ASTRO(2005)6 (final)
Att.: Astro(2005)4
Astro(2005)2
Paris, 22 December 2005

EUROPEAN SPACE AGENCY

ASTRONOMY WORKING GROUP

Report of 122nd Meeting

held on
21-22 April 2005

at ESTEC, Noordwijk (NL)

Those present:

Members of the Working Group:	C. Turon (Chair) D. Barret A. Bazzano J. Cernicharo A. Goobar R.J. Ivison S. Lilly G. Micela A. Quirrenbach G. Rauw P. Viana R. Waters (part time) D.M. Worrall W.W. Zeilinger
SSAC Chair:	G. F. Bignami, X. Barcons (both part time)
	(Apologies were received from T. Henning and P. Schneider who were unable to attend)
Invited experts:	A. Poglitsch, M. Griffin and T. de Grauw (Herschel PIs on 21/4 only)
ESA:	S. Volonte (Executive Secretary) J. Clavel, M. Kessler and other members of the Executive

The AWG Chair, Catherine Turon, welcomed the Chairman of the SSAC, Prof. G. F. Bignami who would address the group on the status of the Cosmic Vision activity. She also welcomed the new AWG members and then invited all the attendees to introduce themselves.

1. Adoption of Draft Agenda (ASTRO(2005)2)

After rearranging the order of some items, the Agenda **was adopted.**

2. Approval of reports of previous meeting

The draft report of the 121st meetings would be circulated to AWG as soon as ready.

3. Status of Cosmic Vision 2015-2025 exercise

The SSAC Chairman gave a brief introduction on the status and schedule of the Cosmic Vision (CV) exercise. The AWG Chair, Catherine Turon, briefed the AWG on the CV document in preparation, emphasising the inputs from the AWG. With the aid of a PC presentation, the Executive secretary then presented a more detailed account of the CV status emphasising the preparatory activities for the next Council Meeting at ministerial level scheduled in December 2005. Pending approval by ESA's Director General, the Director of Science would seek a 2.4% yearly increase in the Level of Resources (LoR) above inflation correction, starting in 2007 and lasting for 5 years. This would augment the LoR to roughly 440 M€ per year. In order to introduce flexibility of planning and implementation, the total financial envelope in the 2015-2025 decade could be divided in three programme slices of approximately 1.2 B€ each. Each slice would include a call for mission proposals from which a number of missions (large, medium and/or small) could be selected. A financial wedge would open in 2009, allowing to start implementation of the first CV mission in 2009 for a launch in 2015. In addition to an increased LoR, the above scenario was based on the assumption that a) the reimbursement of the 100 M€ loan would extend to 2009, b) the current recharging policy would continue to apply and c) the financial envelopes of GAIA, LISA, BepiColombo and Solar Orbiter would not significantly change. Note also that an increase in the LoR would allow the science programme to participate in the Aurora programme in the area of scientific payloads and science support, at a level of a few Meuros per year. Without such an increase, the first launch of a CV mission would not be possible before 2018, implying that the first CV call for mission proposals would be delayed from 2006 to late 2008 or 2009. After some discussion and clarification, the AWG took note of the report.

4. Herschel

The Chair opened the item by inviting the three Herschel PIs to introduce themselves. She then gave the floor to the Project Scientist who, with the aid of a PC presentation reported on the various aspects of the Herschel project.

4.1 Status report

In addition to the report given in the Project and Study Scientist reports annexed below, the Project Scientist, Göran Pilbratt, presented the current status of Herschel.
He described the progress made in building the flight hardware and the ground segment. He also reported on the status of the payload, emphasizing the schedule pressure dictated by the agreed delivery dates which might result in possible descoping measures. He mentioned that ASI would deliver the instrument FM DPUs behind schedule, only in March 2006. Regarding the launch procedure, he mentioned that the autonomy of the cryostat on the launch pad was 25 hours giving two launch opportunities of 45 minutes duration each. Missing the second opportunity would result in a launch delay of about one week due the need to refill the Helium tank on the launch pad. He added that launching on the second opportunity would shorten the mission lifetime by 1-2 months because of the Helium evaporation during the 25 hours wait time on the launch pad. It was possible to launch every day throughout the year except for a 4 months interruption from February to June.

