Project and Study Scientist Reports for AWG # 128

05-04-2007

Report compiled, using inputs from Study and Project Scientists by Jean Clavel, head Astrophysics & Fundamental Physics Missions Division,

10 Satellites in orbit

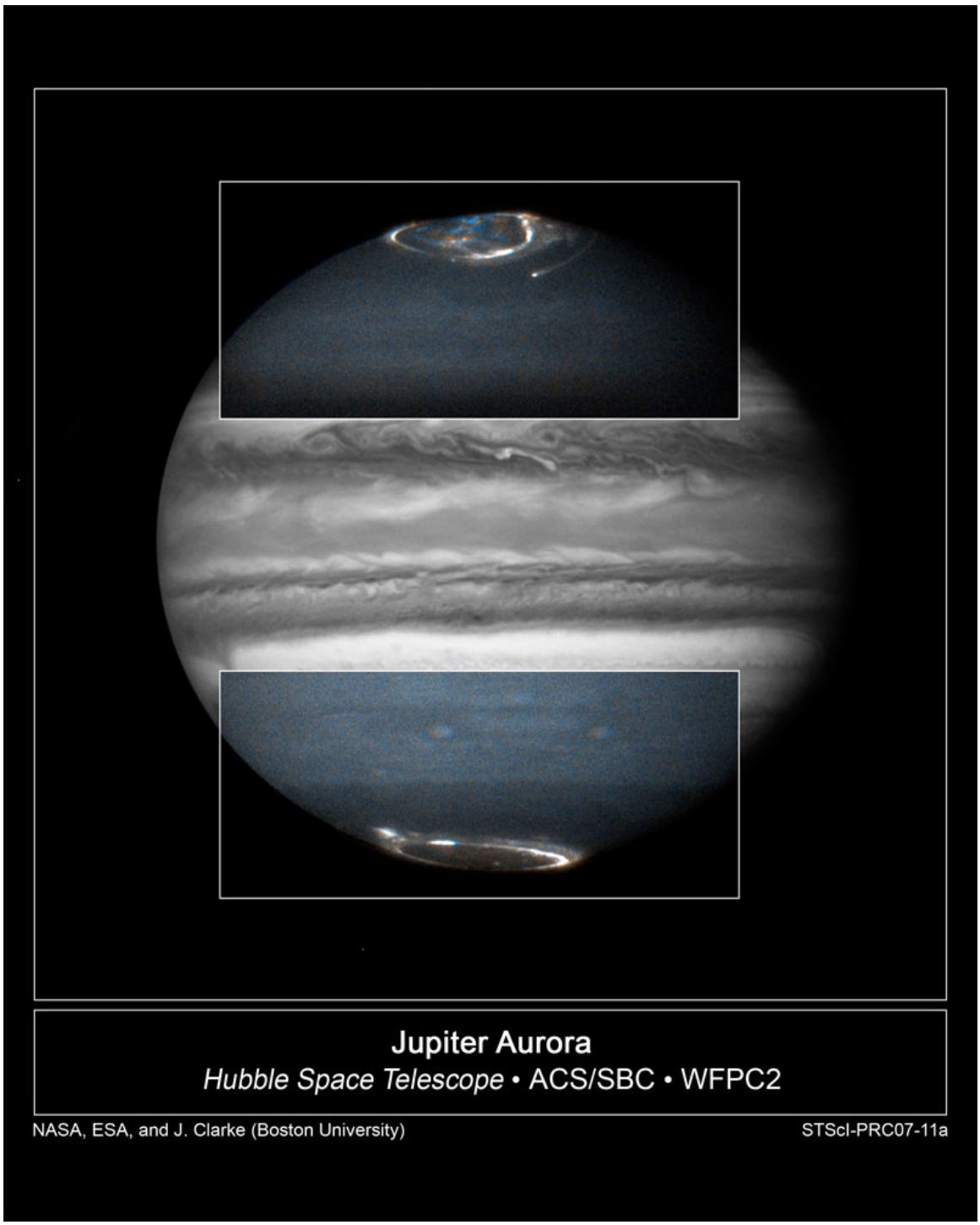
10.1 HST: Duccio Macchetto

HST entered inertial safe mode on Saturday, January 27, 2007, when a pressure sensor located in the section of the telescope that houses the science instruments detected a rise in pressure. At the same time, an electrical fuse blew up in the Advanced Camera for Surveys (ACS), probably as the result of a short circuit. An anomaly review board of engineers and scientists is still investigating the situation and will present its findings in April. The failure is severe and will preclude future ACS CCD observations with the Wide Field Channel and the High Resolution Channel. Following the partial loss of the ACS, the Project and the STScI worked very hard to restore the still available capabilities on that instrument. The Solar Blind Channel (UV) was brought back to full performance in time for the New Horizons' fly-by only two weeks later. Excellent scientific data were obtained. A team of STScI scientists reviewed about 120 currently active Cycle 14 and 15 ACS proposals. In a two-stage process, the goal was to ascertain, first, if a proposal could be converted to other science instruments, particularly WFPC2, from the technical point of view, and second, whether the science goals of the program could be achieved with the new configuration. This process was completed at the end of February, and a number of programs were recovered and are being implemented using WFPC2.

The formal Cycle 16 deadline occurred on Friday, January 26, the day before the ACS failure. A total of 747 proposals were received, including 498 to use ACS/WFC or ACS/HRC. Since the latter proposals were no longer viable and in order to ensure the accommodation of the science areas covered by those programs, the HST Cycle 16 deadline was extended to February 9. PIs who submitted proposals for ACS observations with either WFC or HRC were encouraged to consider whether those observations could be made with WFPC2. Contrary to expectations, the total number of new and revised proposals rose to over 850 and the request for observing time exceeds that available by a factor of 7! The HST TAC met during the week of March 19 and the results of their selection will be announced in mid April.

