

ASTRO(2006)6
Att: Astro(2006)7
Astro(2006)8
Astro(2006)5
Annex
Paris, 30th June 2006

EUROPEAN SPACE AGENCY
ASTRONOMY WORKING GROUP

REPORT of 125th Meeting

held on 6-7 April 2006

at ESTEC, Noordwijk (NL)

Those present:

**Members of the
Working Group:**

C. Turon (Chair)
D. Barret
A. Bazzano
H. Böhringer
J. Martin-Pintado
G. Micela
A. Quirrenbach
G. Rauw
P. Schneider (only 6/4)
M. Tornikoski
R. Waters (only 6/4)
D.M. Worrall
W. Zeilinger

(not attended: P. Ferreira, S. Lilly, and S. Hannestad)

ESA: Jean Clavel (Executive Secretary per interim)
Fabio Favata, Martin Kessler,
and other members of the Executive

Apologies for non-attendance had been received from P. Ferreira and S. Lilly.

The AWG Chairperson, Catherine Turon, and the Executive secretary per interim, Jean Clavel, introduced Fabio Favata who will be the new Executive secretary for AWG as of the next (126th) AWG meeting.

1. Adoption of Agenda (ASTRO(2006)5, rev.1)

The Agenda was adopted with some changes in the order of items to take into account the availability of the Project Scientists. However, this report is structured in the order of the original Agenda.

2. Approval of report of 124th Meeting (ASTRO(2006)4)

The minutes of the 124th AWG meeting were approved.

3. Science Programme status & Call for Cosmic Vision Proposals

The Executive secretary, J. Clavel, presented the status of the ESA Science Programme, recalling the financial and programmatic situation and the recommendations made in January 2006 by the working groups and SSAC and the subsequent decisions taken by the SPC at its 8-9 February 2006 meeting.

J. Clavel then went on to present the current plan from the Executive for implementing the Call for Cosmic Vision Mission proposals and showed the tentative schedules for the Call for Proposals (Call release: 22 May 2006, Working Groups selection of missions for study phases: October 2006) and for the development of Small-Medium missions and Large Missions (respective launches by mid-end 2016 and not earlier than 2020).

He also presented some recent developments at NASA concerning astrophysics, which may impact on the ESA Science Programme.

Finally, he briefly described the establishment, purpose and schedule of the Science Programme Review Team.

The AWG was very concerned with the tight schedule for the upcoming Call for Missions, in particular with the relatively short time available to the AWG to perform a proper evaluation of the expected large number of proposals. The AWG recommended that ample time is allocated for evaluation by the working groups (*see recommendation ASTRO(2006)7, attached*). It tentatively agreed to hold a special meeting next November 15 & 16 dedicated to a preliminary review of the proposals and the establishment of a short list of the best ones for further evaluation and ranking.

4. GAIA Science Management Plan

J. Clavel introduced the draft GAIA Science Management Plan (SMP) submitted to the AWG for their review and possible endorsement. The AWG recommended approval of the SMP by the SPC pending on the implementation of the following two modifications 1) it must be clarified that the scientific responsibility for the processing of GAIA data is delegated by the head of the Research & Scientific Support Department to the GAIA Project Scientist, 2) a better description of the different types of data products expected from the GAIA mission must be provided (*see recommendation ASTRO(2006)8 attached*).

5. Satellites in orbit

5.1 HST

5.2 ISO post-operations

5.3 XMM-Newton

M. Kessler briefly introduced the report on missions in orbit and explained that A. Parmar would replace F. Jansen as XMM Mission Manager. The AWG was requested, by their next meeting, to provide suggestions for membership in the XMM User Committee, the plan being to establish a pool of 5 names from which future members could be selected by the executive. The AWG raised the issue of rotation among Mission Scientists. The question will be addressed at the next meeting of the User Committee, and the outcome will be reported at the September 2006 meeting of the AWG.

5.4 INTEGRAL – Presentation by Project Scientist

The Integral Project Scientist, C. Winkler, presented the status of the INTEGRAL mission, and the results of the recent measurement of the diffuse cosmic high-energy background using the Earth occultation technique. The AWG expressed its satisfaction with this original observation and with the significant number of recent press releases highlighting scientific results obtained with INTEGRAL.

5.5 Suzaku (ASTRO-E2)

The ESA Suzaku Project Scientist, A. Parmar, presented the results from the selection process following the AO for European observing time on Suzaku.

5.6 Akari (ASTRO-F)

An update on the status of ASTRO-F (renamed Akari) was provided by M. Kessler. Ejection of the cryo-lid has been delayed due to the failure of star tracker units and the need to update the attitude control law to cope with this net loss of redundancy. Since the lid is warm, helium boils-off at a rate higher than planned. This will ultimately reduce the lifetime of the mission by a few months, thereby requiring a reorientation and prioritisation of the currently approved observing programme.

6. Projects under development

6.1 Herschel

The Herschel Project Scientist, G. Pilbratt, presented the current status of the Herschel project. He informed the AWG that A. Natta had accepted the appointment as Chair of the Herschel Time Allocation Committee, as previously recommended by the AWG. In view of the many problems revealed by the on-going test campaigns, especially the discovery of “extra heat-loads” impacting on the lifetime of the mission, and the unforeseen large shift in telescope focus position between warm and cold conditions, the AWG re-emphasized, in the context of Herschel, the importance of extensive testing and characterisation of the payload at system and instrument level prior to flight.

6.2 Planck

The Planck Project Scientist, J. Tauber, presented the status of the Planck project. The AWG acknowledged that significant progress was achieved over the last year in many areas, but noted that a number of technical and programmatic issues still await resolution, especially the cryogenic test of the integrated telescope and the determination of the best focus location at operational temperatures.