4.2 Science objectives

The Project Scientist reminded the AWG of the main scientific objectives of Herschel. He emphasized the unique capabilities offered by the mission, bridging the wavelength gap between current and forthcoming facilities such as Spitzer (3-180 microns) and ALMA (350 microns-10 mm). He stressed the impact the mission will have on many important topics of modern astronomy. As an example, he mentioned that with its larger telescope and higher resolving power Herschel would contribute to the resolution of the IR background at long wavelengths (above 200 microns) compared to Spitzer which had presently identified 70% of the contributing sources but at 7 microns.

4.3 PI reports

With the aid of PC presentations, the 3 PIs described the status of development of their instruments with emphasis on technical development issues and schedule pressure. They also discussed the instrument scientific performance. They also pointed out that schedule pressure may impact on thoroughness of testing and calibration.

4.4 Update of Science Management plan

The Project Scientist gave an overview of the revised Herschel Science Management Plan (SMP) that had been circulated to AWG prior to the meeting. He explained the context in which it was first written and the reasons for updating. These reasons were, the revised rules governing the use of Herschel observing time, in particular concerning the Key Programmes, and the recent approval by SPC of an increased Cost at Completion (CaC) of the Science ground segment to provide the community with better-processed data and products.

After clarifications were provided on various issues, extensive discussions ensued on the status of Herschel and the updated version of the SMP. The AWG acknowledged the substantial progress that had been made towards building the flight hardware and ground segment of Herschel and reaffirmed its strong support to the mission. The AWG, however, was very concerned about the delay in the delivery of key hardware components and the possible negative impact of the schedule pressure on the testing and calibration of instruments. Regarding the updated SMP, the AWG endorsed the

proposed implementation of Key Programmes, the policy regarding guaranteed time and the inclusion of additional data reduction tasks.

This resulted in the AWG recommendation contained in document ASTRO(2005)4 attached.

Referring to the setting up of the future OTAC, the Project Scientist invited the AWG to propose, names for the chairs of the possible science panels. Proposals should be sent to C. Turon with copy to S. Volonte **by 10 May**.

The Project and Study Scientist Reports (see ANNEX) had been circulated to AWG before the meeting. Items of concern were discussed.

5. Satellites in orbit

5,1 HST: No issue
5.2 ISO: No issue
5.3 XMM-Newton:
The Mission Manager, F.Jansen, informed the AWG that mission extension would be put for recommendation by AWG at its forthcoming September meeting.
5.4 INTEGRAL: the mission extension will also be put for recommendation at the September meeting.

6. Projects under development

6.1 Planck: No issue
6.2 Astro-F: No issue
6.3 Corot: No issue

7. Projects in preparation and ongoing studies

7.1 JWST: No issue
7.2 GAIA:
In addition to the written report (see Annex), the Project Scientist, M. Perryman, gave an update on the status of the definition studies and the next decision milestones. He flagged concern on the implication of cost pressure on the potential degradation of the scientific capabilities of the mission. The AWG commented about ESA including in the Cost at Completion (CaC) an element to cover potential ESA support to the data analysis of GAIA.

Following discussions, the AWG gave strong support to some contingency funding to be included in the CaC, at the discretion of the Project Scientist, to cover margins and potential ESA support to the data analysis.

7**.3 Eddington**: The Executive Secretary clarified the status of the Eddington activities within ESA. He indicated that while the Eddington mission had been formally cancelled, these activities were being finalised in completion of a contract approved in the framework of the Eddington definition studies.

8. Future Mission Studies

8.1 IRSI-Darwin:
In parallel to the annexed report the Study Scientist, M. Fridlund, briefed the AWG on the TE-SAT activities in 2004-2005 related to the Darwin and Genie studies

8.2 XEUS: No issue

8.3 ISS payloads (Euso, Lobster, Rosita): No issue

9. Report on ESA-ESO working groups on exoplanets and Herschel/Alma

As a result of the ESO-ESA discussions on coordination of future activities and long term plans, two joint working groups had been set up to examine coordination respectively in the areas of extra-solar planet detection and Far-IR astronomy in preparation of Alma and Herschel. With the aid of PC presentations, the respective chairmen, M. Perryman and T. Wilson, briefed the AWG extensively on the conclusions of their work. The working group on extra-solar planets had produced its final report which was circulated to the AWG. The report of the Alma-Herschel working group was being finalised. It would be circulated to AWG as soon as available.

10. Any other matter
No issue

11. Date and place of next meeting(s)

- 22-23 September 2005 in ESA HQ, Paris
- 12-13 January 2006 in ESA HQ, Paris

ANNEX

(12 April 2005)

Project and Study Scientist Reports for AWG # 122

Report compiled, using inputs from Study and Project Scientists by:
- Jean Clavel, Astrophysics Missions Division,
- Martin Kessler, Science Operations & Data Systems Division.