The manifest for Servicing Mission 4, currently planned for September 2008, includes two new instruments, the Wide-Field Camera 3 (WFC3) and the Cosmic Origins Spectrograph (COS), as well as several life-extending items such as gyroscopes and batteries. The astronauts will also attempt to repair the Space Telescope Imaging Spectrograph (STIS), which failed in August 2004. Work is under way to analyze possible scenarios for the partial repair of the ACS, however until the failure location and mechanisms are fully identified these plans are just preliminary and there is no strong expectation that they may even be feasible.

The HST spacecraft continues to operate nominally in the two-gyro mode; the STScI staff has succeed in minimizing the restrictions of this mode of operation and the efficiency rapidly returned to the earlier values (greater than 50%) when three gyros were being used.



Combined UV and visible-light images of Jupiter obtained by HST from February 17-21 in support of the New Horizons flyby of Jupiter on February 28. The image segments in the boxes were obtained using ACS ultraviolet camera. The UV images show auroral emissions that are always present in the polar regions of Jupiter. They are typically 10-100 times brighter than the aurorae seen on the Earth. The equatorial regions of Jupiter were imaged in blue light on February 17, 2007 with WFPC2. The atmosphere looks hazier in the ultraviolet because sunlight is reflected from higher layers

10.2 XMM-Newton: Norbert Schartel

The XMM-Newton observatory continues to operate nominally. As of March 22nd, the overall completion status of the AO-5 observing programme is 93.8 % for priority A & B

observations and 13.8 % for category C ("fillers"). Completion of the AO-5 programme is expected later in April, in line with the start of AO-6 observations on May 1.