6.3 JWST

The JWST Project Scientist, P. Jakobsen, reported on the status of JWST, emphasizing that the recent budgetary crisis and re-scoping of the mission by NASA had no impact on the European NIRSpec and MIRI instruments. The launch of JWST was however postponed to 2013, which only has limited impact on ESA since the delivery dates of NIRSpec and MIRI remain in 2010. He reported that the US State Department had recently approved the launch of JWST by an Ariane V rocket.

6.4 GAIA

The AWG Chair welcomed F. Jansen, who took over the function of GAIA Project Scientist as of April 1st, following the resignation of M. Perryman. The AWG also welcomed the deputy Project Scientist, J. de Bruijn and the GAIA Payload Manager, G. Sarri.

G. Sarri presented the current GAIA design which resulted from the competitive selection in early 2006 of EADS Astrium as Prime Contractor. He emphasized issues related to the compliance of the EADS design with the scientific requirements as well as the on-going payload optimisation process which is done in close consultation with the GAIA Science Team. Three issues in particular are the subject of extensive studies: (1) the radiation induced CCD degradation and its impact on all three instruments (astrometric, photometric and spectroscopic), (2) the Low Light Level “L3” CCD option for the Radial Velocity Spectrometer (RVS), and (3) the RVS optimisation. G. Sarri informed the AWG that the results from the upcoming CCD irradiation tests as well as the RVS design optimisation studies will be presented at the System Requirements Review which will be completed in July 2006.

J. de Bruijn presented the scientific status of GAIA, concentrating on a scientific

assessment of the performance of the current EADS design.

6.5 Corot

The ESA Corot Project Scientist, F. Favata, summarised the benefit for ESA member state scientists of ESA's participation to the CNES-led Corot mission.

7. Future Mission Studies

7.1 IRSI-Darwin

J. Clavel reported on the status of Darwin. For their next meeting, the AWG requested a detailed briefing of the possible performance problems induced by temporal variations of the stellar light leakage in the interferometric null which mimic a planetary signal.

7.2 XEUS

The study scientist, A. Parmar, presented the current status, ongoing studies and technological developments of the XEUS project, explaining the plans of the scientific community to submit a proposal for a large collecting area X-ray mission in response to the upcoming Cosmic Vision Call for Mission proposals.

7.3 Lobster, e-Rosita

A. Parmar went on to describe recent developments regarding the Rosita and Lobster payloads on Spectrum-RG, and the anticipated DLR request for ESA funding through the 2006 annual call for Nationally Led Projects.

8. Any other matter

There were no further matters to discuss.

9. Date and place of next meeting

The next (126th) meeting of the AWG was confirmed to take place on 28-29 September 2006 at ESA Headquarters.

In the context of the upcoming Call for mission proposals, it was proposed to reserve the 15 and 16 November in case a special meeting would be required for a preliminary evaluation of the astrophysics mission proposals resulting from the pending Call. Further iteration will be needed by e-mail when the actual schedule for the Call is known precisely.

EUROPEAN SPACE AGENCY

ASTRONOMY WORKING GROUP

Recommendation on the schedule of the Call for Cosmic Vision Proposals
and the evaluation of the proposals

At its 125th meeting held on 6-7 April 2006 at ESTEC, Noordwijk (NL), the Astronomy Working Group (AWG) was presented with the Executive's Plan for implementing the Call for Mission Proposals within the frame of Cosmic Vision 2015-25. The Plan will be submitted to the SPC for approval at its meeting in May 2006.

The AWG strongly supports the timely release of the Announcement of Opportunity, and anticipates a large and enthusiastic response from the scientific community. Mindful of this, the AWG wishes to ensure that ESA and its advisory structure have sufficient time for a thorough review of the proposals before sound recommendations can be presented to the SPC.

The AWG discussed the best ways to guarantee a fair and efficient evaluation of the proposals.

The AWG recommends a two-stage process:

- in a first step, to draw up a short list of the best proposals at a special meeting of the AWG, roughly midway through the review process;
- in a second step, to invite the PIs of the short-listed proposals to present and discuss their proposal with the AWG.

The AWG therefore strongly recommends that a period of at least three months is allocated to the overall process.

ASTRO(2006)8
Paris, 19th April 2006

EUROPEAN SPACE AGENCY

ASTRONOMY WORKING GROUP

Recommendation on the Science Management Plan of Gaia

The draft of the Science Management Plan of Gaia was presented to the Astronomy Working Group (AWG) at its 125th meeting held at ESTEC on 6-7 April 2006.

The AWG recommends approval of the SMP, with the following minor modifications:

- Page 6, paragraph 2, insert a sentence specifying that the head of the Research and Scientific Support Department delegates the scientific responsibility of the data processing to the Gaia Project Scientist.
- Provide a better description of the science data products of the mission that will be offered to the community.

EUROPEAN SPACE AGENCY

ASTRONOMY WORKING GROUP

125th Meeting

to be held on

6-7 APRIL 2006

*(commencing at **14.00 hrs on the 6th** and foreseen to end at 13.00 hrs on the 7th)*

at **ESTEC, Noordwijk (NL)**, Keplerlaan 1
(Room “Fresnel” 1 & 2)

Draft AGENDA

1. Adoption of Agenda (ASTRO(2006)5, rev.2)
2. Approval of report of 124th Meeting (ASTRO(2006)4)
3. Science Programme status & Call for Cosmic Vision Proposals
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 - 5.3 XMM-Newton
 - 5.4 INTEGRAL – Presentation by Project Scientist
 - 5.4.1 Earth occultation observation of γ -ray background
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 - 6.1.2 Expected Mission Performances
 - 6.1.3 Status of Herschel Time Allocation Committee
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- 6.3 JWST
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- 7. Future Mission Studies
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 - 7.3 Lobster, e-Rosita
- 8. Any other matter
- 9. Date and place of next meeting

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ANNEX

Project and Study Scientist Reports for AWG # 125

26-03-2006

Report compiled, using inputs from Study and Project Scientists by:

- Jean Clavel, Astrophysics & Fundamental Physics Missions Division,
- Martin Kessler, Science Operations & Data Systems Division.