5 Satellites in orbit

5.1 HST: Duccio Macchetto

The Hubble spacecraft is operating nominally, with the exception of the Space Telescope Imaging Spectrograph (STIS), one of the five on-board science instruments, which failed on August 3rd, 2004.

To extend the expected scientific lifetime of HST preparations are under way to switch-off one of the gyros and operate in a two-gyro configuration. The on-orbit two-gyro mode test using all science instruments was carried out from February 20th to 23rd, 2005. All indications are that the performance in two-gyro mode is excellent. Measurements of the point-spread function (PSF) with the Advanced Camera for Surveys (ACS) show extremely small differences, if any, between two-gyro and three-gyro mode. Measurements taken with a 14th magnitude guide star are essentially the same as those made with a brighter guide star. Measurements of the PSF of the Near-Infrared Camera and Multi-Object Spectrometer (NICMOS) are consistent with the ACS results, and a first look shows that the NICMOS coronographic performance is unchanged. The three-day duration of the test has accumulated a good variety of circumstances for slews, Fixed-Head Star Tracker (FHST) acquisitions, guide star acquisitions, etc. The performance of the magnetometer guiding has been excellent, with relatively small errors (typically 1-2 degrees) accumulating during occultations and slews. The Two-gyro mode requires the on-board software to identify star fields found by the Fixed-Head Star Trackers, and then to measure and correct the pointing error. The FHSTs occasionally loose stars, track on apparent moving objects, and can misinterpret scattered light as stars. The design of two-gyro mode has taken these types of issues into account, and so far has been shown to be quite robust. This test also exercised the major modifications that have been made to the scheduling systems.

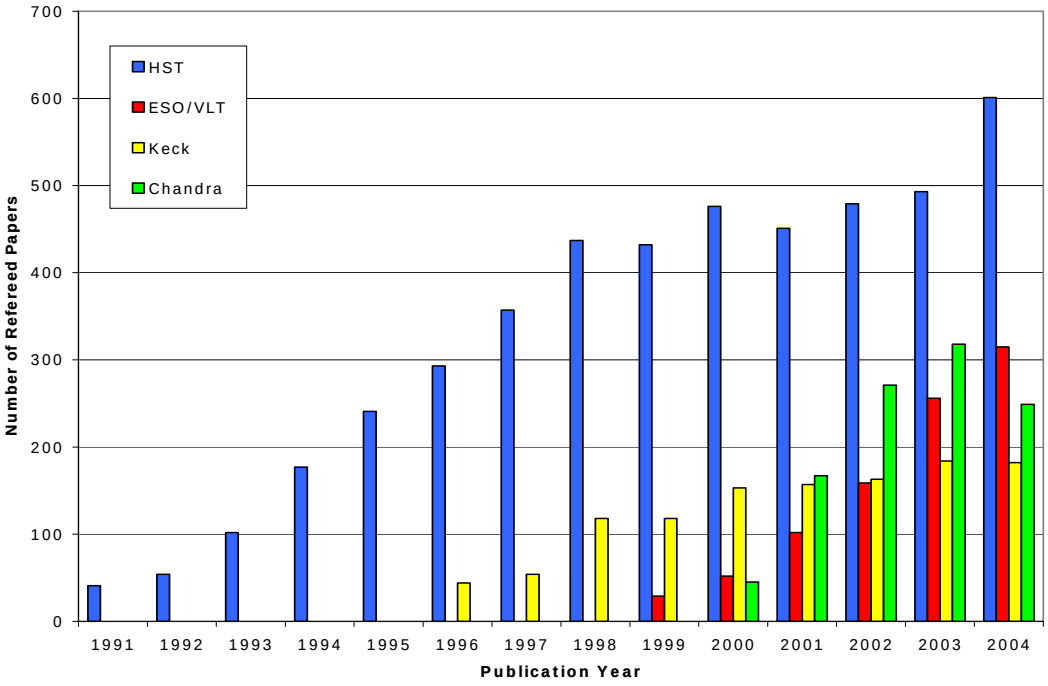
The results from this test will drive the decision whether to make a proactive switch to two-gyro science mode at the beginning of Cycle 14, rather than incur an interruption of the schedule when two more gyros have failed. A final decision on whether to allow only two-gyro guiding for Cycle 14 will be made in late April. An early introduction of the two-gyro science mode is expected to extend the observing lifetime of HST with the current set of gyros by at least 9 months to mid-2008, corresponding to 2400 to 3000 more orbits of useful science.

