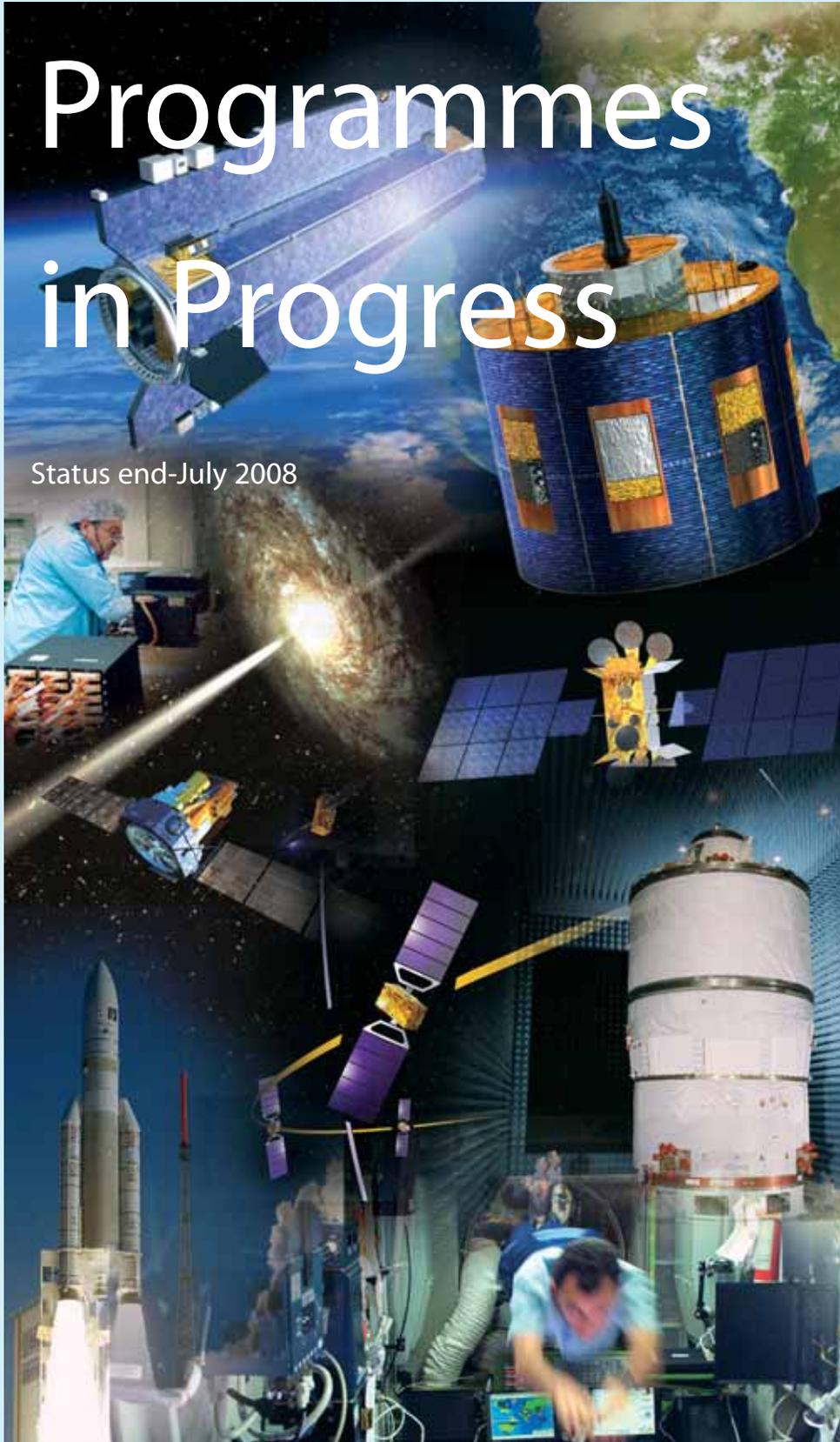
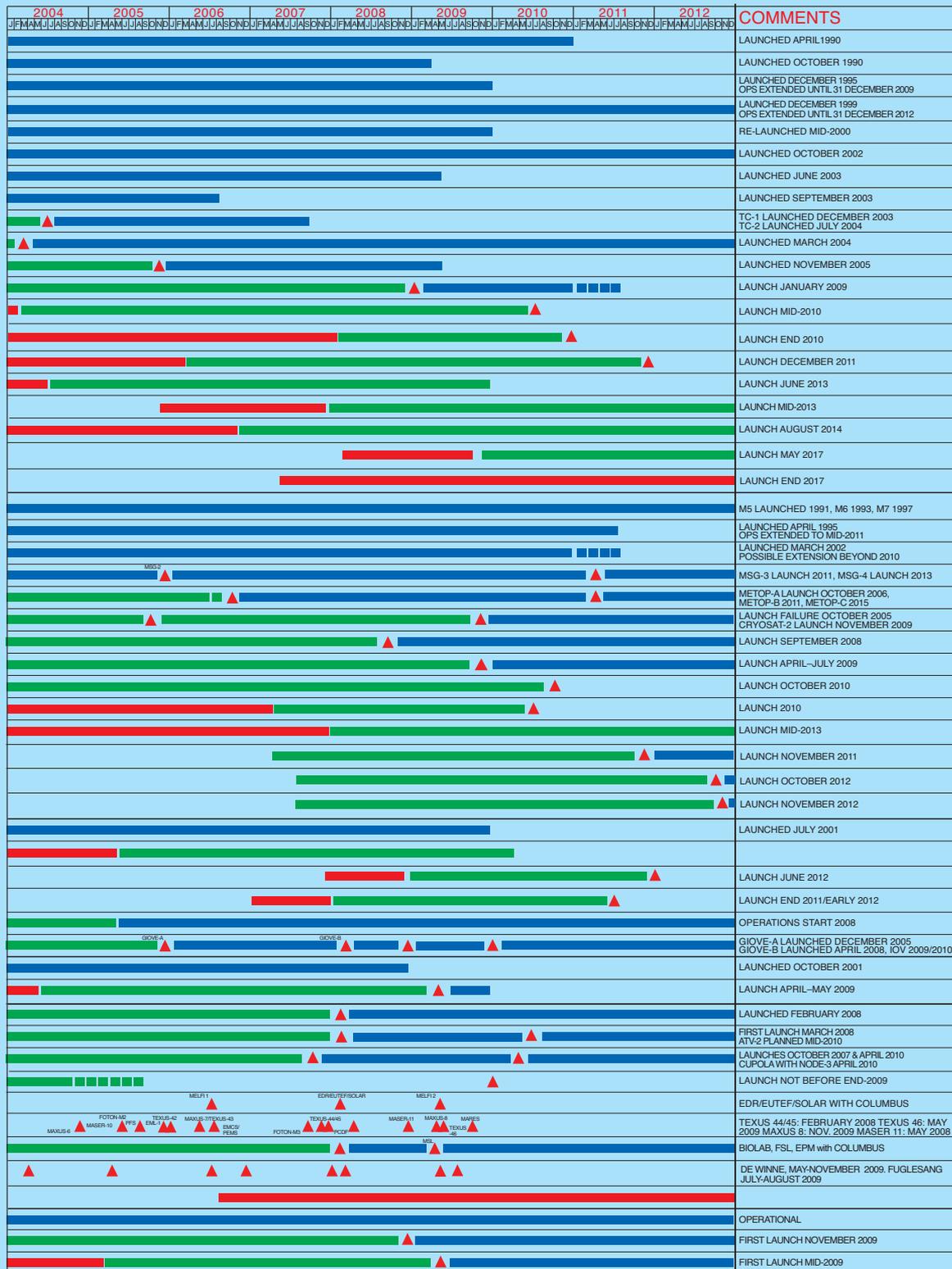


# Programmes in Progress

Status end-July 2008



	PROJECT
SCIENCE & ROBOTIC EXPLORATION PROGRAMME	HUBBLE
	ULYSSES
	SOHO
	XMM-NEWTON
	CLUSTER
	INTEGRAL
	MARS EXPRESS
	SMART-1
	DOUBLE STAR
	ROSETTA
	VENUS EXPRESS
	HERSCHEL/PLANCK
	LISAPATHFINDER
	MICROSCOPE
	GAIA
EARTH OBSERVATION PROGRAMME	JWST
	EXOMARS
	BEPICOLOMBO
	SOLAR ORBITER
	LISA
	METEOSAT-5/6/7
	ERS-2
	ENVISAT
	MSG
	METOP
	CRYOSAT
	GOCE
	SMOS
	ADM-AEOLUS
	SWARM
COMMS/NAV PROGRAMME	EARTHCARE
	SENTINEL-1
	SENTINEL-2
	SENTINEL-3
	ARTEMIS
TECHNOL. PROG.	ALPHABUS
	ALPHASAT
HUMAN SPACEFLIGHT PROGRAMME	SMALL GEO SAT.
	GNSS-1/EGNOS
	GALILEO
	PROBA-1
	PROBA-2
LAUNCHER PROG.	COLUMBUS
	ATV
	NODE-2 & -3 & CUPOLA
	ERA
	ISS BARTER & UTIL. PREP.
	EMIRELIPS
	MFC
ASTRONAUT FLT.	
AURORA CORE	
LAUNCHER PROG.	ARIANE-5
	VEGA
	SOYUZ AT CSG



## Ulysses

Since the failure of the X-band EPC/TWTA in January, numerous attempts to re-establish an X-band downlink have been made without success. Despite this, an S-band science mission is still ongoing at the time of writing. At the end of May, the S-band downlink had deteriorated because of the increasing distance between the spacecraft and Earth to the point that playback of recorded data could no longer be supported and only spacecraft data received in real-time during a tracking pass are now able to be acquired.