5 Satellites in orbit

5.1 HST: Duccio Macchetto

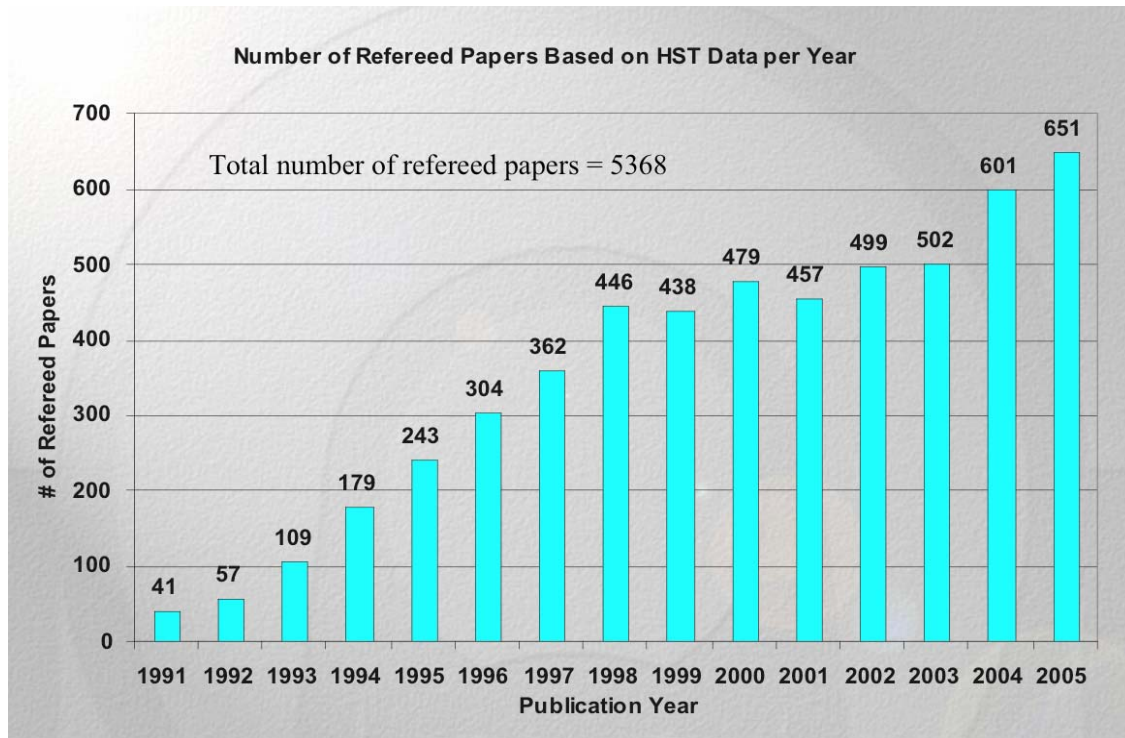
From the operational point of view, the Hubble spacecraft is operating nominally. All science instruments of Hubble – with the exception of STIS – are delivering data that will continue to advance our knowledge of the universe.

To extend the expected scientific lifetime of HST, preparations were made over the last year to switch off one of the gyros and operate in a two-gyro configuration. Since the switch to two-gyro mode in late August 2005, operations have continued successfully and without any problems. Operational trending began immediately to evaluate the new mode and identify potential areas for improvement. A trending meeting in October identified several opportunities for efficiency improvements, which were quickly implemented. With the two-gyro mode operating well, work shifted to evaluating the potential for a one-gyro mode of operations. An initial study by pointing control engineers confirmed the feasibility of the mode, and work began in earnest to define the operational concept and requirements. A successful concept, requirements, and preliminary design review was held for one-gyro mode in November and the various teams began moving forward on detailed design activities for implementing this contingency mode.

Plans for a servicing mission to Hubble using the space shuttle continue; however the final decision on whether to actually fly the mission will only be made after a successful second flight of the shuttle after the Columbia accident, now expected for early spring of 2006. The manifest for this Servicing Mission 4, planned for late 2007 now includes two new instruments, the Wide-Field Camera 3 (WFC3) and the Cosmic Origins Spectrograph (COS), as well as many life-extending items such as gyroscopes and batteries. A repair of the Space Telescope Imaging Spectrograph (STIS) – the instrument failed in August 2004 – may also be attempted by the astronauts. A de-orbit module and the Aft-Shroud Cooling System are no longer part of the plans for this servicing mission, due to general consensus that they are not needed at all (cooling system), or at least not until 2020 (de-orbit module).

Following the recommendations of AWG and SSAC, the SPC and later the ESA Council have approved the extension of the NASA/ESA MOU until 2010.

A series of HST images obtained between February 2 and March 15, 2006 shows the motion of the 2 newly discovered satellites of Pluto. While S/2005 P2 moved counter clockwise from the noon position to the 5 o'clock position, S/2005 P1 moved counter clockwise from the 1 o'clock to the 7 o'clock position. During that same period, Pluto's much larger and closer moon, Charon, made more than 2 complete counter clockwise revolutions around Pluto, starting at 2 o'clock and ending near the 10 o'clock position. The motions of P1 and P2 are in excellent agreement with predictions based on earlier Hubble observations and confirm that



the 2 satellites orbit in the same plane as Charon, as expected if all three moons had been created during a single, giant impact.