The Cycle 14 Phase I proposal deadline occurred on Friday, January 21st, 2005. In response to the Call for Proposals, STScI received a total of 726 proposals for about 14,000 orbits. The Time Allocation Committee convened from March 14th to 19th to generate the rank-ordered list of proposals for final approval by the Director of STScI. Notifications were sent to the proposers during the first week of April. The deadline for the selected proposals to submit their Phase II information is May 13th, 2005. Routine Cycle 14 observations are expected to

commence in July 2005. Over 28% of proposals from astronomers (PIs) in ESA member states were selected for approximately 19% of the total observing time.

The Space Telescope Science Institute (STScI) announced the 2005 May Symposium with the title "A Decade Of Extrasolar Planets Around Normal Stars", to take place at STScI from May 2nd to 5th, 2005. The symposium will cover a variety of topics related to the formation, evolution, and detection of extrasolar planetary systems and their properties.

To assess the impact of Hubble observations on astrophysical research, standard objective measures of productivity and impact need to be used. One of these measures is the annual number of published papers based on Hubble data. Following a strong and regular increase of publications during the first eight years of Hubble, the number of papers continued to increase, although at a slower pace during the past several years. However, the year 2004 saw another significant increase, reaching a new record value of 601 published papers based on

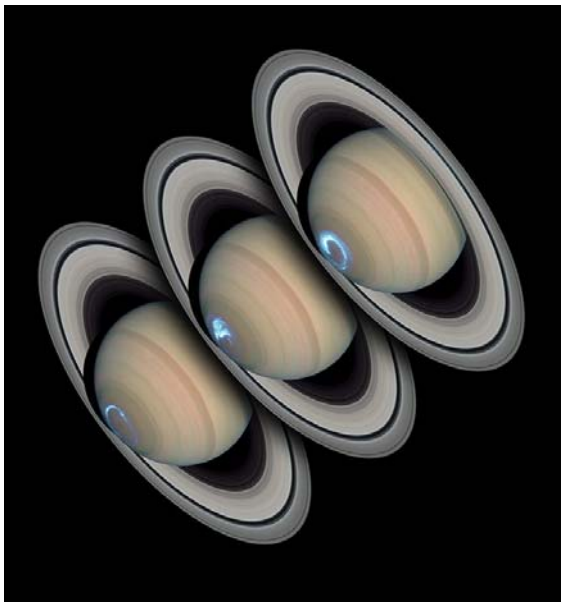


Hubble data, over 100 more than in the previous year. The current total of refereed papers based on Hubble data is over 4700. The figure compares the number of refereed papers per year based on Hubble data to those based on the European Southern Observatory's Very Large Telescope, on the Keck Telescopes, and on the Chandra X-Ray Observatory. These numbers clearly show the large impact of Hubble-based science, compared to other major ground-based and space-based astronomical observatories.

Surprisingly complex loops and blobs of cosmic dust lie hidden in the giant elliptical galaxy NGC 1316. This image made from data obtained with Hubble reveals the dust lanes and star clusters of this giant galaxy. The combination of Hubble's superb spatial resolution and the sensitivity of the Advanced Camera for Surveys (ACS) enabled uniquely accurate measurements

of a class of red star clusters in NGC 1316. Astronomers conclude that these star clusters constitute clear evidence of the occurrence of a major collision of two spiral galaxies that merged together a few billion years ago to shape NGC 1316 as it appears today.

Viewing Saturn's southern polar region for several days, Hubble snapped a series of photographs of the aurora dancing in the sky. The snapshots show that Saturn's auroras differ in character from day to day, as they do on Earth, moving around on some days and remaining stationary on others. But compared with Earth, where auroral storms develop in about 10 minutes and may last for a few hours, Saturn's auroral displays always appear bright and may last for several days. The observations, made by Hubble and the Cassini spacecraft, while en route to the planet, suggest that Saturn's auroral storms are driven mainly by the pressure of the solar wind — a stream of charged particles from the Sun — rather than by the Sun's magnetic field. Seen from space, an aurora appears as a ring of glowing gases circling a planet's polar region. Auroral displays are initiated when charged particles in space collide with a planet's magnetic field. The charged particles are accelerated to high energies and stream into the upper atmosphere. Collisions with the gases in the planet's atmosphere produce flashes of glowing energy in the form of visible, ultraviolet, and infrared light.



