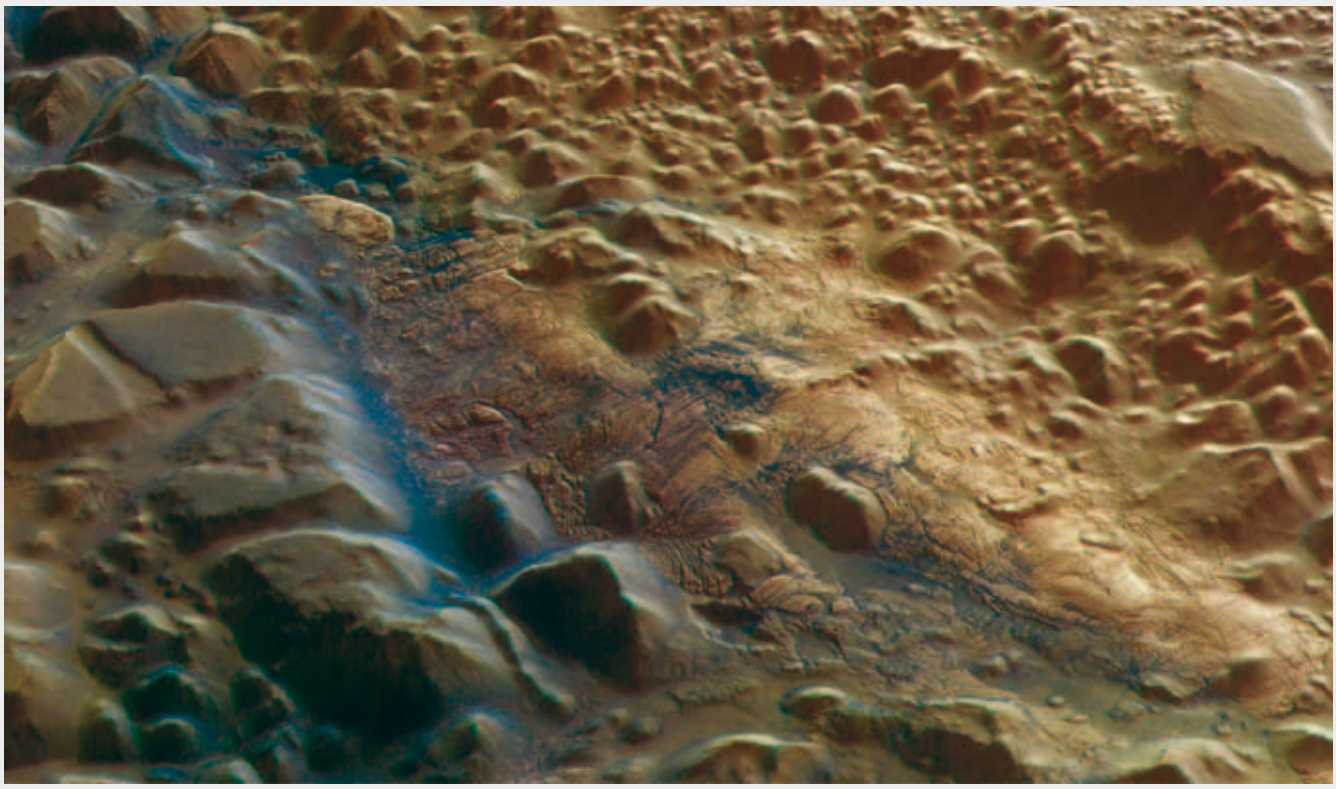
The molecular oxygen abundance is now measured in the atmosphere by the SPICAM spectrometer using the stellar occultation technique, at the altitude range 60–120 km. The previous (and only) measurements in the upper atmosphere were performed by the Viking landers during their descent to the surface in 1976, providing a molecular oxygen profile from 180 km down to 130 km height. The SPICAM data analysis enables the study of the seasonal variations of oxygen in the martian atmosphere.

Data and images suggest that several 'Light Toned Deposits', some of the least understood features on Mars, were formed when large amounts of groundwater burst onto the surface. Scientists propose that groundwater had a greater role in shaping the martian surface than previously believed, and may have sheltered primitive lifeforms as the planet started drying up.

→ ROSETTA

After the successful flyby of asteroid 2867 Steins, the detailed data evaluation is taking place. The first results were already reported at various conferences, confirming that an excellent scientific outcome has been achieved. The surface temperature of the asteroid was found by VIRTIS to vary between –90°C and –240°C. Steins was predicted to be a member of the rare highly evolved E-type asteroids, an assumption that was fully confirmed by the images and spectra taken at optical and infrared wavelengths.

The Rosetta flyby was the first (and might remain the only) spacecraft encounter with this rare type of asteroid. Ground-based observers had determined that the surface of such asteroids might contain large amounts of enstatite, a mineral that is produced only by very high temperatures and



Iani Chaos on Mars, an area where Light Toned Deposits are known to be present. This image was obtained with the High Resolution Stereo Camera on ESA's Mars Express (ESA/DLR/FU Berlin/G. Neukum)

melting, indicating that Steins must have been a part of a much bigger differentiated body. Images taken by the OSIRIS camera through different colour filters make it possible to see how the composition may vary on the surface and provide clues to the history and evolution of the surface of this ancient body.

Directly after the Steins flyby, stereo observations of gravitational microlensing events were obtained by observing in parallel with OSIRIS and telescopes on Earth. Seven slots were allotted to these measurements and about 50 images were obtained near the galactic centre. Events were detected and compared to ground-based observations. The analysis is still under way.

The spacecraft has spent 10 weeks in the active cruise phase, first dedicated to the downlink of remaining scientific data from the asteroid phase and then executing remaining payload checkouts (PC8) and investigations linked to anomalies recorded during the flyby phase.

On 17 December 2008, Rosetta entered the conjunction phase, for which the angular separation between Earth and the Sun as seen from the spacecraft will stay below 3° (conjunction) until 6 January 2009 with the minimum (1.65°) on the 27 December 2008. No special activities were planned for this conjunction phase.

→ VENUS EXPRESS

Venus Express has now sent back more data than any other spacecraft that has orbited Venus (excluding the Magellan mission with its inherently high-rate raw radar data). The data processing is now largely automated and the science teams are focusing on higher level data analysis and interpretation of the results. Several investigations are using data from two or more instruments and a number of such joint studies have recently resulted in publications in leading journals. The Venus Express science archive is being filled with more data for use by the scientific community.

Results published in *Nature*, combining data collected with the VMC and the VIRTIS instruments, address the atmospheric conditions that give rise to the presence and distribution of the as-yet-unidentified UV absorbers. These absorbers are responsible for the characteristic dark features in the UV images of Venus's cloud deck. It is mainly the temperature and atmospheric dynamics that drive the global pattern of the UV markings. These also determine the variations of the cloud top altitudes over the Venus globe.

Venus Express will feature in a 50-minute programme, part of the Discovery Channel's series 'The Naked Scientist', in the second quarter of 2009.

→ AKARI

Akari continues routine operations in its post-helium phase. Open Time observations started on 15 October 2008 and 142 European observations have been executed so far.