The annual number of published papers based on *Hubble* data continued to increase significantly during the past year. The number of publications reached a value of 651 for 2005, with the current total approaching 5400 refereed papers.

5.2 Infrared Space Observatory (ISO) active archive phase: Alberto Salama

Version 9.1 of the ISO Data Archive (IDA) was released on 15 March. It includes an automatic query to other archives via the object coordinates and interoperability with the XMM-Newton and INTEGRAL archives. Also included is VOSpec, a tool developed at ESAC to display spectra from ISO and other VO-compliant archives. Two new Highly Processed Data Sets have been ingested as default products in IDA. A first version of the ISO Astrophysical Spectroscopic Database has been released in CDS/Vizier. It contains extensive information (currently over 3000 entries) gathered from the literature for a number of spectral lines.

ISO continues to have a significant presence in the literature, with over 1330 refereed papers published to date. Recent highlights include the discovery of two very cold and massive molecular cloud cores in the region ISOSS J18364-0221 from the 170 micron ISOPHOT Serendipity Survey (ISOSS), obtained from follow-up sub-millimetre continuum and molecular line measurement.. The first core, at a temperature of 16.5 K, is considered a genuine high-mass protostar and a high-mass analogue to the Class 0 objects. The second core has average gas and dust temperature of only ~ 12 K and a mass of $M \sim 280 M_{\odot}$. Its temperature and level of turbulence are below the values found for massive cores so far and are suggested to represent initial conditions from which high-mass star formation occurs. (Birkmann et al, ApJ, 637, 380).

5.3 XMM-Newton: Norbert Schartel

As of 21 March 2006, the overall completion status of the observing programme is as follows:

- AO-3 programme: 99.7 %
- AO-4 programme: 89.5 % (A and B priority)
- AO-4 programme: 14.4 % (C priority)

Completion of the above programmes is expected by April 2006, in line with the planned start of AO-5 observations.

Several Targets-of-Opportunity were observed, namely V504 Cen, GRB060218, RS Oph (observed twice, one further observation is approved), XTE J1817-330 and Nova SMC 2005.

The Principal Investigators of AO-5 proposals were informed of the OTAC decisions on 10 January 2006. Phase II submission (definition of the observation details) was finished by the PIs of successful proposals by 17 February. The whole process ran very smoothly. Regular observation of AO-5 targets will start on 1 May 2006.

The timeline for XMM-Newton AO-6 was established by the SOC in coordination with the PS and the OTAC chairperson, Prof. B. McBreen. The closing date will be 6 October and the chairpersons' meeting is planned for 30 November and 1 December 2006.

A Scientific Workshop at ESAC with the title "Variable and broad iron lines around black holes" is planned by the XMM-Newton SOC for 26 – 28 June 2006. Prof. A. Fabian agreed to chair the scientific organising committee and has, in coordination with the Project Scientist, established the Scientific Organizing Committee.

The AWG is kindly asked to suggest candidates for future replacements of (voting) User Group (UG) members. It is planned to establish a cycle such that each year one (voting) UG member is rotated. It would be most efficient to have a pool of candidates such that, each time, the geographical and the scientific distributions can be optimised. Since the replacement of Prof. J. Schmitt, there is no member from a German institute regularly attending the UG meetings. Details about the current voting (rotating) and not-voting (permanent) UG members can be found at:

http://xmm.vilspa.esa.es/external/xmm_user_support/usersgroup/members/index.shtml

In January XMM-Newton celebrated its 1000th refereed paper with an ESA science and technology news release. In total, 1070 papers – either completely or partly based on XMM-Newton observations – had been published in the refereed literature by 21 March. Of these, 286 were published in 2005 and 65 so far in 2006.

5.4 Integral: Christoph Winkler & Peter Kretschmar

INTEGRAL operations continue smoothly with the spacecraft, instruments and ground segment performing nominally. The successful 7th SPI annealing took place from 9-24 January. During this time interval, a Target of Opportunity (ToO) observation of 3C279 was scheduled among other observations. Directly after the annealing period, INTEGRAL undertook a series of four special observations using the Earth as an occulting device in order to study the cosmic diffuse high-energy background. A publication is in preparation. Further ToO observations were carried-out in February and March for the new BHC XTE J1817-330.

As we are approaching the solar minimum, a slow increase of the instrumental background counting rates is observed. Work is in progress to re-allocate telemetry between the different instruments and observing modes in order to preserve the core scientific capabilities.

The INTEGRAL AO-4 was opened on 13 March with a proposal deadline of 21 April. It contains a prototype Key Programme with 2 Ms to be spent on the Galactic Centre region. For AO-5, the community will be invited to submit ideas for Key Programmes in a special AO in autumn 2005.

The number of refereed/non-refereed scientific publications over the period 01 December 2002 to end January 2006 is 146/329, respectively; with the figures for 2005 being 77/71. Since the last report, 9 Astronomer's Telegrams have been issued by INTEGRAL.

The findings of Diehl et al. on the ^{26}Al line emission in the inner Galaxy and their determination of the core-collapse SN rate (Diehl et al., Nature 439, 45, 2006) has found a world-wide echo in the media, including in general news sources.

Pian et al. (A&A 449,L21, 2006) report on INTEGRAL observations of a dramatic outburst of the blazar 3C 454.3 indicating inverse Compton scattering external to the broad line region.

A hard tail up to 100 keV in the persistent emission from SGR 1900+14 has been detected by Götz et al. (A&A 449,L31, 2006) in the quiescent state of the source without bursts. A comparison with AXP spectra indicates different spectral behaviour between AXPs and SGR's, both types believed to be magnetars.