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

ISO featured prominently in the third (and final) demonstration of the Astrophysical Virtual Observatory project, which was successfully held at ESAC on 25-26 January 2005. The stellar science case "The transition from AGB stars to Planetary Nebulae" made extensive use of ISO data, accessible via VO-compliant tools in creative cooperation with developers.

A special issue of Space Science Review summarising the major achievement of ISO, has been posted on the ISO web site in December 2004, prior to its publication by Springer this year.

The ISO Data Archive statistics for March 2005 give 36 users downloading 1365 observations (the equivalent of 5 % of its scientific observations content). 12 new users registered in the reporting period, bringing the total number of enabled users to 1623.

ISO continues to have a significant presence in the refereed literature, with 1235 papers published to date (123 in 2004, 36 to date in 2005) embracing all areas of astronomy. Recent highlights include the direct evidence that shock waves generated by galaxy collisions excite the gas from which new stars will form. This is revealed in the Antennae galaxies pair by exceptional H2 rotational line emission at a wavelength of 9.66μm, detected with ISOCAM Circular Variable Filter observations. The result, published in the April A&A issue by Haas et al., is also reported on the ESA News portal as an outreach story.

5.3 XMM-Newton: Norbert Schartel

As of 1 April 2005, the overall completion status of the observing programme is as follows:

- Guaranteed time: 100.0 %
- AO-1 programme: 100.0 %
- AO-2 programme: 99.9 %
- AO-3 programme: 92.0 %
- AO-4 programme: 4.6 %

The AO-4 observations were started slightly ahead of time, largely because of sky visibility reasons.

Several Targets-of-Opportunity and Discretionary Time targets were observed, namely M101, HS0220+0603, V1118 Ori (two observations), GRB 050223, GRO J1655-40 (increase of allocated time), SGR 1806-20 and GRB 050326.

As of 1 April (start of AO-4), the start- and end-times of the science observation window in each revolution are determined by a radiation model developed by members of the XMM-Newton SOC. Although the new visibility window is formally shorter than the previous one, the effective time available for scientific observations is expected to be unchanged because most of the difference in time was affected by high radiation background. The expected advantage of the new scheme –already used in the AO-4 call– is that fewer observations will be effected by high radiation background and, therefore, the number of observations which have (partly) to be repeated will diminish. Thus, an overall increase in quality of the obtained data is expected.

On 9 March, XMM-Newton registered an event in the focal plane of the EPIC MOS1 instrument. The characteristics of the event were reminiscent of a very similar event registered in the EPIC cameras at an earlier point in the mission, which was attributed to micrometeoroid impacts scattering debris into the focal plane. It seems likely that MOS-1 CCD-6, one out of the six peripheral CCDs of MOS-1, will not be usable for scientific observation in future. Evidence of a limited number of new hot pixels elsewhere in the MOS1 focal plane was also recorded. These other effects are relatively minor. Scientific observations are continuing normally with XMM-Newton, including MOS1, but with CCD6 switched off. Investigations are underway to fully characterise changes in the instrument status. For the scientific output of the mission it is important to realise that MOS-1 is operated in parallel with the MOS-2 and the pn cameras. Therefore, the sky area which is no longer covered by CCD-6 is still covered by the remaining two cameras. The net effect of the loss of CCD-6 is therefore limited to only 3% of the total grasp of EPIC. Such a loss will not have a significant impact on the scientific output of the mission.

Version 6.1 of the XMM-Newton Science Analysis System (SAS) had been downloaded 499 times as of 1 April. Based on replies to a questionnaire, about 1057 scientists have access to this version and 290 people were downloading the SAS for the first time.

The XMM-Newton Science Archive (XSA) has 1420 registered external users as of 1 April. The monthly usage can be characterized through the following numbers for March 2005: in total about 1200 separate data sets were downloaded by 115 external users.

In total 795 papers – either completely or partly based on XMM-Newton observations – had been published in the refereed literature before 1 April.

D/SCI has appointed Dr. G. Rauw as a new external member of the XMM-Newton Users' Group, replacing Prof. P. Charles. Dr. M. Arnaud was appointed as new chairperson of the Users' Group. She will replace Prof. J. Schmitt after the extension of the mission in autumn 2005. D/SCI also appointed Prof. B. McBreen as the new chairperson of the Observing Time Allocation Committee (OTAC). He succeeds Prof. M. Longair who chaired the review process for XMM-Newton AO-1 through AO-4.