Without the heating effect of the X-band TWTA, the temperature in a portion of the hydrazine pipe-work in the lower spacecraft section continues to decrease. Since the pipe-work temperature drops when the S-band transmitter is on, tracking passes of only a few hours' duration are now scheduled. In addition, fuel is being moved every two hours through the short length of cold pipe-work where freezing is likely to occur by simultaneously firing two opposing thrusters. As a result of these and other operational measures, the projected mission end date of 1 July 2008 was reached without the hydrazine freezing. Spacecraft operations and science data acquisition will continue using the same strategy until freezing occurs.

An international workshop focusing on the contributions of Ulysses to the network of space missions that are collectively exploring the Sun and heliosphere as an integrated system was held on the island of Kefalonia, Greece, on 6–9 May, followed by a press conference highlighting the legacy of Ulysses in Paris on 16 June.

## SOHO

SOHO has just discovered its 1500th comet, making it more successful than any other comet discoverer throughout history. Not bad for a spacecraft that was designed as a solar physics mission! The small faint Kreutz-group comet was discovered on

25 June by US-based veteran comet-hunter and amateur astronomer Rob Matson.

Roughly 85% of the SOHO discoveries, including this one, are fragments from a once-great comet that split apart in a death plunge around the Sun, probably many centuries ago. The fragments are known as the Kreutz group and now pass within 1.5 million kilometres of the Sun's surface when they return from deep space. Of course, SOHO itself does not make the detections; that task falls to an open group of highly skilled volunteers who scan the data as soon as it is downloaded to Earth (usually within 15 minutes after it is taken). Enthusiasts from all over the world look at each individual image for a tiny moving speck that could be a comet. When someone believes they have found one, they submit their results to the SOHO team where the findings are checked before submitting them to the Minor Planet Center, where the comet is catalogued and has its orbit calculated.

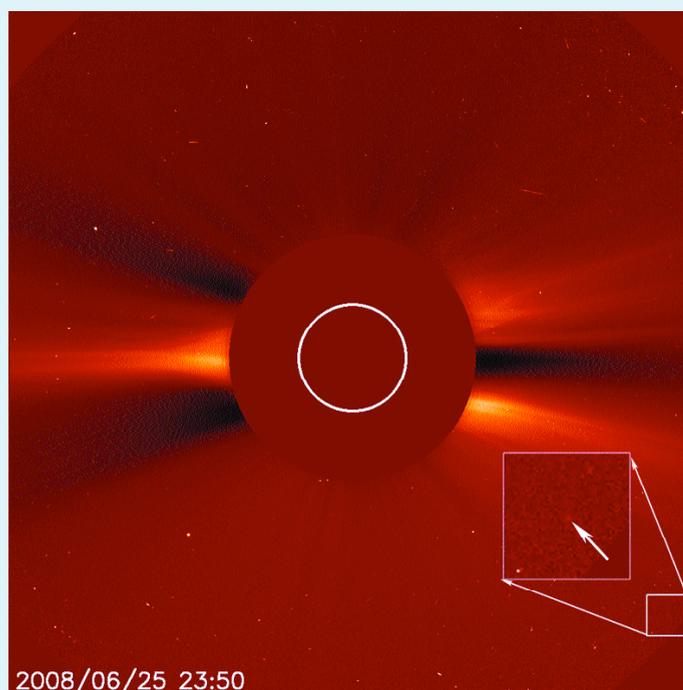
## Cassini-Huygens

The nominal four-year mission of Cassini-Huygens came to an end on 30 June 2008.

However, the journey around Saturn will continue for at least another two years following the recent approval by NASA of the Cassini Equinox Mission. This mission will address discoveries and new questions raised by Cassini-Huygens and will continue exploring two of its most intriguing targets: Titan (26 targeted flybys planned) and Enceladus (6 flybys planned).

## XMM-Newton

All the stars, galaxies and gases observable in the Universe account for less than a half of all the atoms (baryons) the Universe is made of. Scientists have predicted that the 'missing' matter exists in the form of low-density gas that fills vast spaces between galaxies forming a web-like structure. The 'missing' matter would have a high temperature and so it would primarily emit low-energy X-rays. But its very low density made observation extremely difficult. XMM-Newton's observations of a pair of galaxy clusters, Abell 222 and Abell 223, situated at a distance of 2300 million light-years from Earth, detected a bridge of hot gas connecting the two clusters. The hot gas in this bridge or filament is probably the hottest



SOHO's record-breaking comet discovery was made on 25 June 2008. Images of this small faint object were captured by the Large Angle and Spectrometric Coronagraph (LASCO), one of SOHO's 12 instruments on board (ESA/NASA)

and densest part of the diffuse gas in the cosmic web.

About 330 scientists participated in the 'The X-ray Universe 2008' symposium in Granada (E), on 27–30 May 2008 and opened by ESA's Director of Science and Robotic Exploration, Prof. David Southwood. A smooth and professional organisation of the conference contributed significantly to the overall success of the symposium and to the good impression made on all participants. The conference was exceptionally interesting from the scientific viewpoint reflecting the mature state of the scientific return from XMM-Newton.

## Cluster

From 25 April to 30 May, a 'tilting campaign' was performed, in which the spin axis of Spacecraft 3 was tilted by 45 degrees relative to the other spacecraft to allow electromagnetic waves and electric fields to be measured in three dimensions. Throughout the campaign, platform and payload temperatures remained within the forecast range.

The periodic magnetic activity, or substorms, at Jupiter and Earth was compared using Galileo and Cluster data respectively, by Kronberg *et al.* in the *Journal of Geophysical Research*. The paper highlighted striking similarities, suggesting that the same cyclic mechanism of loading and unloading affects both magnetospheres. A special issue of the *Journal of Geophysical Research* has been published containing 32 papers on Cluster and Double Star's most recent results.

## Double Star

Observations made by a unique constellation of Double Star TC-2 (at 10 Earth radii), Cluster (at 14–16 Earth radii), GOES-10 and the LANL spacecraft (near 6.6 Earth radii) have allowed Sergeev *et al.* to study the details of three reconnection events located unusually close to Earth (10–12 Earth radii).

The period August–September is critical since it was at this time last year that contact with Double Star was lost. The reason was most likely due to very high spacecraft temperatures and minimal solar array power. Because of the low power, instrument operations will be suspended from 15 July to 15 September. If the situation improves during that time, the instruments (FGM and PEACE) will still be able to operate via direct command from the Chinese Operations Centre.

## Mars Express

The PFS instrument has studied seasonal, diurnal, and spatial variations of methane in the Martian atmosphere. The so-called methane mixing ratio shows a slow decrease from northern spring to southern summer. The change is extremely small, but can still be clearly observed.