The first All-Sky Survey catalogue was released internally to the project teams. It contains 64 000 bright sources detected in the far infrared bands (65, 90, 140 and 160 micron) with good quality in the 90 micron band. The public release is planned for Autumn 2009. The second special issue of the *Publication of the Astronomical Society of Japan* dedicated to Akari, containing 13 papers, was published in December 2008.

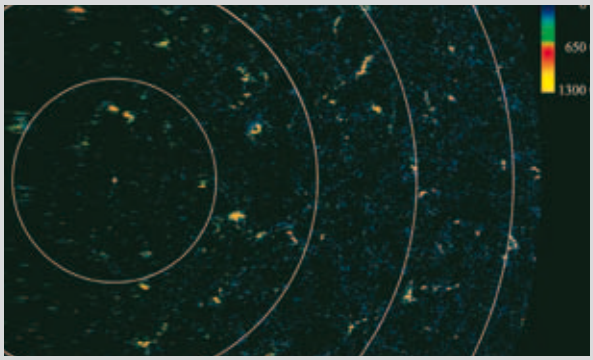
→ HINODE

The Hinode team has published observations of the magnetic landscape of the polar region of the Sun that are unprecedented in terms of spatial resolution, field of view and polarimetric precision. They found many vertically oriented magnetic flux tubes with kGauss field strength at latitudes between 70° and 90°. All flux elements have the same polarity, consistent with the global magnetic field structure of the polar region. The field vectors are observed to diverge from the centres of the flux elements, consistent with a view of magnetic fields that are expanding and fanning out with height. The polar region is also found to have ubiquitous horizontal fields. The scientists suggest that the flux tubes serve as efficient 'chimneys' for Alfvén waves that accelerate the solar wind.

→ COROT

COROT continues to operate normally. The rate at which planet candidates are confirmed by follow-up observations has increased to about one planet every four weeks. The number of candidates is however increasing faster and the total is several hundreds. The confirmation process takes anything from several months to over one year, depending on a combination of factors, ranging from celestial mechanics to the access to and schedule of ground-based telescopes. The situation should improve thanks to the recent allocation of up to 60 nights of observations on the Keck telescopes through collaboration with the University of Texas. The first Keck observation is scheduled on 7 January 2009.

Up to now, four COROT exoplanet detections have been published, and articles are in preparation for two additional planets. A further six exoplanets are in the final stages of confirmation and analysis. The most interesting object being followed up at the moment shows an eclipse depth of 0.0003. Pending final confirmation, this is probably a multi-planet system involving a low-mass terrestrial planet.



Magnetic landscape of the Sun's polar region as seen by Hinode (Tsuneta et al)

→ HERSCHEL/PLANCK

The test activities on both spacecraft are coming to an end in January 2009 and the shipment to the launch site is scheduled for mid-February.

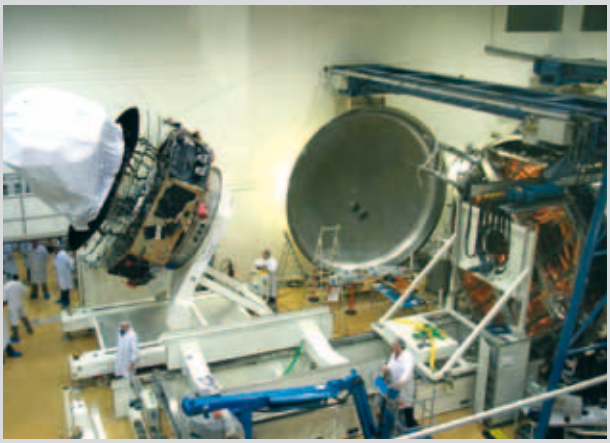
The highlight for the Herschel spacecraft of the last quarter of 2008 was the conduct of the Thermal Balance and Thermal Vacuum (TB/TV) test of the fully integrated spacecraft in the Large Space Simulation (LSS) facility at ESTEC. This test followed a launch simulation in which Herschel helium cryostat was filled, and the launch transient behaviour of the complete cryo-system was demonstrated. The cryostat temperature evolution as measured during the test followed the prediction very closely, clearing this major performance verification aspect.

In addition to proving of the cryogenic performance of the system, the test was used to demonstrate the spacecraft and instrument functional performance and operation in close to orbit thermal conditions. The outer cryostat shell and the telescope on top were cooled down to about –170°C. The spacecraft tests demonstrated full readiness for launch.

The near-orbital environment was also used to include the science operations validation test, and simulation of five days of nominal operation in orbit and commanded by mission control in ESOC. After completion of both test campaigns, the spacecraft was stored inside the LSS over Christmas with the return to the cleanroom in early January 2009 for the final functional test sequence before shipment to Kourou in February 2009.

For the Planck Flight Model, the last part of the year saw the final functional testing, the second integrated system test and, as for Herschel, the operational testing and controlling

Herschel being lifted out of the Large Space Simulator at ESTEC after completion of its last TB/TV test



Planck after completion of its last functional tests at the Centre Spatiale de Liège (CSL)

the spacecraft from ESOC. Some final leak-tightness verifications of the cryo-coolers and the reaction control subsystem were completed. After some functional tests and the completion of some repair activities of the dilution cooler, the spacecraft will be ready for shipment at the end of January.

The test activities on both satellites will be completed by end of January 2009 and the launch campaign will start with the shipment of the spacecraft and the necessary ground support equipment by mid February 2009. The launch date has been fixed at 16 April 2009.

→ LISA PATHFINDER

Development reached a major milestone with the system Critical Design Review (CDR), marking the completion of Phase C. The review resulted in a number of actions to be closed by April 2009 (CDR close-out). The main issues were found in the onboard software and software requirements definition, in hardware/software testing at test bench level and in the verification of the 'science runs', or experiment sequences. Also, the mass margin with respect to the declared capability of the Vega launcher was found to be small.

On the testing side, the repaired Flight Model of the science module has completed its structural tests. The propulsion module Flight Model has undergone to an acoustic test followed by two separation and shock tests (from the launcher and from the science module). The verification of the on-board software is continuing on the Software Verification Facility and on the two parallel test set-ups (Real-time Test Benches) at Astrium Ltd and Astrium GmbH.

The slit caesium thruster micropropulsion CDRs are being held at subsystem level. The power control unit CDR has been held, while the FEEP Cluster Assembly is under way. The plan is to have the entire micropropulsion system CDR concluded by April. The needle indium FEEPs are continuing as back-up technology development.

The American payload DRS is ready to be shipped to Europe. The suppliers of the various parts of the European payload (LTP) have delivered all Electrical Model units to Astrium GmbH for the Real-time Test Bench. The inertial sensor remains the most critical item, with the caging mechanism, the electrodes housing and the vacuum system. Other subsystems, such as the Phasemeter Unit, the Laser Reference Unit, the Front-end Electronics and the LTP software are also critical, in spite of substantial progress.

Launch is expected by the first quarter of 2011.

→ MICROSCOPE

Microscope activities are mainly related to the T-SAGE payload electromagnetic test completion and QM manufacturing. CNES and ESA are considering how to proceed on the Phase B of the cold-gas propulsion system alternative. CNES is trying to limit the work done to get a minimum set of information required to perform a delta satellite PDR based on cold gas, after which CNES and ESA would decide how to proceed.