In coordination with Prof. B. McBreen a timeline for AO5 was established:

Announcement of Opportunity	05 September 2005
Due date for proposals	14 October 2005 (12:00 UT)
Final OTAC approved programme	early January 2006

For approved proposals only:

Start of phase II proposal submission	23 January 2006
Closure of phase II proposal submission	17 February 2006
Start of AO5 observations	May 2006

5.4 Integral: Chris Winkler & Peter Kretschmar

INTEGRAL operations continue smoothly with the spacecraft, instruments and ground segment performing nominally. The INTEGRAL Science Operations Centre (ISOC) completed its move from ESTEC to ESAC. After a period of parallel operations, ISOC operational responsibility was transferred to ESAC on 2005 February 3 coincident with the start of the AO-3 observations.

INTEGRAL experienced its first Emergency Sun Acquisition Mode (ESAM) on 2005 January 8. The ESAM was triggered by an incorrect calculation at MOC following a re-planning request for a ToO observation, rather than an on-board anomaly. The recovery from the ESAM was very smooth and only 12 hours observing time was lost, together with fuel corresponding to approximately 3 weeks normal observing. Indeed, during January, solar activity forced the suspension of science operations on a number of occasions, resulting in a much larger loss of observing time.

The 5th SPI annealing took place from 2005 January 20 to February 3. This procedure is necessary to maintain the SPI high spectral resolution. The SPI switch-on was nominal and the energy resolution appears to have recovered, as expected. It is worth recalling that following the losses of two (out of 19) SPI detectors approximately 2 weeks after the ends of previous annealing cycles, extensive ground tests were conducted. However, these failed to reveal any link between annealing and the failures and as a precaution, the procedure for the last annealing was modified to minimize the thermal stresses on the pre-amplifiers. Currently, some 2 months after the end of the last annealing cycle, there have been no additional SPI detector failures.

With the endorsement of the AO-3 general program by the Director of Science, observations in the AO-3 cycle began on 18 February 2005. The observation planning is now done from ESAC (Villafranca, Spain). Several TOO observations on the transient BHC GRO J1655-40, when possible in coordination with XMM-Newton, have been organised.

Instrument teams and ISDC are working hard on the next major release of the scientific analysis software (OSA 5), scheduled for end of May. The major improvements are improved

image and lightcurve extraction for IBIS, new imaging software for JEM-X and improved user friendliness generally.

As a service to the community, images and light curves from the INTEGRAL Galactic Bulge monitoring program (PI: E. Kuulkers) are made publicly available on the Web (http://isdc.unige.ch/Science/BULGE/) as soon as possible after each observation. The community has been informed via ATEL #438 and the News section of the ISOC WWW site.

From 2005 April 5, the ISDC has also opened its public on-line archive including nearly all public observations made until 2004 March 7. The INTEGRAL source results archive (http://isdc.unige.ch/index.cgi?Data+sources) allows easy access to downloadable IBIS and JEM-X lightcurves, spectra and images of the brightest ~180 sources in various energy bands. In addition, data from the recent ToO observations of the bright transient V0332+53 are available from the ISDC site.

D/SCI has appointed the members of the Integral Users' Group. It consists of: Chris Done (Durham, Chair), Eugene Churazov (Moscow), Stefane Corbel (Saclay), Wim Hermsen (Utrecht), Gottfried Kanbach (Garching), Chryssa Kouveliotou (Huntsville) and Luigi Piro (Rome).

The number of refereed/non-refereed scientific publications over the period 01 Dec 2002 until 31 March 2005 is 80/263, respectively. A very lively and productive internal science workshop took place 18-21 January 2005 in ESTEC with many interesting and promising results. Most of the presentations are available on-line at:
http://www.rssd.esa.int/INTEGRAL/workshops/Jan2005

After ~15 years of quiescence, the transient X-ray pulsar V0332+53 became bright again in November 2004. INTEGRAL observed the source at the earliest possibility in TOO observations during January with the data immediately made public. First results, with beautiful cyclotron line spectra were obtained a a few days only after the data became available (Kreykenbohm et al. A&A 433, L45-L48 (2005)

INTEGRAL observations of gamma-ray emission from the molecular cloud Sgr B2 indicate that Sgr A* was much more active 350 years ago (Revnitsev et al., A&A 425, L49-L52 (2004)).

^{60}Fe decay lines at 1173 keV and 1333 keV have been detected in SPI spectra (Harris et al A&A 433, L49-L52 (2005)), constraining the contributions of Core Collapse SNe to ^{60}Fe and ^{26}Al production in the galaxy.

A detailed analysis of the SPI anti-coincidence shield data of the Dec 27 giant flare from SGR 1806-20 has been done by Mereghetti et al. (ApJL accepted, 2005). In the pulse profile of the pulsating tail, they find two components with different properties suggesting two emission regions.