Data from OMEGA and PFS have been used to study the evolution of the water vapour concentration over the Hellas basin as a function of the seasonal cycle. The data show an abrupt enhancement of the water vapour

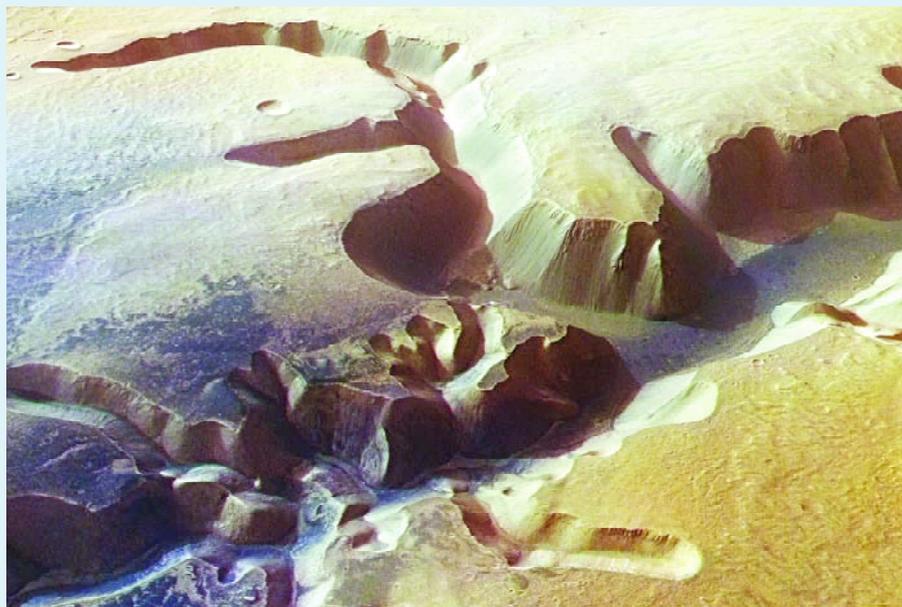
column density on a timescale of three days. Such an increase is not predicted by models, and was also occasionally observed by Mars Global Surveyor over the Hellas basin during previous martian years at the same season; however, its origin is not yet understood.

The first article to be fully based on data from three Mars Express experiments was accepted for publication in June 2008. This study suggests that the crustal magnetic fields, when they happen to be organised in 'cusp-like' structures, can trigger the aurorae observed.

## Rosetta

The Rosetta spacecraft has spent the last three months in passive cruise model, while the ground segment finalised preparations for the active payload checkout (PC8) and interference campaign in July 2008, and the subsequent flyby of asteroid (2867) Steins, for which the navigation started on 4 August 2008.

Asteroid (2867) Steins was discovered by N.S. Chernykh on 4 November 1969 at the



The High Resolution Stereo Camera (HRSC) on board ESA's Mars Express spacecraft has returned images of Echus Chasma, one of the largest water source regions on the Red Planet. Echus Chasma is the source region of Kasei Valles that extends 3000 km to the north. This image was taken on 25 September 2005, centred on 1° North and 278° East, with a resolution of about 17 m/pixel. The dark material shows a network of light-coloured, incised valleys that look similar to drainage networks known on Earth. It is still debated whether the valleys originate from precipitation, groundwater springs or liquid or magma flows on the surface (ESA/DLR/FU Berlin)

Crimean Observatory, Nauchnyj, Ukraine. It was provisionally designated as 1969VC and later numbered, and named after the astronomer K.A. Steins. It is an asteroid of the Main Belt with an eccentricity of 0.145 and a perihelion distance of 2.019 AU. (2867) Steins is believed to be an E-type asteroid, which is characteristic of iron-poor or iron-free silicates. It has an irregular shape with an average diameter of about 4.6 km and an albedo of  $0.45 \pm 0.10$  derived from polarimetric data. Its rotational period was recently determined also from observations obtained with the OSIRIS camera system on board Rosetta. From the light curve obtained a rotational period of  $6.052 \pm 0.007$  hrs was derived.

The flyby of this asteroid has been scheduled from 4 August to 5 October 2008 with closest approach on 5 September 2008, 18:37 UTC, when the asteroid is at a heliocentric distance of 2.14 AU and a geocentric distance of 2.41 AU. The targeted minimum flyby distance is 800 km and the relative flyby velocity is 8.62 km/s. A flyby strategy was selected that will allow continuous observation of the asteroid before, during and after closest approach. Rosetta will pass the asteroid on the sunward side approaching from low phase angle, going through phase angle zero, and entering high phase angles after closest approach. The planning activities for the asteroid flyby phase have been completed and detailed scheduling is now proceeding. By the end of June 2008, Rosetta was 285 million km (1.9 AU) away from the Sun and 211 million km (1.41 AU) from Earth.

## Venus Express

The airglow of the hydroxyl molecule has been detected in the upper atmosphere of Venus for the first time. This will improve the understanding of the chemical processes and is useful for tracing the dynamics in this region.

A first-ever surface temperature distribution map of the southern hemisphere has been compiled. New data have shown a

surprisingly variable concentration of sulphur dioxide in the upper atmosphere. This has led to a renewed discussion on the case of present volcanism on Venus.

The clouds on Venus, which exist in a layer extending between 45 and 70 km above the surface, move rapidly. These clouds are mainly composed of micrometre-sized droplets of sulphuric acid and other aerosols, the origin of which is unknown.

The Venus Monitoring Camera (VMC) on board Venus Express has been observing the top of the cloud layer in visible, near-infrared and ultraviolet wavelengths. Ultraviolet observations have shown a wealth of new details including a variety of markings created by variable concentrations of different aerosols located at the top of the cloud layer. The shape of the clouds on Venus changes dramatically from the equator to the pole. At low latitudes, the cloud shape is spotty and fragmented, a consequence of a vigorous convective movement powered by the radiation of the sun heating the atmosphere itself.

## COROT

COROT has now been in orbit for more than one and a half years. During this time, more than 30 000 stars have been observed during

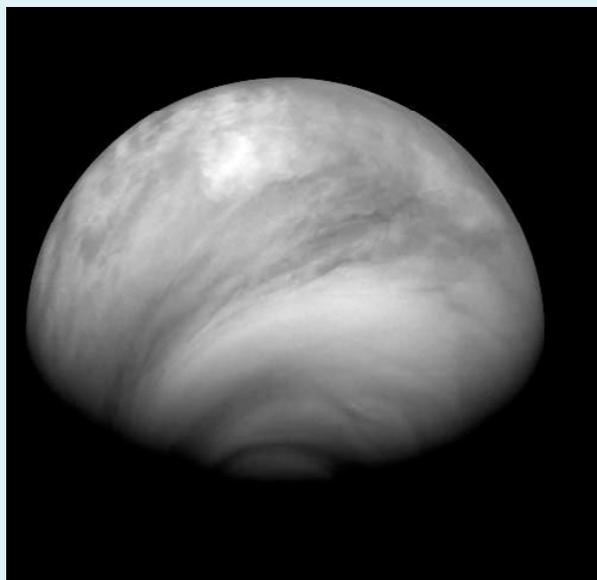
unprecedented long (and uninterrupted) periods of up to 150 days.

A characteristic of the COROT mission is that since the observing periods are so long, by the time the data has been acquired by the co-investigators, the Sun is in the part of the sky which the spacecraft has just observed, making the follow-up observations from the ground (necessary to confirm any planet candidates) impossible during a further six months. This causes a serious bottleneck in the follow-up process. Therefore, there is a significant delay in the presentation of scientific results. It is expected that this will be alleviated in about six months when the first data will become public.

Nevertheless, seven extrasolar planets have been confirmed, and about 30 more high-priority candidates are currently being followed up. About 10 papers in refereed journals are published or submitted. All of these potential planets are similar to Jupiter in our Solar System. A re-evaluation of all hitherto observed fields is under way, as the software for planetary detection is continuously being refined, in order to search for smaller planets.

The first asteroseismological signatures, at a level similar to those previously only detected in the Sun, have been detected in a solar-type star. The results have been submitted to scientific journals.

*An ultraviolet VMC image of Venus from 30 000 km. The south pole is at the bottom, while equator is at the top. The bright lace visible on top of the darker cloud deck is made of freshly formed droplets of sulphuric acid. At mid latitudes, the convective clouds make way for more streaks, indicating that the flow is basically laminar in this part of the atmosphere. At high latitudes, the cloud structure appears as a dense, almost featureless haze forming some a 'polar cap' on Venus. The dark, circular feature visible at the lowest part of the image is one of the dark streaks usually present in the polar region, indicating atmospheric parcels spiralling towards the pole (ESA/MPS/DLR/IDA)*



## Herschel/Planck

Both spacecraft are in the final stages of the flight acceptance testing and have completed a set of major milestones.

The main highlight of the Herschel flight model test campaign was the completion of the mechanical test campaign (sine vibration test and the acoustic noise testing). The satellite is now undergoing the final functional and performance verification before the thermal vacuum and thermal balance test later this year. All the functional testing that needed to be completed before and after the mechanical test campaign have also been carried out, including the system validation test where the satellite is operated by the mission control centre in ESOC. A first electromagnetic compatibility test has been carried out, measuring the radiated emission of the operational satellite in the large anechoic chamber in ESTEC, showing the expected very low emission level of the satellite, a key input to the demonstration that the satellite will not disturb the very sensitive detectors of the scientific instruments in orbit.