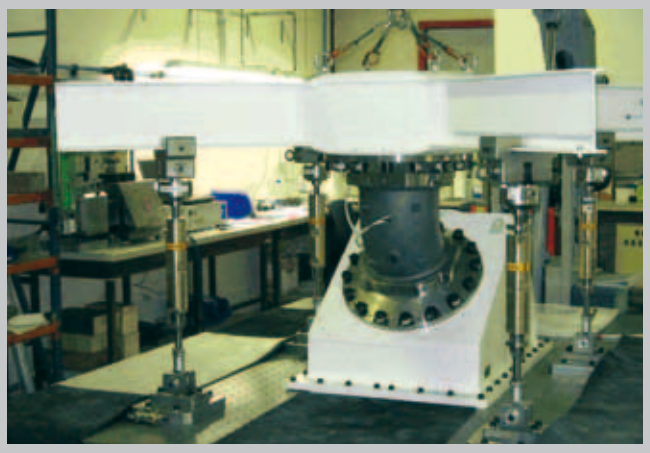
→ GAIA

Both engineering models and first flight quality models have been delivered. The engineering models and early versions of the central software are required for the expanding activities on the avionics test bench in Stevenage (UK), and to populate the test set up of the Focal Plane Assembly in Toulouse (F).

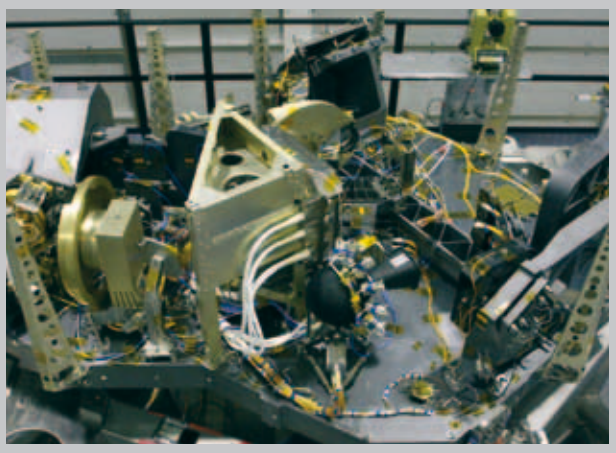
The production of the individual elements of the silicon carbide torus (carrying the optics) and focal plane assembly has continued. The first three elements have already passed their final mechanical stress testing in December 2008. Some of the smaller flight mirrors have already completed their polishing phase and await final silver coating. The two big and most complex mirrors have been surface-coated and the first one was handed to the polishing facility at the end of 2008.

A number of working groups, also involving the Data Processing and Analysis Consortium (DPAC) and industry representatives, have had further meetings to coordinate activities in their respective areas, for instance CCD radiation testing and evaluation, ground segment engineering and the preparation of the ground- and in orbit calibration activities.

The Gaia Science Team met to follow closely the progress on both space and ground segments. DPAC has established all its management and engineering layers. All interfaces within



One of the silicon carbide-elements of the Gaia torus in preparation for its mechanical load testing



JWST NIRSpec instrument development model fully integrated (EADS Astrium)

the consortium, as well as external interfaces to the project, have been defined and implemented. A meeting of the DPAC Steering Committee also took place. This committee welcomed the news that the selection of staff for the DPAC Project Office has been completed and the office should be fully operational in early 2009.

→ JAMES WEBB SPACE TELESCOPE

The environmental and ambient optical test of the first fully assembled JWST flight Primary Mirror Assembly segment has been completed. The Critical Design Review (CDR) of the Integrated Science Instruments Module (ISIM) structure was passed and the flight structure integration has started.

Integration activities on the Near Infrared Spectrograph (NIRSpec) development model are complete and the test campaign started. Vibration tests are taking place in January followed by a cryogenic test. The Instrument CDR was passed in December and the integration of the instrument Flight Model was formally released. The testing of the Flight Model detector unit has been completed by the US supplier and delivered to NASA, for further testing and integration. The development of the cryogenic mechanisms remains critical for both ESA and NASA deliveries.

Following the Mid Infrared Instrument (MIRI) Verification Model (VM) test campaign, all data were analysed and the post-test review was passed in December. The instrument Flight Operation Procedures were also exercised against the VM, without problems. The Imager Flight Model has completed its second cryogenic test campaign and has seen 'first light'. The development of the cryogenic mechanisms remains critical and is now affecting the delivery date.
Activities on the launcher side are progressing well and support is being given to NASA in the preparation of the CDR at spacecraft and observatory level.

→ BEPI COLOMBO

The Critical Equipment Review Board have reviewed the technology status and concluded that the system Preliminary Design Review (PDR) can be started in March, aiming at a Board conclusion in May 2009. The system design is consolidated and the preparation of the PDR data package is under way. Progress was made on testing different solar cell assemblies under various conditions and technology demonstration is expected before the PDR. About 50% of the equipment suppliers have been selected and ITTs for another 25% are issued.

The Instrument PDRs were continued according to plan with 10 of 11 completed. Generally, an adequate payload definition status and compliance with spacecraft interfaces was demonstrated. The remaining design review is for February 2009.

The Structural and Thermal Model (STM) of the Mercury Magnetospheric Orbiter (MMO) is nearly complete in Japan. Preparation has started for STM testing in early 2009. Tests of the MMO electrical model started. Characterisation tests of thermal hardware and solar cells are ongoing.

→ EXOMARS

Final inputs were prepared for the Ministerial Council 2008 with updates of the financial and programmatic proposals from industry as part of the Commitment Confirmation Review. The cost at completion for the 'Enhanced ExoMars' mission was presented to the HSF Programme Board and to Council.

The participating states decided not to fund the full Enhanced ExoMars mission, due to financial limitations in some of the

leading states. Consequently, it was agreed that ExoMars will be delayed by two years, with a launch date now in 2016, and that a substantial proportion of the total cost of the mission shall be provided through a mechanism of international cooperation. A timeline for the reformation of the project was agreed, with a report from the Director General due at the end of September 2009 and the closure of subscriptions on 31 December 2009.

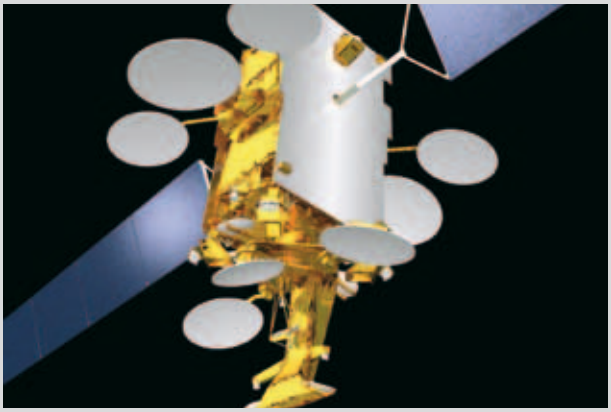
The project is now studying various possibilities for international cooperation and is establishing relations with potential partners in NASA, Roscosmos and the Canadian Space Agency. These relationships will be developed in 2009 and a Phase B2 extension of one year will be implemented in the second quarter of 2009 to reorient the mission to any new configuration necessary to meet the financial restrictions imposed by the participating states.