Two long GRBs in the FOV were observed on December 18+19 (GCN 2858, 2866), the second was also caught by Swift-BAT and the RXTE/ASM. This exceptionally long and bright event is the first with near simultaneous IR observations due to the prompt IBAS detection. Further bursts in the FOV were observed on January 29 (GCN 3003) and February 23 (GCN 3059).

6 Projects under development

Herschel: Göran Pilbratt ***(Item 4. of Draft Agenda)***

The Mission Level Critical Design Review (M-CDR) was kicked off on 11 March 2005 with a full day of presentations by Project and Industry for the Board, observers, and invited instrument team representatives. A number of issues were raised during the presentations, mainly already identified ones from earlier reviews not yet closed. The Project produced and circulated a written response to all issues raised before the Board meeting that took place on 5 April, where the responses were discussed. The schedule is the overriding concern of the Board, and the introduction of 'Senior Management Board' to deal with potential – the discussion centred on payload activities – descoping measures suggested by the Project Manager was supported.

It was expected to complete the grinding of the Herschel flight telescope primary mirror in January 2005. However, the pentaprism measurement, intended to verify the correctness of the surface figure, indicated that the surface figure was not as intended and expected. The problem was thoroughly investigated and tracked down to mechanical play in the profilometer used to control the lapping process, thus, the continuation of the lapping was done with frequent pentaprism measurements. However, polishing is required to enable each pentaprism test, consequently slowing down the lapping progress. The completion of the lapping has now been achieved, and delivery of the 'ready-to-be-coated' M1 mirror to Astrium is planned for later this month. This delay has no overall mission implications.

The EQM tests of the instrument Cryo-Qualification Models Focal Plane Units are now scheduled for June; redelivery activities of the warm electronics are underway.

The Herschel team of astronomers have partly relocated to ESAC, Villafranca, and the strengthening of the team is continuing by transfers of existing personnel from other missions, and by the hiring of contractor staff. The latter has been a major effort, with a very large number of proposals being received. Preparations are underway to strengthen the HSC Development Team in the area of data processing.

6.1 Planck: Jan Tauber

Concerns regarding the reflector and telescope verification have been previously raised in this report. It is now confirmed that the verification programme must be curtailed due to technical difficulties with the foreseen measurements. The reflectors and telescope are very likely quite adequate for flight; what will not be fully adequate is the *knowledge* we have of their performance and characteristic, an important ingredient in the quality of the science return. The impact is being assessed.

Development of the LFI instrument hardware is advancing. The LFI Qualification Model (QM) has been integrated and is now being cryo-tested; in this respect LFI lags behind all other Herschel-Planck instruments, which have finished their QM campaigns. The LFI Qualification Review is pending.

The Qualification Review of the 20 K sorption cooler is finished. The major open issue remains the zero-g performance of the cooler, since the available test results indicate sensitivity to gravity; we are not sure of what will be its performance in orbit in terms of

temperature stability. Experts have recommended design changes, but there is no opportunity to implement them. The first flight unit is being shipped from JPL to Europe this month.

The Cryo-qualification model of the HFI instrument has been delivered to ESA and integrated into the Cryo-qualification Satellite. The satellite will be shipped to CSL (Liège) in early May, where it will be tested at cryo-temperatures starting in June. Note that this model includes neither LFI, nor the warm part of the sorption cooler.

The mission-level Critical Design Review (CDR) of the spacecraft has been completed. One of the major concerns flagged by the Board report is the Planck telescope verification programme (see above). The schedule is of course another major concern, though the launch date officially remains set on 3 August 2007.

The Board report of the recent Review of the Science Ground Segment was issued in January. A working group is currently defining a "minimum launch system" to which strict Quality Assurance standards must be applied. Once this is finished, the level to which this system meets the review objectives will be reassessed. An end-to-end plan for DPC pipeline testing is being put together.