The Planck flight model satellite is undergoing its last big environmental test before flight, the thermal balance and thermal vacuum test in the test chamber at CSL in Liege (B). During the two-month long test, the performance of the scientific instruments under orbit like cryogenic conditions will be verified. This includes cooldown of the system with the three cooler stages of Planck with the lowest temperature of 0.1K being reached at the HFI bolometers. The test started with the satellite in the chamber in mid June to functionally test the satellite. One of these tests was the science operations validation test with the satellite being operated by the control centre in ESOC, simulating five operational days in orbit and processing the data coming from the satellite through the complete ground segment, including the data-processing centres of the two scientific instruments.

Overall, the test activities of the last months

were carried out on time, leading to readiness of both satellites for launch just before the end of the year.

## LISA Pathfinder

The LISA Pathfinder development is in progress despite a delay in the schedule. The main engineering activities are related to finalising the spacecraft design, in

preparation for the spacecraft CDR to be held in the autumn. All subsystems have already had their own subsystem CDRs and many equipment suppliers have delivered electrical units and some their Flight Models. The science module FM structure that was damaged during the static test has been repaired and will be used in the summer together with the propulsion module structure for a combined acoustic and separation test. A new FM structure has been

*Planck fine-balancing test at ESTEC inside the Large Space Simulation facility*

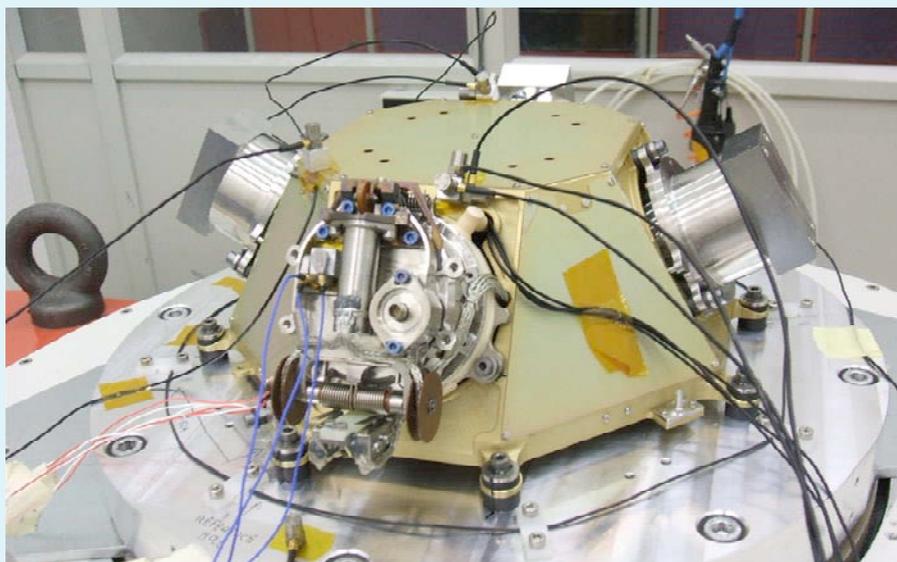


built in parallel by Oerlikon Space (CH) to be used for flight. The on-board software development is proceeding. The versions 2.0 and 2.1 are being used by the Drag Free Attitude Control (DFAC) team in Astrium GmbH and by Astrium Ltd for their testing. These two test set-ups (Real-time Test Benches) will proceed in parallel initially with electrical units and later with flight units until spacecraft FM integration.

The two European micropropulsion technologies (needle indium thrusters and slit caesium thrusters) continue their challenging development to prove the readiness of the technologies. Especially in slit technology, substantial steps have been made towards a final validation of the technology, expected by the end of the year. The technology that will not be selected for flight will be held as a back-up.

Concerning the LTP, after completion of the system CDR, the work is focused on the critical subsystems, e.g. caging mechanism, electrode housing and Data Management Unit software. All the LTP Electrical Models (ELM) have been built and delivered to Astrium GmbH for the Real-time Test Bench and all electronics FM units are expected to be delivered by the end of the year.

The launch is expected to take place at the end of 2010.



*Slit FEFP thruster cluster development model for LISA Pathfinder under vibration test at ALTA (1)*

## Microscope

The T-Sage payload development is progressing on schedule.

In the micropropulsion area, an ESA/CNES status review was held end April 2008. At the Microscope Steering Committee meeting, held in May 2008, it was recognised that a decision could not be made then on the thruster technology to be adopted for Microscope. It was requested to define objective criteria that will permit the choice between FEFP and cold-gas micropropulsions and to make sure

that the corresponding tests required to demonstrate fulfilment of these criteria are properly planned. In the meantime CNES will pursue a Phase B of the cold-gas mission configuration to obtain the same level of definition as for the FEFP-based mission for which Phase B has been completed already.

## Gaia

Contract negotiations with the prime contractor Astrium SAS (F), for the conversion of the C/D ceiling price, are almost completed. The contract should be signed within the third quarter of 2008.

The equipment procurement has continued and only few non-flight items remain to be subcontracted. At unit level, only two PDRs are still to be held. As a consequence the CDR's process has started.

The release of the manufacturing drawings for the production of the optical bench (Torus) is progressing almost nominally. The first segment has been manufactured.

The implementation of the science ground segment moves ahead as well. The second meeting of the Steering Committee of the Data Process and Analysis Consortium (DPAC) has taken place.



*Telescope integration to the Herschel spacecraft*

## JWST

After successfully passing the mission PDR and the Non-Advocate Review, the James Webb Space Telescope was formally approved at the NASA programme management council meeting.

Integration activities on the Near Infrared Spectrograph (NIRSpec) development model are progressing, with the cryogenic harness already routed on the optical bench and the structural-thermal assemblies integrated. The instrument control electronic and control S/W passed successfully their CDR and the optical performance at ambient of the Integral Field Unit Qualification is within specification. The measurements of flight candidate detector chips are ongoing. Intensive work with breadboard models continues for the cryo-mechanism's grating and prism mount and for the refocus mechanism mirror. The instrument CDR board meeting is now planned for December 2008.

The first cryo-test campaign of the Mid Infrared Instrument (MIRI) Verification Model was successfully completed. Following the successful delivery of the telescope simulator, final cryo performance test is now due to start in August. The imager qualification review was passed successfully. The MIRI schedule has been recovered by modifying the manufacturing sequence of the grating and filter wheel mechanisms; the first units delivered will now be used for integration in the instrument flight model.

The launcher Interface Control Document issue 1.0 was released in June by Arianespace. Improvement of cleanliness control of the launcher environment, using Herschel/Planck as test case, is also ongoing.

## BepiColombo

The mission Tiger Team has been tasked to define a mission based on a launch with

Ariane-5 in order to accommodate the severe mass increase. The extra launch capacity will also be used to provide design robustness for critical areas, e.g. for adequate radiator margin and for a temperature decrease on solar arrays and mechanisms. On that basis, the system design is now being reiterated. The PDR has been pushed back by one year and as a consequence, the launch is foreseen in August 2014. The SPC has been informed of the BepiColombo situation and of the order of magnitude of the cost impact. In view of the overall impact on the scientific programme, the SPC was asked to vote for cancellation of the BepiColombo project, however, the required 2/3 majority was not reached. Therefore the project team should propose a workable solution by the November SPC.

The schedule for the Instrument Preliminary Design Reviews (IPDR) has been adjusted to the actual project programme taking into account the individual payload status, and priorities for the near-term workplan were agreed with the Principal Investigators. The first IPDR started in March 2008, and the last design reviews should be completed in Autumn 2008. Interfaces for both instruments are being consolidated in close cooperation with the spacecraft prime contractor team. The BELA experiment definition is progressing with an optimised laser transmitter subsystem. The MIXS mirror optics module has completed the first design phase and the experiment configuration is being consolidated.

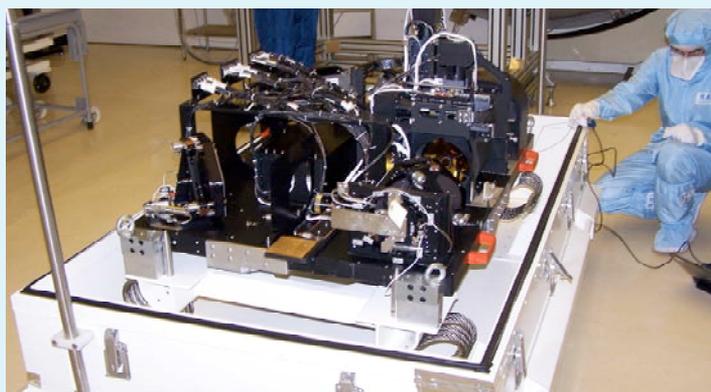
Work in Japan on the Mercury Magnetospheric Orbiter (MMO) is continuing in the C/D phase.