The present industrial contract has been redirected to maintain a Phase B2 level of activity through the first quarter of 2009, rather than the previously planned move to Advanced C/D activities to start the implementation phase. The Phase B2 extension will start at the end of the present contract and will maintain the industrial team through the reformation of the project, assuming a larger component of international cooperation. The present planning is to start the Phase C/D in the second quarter of 2010.

The first set of Interim Preliminary Design Review documents were delivered in December as agreed. The Interim PDR will close out the existing industrial contract for Phase B2 and will act as an interim review until the full PDR is completed at the end of the planned Phase B2 extension in the first quarter of 2010.

→ ALPHABUS

'Alphabus', or ARTES Element 8 Sub-element I, is the ESA programme to develop, in cooperation with the French space agency CNES, the next generation of large platforms for telecommunications satellites. The Alphabus Phase C/D contract, running since mid 2005 is complemented by the start of the Alphasat Programme (ARTES Element 8 Sub-element II), which utilises the Alphabus Protoflight Model (PFM) platform for a flight opportunity to be jointly funded by ESA and the selected commercial operator Inmarsat. Specific adaptations to the PFM platform to suit this first application have been identified and are being implemented in the ongoing Alphabus development through a rider to the original contract.
The Alphabus System CDR was passed in April 2008. This major review confirms the capabilities of the Alphabus product line to meet the requirements of high-power satellites in the 12–18 kW range. The review also confirmed the assembly and integration programme for the first platform, to be customised as Alphasat. The qualification of



Artist impression of Alphabus (EADS Astrium)

Alphabus equipment and functional chains is ongoing. In parallel, flight hardware for the PFM service module is due for delivery in 2009.

ARTES Element 8 Sub-element III and IV were approved at the Ministerial Council in 2008, and Sub-element III will progress the extended Alphabus range to address the high-power end of communication satellite market.

→ ALPHASAT

After the Alphasat signing with the operator Inmarsat, Alphasat project teams in industry, Inmarsat and ESA have been established and started focusing on specific Inmarsat requirements. The Alphasat Preliminary Design Review, co-chaired between Inmarsat and ESA, was passed in October 2008. The review considered the Alphabus platform and its specific adaptations for the Inmarsat mission. Despite the challenges of the onboard payload processor, the level of payload definition was found adequate to proceed with the programme.

The technology demonstration packages for flight on Alphasat have also gone through their respective PDRs:

- an advanced Laser Communication Terminal to demonstrate geostationary orbit to low Earth orbit communication links;
- a QV-band communications experiment to assess the feasibility of these bands for future commercial applications;
- an advanced Star Tracker with active pixel detector.

A fourth technology demonstrator, an environment effects facility to monitor the radiation environment in geostationary orbit and its effects on electronic components and sensors, has been successfully accommodated on the satellite. Its development and implementation is currently under consolidation.

ARTES Sub-element IV is to prepare in partnership with Inmarsat and industry the development of the user segment

associated with the advanced mobile payload on board the Alphasat/Inmarsat I-XL satellite. The User Segment and Application programme is aimed at developing new services with enhanced performances and will allow for the provision of value-added applications to mobile institutional and public users across Europe.

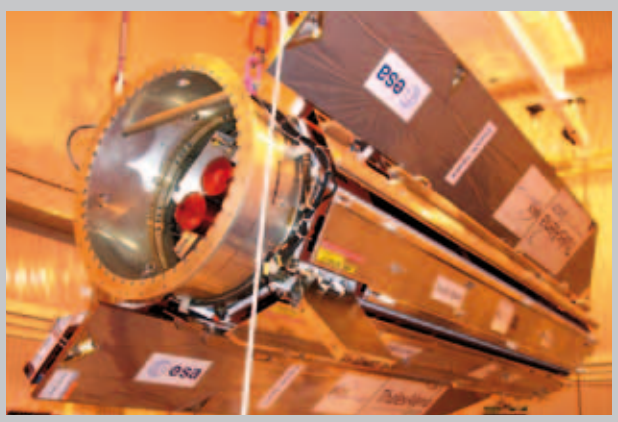
→ GOCE

Following the interruption of the launch campaign in September 2008, due to an anomaly in the launch vehicle, the GOCE satellite has been stored in its transport container at Plesetsk. Investigations to find the cause of the anomaly were completed in November, and the decision was made to replace a power supply unit in the Breeze-KM upper stage. This upgrade was completed in January 2009. The upgraded unit is being tested together with the rest of the Breeze-KM avionics. Tests will last until February when also activities will begin to take GOCE out of storage. This plan leads to a launch in mid March.

→ CRYOSAT

Environmental testing, at IABG in Munich (D), started in September 2008, beginning with mechanical tests. In these tests the S-band Transponders, which had not been delivered on time, were replaced by mass-representative dummies. All the tests which could be performed without this equipment were done. At that point the decision was taken to put the satellite into storage, to allow time for the missing equipment to be delivered. Advantage was taken of this storage period to perform minor repairs on other equipment. Activity continues in onboard software qualification.

The overall validation of the ground segment continues, with integrated testing of the end-to-end processes. This exercises all the facilities and interfaces involved in satellite control, payload commanding, performance monitoring and science data processing and dissemination.



GOCE at the Plesetsk Cosmodrome in Russia

→ SMOS

After uploading the final payload flight software, the third system validation test and the repeat of the launcher adaptor fit check, the satellite is back in storage. Flight operations ground segment, including long-term test and Low Earth Orbit Phase rehearsal is nearly complete. Version 2 of the Data Processing Ground Segment had its on-site acceptance test which was a major step forward, but a number of facility updates will be needed in early 2009 before the launch version is ready. Project planning proceeds based on a launch on 16 July 2009 – pending confirmation of the launcher authority.

→ ADM-AEOLUS

The design improvements identified in the ALADIN laser critical review in July 2008, together with architectural studies for potential laser back-up options were further elaborated. These results were used for an update of the instrument performance predictions. A Design Key Point was performed in November 2008, in which the available data were reviewed and the design changes to be implemented were frozen. The performance predictions could demonstrate that the expected stability after upgrading the laser is in line with mission needs.

A replacement for the Q-switch crystal and anti-reflection coating could be found which significantly improves the robustness of this component against laser-induced damage. Also this modification was selected for implementation in the laser Design Key Point.

An engineering vacuum test of a partially upgraded laser engineering model was performed which showed the stability improvements expected for the chosen test configuration.

Work on the formal system-level test campaign at platform level has continued and further formal test cases were carried out. A specific radio-frequency compatibility test using the actual ground station receiving equipment was performed, which demonstrated the instrument data link between satellite and ground station.

→ SWARM

The engineering models of the instrument and satellite unit were delivered for further integration and testing

with the satellite Real-time Test Bench. A compatibility test was completed between the scalar magnetometer star tracker and the test bench. The qualification test of the boom deployment mechanisms has been initiated. The manufacturing and assembly of the structure is well advanced and is due for completion in the first quarter 2009.