The Principal Investigators of AO-6 proposals were informed about the OTAC decisions on 19th of December 2006. Phase-II submission of observing details by the PIs of successful proposals II was completed on February 9, as planned. In consultation with the OTAC chair, Prof. B. McBreen, the following AO-7 milestones were established:

- 28 August: announcement of opportunity;
- 5 October: due date for proposals;
- End December: publication of the OTAC selection

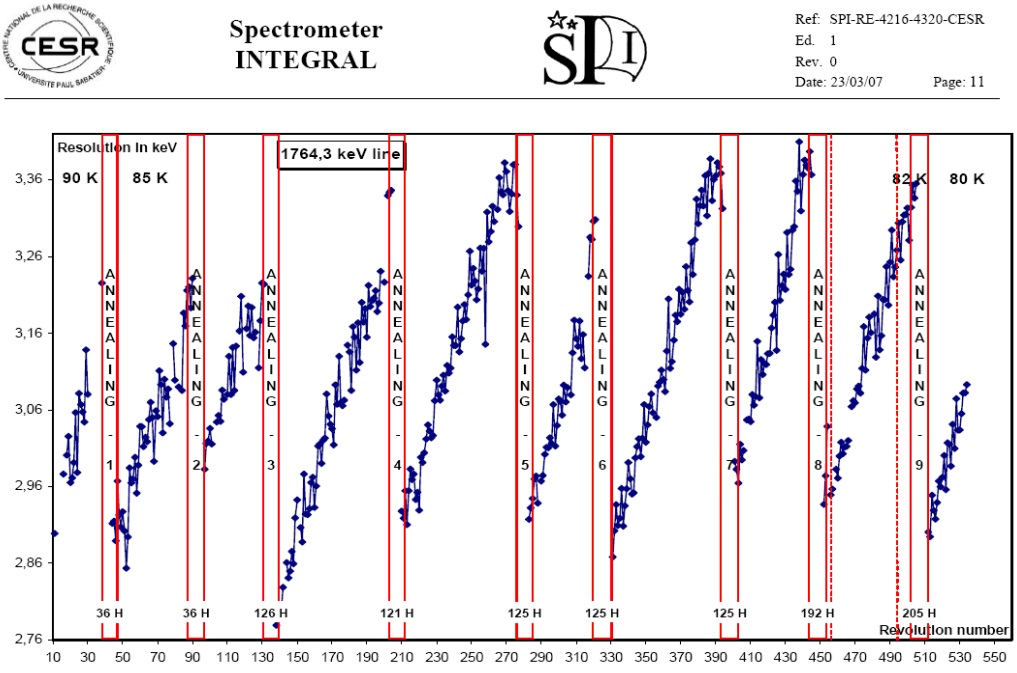
The community was informed accordingly. The Project Scientist has initiated the replacement of about one third of the allocation committee.

The first announcement of the workshop, "XMM-Newton: The Next Decade", to be held at ESAC next June 4-6, was issued on March 1. The Scientific Organising Committee, chaired by Dr. M. Arnaud (chairperson of the XMM-Newton Users Group), is currently finalizing the list of invited speakers.

Several Targets-of-Opportunity were observed during the reporting period, namely 4U 0142+61, CXOU J164710.2-45521, GX 339-4 (three times) and XTE J1856+053.The XMM-Newton Science Analysis System (SAS), version 7.0, has been downloaded 1340 times since its release in June 2006 and is used by about 2380 scientists worldwide. At the time of writing 1396 papers – either completely or partly based on XMM-Newton observations – have been published in the refereed literature, of which 55 are from 2007.

10.3 Integral: Christoph Winkler

INTEGRAL continues to operate nominally. The 9th SPI annealing (duration of 205 hours) was performed in December 2006. The recovery after annealing is good, better than after the last two annealings. The figure below shows the energy resolution at 1764.3 keV as a function of revolution number before and after all 9 annealing procedures since launch.



The INTEGRAL Mission Extended Operations Review is planned for 7/8 May 2007 with a board meeting on 22 May. One purpose of the Review is to identify scientifically acceptable cost saving measures in preparation for a possible extension of Integral operations beyond December 2010. Preparation of the science case has also started in view of submitting a mission extension request to the advisory structure in the fall of 2007.