Kuiper et al. (ApJ in press, 2006) have studied four AXP's combining INTEGRAL & RXTE data. They find exceptionally hard total emission and hard pulsed emission above 10 keV, exceeding spin-down power by a few orders of magnitude, and supporting the magnetar interpretation for AXPs but requiring a new mechanism for particle acceleration in the magnetospheres.

5.5 Suzaku (ASTRO-E2): Arvind Parmar

The ESA AO for observing time on the Japanese-US X-ray astronomy mission Suzaku (formally Astro-E2) closed on 2006 January 6. The AO covers one year of observations and JAXA have kindly offered to allocate 8% of the observing time to successful proposals from scientists in ESA Member States. A total of 52 proposals were received corresponding to an over-subscription in time of 6.4. These have been reviewed by the ESA appointed TAC and the ranked list of top proposals forwarded to JAXA. Following merging with the Japanese and US proposals the final results are expected around the time of the AWG meeting.

5.6 Akari (ASTRO-F): Alberto Salama & Martin Kessler

ASTRO-F was successfully launched on 21 February 2006 at 21:28 UT from the Uchinoura Space Centre by JAXA's M-V-8 rocket and renamed Akari (meaning "light"). Generally, the performance and health of the satellite is good. However, two Sun sensors are not operational. With this configuration, the survey and pointed observations are possible with star trackers, but there is no safe contingency configuration. Thus, the on-board attitude software needs to be updated. Jettisoning of the cryostat lid has therefore been postponed to mid April at the latest. This delay, combined with an increased heat load (due to the lid being still on), will result in a shortening of the effective mission cryogenic lifetime by up to a few months. Initial testing with the two focal plane instruments showed no anomalies. The ESA Kiruna antenna has successfully tracked Akari for a number of passes, with both S-and X-band signals being acquired. Data were recorded and successfully retrieved and processed by JAXA/ISAS, thus validating the end-to-end telemetry data flow.

The successful proposals resulting from the parallel Japanese and European peer reviews have been merged with no major conflicts. However, the whole observing programme strategy is being revised due to the shorter cryogen lifetime. The pointing reconstruction software version 1.0 has been released at ESAC and is awaiting satellite data for further optimisation.

6 Projects under development

6.1 Herschel: Göran Pilbratt

The Herschel Proto-Flight Model (PFM) satellite in Structural & Thermal Model (STM) configuration has undergone mechanical verification in the ESTEC Test Centre. The flight cryostat is currently being prepared for shipment back to EADS Astrium in Friedrichshafen. In EADS the cryostat will have to be “refurbished”, eliminating the “extra heat-loads” that were discovered during the Thermal Balance/Thermal Vacuum (TB/TV) tests in the Large Space Simulator, in order to fulfil the lifetime requirement. The ad-hoc ‘Tiger Team’ formed to address this issue has completed its work, and has identified a number of necessary “repairs”. When the repairs have been completed, the lifetime requirement will need to be verified; the details of this verification are under discussion, the most important issue being whether an additional TB/TV test is required or not, and where it would take place.

The series of special meetings between the ESA executive, the Herschel and Planck PIs and representatives from their funding agencies is continuing; the 4th such meeting was held at ESTEC on 6 March 2006. It was stated that the measures implemented to stabilise the instrument flight model schedules are effective, but also that there still are severe technical problems that could potentially affect their delivery dates. A recently discovered problem is that the “black paint” inside the PACS FM Focal Plane Unit (FPU) is delaminating. As a consequence, it has been decided to fly the Cryogenic Qualification Model (CQM) FPU structure instead of the FM unit. The currently predicted Herschel FM instrument delivery dates are in the range September to December 2006.

The Herschel FM telescope has been measured in warm conditions as well as during a total of six cryogenic cycles in CSL, Liège. The unforeseen large shift in telescope focus position between warm and cold conditions that was reported last time was confirmed. It is stable from cycle to cycle within the measurement uncertainties and is therefore considered not to be a problem. It is currently attributed to differential thermal expansion effects. Laboratory measurements at sample level are being conducted to verify this hypothesis.

The Engineering Qualification Model (EQM - Herschel focal plane ‘simulator’ using refurbished ISO equipment with instrument CQM FPUs) campaign in EADS-Astrium, Ottobrunn has been completed and the CQM instruments have been returned to the instrument teams. The most important results from this campaign concern the unacceptable straylight environment and Electro-Magnetic Compatibility (EMC) problems which could affect the in-orbit performances of PACS and even more so SPIRE. Both of these problems are being addressed. In addition to further modelling, one also investigates the feasibility of actually measuring the stray-light in the flight-model cryostat during the cooldown sequence of the lifetime verification test, using the SPIRE CQM as a detector.

At the March 6 meeting (see above), it was stated that the earliest possible launch date of Herschel & Planck is February 2008 and that all parties should work toward that goal.

6.2 Planck: Jan Tauber

LFI detector-chain-level testing is completed at 70 GHz and progressing at 30 and 44 GHz. The integration of the flight instrument has started with the available detector chains. Cryogenic testing of the complete flight instrument should start around early May. Delivery is currently expected somewhere between mid-July and mid-August, depending on the ability to work multiple shifts during test and calibration campaigns. A number of technical issues remain under investigation which could have some impact on performances or schedule.

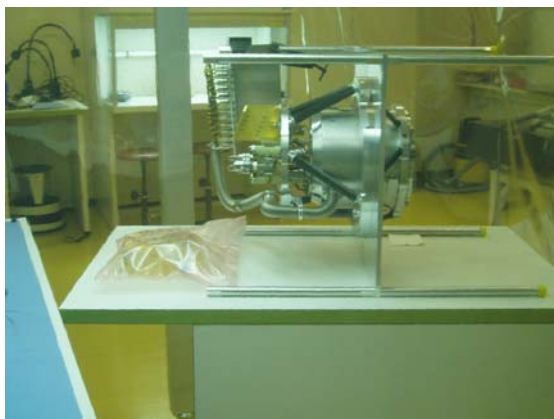
The HFI flight detectors have been integrated into the focal plane. The focal plane has now started its cryogenic characterisation phase, to be followed by environmental tests, and then final cryogenic calibration. The current delivery date of the flight focal plane to ESA is now expected end of June; most of the warm units would be delivered in mid-July. The problem with the 4K cooler electronics has been solved technically and a development and test plan exists.