The testing of the structural model of the optical bench is complete, providing excellent results with respect to thermo-elastic stability, a key parameter for mission performance. The ground segment Preliminary Design Review for the development of the payload data and the flight operation system is complete. All the Critical Design Reviews at unit instrument level are complete except for the accelerometer and scalar magnetometer instruments. The next major step for SWARM will be the consolidation of the satellite design with the start of the System Critical Design Review.

→ METOP

MetOp-A

MetOp-A is in good health and the instruments continue to perform excellently in orbit. In January, the Central Computer Unit experienced an anomaly. Operations are now switched to the B-side and investigations are under way. The High Rate Picture Transmission is being operated using a restricted, zone-based scenario. The Component Health Assessment Process Reviews, covering the entire satellite, have been held together with industry and partners during the last quarter of 2008. It was concluded that MetOp-A should be capable of continuing its mission beyond a six-year lifetime, allowing the MetOp-B launch to be scheduled for the latest possible opportunity (mid 2012).

MetOp-B and MetOp-C

Although the MetOp Payload Modules, PLM-1 and PLM-3, are in long-term storage, there are still some AIT activities to be performed which require dismounting of the instruments for repair, recalibration and/or alignment, which are planned to be performed in blocks.

The MetOp Service Modules are kept in hard storage at Astrium Toulouse's premises, waiting for the restart of AIT activities in 2009 and a planned MetOp-B launch in 2012.

→ METEOSAT

Meteosat 8/MSG-1

Meteosat 8 is in good health with instruments performing flawlessly. All parameters still remain in the nominal area. The satellite serves as back-up for Meteosat 9/MSG-2 and performs the Rapid Scan Service.

Meteosat-9/MSG-2

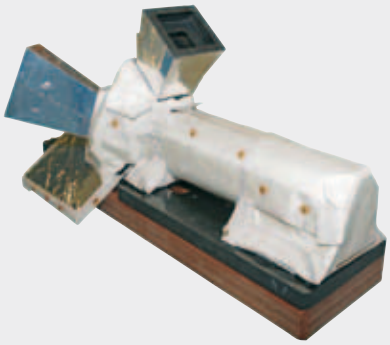
Meteosat-9 is Eumetsat's nominal operational satellite at 0° longitude. Satellite and instruments performance are excellent.

MSG-3 and MSG-4

MSG-3 is in long-term storage in the Thales Alenia Space Cannes, awaiting the restart of the AIT campaign in 2010 to prepare for its launch, planned for early 2011. MSG-4 is still awaiting its completion of the MSG-4 Pre-Storage Review.The MSG-4 launch is planned not earlier than 2013.

→ METEOSAT THIRD GENERATION (MTG)

Some important steps have been made towards the implementation of the MTG programme. In October 2008, the Eumetsat council approved the full proposed MTG Payload Complement. In November 2008, the ESA Ministerial Council approved the overall concept and the development

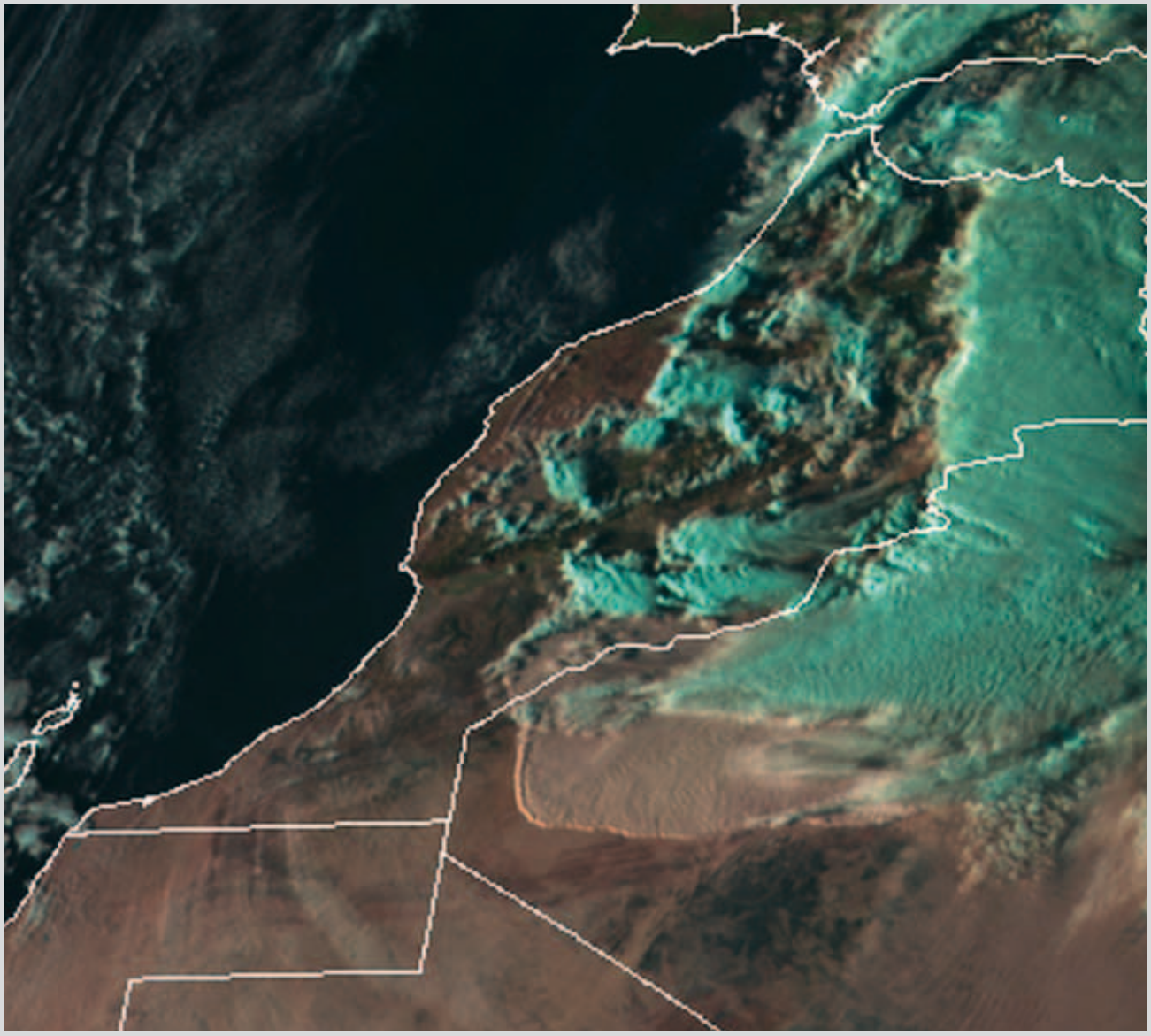


Two views of SWARM optical bench with magnetometer sensor head on the front and the three stellar sensors head on the back (left, the white cloth is thermal protection with the star tracker baffles) (EADS Astrium)