## Solar Orbiter

The Solar Orbiter Definition Phase (Phase B1) is being performed by an industrial team led by Astrium Ltd (UK) and including Astrium GmbH (D) and Thales Alenia Italy. It will culminate in Autumn 2009 with a System Requirements Review. Design trade-offs are addressing all major subsystems and the spacecraft heat shield upon which the survival of the spacecraft will depend when it gets close to the sun. The spacecraft baseline design relies heavily on the re-use of technology and equipment from the BepiColombo project.

The instrument proposals received from Europe and the United States in response to the Solar Orbiter Payload Announcement of Opportunity released in October 2007 have been subjected to a scientific and technical evaluation by both ESA and NASA. The spacecraft definition will now be adjusted to take into account the detailed payload complement as selected.

In parallel, technology development activities are advancing the readiness level of several key elements. The Heat Rejecting Entrance Window breadboard has been submitted to a full qualification testing sequence. A commercially available visible light detector has been characterised and submitted to total-dose radiation testing, to be followed later by proton testing. Investigations into the possibility of space qualifying a liquid crystal polariser have been started.



*MIRI Telescope Simulator after delivery to RAL (UK) (MIRI European Consortium)*

## LISA

The Mission Formulation contract started in January 2005 with Astrium GmbH has produced a solid mission baseline design and has analysed in detail a few alternative designs aimed at reducing complexity and cost. Recent discussions with NASA have led to the concrete possibility of ESA assuming the LISA mission leadership, thanks to the fundamental preparation performed in the framework of the LISA Pathfinder mission. This implies that ESA will be responsible for the LISA mission performance and eventually for the mission success.

The scope of the work that has been carried out by Astrium so far was mainly concentrated on the payload design. In the forthcoming extension, it will be extended to the overall system and mission, encompassing initiation of an end to end performance simulation, apportionment and iterations on the performances required by the various subsystems, in relation with the CTP technology development activities, consolidation of the system design and interface requirements. This will allow to progress with NASA on respective roles and responsibilities and the mission to reach the required level of maturity for the Cosmic Vision L1 mission selection planned for the end of 2009.

## ExoMars

Phase B2 work progressed well during this period with the entire industrial team being kick-off and a contract for the Phase B2 and Advanced C/D activities signed in June. The Advanced C/D activities are proceeding well, with the issue of several ITTs to start schedule critical procurements and to build up the industrial team.

On the international cooperation side, an ESA/NASA Letter of Agreement for cooperation on ExoMars was signed as well as the ExoMars and Phobos-Grunt cooperation agreement for cooperation with Russia.

The Instrument Multilateral Agreement for the ExoMars payloads was approved by the HME Programme Board and now awaits signature by the Lead Funding Agencies that will be delayed until the results of the ESA Ministerial Council in November 2008. The ExoMars Programme Proposal was reviewed several times in this period and is essentially in its final form pending last inputs related to the overall programme costs expected in September-October.



Enhanced ExoMars Rover

GOCE in flight configuration at ESTEC



## AKARI

The AKARI project has been reviewed by JAXA, who supported the implementation of the Post-Helium (i.e. warm) Phase observations for an interval of three years. Post-Helium phase observations offer imaging and spectroscopy in the 2–5 micrometre wavelength range. The routine phase started with guaranteed time observations on 1 June. The ESA and JAXA Call for Proposals for open time observations, issued in May, closed in July with 40 proposals received in total. Further to peer review, open time observations are expected to start in mid October.

The AKARI pointed observation data archive was opened for general community use on 7 March. The data being made available at this time are those taken in the Large Area Surveys and in the guaranteed time programmes, which were archived before March 2007 for internal use, and all Director's Time and Calibration observations, including data taken in the Performance Verification phase. AKARI cold-phase open time observations will be in the public domain in September 2008. New versions of the data reduction pipelines and associated user documentation have been released in June by the AKARI User Support teams.

ESA pointing reconstruction data have been delivered to ISAS for inclusion in the survey catalogues generation software. The catalogues are planned to be released for internal use in September 2008 and one year later for public use.

## GOCE

The investigation into the cause of a Breeze-M upper-stage rocket failure that led to the temporary halt of Rockot launches – thus delaying the launch of GOCE – concluded that the failure was linked to pipework being stressed in long-duration burns not foreseen for launches into low Earth orbit. Following confirmation of the flight-worthiness of the Breeze upper stage

for Rockot, a new launch date in September was agreed by all parties.

The activities required to cope with the new launch date included the selection of new optimal orbit injection parameters. As a consequence, GOCE will be launched into a dusk-dawn orbit, which will allow science operations to remain unaffected by eclipses until end of March 2009. Moreover, the presently low solar activity has offered the opportunity to lower the satellite injection altitude by 10 km, which in turn improves the gravity gradient signal strength and reduces the time needed to decay to the target altitude for the first measurement phase. Finally, changing from a dawn-dusk orbit to a dusk-dawn orbit has required the reconfiguration of some platform and payload elements, notably the mounting location of star cameras and GPS antennas, and an update of the on-board application software. The formal consent to ship the satellite to the launch site was given on 18 July.

On the ground segment side, the main activities have been the rehearsal of all Payload Data Ground Segment operations and the preparations for the final Low Earth Orbit Phase and commissioning phase simulations. Additionally, a slightly updated version of the Level 1 to Level 2 processing facility has been accepted. With the conclusion of these activities the ground segment is ready for launch.

## CryoSat

The satellite is fully integrated except for one delayed subsystem. Nevertheless, system level testing is proceeding with engineering model equipment as a substitute. However, a delay in the satellite's environmental test campaign is required and consequently the start of the campaign (requiring transport of the satellite from Astrium Friedrichshafen to IABG Munich) has been formally moved from mid-July 2008 to mid-September 2008.

Following the successful System Validation Test (SVT) in March 2008, which tested the

compatibility of the command and control centre at ESOC with the satellite, a complementary SVT has been planned for September 2008. Additional compatibility testing has been performed with the 'RF-suitcase', which demonstrated the compatibility of the satellite telecommand and telemetry physical radio-frequency links with a reference ground station. Testing of the interfaces between the different elements of the ground segment has also continued.

During April, a further measurement campaign in the CryoVex series was completed very successfully. The calibration, validation and retrieval team is now working on processing the results.

## SMOS

With the satellite AIT programme finished, SMOS is being prepared for storage, with some remaining activities to be performed towards the end of the year (final software uploading, third system validation test, second adaptor fit check). In the meantime, the satellite qualification review is conducted under CNES lead. In parallel, the finalisation of launcher-related documentation is taking place, to be reviewed at the final mission analysis meeting scheduled for October 2008 in Moscow.

Delivery and integration testing of the ground segment elements is taking place in the ground segment overall validation. While most functions are available as needed, the final operational processors to be installed are still under development. However, intermediate deliveries allow reasonably representative test scenarios to be run.

A rehearsal of the validation campaign took place in Spring with the University of Helsinki's Skyvan aircraft, equipped with real and synthetic aperture radiometers, an infrared camera, and GPS reflectometry instrumentation. This exercised all logistics, procedures, data processing and interpretation in order to make sure everything works for the real validation campaign after launch.

## ADM-Aeolus

Investigations could show that the anomaly found during the laser vacuum test in April 2008 was due to particles on the surface of one of the optical elements in the laser Master Oscillator that led to laser-induced damage of the optical coating. The particles were released by an adhesive bond near the component. An updated manufacturing procedure will be applied to prevent release of particles in the future.

To reduce the risk of further anomalies that could delay the qualification of the laser it was decided to perform a comprehensive review of the laser design margins and performance predictions and identify weaknesses in the baseline configuration, if any. This review, with experts from the industrial consortium, ESA and external independent consultants, took place in May and June 2008.

On the basis of existing vacuum test data and performance predictions the review came to the conclusion that the required thermo-elastic stability improvements of the Master Oscillator have been achieved, as the result of the extensive modifications that were implemented in the Master Oscillator. It pointed out, however, that further improvements of the beam stability in the amplifier and harmonic section are necessary. Also, the robustness of some optical elements against laser-induced damage should be increased by implementing new state-of-the-art coatings.