Cryogenic videogrammetry of the Planck flight reflectors has been completed. Technically these measurements have been very successful. The data is still being reduced to ascertain how well these measurements can constrain the large- and medium- scale surface errors which determine a large fraction of the power non-ideally scattered by the telescope. Cryogenic videogrammetry of the complete telescope will take place in June at ESTEC.

The Radio-Frequency Qualification Model (which consists of the QM telescope and associated structures) is being measured at operational frequencies in a Compact Antenna Test Range at Alcatel. These tests will validate the physical optics model to be used for optical flight predictions.

A model of the satellite (“PFM1”) is now being prepared for cryogenic tests in Liège, which includes the flight Service Module and both flight sorption coolers. It will validate the operation and partly the performance of the sorption cooler in flight.

Development of the Ground Segment is advancing. The focus is now on establishing test plans at system and element levels. End-to-end tests for the scientific pipelines in the Data Processing Centres are also being planned. The next major review of the Science Ground Segment is planned in November 2006.



(left) The HFI flight model focal plane during integration; and (right) preparing the cryogenic test chamber.



(left) The Radio Frequency Qualification Model of Planck being tested in the CATR at Alcatel; and (right) the PFM1 model before shipment to the Centre Spatial de Liège.

6.3 JWST: Peter Jakobsen

Although it is still early in the US budget cycle, NASA's proposed FY2007 budget has caused some consternation in the US science community since ~2G\$ has been moved from the NASA science budget to pay for manned spaceflight activities. JWST, however, is marked to receive ~443 M\$, a number close to that originally requested for a 2013 launch.

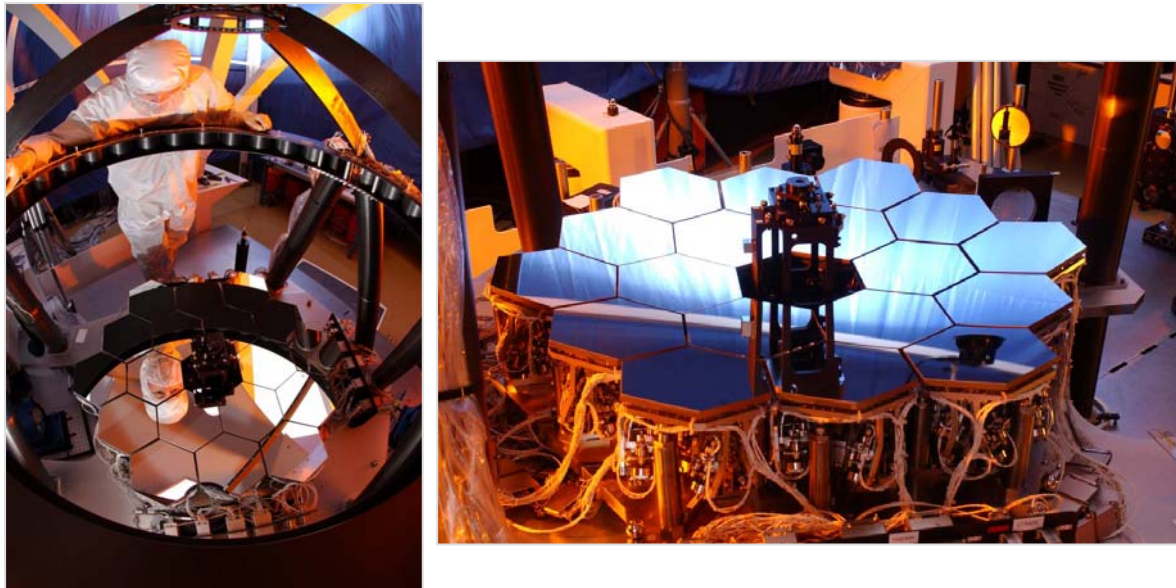
The draft ESA-NASA MOU on JWST has been released by the US State Department, meaning that negotiations to finalize the document can now go ahead.

The JWST Observatory level System Design Review was successfully held on 24 – 27 January. The 18 1.3 m hexagonal beryllium blanks of the JWST primary mirror are all in various stages of coarse machining and light-weighting. Fine polishing of the first Engineering Development Unit is to start soon. Two spare blanks are also being procured. The Wavefront Sensing and Control Testbed (essentially a scaled-down version of the segmented JWST telescope) is nearing completion.

The NASA Project and the Science Working Group are still in the process of assessing the recommendations made by the Science Assessment Team (SAT). Especially the recommendation to relax the cleanliness specifications placed on the telescope primary and secondary mirrors continues to cause concern due to fear of excessive stray light and consequent loss of limiting sensitivity.

On the European side, progress on NIRSpec and MIRI remains steady. The Preliminary Design Review for NIRSpec was successfully completed on February 15. Potential suppliers for 10 out of a total of 21 open competition NIRSpec subsystem contracts have so far been selected and negotiated. The tender processes for the remaining subsystems are on schedule.

and progressing well. The MIRI Thermal Structural Model has completed cryogenic testing. The Critical Design Reviews of the MIRI subsystems and Optics Module are ongoing and will run through to July.



Two views of the JWST Wavefront Sensing and Control Testbed at Ball Aerospace, which will be used to test and validate the techniques required to align the segmented JWST telescope in orbit.