The Announcement of Opportunity AO-5 for INTEGRAL open time observing proposals opened on 12 March with a due date of April 20. This AO also solicits proposals for data rights on sources in the Integral field-of-view of the four Key Programme observations selected by the TAC in December 2006. The TAC will meet in the week 28 May – 1 June and the result of their selection will be available in early June. The AO-5 observing cycle will start on August 16, 2007 and last 12 months.

A joint meeting of the Integral Users Group (IUG) and Integral Science Working Team (ISWT) took place on 28-29 March 2007. The ISWT will cease to exist after 2007 since the Core Programme (CP) AO-5 observations will have been completely defined and CP observations will cease completely in 2009. The IUG structure is being modified along the line of the XMM Users Group.

At the time of writing, four Target-of-Opportunity observations have been granted in 2007: the X-ray Nova GX339-4 (coordinated with XMM-Newton), the Anomalous X-ray Pulsar 4U 0142+61, the transient IGR J11215-5952 and SGR 1806-20. The observation of 4U 0142+61 was the fastest ever with less than 6 elapsed hours between reception of the request and the start of data acquisition.

The Integral archive at ESAC has been upgraded with a tool that allows easy visualization of long term light curves or spectra of sources in the INTEGRAL/IBIS catalogue.

A. Bird et al. have published the 3rd IBIS soft gamma-ray source catalogue (ApJS 2007, in press) which contains more than 400 sources detected in the 17-100 keV range and substantially increases the number of extragalactic objects. A. Bodaghee et al. (A&A in press, 2007) have collected parameters, such as positions, photoelectric absorption, periods, and distances for all ~500 sources detected by INTEGRAL until December 2006. The distribution of currently unidentified sources indicates that a large fraction of these are probably Galactic Low Mass X-Ray Binaries. The total number of INTEGRAL related publications in refereed journals since launch is 245, with 98 from 2006. Three additional ESA News Releases on INTEGRAL science already appeared in 2007.

On the occasion of the 5th launch anniversary, a workshop entitled “INTEGRAL – the first five years” will take place in Sardinia during the week 15-19 October 2007. The 7th INTEGRAL workshop focussing on compact Galactic objects is planned in the period 08-11 September 2008 in Copenhagen.

10.4 Suzaku (ASTRO-E2): Arvind Parmar

The Suzaku AO-2 closed on 1 December 2006. JAXA has kindly offered 8% of the total observing time to astronomers from institutes located in ESA Member States. The 39 European proposals were reviewed by the ESA appointed TAC and the ranked list of proposals forwarded to ISAS/JAXA for merging with the Japanese and U.S. programmes. Fortunately, there were no target conflicts and the European list was accepted unchanged. Details of the selected European proposals can be found at http://www.rssd.esa.int/Suzaku.

10.5 Akari (ASTRO-F): Alberto Salama

Akari remains healthy. A liquid Helium content measurement carried out on March 8 shows that the cryogen will not be exhausted before September 9, 2007. With 566 days, the mission lifetime therefore exceeds the 550 days expected before launch. The initial conservative time estimates were based on the assumption of a degradation of the cryo-coolers which has not been observed so far. On March 26, JAXA issued a press release on recent Akari results, with parallel announcements made by PPARC and ESA. These results were also presented at a press conference held during a meeting of the National Astronomical Society of Japan in Tokyo. Among other things, the results reported include the first infrared detection of a supernova remnant in the Small Magellanic Cloud, the detection of mass-loss from relatively young stars in the globular cluster NGC 104 and confirmation from deep survey data at 15 μm that star formation started early in the history of the Universe. A special issue of PASJ dedicated to Akari will appear this summer.

At the time of writing, 240 European Open Time (OT) observations have been executed successfully. At 11 %, the European return exceeds the 10% specified in the cooperation agreement. For comparison, the Japanese OT success rate is 17% (versus 20% in the agreement). Planning for the last mission phase 2c (8 May – 9 September 2007) has started. The archive repository at ISAS (and its mirror at ESAC) was opened to the observers on March 7. The archive includes a substantial ESAC contribution in the form of documentation and pipeline testing, well appreciated by our Japanese colleagues.