The parallel activities of performing of the repairs in the Master Oscillator, improving the beam stability of the amplifier and harmonic section, and replacing some of the optical elements by upgraded ones have been initiated. The laser qualification programme will be resumed once these modifications are in place. In addition, some back-up solutions are being prepared in case these measures do not prove fully successful.

The system tests at satellite platform level

are making good progress. An advanced version of the satellite application software is currently under test and the formal qualification review of the application software is foreseen in July 2008.

## Swarm

The Critical Design Review (CDR) of the structure was successful. This paves the way for the manufacturing and assembly of the satellite structural model due to be tested during the first quarter of next year within the test facility of IABG at Ottobrunn. The recovery plan initiated last quarter for the development of the optical bench in carbon fibre is completed. The structural model of the optical bench will be tested early September this year.

The CDR of the Electrical Field Instrument (EFI) is ongoing. The engineering models of the EFI instrument and the digital processing unit of the Scalar magnetometer are ready for an electrical compatibility test with the satellite. The ground segment activities for the development of the payload data and the flight operations system are on track with a Preliminary Design Review (PDR) scheduled in September.

The next major step for the Swarm programme during the next quarter will be the consolidation of the satellite design at unit/instrument level with the completion of the unit level CDR.

*Swarm's new CFRP STM optical bench with the Vector Fluxgate Magnetometer sensor head assembled on the right side of the picture (EADS Astrium GmbH)*



## MetOp

### MetOp-A

MetOp-A continues to perform excellently in-orbit. Investigations on the HRPT anomaly on MetOp-A revealed the unanticipated sensitivity of the power gallium-arsenide field effect transistors. Pending the results of the investigation and eventual corrective action, procurement of replacement transistors, less sensitive to heavy ions, is under way. The replacement transistors would be integrated on the MetOp-B and MetOp-C HRPTs. The transistors have successfully passed their heavy ion radiation test.

On 1 July, the Eumetsat Council has decided to abandon the LRPT services on the Eumetsat Polar System (EPS), which means that the LRPT on board the MetOp spacecraft will remain switched off.

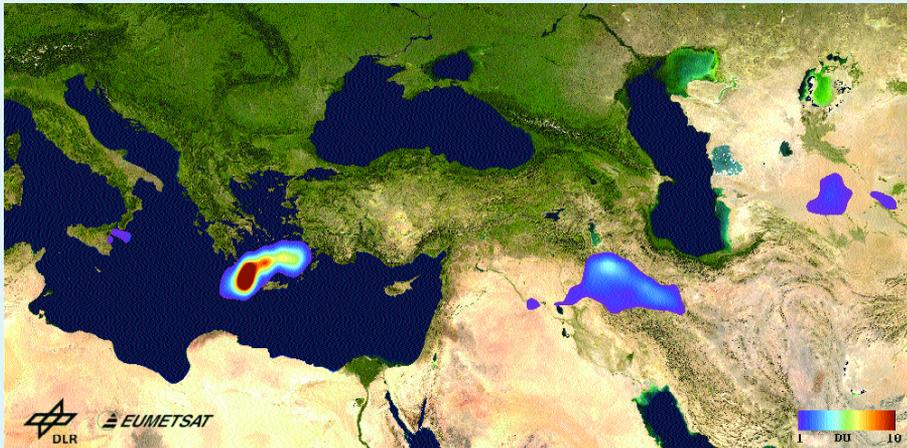
### MetOp-B and MetOp-C

Although the MetOp Payload Modules, PLM-1 and PLM-3, are in long-term storage, there are still some residual AIT activities to be performed that require dismounting of some instruments for repair, recalibration and/or alignment. The MetOp Service Modules are kept in storage at Astrium Toulouse, waiting for the restart of AIT activities in 2009 for a planned MetOp-B launch in 2011.

## Meteosat

### Meteosat 8/MSG-1

Investigations into the uncommanded orbit change of the Meteosat-8 spacecraft are still ongoing. The most likely cause for the observed anomaly would be the loss of two



On 10 May 2008, the volcano Etna erupted on Sicily. The Global Ozone Monitoring Experiment 2 (GOME-2) on MetOp-A measured the resulting sulphur dioxide SO<sub>2</sub> plume, which reached an altitude of 12 km. The data were evaluated by scientists at DLR (Eumetsat/DLR)

thermal frames, on the side of the radial thrusters. With the satellite spinning at 100 rpm, the centrifugal forces experienced on these frames are about 17g. The thermal and dynamic behaviour of the satellite fit with this assumption. The satellite experiences larger thermal gradients during eclipse nights, however all parameters remain in the nominal area. The performance of the imaging service has not suffered and is still excellent.

On 2 April 2008, Meteosat-8 started a drift from 3.4° West to 9.5° East, in preparation for the new Rapid Scan Service (RSS), and arrived there on 28 April. The MSG Rapid Scan Service was declared operational on 13 May 2008, with new MSG Level 1.5 Image Product Effective Radiance Definition being applied. The MSG RSS is a follow-on to the Meteosat-6 RSS (terminated 8 January 2007).

**Meteosat-9/MSG-2**

Meteosat-9 is Eumetsat's nominal operational satellite at 0° longitude, with Meteosat-8 as its back-up. Satellite and instruments performance are excellent.

**MSG-3 and MSG-4**

Both MSG-3 and MSG-4 are in intermediate storage in the Thales Alenia Space Cannes, awaiting the restart of the AIT campaign begin 2010, to prepare MSG-3 for its launch, currently foreseen 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.

**Sentinel-1**

The Phase B2 is approaching its conclusion with the Preliminary Design Review. The Data Package was delivered on 25 April, the main presentation was held on 9 May at ESTEC (attended also by external experts from DLR, CSA, CNES, CDTI) and the PDR Board was held on 4 July at ESTEC.

The PDR was successful pending the resolution, within next October, of a limited number of issues. The procurement of equipments has progressed and only about a dozen equipments remain to be assigned. For the equipments to be procured in a

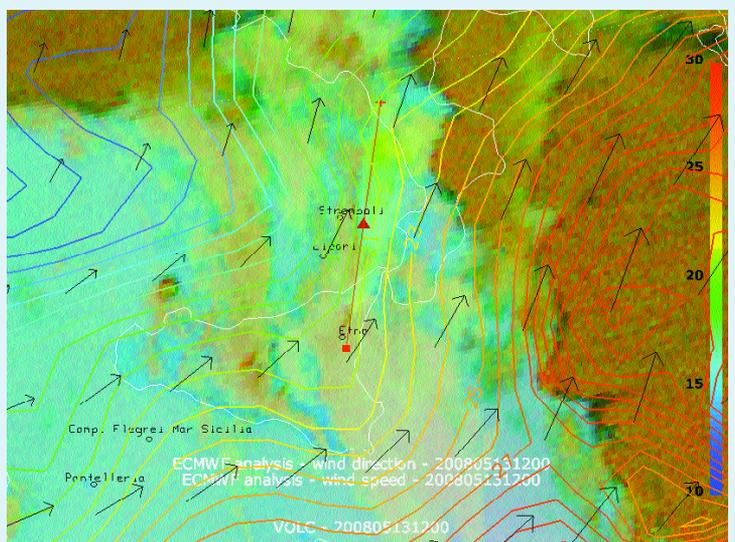
coordinated fashion among the three Sentinels, good progress has been achieved following a commonly agreed among the three Sentinel prime contractors. The negotiation of the conversion of the ceiling price for the Phase C/D is progressing in parallel.

**Sentinel-2**

Following prime contract signature for the delivery of the first satellite model between ESA and Astrium GmbH on 17 April 2008, the satellite and payload instrument system level trade-offs have been completed allowing the generation of consolidated specifications. Phase B2 procurement activities are intensifying (about 60 procurement actions), and several equipment manufacturers have now joined the industrial prime and core team consortium (e.g. for the GPS receiver, instrument optical filters). The first equipment PDR for instrument SWIR detectors has been held. Activities related to image quality monitoring and the definition of prototype processor algorithms has been initiated by CNES in support to the Sentinel-2 project team.

The 'Sentinel-2 Payload Instrument PDR' and the 'Sentinel-2 System PDR' will take place in two incremental steps from September to November 2008.