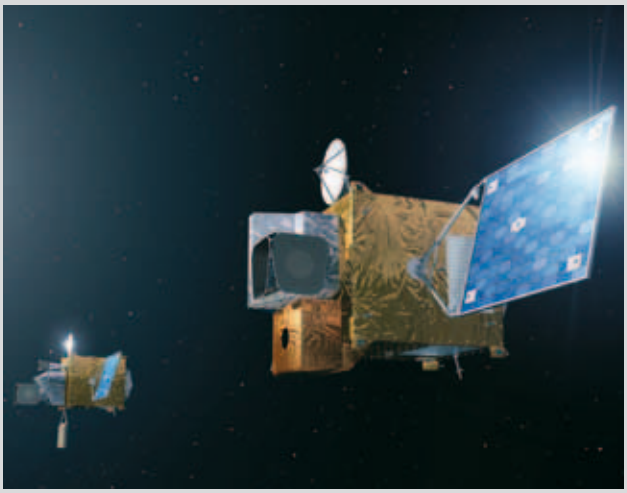
MetOp in orbit (Medialab)

of MTG, and full subscription was received. A final decision will have to be taken when the Eumetsat council meets in June 2010, to decide on its contribution to the ESA development programme and approval of Eumetsat's part of the programme.

MTG will be based on a twin-satellite concept in which two types of three-axis stabilised satellites, one for imaging (MTG-I) and one for sounding (MTG-S) will be developed. The payload for MTG-I will consist of a flexible combined imager, a lightning imager, a data collection system, and a search and rescue system (GEOSAR), while MTG-S will have an infrared sounder and an ultraviolet/visible/near-infrared sounder, the latter to be provided from the GMES Sentinel-4 programme. The MTG space segment is composed of six satellites: four MTG-I and two MTG-S.



Dust wall cloud over Western Algeria, as observed by Meteosat 8 on 9 October 2008 (Eumetsat)



MTG will consist of two three-axis stabilised satellites: the imaging satellite (MTG-I) and the sounding satellite (MTG-S)

The Phase A studies performed by respectively Astrium GmbH and Thales Alenia Space France came to an end with the Preliminary Requirements Review in December. This phase will now be extended up to June 2009 to cover the scope of work equivalent to a Phase B1.

→ SENTINEL-1

Sentinel-1 will carry a synthetic aperture radar (SAR) in C-band in response to user requirements from the European Commission and to ensure continuity of radar observations initiated with ERS-1/2 and continued with Envisat ASAR. Weighing about 2.3 tonnes, it is scheduled to be launched at the end of 2011, with design lifetime of seven years (and consumables for 12 years).

The industrial team is led by Thales Alenia Space Italy as prime contractor, responsible for the spacecraft and the transmit/receive modules). The team also includes Astrium GmbH (SAR instrument and antenna) and Astrium Ltd (SAR electronics subsystem).

The Sentinel-1 system and subsystem PDRs were held in mid 2008 and equipment PDRs are ongoing. Procurement of equipment via the Best Practices procedure is almost complete, with one last evaluation to be finalised and negotiations (with selected bidders) still to be concluded. A preliminary launcher coupled analysis was performed with good results.

The Ground Segment Requirement Review (covering both the Flight Operation Segment and the Payload Data Ground Segment) has been held. An early compatibility test between the SAR Antenna Electronic Front-End (housing the transmit/receive modules) and the Tile Control Unit was performed in December 2008. Production of the first engineering model hardware has started for some equipment. Following authorisation by the IPC, the procurement of the second satellite, Sentinel-1B, will soon be initiated.

→ SENTINEL-2

Sentinel-2 is the optical multispectral mission of the GMES space component programme, ensuring continuity and further development of the SPOT/Landsat land observing missions (vegetation and human habitats). This mission is uses two satellites flying in a unique sun-synchronous orbit with a separation of 180 degrees. This orbital configuration, combined with the very wide 290 km instrument swath, provides a five-day revisit time between 83°N and 56°S. A versatile set of 13 observation and calibration bands (VNIR to SWIR) provide a range of spatial resolutions between 10 m and 60 m.

The scope of the Sentinel-2 programme was enlarged after the Ministerial Council 2008, to cover the development of a second satellite Flight Model, allowing the deployment of a fully operational 'twin satellite' system around 2016. In addition, the inclusion of a laser communication terminal to be used as a pre-operational complement to the X-band telecommunication subsystem is being analysed in cooperation with the Dircectorate of Telecommunications and Integrated Applications.

The Payload Instrument PDR and the System PDR were completed in November 2008. The satellite Flight Acceptance Review is scheduled for July 2012, with a launch on Vega (Rockot as back-up) in October 2012. The first half of 2009 will be spent finalising the build-up of the industrial consortium, at revising the Sentinel-2 contract including the Sentinel-2A phase C/D price, the LCT and the Sentinel-2B. The Sentinel-2 Ground Segment Requirement Review will be held in that period. Preparatory activities have also been initiated with two launch service providers. The cooperation agreement on Sentinel-2 image quality with CNES is now finalised and ready for approval at Programme Board level.

→ SENTINEL-3

The Sentinel-3 Prime Phase B2 activities concluded in November 2008, following a successful system Preliminary Design Review (PDR). Four additional PDRs have also been completed in the meantime: for the platform and three instruments (OLCI, SRAL and MWR). For most of them, Phase B2 has also been completed, while in a few cases closure of some PDR actions is conditional to the completion. The last remaining instrument PDR (SLSTR) is ongoing, to be completed by February 2009. Contractually, the necessary steps to convert the C/D ceiling price to a fixed price have started, but C/D technical activities have been authorised since December

2008 to allow continuity of work within industry and prevent disruptions and additional delays. These early C/D activities will focus on the consolidation and freezing of the design based on the recommendations and actions placed during the PDRs, preparing for the manufacture and test of the first hardware.

On the technical side, the main effort at satellite level has been to reduce the mass budget. There is no margin compared to the current maximum estimated launch mass for the candidate launchers (Vega and Rockot), meaning a thorough review of all satellite elements is needed to reduce mass. This task will still continue in the coming months with the support of the launcher organisation in assessing the Sentinel-3 compatibility and mission performance. On the instrument side, the only technical criticality remains with the SLSTR instrument where, even if the revised thermal architecture and accommodation has allowed overall performance improvements, further work needs to be done, taking into account the mass problem as well.

Procurement tasks through competitive Invitations to Tender (ITTs) is proceeding in all fields and, together with the PDRs, has been the main effort in this phase. Out of 120 procurement contracts to be placed, 75 have either been concluded or are under final negotiation. In line with the objectives established at the beginning of the Phase B2, the remaining ITTs to be issued during Phase C/D are not related to procurement of flight hardware but exclusively to ground support equipment and test facilities.

→ EARTHCARE

Following a successful series of pre-System Requirements Review (SSR) status meetings for the four payload instruments and the base platform, the EarthCARE industrial consortium led by Astrium GmbH prepared the data package required for the SRR. For the cloud-profiling radar, JAXA prepared an additional and specific set of documentation covering in particular the instrument interfaces and the CPR requirements relevant to the overall mission performance.

The EarthCARE SRR process was formally initiated on 11 December 2008 with industry's presentation and the release of the complete data package of more than 400 documents. The review process is currently ongoing and the SRR Board is planned mid-February 2009.