6.4 GAIA: Michael Perryman

The review of the industrial proposals for Phase B2/C/D was completed in December, and the recommendation to award the contract to EADS-Astrium was endorsed by the Industrial Policy Committee (IPC) at the end of January. A parallel review of the ongoing science programme missions by the advisory structure (AWG on 12 January, SSAC on 18 January), culminated in the unanimous approval of Gaia for proceeding into Phase B2 by the SPC on 8-9 February. The resulting kick-off meeting between the project team and industry took place between 13 & 17 February. Launch remains scheduled for December 2011 (and can be favourably compared with “not later than 2012” when Gaia was approved by the SPC in 2000).

A first meeting of the Gaia Science Team for Phase B2 took place on 20-21 February. The new, and previously competitively confidential, industrial design was presented. The three distinct measurement elements of Gaia (astrometry, photometry, radial velocities) are now combined into a single telescope structure (rather than two separate telescopes as previously, where one was dedicated to the photometric and radial velocity measurements). This has the great advantage of a common instrument (including common angular resolution) for all measurements, a single-pass on-board object detection which applies to all three measurements, and a common CCD format. In detail:

- *Astrometry*: the principles of the previous measurements are preserved. By downsizing again the focal plane from 9x8 to 9x7 astrometric CCDs, cost, schedule and risk have admittedly been decreased yet further. The accuracy specification of 25 microarcsec at 15 magnitudes is formally respected, and the design thus accepted by the project team. However, it leaves little margin for one dominant effect still not properly accounted for: charge transfer inefficiency (CTI) induced bias on the

elemental observations due to radiation damage (note: launch will occur close to solar maximum). The effect is difficult to quantify precisely. A physical model has been developed by the Project Scientist (PS) team over the years to assess the risk and investigate possible mitigation strategies, such as charge injection. However, the model needs to be validated and calibrated by extensive laboratory measurements. The Project team was initially reluctant to perform such tests and wanted to delay them to the phase B2. After much insistence from the PS and GAIA Science Team, the Project Manager eventually agreed to advance the radiation tests to April 2006, with further measurements in July. Since a significant mass margin has been recovered with the EADS design, another obvious possible mitigation beside charge injection is to increase the shielding of the detectors. Finally, it may also be possible to model and calibrate-out the effect of radiation damage within the data processing system.

- *Photometry*: the filter system considered for Gaia between 1995 & 2005 has been replaced by a dispersive element system, which leads to compact red and blue dispersed images, containing essentially all of the previously demanded photometric data. This has the advantage of providing the full optical spectrum (at low spectral resolution), simplifies some aspects of the photometric calibration, and eases the telemetry budget. The effect of CTI, however, remains to be assessed.
- *Radial velocity*: the new design preserves the essential features of the previous concept, although with some degraded spectral resolution, degraded observational coverage for bright stars, and degraded S/N at faint limiting magnitudes. The science team has stressed that the present performances must be improved by optimisation studies during Phase B2, and ideally with the replacement of standard CCDs by L3 CCDs. Again, two main effects remain to be assessed: the effect of CTI on the signal amplitude and (spectral) smearing, and the transfer of faint star signals across the enlarged (common) CCDs.

An overall increased data rate demanded by the new design (driven by the radial velocity measurements) should be satisfactorily covered by the inclusion of a second ground station, now included in the cost-at-completion (CaC) approved by the SPC in February.

Planning for the construction of an overall Gaia Data Processing Consortium continues to advance satisfactorily. An overall structure centred around 8 coordination units, and 4-5 main processing centres (ESAC, CNES Toulouse, Cambridge, ISDC-Geneva, and Barcelona), is being developed, as described during the previous AWG meeting. The contribution of an ESA effort to the data processing, through a Science Operations Centre (SOC) at ESAC, has been funded to the requested level of 50.8 M€, also included within the CaC approved by the SPC. The concept for the Data Processing and Analysis Consortium is now well-enough advanced to proceed with a presentation of the Science Management Plan to the SPC in May, and the release of the ESA AO for the data processing at the end of May. The community response is then due by 10 July, and the ESA review (assisted by the AWG if required) should be completed by 15 September. The document proposed to be used as the SMP, and including the science requirements to be used as the basis for the ESA AO, has been circulated to the AWG in advance of the meeting.

A breakthrough in the development of the data processing came at the end of 2005 with the ESAC Gaia SOC team completing a successful new implementation of the astrometric “Global Iterative Solution” (GIS), results central to demonstrating the principles of the Gaia data analysis. Technical notes describing the method, programming approach and results,

have been published. The system, applied to an 18-month, 1.1 million star simulation “collapses” to results close to the input data in 1 outer iteration, and converges in 4-5 outer iterations (each comprising source, attitude, and calibration steps). The total run time on the dedicated Dell 140 GFLOP machine is just 1hr per iteration, thus 5 hr for 5 iterations. Lennart Lindegren (Lund Observatory) provided the AGIS mathematical framework, code, and advice during the implementation.

The www site (<http://www.rssd.esa.int/Gaia>) maintains an up-to-date record of overall status, technical progress, working group meetings, etc.

6.5 Corot: Annie Baglin & Thien Lam-Trong

The instrument (Flight Model) has been successfully qualified and delivered to Alcatel (Cannes) for integration at satellite level. After a nominal phase of mechanical and electrical integration with the Protéus bus, the satellite is undergoing the final Electromagnetic Compatibility, Vibration and Thermal Vacuum tests. It will be ready for shipment to Baïkonour in August 2006. The launch date remains mid-October 2006 but with a risk of slippage, depending on the Calipso Project which shares common resources with Corot.