The movement of the SO<sub>2</sub> cloud from Etna over the Mediterranean Sea towards the Middle East and up to Iran can also be followed with Meteosat-9 in this composite RGB/IR image, taken on 13 May 2008, 12:00 UTC with ECMWF winds at 200 hPa (Eumetsat/ECMWF)



## Sentinel-3

Following the signature between ESA and the Sentinel-3 prime (Thales Alenia Space – France) of the Phase B2-C-D-E1 Contract on 14 April, the finalisation and signature of the lower level contracts between the prime and the other core team partners is on going, aiming to have most of them completed before the summer holidays break. All activities have been proceeding in the meantime through PATPs.

The execution of the procurement tasks through competitive Invitations To Tender (ITTs) is proceeding in all fields and it still represents the main effort in this phase of the programme. Roughly 100 procurement contracts have to be placed, 18 have been concluded and another 25 are under negotiation. All the ITTs related to flight hardware have been issued and their completion is expected in the coming quarter.

On the technical side, the satellite baseline configuration to be presented at the PDR including the launcher interfaces, has been completed. At instrument level, the Ocean and Launcher Colour Instrument (OLCI) and the Radar Altimeter (SRAL) consolidation are proceeding nominally. On OLCI, due to the advanced status of development, the PDR of the Video Acquisition Module is already ongoing, as well as the preparation of the OLCI S/S breadboarding activities. On SRAL the design activities during this period focused on the replacement of several obsolete or non-European components, present in the original design inherited from previous projects. Alternative design solutions are being assessed through unit breadboards. On the Microwave Radiometer, the design of the switch assembly for calibration and redundancy has evolved and a consolidation is expected within the next month.

Finally the Sea and Land Surface Temperature Instrument is undergoing an overall consolidation of the thermomechanical design of the instrument

is ongoing, aiming to optimise the working temperature while reducing the overall instrument mass.

The first major programme review is the satellite PDR, planned to start in August 2008 and the agreed list of PDR documents is under preparation. Also the preparation of the five lower level PDRs (platform and instrument) planned in the forthcoming months is on going.

## EarthCARE

The EarthCARE contractual and technical baseline documentation was finalised in preparation for the signature of the industrial contract with Astrium GmbH. Contract signature took place at the Berlin Air Show on 27 May in the presence of the German Chancellor Angela Merkel.

Early Phase B activities are continuing with the goal of consolidating system trade-offs at base platform and instrument level prior to the System Requirements Review scheduled for later this year.

The participation of ESA's partner agency JAXA, which is responsible for the delivery of the EarthCARE Cloud Profiling Radar, has been formally approved in Japan and the JAXA project team was officially instated on 1 July.

Activities are in progress in the project's Joint Mission Advisory Group to establish a way forward for the collaborative European/Japanese development of level 2 algorithms which will allow full exploitation of the synergy between the four instruments of the EarthCARE payload.

## Alphasat/Alphasat

The Critical Design Review for the generic Alphasat platform was successfully completed with a final Board close-out meeting in April. In parallel, a detailed definition of the specific adaptations required

for the protoflight platform, to ensure compatibility with the first flight application (Alphasat), has been satisfactorily concluded and manufacturing of the flight structure has been authorised.

In the Alphasat programme, the detailed definition of the challenging operational payload required for the Inmarsat I-XL continues. The main reflector and feed configuration has been frozen and the associated subcontracts begun. The Alphasat payload and satellite PDR is scheduled for September.

The development of the four Technology Demonstration Payloads, to be provided by ESA for the Alphasat satellite, is under way. These include an optical communications terminal, a Q-V Band experiment, an advanced star tracker and an environments and effects facility.

### Vega

Flight Model manufacturing activities started. The Z23 Inert Motor Case Thermal Protection manufacturing was completed as well as the InterStage Qualification Model. The structure was sent for static tests to be performed in July. In parallel, test activities are proceeding with Z9 firing test scheduled in September. An updated plan was issued with a launch date in November 2009.

### Soyuz at CSG

The Mobile Gantry Steering board took place on 3 April 2008. The Critical Design Review of the Soyuz Launch System ground segment took place from 8 April to 16 May and the relevant Steering Board closed the review on the 20 June 2008.

The arrival of the first shipment of Russian equipment in French Guiana is expected by the end of July, in parallel with the arrival of a precursor team of 40 Russian specialists.

### FLPP

The IXV System Requirement Review was successfully completed. Wind tunnel test campaign started and has already shown promising results on the stability of the IXV in transonic phase.

The Expander Demonstrator test campaign

with M2R engine has been completed with a total of more than 4500 s cumulated hot-firing test duration demonstrated on the Vinci engine.

In Main Stage Propulsion activity, the post-test review of LOx/LH2 coupled test was held on 21 May. The subscale demonstrator accumulated 450 s hot-firing test time, where main combustion chamber and pre-burner pressures reached respectively more than 160 bars, and 220 bars and it enabled also to characterise different injectors in a wide operating domain. These tests constitute a first major step towards the high-thrust engine.

A first set of cryogenic upper-stage technologies has been selected; technology development and validation plans are being worked out.

## ARTA

The ARTA Programme, part of ESA's Ariane-5 Development Programme, is aimed at the continuous verification of the qualification status of the Ariane-5 launch system, checking the current production and qualifying required modifications to the launcher design before they enter service.

The ARTA 4 MPS (Moteur Propergol Solide) test-firing took place on 5 April at the BEAP (Banc d'Essais des Accélérateurs à Poudre) in Guiana Space Centre, Kourou, French Guiana. Initial analysis of the data shows that performance was in line with predictions. An in-depth analysis has started now to evaluate the results with respect to the specific objectives of the test: verification of current production stability, efficiency of pressure oscillation reduction device, simplification of manufacturing process, behaviour of new products to solve current obsolescence, etc.

The main goal of this ARTA test was to verify the qualification status of the current MPS solid rocket booster production with respect to potential manufacturing process drifts. This was the fourth test of an MPS since the beginning of the Ariane-5 ARTA programme and the eleventh since the start of the



The ARTA 4 MPS test-firing on 5 April at the Guiana Space Centre, Kourou

Ariane 5 Development Programme. The next MPS ARTA test is expected in about two years from now.

## Human Spaceflight, Microgravity and Exploration

### International Space Station

The Expedition 17 crew, aboard Soyuz TMA-12, successfully docked with the ISS on 10 April 2008.

ESA's Automated Transfer Vehicle, ATV *Jules Verne*, was used for the first time on 25 April to raise the orbit of the ISS. A 740-second burn of the ATV's main engines successfully lifted the altitude of the 280-tonne ISS by around 4.5 km to a height of 342 km above Earth's surface. The reboost set up the ISS for the arrival of Space Shuttle *Discovery* (launched 31 May) on the STS-124 mission that delivered the Japanese 'Kibo' (Hope) laboratory.

On 19 June, ATV *Jules Verne* was used to reboost the ISS for the second time. The reboost consumed about 400 kg of propellant on board *Jules Verne*. The ATV *Jules Verne* was also used for the first time to successfully transfer about 280 kg of the

Russian UDMH (unsymmetrical dimethylhydrazine) propellant fuel and 530 kg of nitrogen tetroxide (which provides a source of oxygen so that the fuel can ignite and burn in orbit) to the Russian-built Zarya module's propulsion tanks.

The on-orbit commissioning of ESA's Columbus laboratory payloads continued over the last few months. The Biolab facility commissioning was completed, the Fluid Science Laboratory is in the final stage of facility commissioning, the European Drawer Rack including the Protein Crystallisation Diagnostics Facility have been successfully commissioned, and the European Physiology Modules have been largely commissioned with the exception of few minor steps at instrument level.

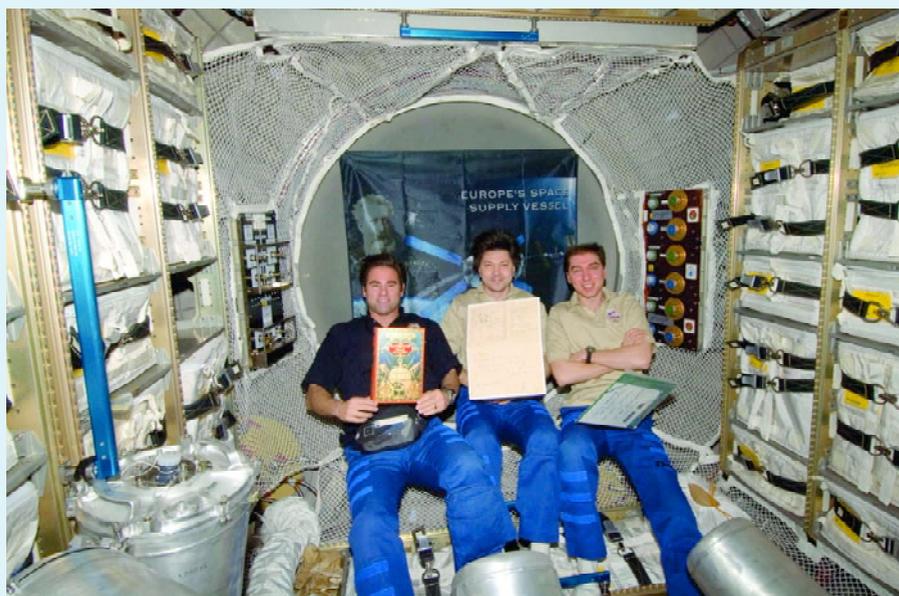
### Space Infrastructure Development and Exploitation

#### Infrastructure Development

The Study on a Columbus external platform capability for small payloads (SPERO) and a EuTEF-2 Feasibility Study are ongoing with industry.