→ VEGA

On 23 October, Vega's Zefiro 9A solid-fuel rocket motor completed its first test- firing at the Salto di Quirra Interforce Test Range in Sardinia (I). The Level 0 analysis meeting took place on 7 November and no major anomaly was found. The AVUM Propulsion System test-firing campaign (UCFire) started with a series of short duration ignition tests. The separation test of the Y2 interstage was performed on 17 October.

The Vega Mobile Gantry at Kourou (ESA/CNES/Arianespace)

For the ground segment, the Vega Mobile Gantry achieved its first movement (by 5 m) on 14 and 15 November, while all installations of air conditioning and ventilation in the Mobile Gantry and in the bunker have been completed. The first release of the Vega Control Centre has been qualified, including full synoptic and database population.

The manufacturing of the second Zefiro 9 test-firing model is progressing. The Inert Motor Case was hydro-proofed on 9 October and the propellant casting operations were completed on 18 November. The Zefiro 23 Qualification Review is coming to an end, relevant Steering Board being planned for 3 December. The propellant casting of the Flight Unit was completed on 7 November.

The preparations for the qualification flight are in progress, with the finalisation of the interface specification with the LARES payload.

→ SOYUZ AT CSG

The European Infrastructure On-site Acceptance Review took place in the beginning of October. The production of the Mobile Gantry is still a main concern for the programme; a management meeting was held in Paris on 23 October, in which the arrival of the gantry at the launch site is foreseen by end of February 2009. The site is called l'Ensemble de Lancement Soyouz (ELS), located near Sinnamary, a village 10 km north of the site used for Ariane 5 launches.

Regarding Russian equipment, the assembly of the first batch of equipment was completed on 22 October and part of the team has left French Guiana. Seventy Russian technicians are working on the ELS site. Progress of equipment integration

Ariane 5 stands ready for flight V186 on the evening of 20 November, the last launch of 2008. The payload comprised Hot Bird 9 and W2M delivering TV and data network services throughout Europe, North Africa and the Middle East

is good and in line with the planning of August. Following subscription to more funding at the Ministerial Council 2008, an additional 2009 budget has been prepared.

→ FLPP

The general key-point review for the Expander Demonstrator was held. The third industrial workshop was held on 15 October in ESTEC, attended by more than 100 participants. The IXV System Preliminary Design Review began on 6 November after submission of the complete technical and programmatic data package by industry. The industrial contractor presented the current IXV design baseline plan to the review team (from ESA, ASI, CIRA, CNES and DLR). The review is progressing, all documentation was assessed and no 'showstoppers' were identified.

→ HUMAN SPACEFLIGHT

European human spaceflight activities are set for a bright future after the Ministerial Council in 2008. The following human spaceflight and exploration proposals were endorsed by ESA Member States, and received good support and a substantial share of ESA's optional programmes overall.

- International Space Station (ISS) Exploitation Programme
- Period 3 (2008–12), aimed at operating, maintaining and exploiting the European elements of the ISS and providing Europe's contribution to common operations by delivering cargo and services;
- European Transportation and Human Exploration Preparatory Activities Programme (2009–12), including the initial definition phases of a cargo download system based on the Automated Transfer Vehicle (the Advanced Reentry Vehicle, ARV), and studies on the definition of a Lunar Lander;
- ELIPS Period 3 Programme (2008–12), which will be the continuation of the European Programme for Life and Physical Sciences.

→ INTERNATIONAL SPACE STATION

The ISS celebrated its tenth birthday on 20 November 2008. This international cooperation has led eventually to 14 nations building and assembling a unique space infrastructure where women and men from several different nations have been living and working together uninterruptedly since the year 2000. The level of funding received from the ESA Member States at the Ministerial Council will further strengthen and sustain Europe's role in the ISS programme.

The ISS configuration in November 2008

→ SPACE INFRASTRUCTURE DEVELOPMENT AND EXPLOITATION

Node-3

Node-3 post-storage work at Thales Alenia Space has been completed. A pre-shipment Acceptance Review will take place in April 2009 to authorise the shipment of Node-3 to NASA Kennedy Space Center (KSC). Ground operations at KSC, under ESA responsibility and including the mating of Node-3 with the Cupola observation module, will start in preparation for the Flight Acceptance and transfer of Node-3 ownership to NASA, planned for July 2009.

ATV production and cargo integration

ATV production sustainability activities have been approved as part of the ISS Exploitation Period 3 programme. The negotiations with industry for implementation have started. The ATV Jules Verne Post-flight Analysis Review Board was held in January and gave indications about potential design changes to be implemented in follow-on ATVs.

The ATV-2 integration and test is going well. In the second quarter of 2009, the ATV-2 Avionics Bay will undergo a thermal test at ESTEC. The ATV-2 high-level cargo manifest is about to be defined and the launch is scheduled in 2010. The ATV-3 equipment procurement has been released and is running without problems for an ATV-3 launch in 2011.

→ UTILISATION

The main focus of European utilisation of the ISS has been the Columbus laboratory. Columbus continues to function nominally supporting the various payload activities. Final troubleshooting and facility maintenance activities on Biolab are due to be carried out during Increment 18. The second run of the Biolab experiment, WAICO (investigating effects of microgravity on plant root growth) is scheduled to start during Increment 19 in spring 2009.

Cupola, shutters closed, seen at KSC

On 13 November, the Fluid Science Laboratory was activated and a functional test successfully performed. The test showed that the Geoflow Experiment Container was correctly installed inside the facility and was ready to resume the Geoflow science runs in December. The Geoflow science programme of more than 100 experiment runs will continue throughout Increments 18, 19 and into 20, up to the tentative return of the experiment unit on the Shuttle flight 17A in August 2009.

The European Drawer Rack, including the Protein Crystallisation Diagnostics Facility (PCDF) are now ready for the start of the four-month protein science programme of the first PCDF experiments which will be sent up on the 15A Shuttle Flight, due for launch in February 2009. Final calibration of the Multi-Electrode Electroencephalogram Measurement Module (MEEMM) is scheduled for Increment 18. This module is a subsection of the European Physiology Modules (EPM) facility and will be used for different types of non-invasive brain function investigations. NeuroSpat, the first experiment to use the EPM facility will take place when the next ESA astronaut arrives at the ISS in May 2009.

The European Technology Exposure Facility (EuTEF) has again been permanently activated since 5 November and has resumed full science operations. The latest science acquisition cycle for the SOLAR facility and its individual instruments (SOVIM, SOLSPEC, SOLACES) started on 29 October and finished on 9 November following the end of the latest Sun observation window.

All four runs of the new 3D Space neurophysiology experiment have been successfully performed by the NASA astronaut Greg Chamitoff before his return on Shuttle flight STS-126 (ULF-2), and a new set of runs are planned for Increment 18 with NASA astronaut Mike Fincke. This human physiology study investigates the effects of weightlessness on the mental representation of visual information during and after spaceflight.