Version 2 of the Pointing Reconstruction software was released on January 24. It includes a correction for distortion of the IRC signals. Current work is now focusing on a statistical analysis of the alignment residuals (close to the input catalogues accuracies) and on the preparation of a sample IRC (mid IR) catalogue limited to a 2 square degrees region where 95 % of the sources are already identified.

10.6 CoRoT: Malcolm Fridlund

Because CoRoT's launch was nearly perfect, orbit correction manoeuvres could be skipped thereby saving a large amount of propellant. This will permit to extend operations by several years beyond the 2.5 years nominal duration of the mission. The verification phase went flawlessly, with no significant anomaly. Science operations could therefore start on February 2, two months earlier than planned. The first 60 days long observation focused on astroseismology. However, the adjacent exo-planetary field contains 6000 targets which are also being monitored. The amplitude of the pointing jitter is 60% smaller than specified. The quality of the data is impressive: even without jitter correction the noise level is already below the specifications ($7x10^{-4}$ in the exoplanets channel). The Point Spread Function is also better than expected and the photometric masks which have been uploaded are therefore slightly too large. When jitter corrections are applied and optimized masks are in use, the achievable accuracy will probably approach $1x10^{-4}$, which implies that planets as small as the Earth will become detectable.

The first observation was completed on April 2. The spacecraft was then re-pointed toward the galactic centre for a 26 days observation mainly dedicated to astroseismology. It will be followed by the first 150 days observation of an exoplanets field with ~12000 targets. Data from the first observations are being complemented with follow-up observations from the ground. No results will be announced prior to the April 20 meeting of the CoRoT Science Committee.

11 Projects under development

11.1 Herschel: Göran Pilbratt

The "refurbished" Herschel flight cryostat underwent a series of tests in the ESTEC Large Space Simulator (LSS) in January-February 2007. Initially there were problems with excessive heat-loads necessitating an unplanned warm-up, but after the second attempt the test campaign went relatively smoothly, and most test objectives could be achieved. Although test results are still being assessed and formally documented, it appears the lifetime specifications will be met with large margins. The cryostat has been shipped back to Astrium, Friedrichshafen, where a leak in the helium-I system (which caused the initial LSS problems) will be repaired, and the cryostat will be prepared for integration of the flight instruments.

A Qualification Review (QR) of the entire space segment (satellite) took place in February-March. The main concerns are the slow progress in the development of the on-board software and poor manufacturing of the solar arrays. The Ariane V launch shock levels for the telescope are also being looked at. The schedule remains geared toward a launch on July 31, 2008.

SPIRE was the first Herschel flight instrument to be delivered to ESA. PACS and HIFI are continuing their instrument level test (ILT) campaigns. During the first part of the PACS ILT internal alignment problems were discovered, which had to be corrected. About 20% of the spectrometer field-of-view remains however imperfectly illuminated but PACS will be flown as is. When the flight warm electronics (DECMEC) was finally delivered, problems with controlling the mechanisms (chopper, grating, filter wheel) were encountered which required additional time to fix. For HIFI, the broken isolators in local oscillator chains 3A and 7A had to be replaced. Additional screening confirmed that this was not a generic problem and it was therefore decided not to replace the remaining isolators. There is actually an excess of oscillator power in some frequency ranges, which will need addressing.

The Guaranteed Time (GT) Key Programme (KP) Announcement of Opportunity (AO) was released on February 1, as planned. Twenty-one proposals were received by the April 4 deadline, some involving consortia across instrument boundaries. The Herschel Observing Time Allocation Committee (HOTAC) is in place and will meet on 30-31 May. The selected KP GT programme will be published on July 5, at which point the call for Open Time proposals will be issued. The Herschel Science Centre (HSC), supported by the NASA HSC and the PI consortia, organised a successful workshop to assist the scientific community in preparing open time proposals. The workshop took place at ESTEC on 20-21 February and was attended by more than 250 scientists from all over the world. All material presented has been posted online; see links from the HSC website http://herschel.esac.esa.int/ under Conferences/Workshops.