#### ATV Production

The ATV-2 integration progressed well. The ATV-3 equipment was released for procurement with a few exceptions following the ATV Production Readiness Review on



An original 19th century luxury edition of Jules Verne's book 'De la Terre à la Lune' and two of his handwritten manuscripts were among the cargo to arrive at the ISS when ATV Jules Verne docked last April. The Expedition 17 crew, Greg Chamitoff, Oleg Kononenko and Sergei Volkov, are seen here retrieving the book and manuscripts from the ATV's cargo hold to mark the occasion of July's ISS Heads of Agencies meeting in Paris. (NASA)

17 April 2008. The ATV-2 launch is now scheduled for the second quarter of 2010. The ATV rack design was optimised and qualification tests were running without any problems. The formal transition process between ATV development and ATV production has been started both at ESA and on the industry side.

#### Operations

The Columbus laboratory operations continued without problems on the system side. All ATV *Jules Verne* systems continued to operate nominally. Most of the remaining docked phase activities were carried out in June. In addition to the propellant, over 80 litres of water were successfully transferred from the ATV to the Russian segment. In addition, two of the empty ATV water tanks have been used to collect ISS condensation water following anomalies in the ISS condensate collection system.

Discussions are taking place on the ATV undocking date. To allow reentry at night, a date of 29 September is currently targeted. The target undock date will be early September to make way for the docking of the next Progress.

#### Utilisation

The first Biolab experiment, WAICO Run#1 (studying the waving and coiling behaviour of Arabidopsis roots), has been completed; and the for experiment reactors with the zero-g plants have been returned to Earth for detailed laboratory analysis.

The first Fluid Science Laboratory experiment, GEOWFLOW (studying the thermally-driven and magnetic field driven geophysical flows) is on board and is expected to begin immediately after the final optical checkout of FSL at the end of July,

with an exhaustive science programme until end 2008.

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 uploaded on the next Shuttle flight (ULF-2) to ISS.

The first three sessions of the 3D space neurophysiology experiment has been successfully performed. The preparations for the SOLO nutrition experiment are completed and it is ready for execution by the end of the ongoing mission increment.

The European Technology Exposure Facility (EuTEF) science and technology programme is progressing well; all nine instruments are continuously delivering science data according to their experiment protocols. The SOLAR payload and instruments have been performing the first three sun observation cycles. Currently a communication link failure is under investigation.

The Cell Wall Resist Wall experiment of JAXA has been completed in ESA's European Modular Cultivation System (EMCS) and the plant samples returned to ground on the Shuttle. Exhaustive ground tests are ongoing to secure the full EMCS facility performance for ESA's next experiment, GENARA, which will study the existence of gravity-regulated genes in Arabidopsis plants. The ANITA



Mounted on Columbus, SOLAR is seen here in front of the Shuttle Atlantis, showing the movement bracket holding the scientific instruments (NASA)

instrument still runs operationally in Destiny and continues to deliver invaluable cabin air constituents data.

ESA's complementary experimental programme in the Russian ISS segment is nominally progressing with five experiments in respiration (NOA-1/-2), radiation (Altcriss, Matroshka-2B) and technology (GTS-2).

The MASER-11 sounding rocket flight was successfully performed at Esrange (Sweden) on 15 May, with a set of four extraordinary applied research experiments with novel instrumentation on board. This accomplishment proves again this invaluable mission asset for the European science community.

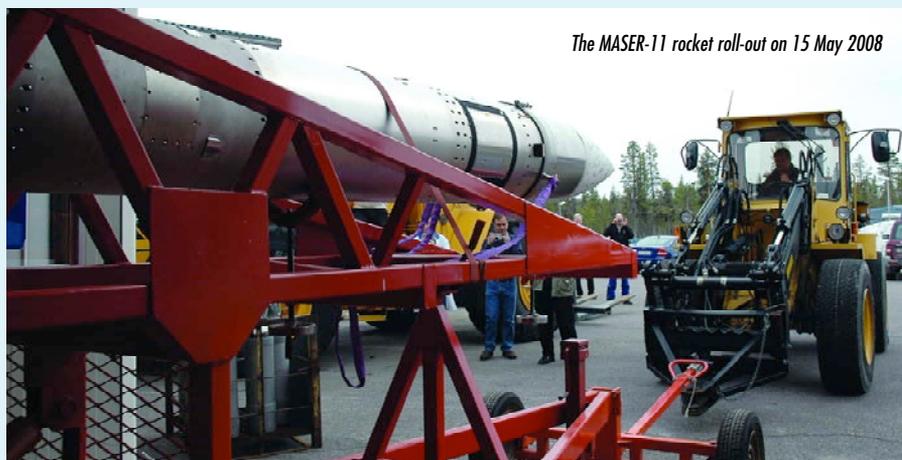
The 48th ESA A300 Parabolic Flight Campaign was successfully performed in March with a focus on fundamental and applied research in heat and mass transfer. The next flight campaign is already under preparation for Autumn 2008.

### Astronauts

On 19 May, ESA began its search for new astronauts, calling for applications from talented individuals who wish to join the European Astronaut Corps. At the close of the application phase, ESA received 8413 completed applications. The Astronaut Selection Team, based at the European Astronaut Centre (EAC) in Cologne, Germany, now have the challenging task to select the best applicants. Those who make it through this first screening step will be invited in the next weeks to the first round of psychological tests in Hamburg.

### *ESA Medical Operations for long-duration missions*

The successful Columbus mission signals the beginning of a long-term European presence in space. Columbus is a place for European astronauts to live and work on a regular basis, protected from the harsh environment of space. As such, there is a corresponding dedicated team of experienced medical and health professionals in the ESA Crew Medical Support Office (CMSO) working to support European astronauts. The CMSO team consists of physicians,



*The MASER-11 rocket roll-out on 15 May 2008*

engineers, exercise specialists, medical experts in nutrition, radiation, psychology and physiotherapy, information technology experts and project managers, all focused on providing the best possible care for European astronaut health. The CMSO team is a significant contributing partner of the Integrated Medical Group (IMG) that comprises representatives from all five international partner agencies.

ESA astronauts will have more opportunities to participate in long-duration missions now that Columbus is an integrated part of ISS. Hence, the CMSO is constantly engaged to help optimize their health before a mission, reduce as much as possible the deleterious physiological effects of being in space during a mission, and maximise a rehabilitation and health programme after a mission to return the ESA astronaut back to optimal health as quickly as possible. CMSO works closely with both the US and Russian space agencies to combine efforts and use most effectively the resources to provide this support.

### Exploration

#### *Core Element*

In the European Aurora space exploration programme, the Core element is meant to 'define, implement, and where possible/ useful, demonstrate capabilities and/or technologies to support a European long-term plan for robotic and human exploration', whose ultimate goal is a human mission to Mars.

To prepare for this ultimate goal, ESA envisages a series of intermediate steps, similar to its international partners, such as technology developments and technology-driven precursor and exploration missions. ESA intends to make the Core programme a source of key technologies and capabilities that can support Europe's ambition for an enhanced role in the upcoming human exploration endeavours.

#### *CSTS*

The situation in the crew transportation field has evolved considerably in the last weeks. On the Russian side, the work under the Crew Space Transportation System (CSTS) Preparatory Programme has focused on the further definition of the concept selected for the crew transportation vehicle.

In the meantime, with the support of European industry involved in CSTS, ESA has evaluated alternative options for a crew transportation system based on the Ariane-5 launcher and a stepped approach, with the first element being a cargo return capability from the ISS.

A programme proposal for the development of a new crew transportation system is being prepared by ESA. The proposal would aim to establish a European level of autonomy in the strategic field of human access to space, while positioning Europe for a more effective cooperation with the international partners.