Samples of the Sodium Loading in Microgravity (SOLO) experiment with the first test subject, again Greg Chamitoff, have been sent back on the ULF-2 flight. The SOLO research programme, which carries out research into salt retention in space and related human physiology effects, will be continued during the ongoing ISS Increment 18. The Analyzing Interferometer for Ambient Air (ANITA) has been deactivated and also returned to Earth on ULF-2 for detailed post-flight inspection and calibration.

The Flywheel Exercise Device will be removed from its storage location in the European Transport Carrier of Columbus for deployment and first functional checkout after Shuttle flight 15A due in February 2009.

Spares and consumables were sent up on STS-126 to re-establish the full European Modular Cultivation System facility performance before the start of ESA's next experiment, GENARA, in Increment 20. GENARA is dedicated to study

Astronaut Greg Chamitoff prepares the 3D Space experiment inside Columbus

plant (*Arabidopsis*) growth activity at a molecular level in weightlessness.

The BIO-4 experiment complement (XENOPUS, BASE-B and C, and ROALD) was launched with Soyuz 17S on 12 October. The in-orbit activities for the BASE and XENOPUS experiments have been completed and the processed samples returned on Soyuz flight 16S on 24 October; the chemically fixed samples for the ROALD experiment were returned on STS-126 on 30 November.

A suite of new ESA astrobiology experiments, some of which could help understand how life originated on Earth, has just been launched on the Russian Progress vehicle 31P to the ISS. The nine experiments are part of the Expose-R payload loaded with a variety of biological samples including plant seeds and spores of bacteria, fungi and ferns. As the installation attempt on 23 December was unsuccessful due to the power interference, the Expose-R payload is planned to be installed on the outside of the Russian segment of ISS during a spacewalk in January.

→ ASTRONAUTS

The selection campaign for new ESA astronauts entered its final phase: 192 candidates completed the Psychological Test Phase 2, which ended on 17 November. 45 candidates made it through to the next phase of medical evaluation, starting on 12 January 2009.

On 21 November, ESA astronaut Frank De Winne (B) was nominated as the first European Commander of the ISS. He will fly to the ISS in a Soyuz spacecraft in May 2009 with cosmonaut Roman Romanenko (RUS) and astronaut Robert Thirsk (CDN), bringing the total number of crew on the ISS to six for the first time.

For the first four months, De Winne will be Flight Engineer as a member of Expedition 20. He will be joined on board by astronaut Christer Fuglesang (S), who will fly as mission specialist on the 11-day STS-128 mission scheduled for August 2009. With a rotation of three of the crew due in October, De Winne will become Commander of Expedition 21 until his return to Earth in November 2009. He takes over the responsibilities from Expedition 20 Commander Gennady Padalka (RUS). His back-up is ESA astronaut André Kuipers (NL).

De Winne was nominated to serve as Commander by the Multilateral Crew Operations Panel of the ISS Programme. As Commander, De Winne will be responsible for conducting operations on the ISS, directing the activities of the ISS crew as a team, and ensuring the safety of the crew and the protection of the ISS elements, equipment and payloads. He will also be the main operator of the Japanese robotic arm and will be one of the two astronauts who will berth the Japanese cargo spacecraft HTV-1 to the ISS in autumn next year.

The next European long-term mission has also been confirmed. Italian ESA astronaut Paolo Nespoli (I) will be Flight Engineer on Expeditions 26 and 27. His launch is due in November 2010, returning to Earth six months later in May 2011.

Frank De Winne

Paolo Nespoli

André Kuipers

→ CREW TRANSPORTATION AND HUMAN EXPLORATION

Advanced Reentry Vehicle (ARV)
Based on the results of previous studies, two industrial studies to define requirements and an initial vehicle configuration (Phase 0) were initiated in September with European industry in the frame of the General Studies programme. ARV Phase A activities will start in mid 2009 on the basis of budget approved at the Ministerial Council and after IPC approval of the related procurements.

Technological and system activities
Three MoonNEXT Phase A/Part 2 industrial study activities began in October.

International Berthing Docking Mechanism (IBDM)
The preparation for open loop tests for the IBDM Soft Docking System (SDS) is in progress and the control algorithms are being developed. After completion of initial testing in January, the real hardware tests will take place in February. The IBDM Crew Space Transportation System alternative load sensing systems have been designed and reviewed and are being manufactured. They will be tested in March.

A meeting on the interoperability of the docking system for future international cooperative missions has taken place with NASA, assessing the evolution of the IBDM and the corresponding Low Impact Docking System (LIDS) of Orion since the joint work performed under X-38/CRV.

EXPERT
The Subsystems Critical Design Reviews (CDRs) are in progress, while the preparation of the System CDR is ongoing. Activities corresponding to the Authorisation to Proceed on the Phase C/D activities agreed in June are near completion. Negotiation of the launch contract was completed with the Russian provider.

International architecture development
Consolidated lunar exploration scenarios and related architecture elements were reviewed at the Second Lunar Exploration Workshop of the International Space Exploration Coordination Group (ISECG) Interface Standards Working Group (ISWG) in Florida, 29–31 October. The kick-off meeting for Phase 1 of the ESA/JAXA Comparative Architecture Assessment took place in Florida on 27 October. ESA and Japan Aerospace Exploration Agency shared initial information on their current lunar exploration architecture analysis.

Phase 2 of the ESA/NASA Comparative Architecture Assessment (CAA) began on 31 October. ESA and NASA agreed to focus this on the integration of the ESA lunar cargo lander and its payloads into cooperative lunar exploration mission scenario plans.

Human Exploration
A system study to define a Pressurised Lunar Rover system has begun, with the mission requirements and initial conceptual designs under evaluation. A study on the use of the ISS for human exploration is being finalised.

The first phase of the MELiSSA Food Characterisation activity has begun, to be followed by more work leading to a innovative methods of food production for human spaceflight. The build-up of the MELiSSA Pilot Plant is going as planned with the latest delivery of the higher plant chambers to Barcelona. The development of the final devices for the Long Term Medical Survey has been initiated and will provide a monitoring system for use at the Antarctica Concordia Station.

A study on the analysis of Lagrangian Trajectories in the Earth-Moon system is nearing mid-term review. This will provide better mathematical models and analysis tools for mission operations analysis in the Lagrange points.

Stakeholder agreement
ESA's Human Spaceflight Directorate participated in the 'Open Days 2008 for Regions and Cities', in Brussels in October. A dedicated meeting on 'Engagement of European Regions in Future Space Exploration' was organised, and a presentation about opportunities for regional engagement in human space exploration was given at the Committee of the Regions' Working Group meeting on 'Knowledge and Innovation'.

ESA also participated in the Eighth Mars Convention, Antwerp, in October, making presentations on 'Analysis of Architectures for Human Exploration' and 'The Role of the Moon in Preparing for Mars'.

The Committee on Industry, Research and Energy (ITRE Commission) held a mini-hearing in November at the European Parliament in Brussels on the 'Human Exploration of Space'. The hearing was attended by the ESA Director General, who spoke about aspects of European Space Policy, and by the ESA Director of Human Spaceflight, who gave a presentation on 'Space Cooperation' in relation to the challenges of human space exploration. On 20 November, the European Parliament released a Resolution on European Space Policy with a significant reference to human space exploration.