11.2 Planck: Jan Tauber

The combined focal plane assembly has been integrated onto the Service Module. After evaluation of the telescope alignment it was decided to re-align the secondary reflector to optimise the image quality. The focal plane location is also being re-evaluated. Within a few weeks, the fully aligned telescope will be integrated onto the Service Module. Once assembled, the satellite will embark on a long series of tests culminating in early 2008 with

an end-to-end characterisation in simulated flight conditions in a specially-built chamber at the Centre Spatial de Liège (CSL).

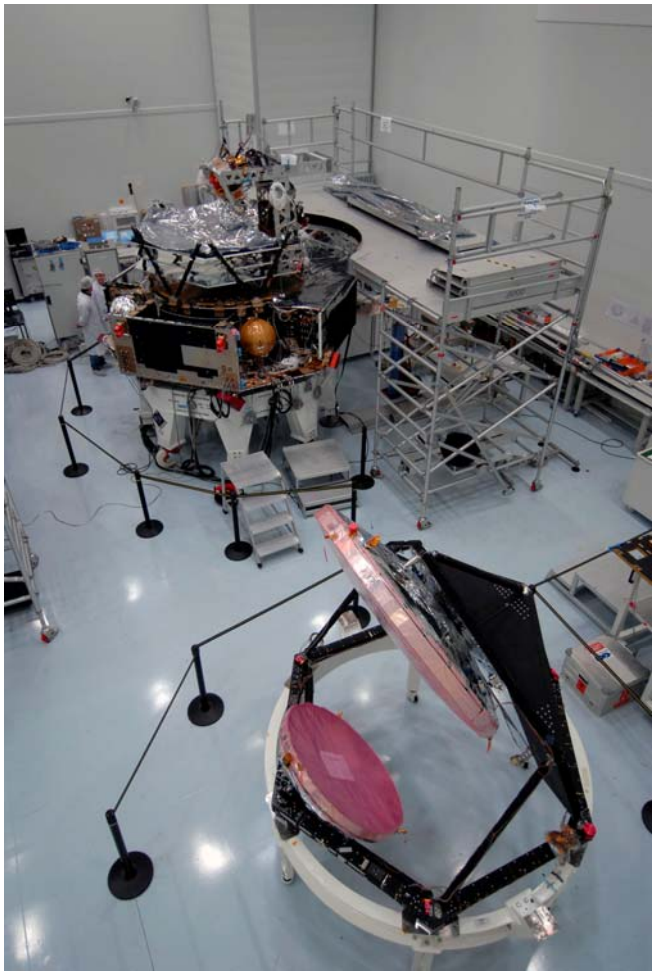


Figure caption: The Planck satellite, including the Service Module and the instrument units, is seen here in January 2007 in the clean room of Alcatel Alenia Space (France), ESA's prime contractor for Herschel and Planck. In the foreground the Planck telescope is visible, waiting for final alignment and assembly onto the satellite.

Post-facto evaluation of the data taken during the HFI calibration campaign revealed that many of the bolometers suffer from excessive low frequency response (i.e. long time constants). These needs to be characterised to avoid compromising the in-flight calibration. Intensive effort is underway to prepare for such a characterisation at the last possible opportunity, namely the satellite-level test at CSL in early 2008. There is still a question mark on the quantity of Helium that will be embarked on the satellite and therefore on the mission lifetime. Currently CNES has funded enough helium to allow one additional sky-survey on top of the two surveys in the nominal mission; the tank capacity would allow enough Helium for at least one additional survey, but this has not been funded yet.