The Mission Centre, still under integration, is now on the critical path of the launch schedule. The System Tests are progressing nominally. Preparation of the operational flight procedures is underway.

The tools needed to process in-flight images are now integrated in the Centre de Mission. The observing programme is almost ready and undergoing final tuning. A forum on the initial observing runs was held and a synthesis is in preparation. The final decisions will be taken at the next meeting of the Scientific Committee on April 5. Phase B study for the selection and prioritization of the Additional Programmes short observing runs is nearly completed. Dedicated astrophysical data bases are now available to the whole CoRoT Community. A CoRoT book on the different aspects of the mission will be published in May 2006 in the ESA-SP series.

7 Ongoing Studies

7.1 IRSI-Darwin: Jean Clavel

The two parallel system level studies by Alcatel and Astrium are progressing well. The mission architecture will be selected by the end of phase 1, in late April. The selection will take into account the on-going TPF studies and a coordination meeting with the US team is planned for that purpose, next April 19-21.

A Technical Assistance Agreement (TAA) has been signed with NASA that will alleviate the ITAR rules and facilitate the exchange of information between TPF and Darwin. A long term Darwin Technology Development plan is nearing completion. SCI-A is also investigating various possible ways to alleviate the sensitivity of the interferometer to variability noise, a recently identified problem that could ultimately limit Darwin performances.

7.2 XEUS: Arvind Parmar

Following the US decision to suspend collaboration on a major X-ray mission in the 2015 timeframe, SCI-A have completed a preliminary mission design based around two Formation Flying spacecraft placed into halo orbits around L2 by an Ariane V ECA. Two separate baffles are required in order to restrict the detectors' view of the X-ray sky so as to reduce the level of background light. The first is a long (~5 m) conical baffle extending forwards from the detector spacecraft which obscures most (almost 2π) of the visible sky. The second is a "skirt" located around the outer rim of the mirror. Previously it had been assumed that a deployable skirt was necessary, but calculations by the XEUS Science Advisory Group have shown that a small area of X-ray sky can be viewed without increasing the counting rate significantly above that of the particle induced background and a fixed skirt can thus be employed. This allows a major simplification of the design.

A circular optic has been adopted. This has several advantages for thermal control, mass, range of allowable Sun angles and baffling. The outer radius of 2.1 m is limited by the skirt dimensions and the Ariane V launch shroud diameter. The inner radius of 0.65 m results from a preliminary structural analysis and is limited by the diameter of the adaptor necessary to support the launch loads of the two spacecraft. For focal lengths in the range 35-40 m, the mass of the silicon High-precision Pore Optics (HPO) appears consistent with the launcher capability, assuming the core payload of wide and narrow field imagers. The detector spacecraft accommodation study that has commenced will also investigate the implications of accommodating the high priority additional instruments: High Time Resolution Spectrometer, Hard X-ray Camera and X-ray Polarimeter. The current optic design, using an iridium coating together with a thin carbon overcoat, will provide areas of about 5 m² at 1 keV and 2 m² at 6 keV, as well as an extended high-energy response to well above 10 keV. This design fulfills the relevant XEUS science *requirements* and may meet the *goal* upper energy range of 40 keV with the application of multi-layers on the inner mirror petals.

The Formation Flying contract kick-off meeting has taken place and work is proceeding in SCI-A to prepare for the release of the ITT for the mirror accommodation study.

7.3 Lobster and eROSITA: Arvind Parmar

These X-ray payloads are no longer being considered for accommodation on the ISS and may instead become part of the payload of the Russian-led SRG mission which is an element of the Russian space plan. The estimated spacecraft mass is 2200 kg with a payload consisting of 3 main instruments (e-ROSITA, Lobster and Russian hard X-ray imaging cameras). The spacecraft is projected to be launched on a Soyuz 2 from Baikonur or Kourou into a 600 km circular orbit with an inclination of 29 degrees in around 2010. ROSKOSMOS will decide in the next 2 to 3 months which of the two possible spacecraft platforms (Yamal or Navigator) will be used. Wishing to take advantage of the low and stable background offered by a <5 degree inclination 600 km orbit, ROSKOSMOS have contacted Arianespace to open discussions on the possibility of launching a Soyuz from the Kourou launch site.

In the European institutes, activities have revolved around modifying the original instrument configurations to be compatible with the Russian platforms, as well as continued testing of

the detectors and optics. A prototype eROSITA camera is being installed in the Panter facility as a new “work horse” detector to allow extensive operations and an initial contract with ZEISS for the production of new mirror shells has been signed. The low-energy sensitivity and energy resolution of the prototype eRosita detectors is far better than that of the XMM-Newton and *Chandra* detectors and the carbon line at 270 eV is well resolved. Thermal modelling and mechanical design of the eROSITA camera (MPE) and telescope (Kayser-Trede) are proceeding in collaboration with Russian colleagues. It is expected that DLR’s advisory committee will be requested to provide full funding of eROSITA in their June meeting.

On Lobster, further refinement of the micro-channel optics has resulted in an improved position resolution of 2 arcmin FWHM, compared to the 4 arcmin achieved previously. Due to the limited detector spatial resolution, the optics focal length will have to be extended from the 37.5 cm assumed in the ISS configuration to take advantage of the increased optics resolution. Fortunately, both Russian spacecraft platforms allow the accommodation of longer optics and work is underway, in collaboration with Russian colleagues, to define an optimum instrument layout. The Lobster instrument consortium has been expanded to include groups in the UK, Italy, Finland, Australia, Switzerland and the Netherlands; although it appears that the US members of the original consortium will not be able to participate significantly in the revised mission. Discussions are taking place about a possible Spanish role in Lobster and a statement of interest for full funding of the UK elements of Lobster is expected to be submitted to PPARC shortly.

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