As described above, the Herschel-Planck System-level Qualification Review (QR) flagged the problem with the late development of the on-board software and requested a delta-review. The QR also closely scrutinised the verification programme of the Planck Telescope. Due to the complexity of the alignment process and mirror characterisation several questions are still open and are being pursued actively. Though its final performances are not yet fully estimated, it can be anticipated that the telescope will meet the project specifications, but not the more ambitious goals. The main problem is that the pre-flight knowledge of that performance will not be as good as originally expected, and this will have an impact on the in-flight optical calibration. Investigations are now ongoing as to what extent this can be compensated by using in-flight retrieval techniques, probably requiring specific ground observation campaigns to provide calibrated celestial sources.

An Implementation Review of the Planck Science Ground Segment took place between November 2006 and March 2007. The Science Panel (chaired by Prof. Malcolm Longair) re-emphasized the strength of the scientific case for Planck. Because of a lack of documentation, the Board requested a delta-review toward the end of May, concentrating on the status of the HFI Data Processing Centre and some of the common LFI-HFI

infrastructures. No show-stoppers were otherwise identified. System-level end-to-end testing of the data-processing pipeline has started for LFI, but is lagging for HFI due to infrastructure issues.

As mandated by the Science Management Plan of Planck, the Core Programme of scientific exploitation activities which will be carried out by the PI Consortia during the proprietary period (equivalent to "guaranteed-time activities") must be established before launch. This includes also supporting observations with other ground or space facilities and in particular the preparation of Herschel Open Time Key Programmes by common Planck-Herschel teams. The process started on March 23 with the issue of a Call for Proposals internal to the Planck collaboration. It is planned that the programme and associated plan of activities will be established by the end of 2007.

A large press event was organised in January by ESA and Alcatel to present the (almost fully) assembled Planck satellite. The event was attended by George Smoot (2006 Nobel Prize in Physics and a Planck Co-Investigator) and attracted a lot of media attention.

11.3 JWST: Peter Jakobsen

Progress remains steady on the US side, although some recent budget issues have emerged and prompted NASA to revisit the planned system level testing involving the Structural Thermal Models of the instruments. The JWST launch date is reportedly still 2013. The technical issue of most concern remains the thermo-mechanical stability of the Telescope Backplane Structure and its potential schedule impact on the overall observatory integration. Fourteen Primary Mirror segments are currently undergoing grinding and polishing at Tinsley in California.

The JWST Technology Non-Advocate Review (T-NAR) was successfully held on 30-31 January at NASA GSFC. Nine out of the ten critical JWST technologies under review were confirmed to have reached a Technical Readiness Level 6 or higher. The dilatory technology was the MIRI Cryo-cooler, which, however, was deemed to be on track for reaching TRL-6 in time for the JWST Non-Advocate Review proper. The cooler has since then been demonstrated to be capable of yielding the required heat lift within the allocated power.

The NIRSpec Micro-Shutter Array (MSA) was also reviewed as part of the T-NAR process. At NASA's request, a White Paper providing a critical reassessment of the science impact of failed-open and failed-closed shutters were prepared by the NIRSpec Instrument Science Team in support of the T-NAR. In parallel, the NASA/GSFC MSA group made substantial progress in addressing the shutter stiction problem: the most recent array produced (#73) displays an order of magnitude fewer faulty shutters than previous units and is close to fulfilling the requirements. Life testing of the array continues as well as various experiments aimed at identifying and quantifying the environmental and use factors influencing the shutter failure rates.

On the European side, the procurement of NIRSpec is progressing steadily. All post-PDR (Preliminary Design Review) change requests to the grating and filter wheel mechanisms have been implemented by Zeiss and will be the subject of a delta-PDR on April 18. The Astrium designs for all SiC components (bench, optics, mounts) have been completed and released for manufacture.

The MIRI instrument is also progressing steadily. The Critical Design Review (CDR) of the Optical Bench Assembly was completed with the release of the Board report on 19 February. The CDR uncovered a number of items which were judged not to have the expected maturity level but actions are in place to resolve these shortfalls. The Board therefore concluded that the objectives of the CDR will have been met subject to the successful closure of all these actions. The MIRI subsystem of most concern is the Filter Wheel Assembly, which has encountered problems during vibration testing.

The plans for ESA's contributions to JWST operations presented at the last AWG meeting were approved by the Science Programme Committee at its February 5 meeting for a cost of 23.6 M€ . The SPC also approved a 40.3 M€ increase in the Cost-at-Completion of the ESA-supplied payload components to JWST. This cost increase reflects the impact of the JWST launch delay introduced by NASA during its 2005 re-plan exercise, higher than anticipated NIRSpec industrial costs, and an increase in the ESA-held contingency for MIRI.

11.4 GAIA: Timo Prusti

The procurement of Gaia subsystems is almost complete. Most subsystems have already passed their respective Preliminary Design Review (PDR). The system and payload PDR will start at the end of April and run until the end of June. The Gaia Science Team (GST) is deeply involved in the PDR. GST members who already participated in earlier Gaia reviews are formal members of the payload review panel. The next GST meeting in mid-May will be dedicated to PDR topics to ensure that the design will allow Gaia to achieve its scientific objectives.

The current GST will remain in post till completion of the PDR after which it must be renewed, as mandated by the Science Management Plan (SMP). An announcement of opportunity for GST membership was therefore issued in early March with a deadline of April 4. The AWG is expected to select the members of the new science Team and recommend their appointment. The new GST needs to be in post in September 2007.

At its January meeting, the AWG reviewed the single proposal received in response to the announcement of opportunity for the processing of Gaia data. They drafted a list of 71 questions and queries which the potential Data Processing and Analysis Consortium (DPAC) need to address before their proposal can be recommended for approval. Various discussions have taken place since then between ESA, the DPAC and their funding authorities in order to arrive at a satisfactory solution. The AWG is expected to assess the updated DPAC proposal and hopefully, recommend its approval. Negotiations of the Multi-Lateral Agreement (MLA) between ESA and the DPAC national funding authorities have also progressed satisfactorily with a view of submitting the MLA to the SPC for approval at its November 2007 meeting.

CCD radiation damage and its impact on the overall performance of Gaia remain the main concern. The risk can be mitigated to some extent by design of the spacecraft (e.g. additional shielding, flashing of the CCD …) but the problem will not go away. The radiation damage induced PSF degradation can potentially be corrected for during the processing of the data provided the effect can be modelled to a sufficient level of accuracy. This is the purpose of the intensive CCD irradiation test campaign currently in progress at Astrium with support from the GST. A large amount of data has already been acquired which now needs to be digested and integrated into a physical model of the CCD.

12 Ongoing Studies

12.1 IRSI-Darwin

All Darwin related activities have been put on hold pending confirmation of the mission via the Cosmic Vision Proposals selection process.

12.2 XEUS

All XEUS related activities have been put on hold pending confirmation of the mission via the Cosmic Vision Proposals selection process.

12.3 Lobster and eROSITA: Arvind Parmar

Though studies of these 2 missions have been completed and the missions have not been selected for implementation, the AWG is herewith provided with information concerning their current status outside of ESA.

On March 26, DLR and Roskosmos signed a Memorandum of Understanding (MoU) in which DLR provides the eRosita instrument for integration on a Roskosmos built Navigator platform and launch on a Soyuz 2 rocket from Baikonur in 2011 as “Spectrum X-Gamma” (SRG). The situation with the rest of the payload (Lobster, the Russian provided ART-XC hard X-ray telescope, and possibly a calorimeter) is less clear. Leicester University plans to submit a Statement of Interest pertaining to Lobster primarily to the STFC (the successor to PPARC) shortly. A 2011 launch appears difficult to achieve given that 3 other missions have to use the Navigator platform before SRG.