6.2 ASTRO-F: Alberto Salama & Martin Kessler

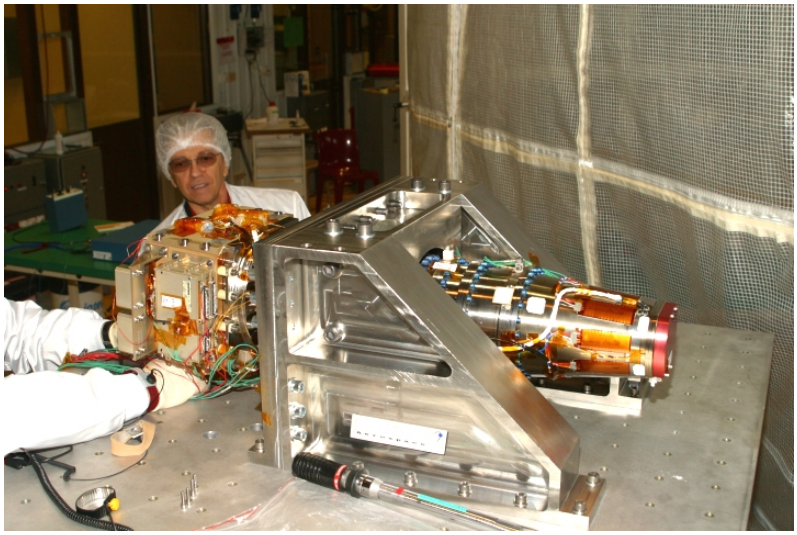
Following the successful launch of HIIA F7 on 26 February, the Japanese Space Activities commission has allocated the launch period of January-February 2006 for the launch of ASTRO-F. A more precise launch date will be set after negotiation with the fishermen. Performance tests of the telescope and focal-plane instruments in the FM cryostat have been carried out in February. Operational modes (AOTs) have been defined. The Call for Observing Proposals (Japanese/Korean and European) is now targeted for 1 September. ESAC has opened a "European User Support" web site at http://www.astro-f.vilspa.esa.int. An ESA Call for Letters of intent is targeted for issue in April.

In ESAC, a new strategy for pointing reconstruction has been agreed with ISAS. It will be based on using data from the focal plane instruments and not on spacecraft attitude, as its complete definition is not yet available at ISAS. Regarding tracking support, ESOC will start operations preparations at L-6 months.

6.3 Corot: Annie Baglin (PI) & Thien Lam-Trong (Project manager)

Corot is on schedule for a July 2006 launch by a Soyuz rocket from Baïkonour. Development of the Corot System is progressing nominally. The difficulties with the baffle have been overcome. Calibration of the camera at IAS (Orsay) has been completed. Integration of the electronic boxes into the service module is in progress. The signature of Electro-Magnetic Interferences (EMI) has been quantified and included in the data processing chain for removal. The Data Processing Unit (DPU) is currently being tested and the complete chain is undergoing integration. Final integration of the instrument at CNES-Toulouse has started, with the alignment and optical tests following integration of the camera in the telescope. The Proteus Bus is also under integration at Alcatel, Cannes. The System Interfaces Review is proceeding smoothly and demonstrates a good overall status of the Ground Segment. The network of antennas is under consolidation and now includes a contribution from Brazil and a possible cooperation with the MOST micro-satellite team in Vancouver.

Scientific preparation of the project is also on schedule. As far as seismology is concerned, the ground based complementary observing programme is virtually completed, while a few more nights of observation at INT are still required to complete the exoplanetary part. Many thematic teams have been formed, gathering experts in a given field in order to optimise the target selection and the immediate scientific return of the mission. The Corot observing programme is defined step by step. The two first fields for the first year of observation have been selected at the last meeting of the Scientific Committee, on March 7th 2005. The first open AO for "Additional Programmes" during year-1 was issued at the end of March. Proposal selection is expected by the end of August. The programme of follow-up observations - essentially spectroscopy from the ground, but also with other space missions - is being finalised and will be presented soon to the different institutions concerned.



7 Projects in preparation and ongoing studies

7.1 JWST: Peter Jakobsen

At the time of writing, NASA has still not received final approval to launch JWST on an ESA-supplied Ariane V. However, this remains the working assumption in NASA and throughout the JWST Project. The alternative would be to fly JWST on a Boeing Delta IV Heavy, which would have dramatic cost and schedule implications for the project.

The JWST observatory is currently facing a potential mass problem that if left uncorrected would bring the observatory ~370 kg above its Ariane V compatible launch mass limit of just under 6200 kg. This problem is caused by a ~125 kg increase in the projected JWST spacecraft mass, an unforeseen additional ~163 kg needed to stiffen the backplane of the 6.6 m deployable telescope, and another ~29 kg of other increases. Although a full review of all subsystems is in progress, none of the instrument capabilities are presently a target for significant mass savings. One key remedy already decided upon is to replace the MIRI solid hydrogen Dewar with a cryo-cooler system. This will result in a net saving of ~227 kg. Ironically, a cryo-cooler was the scientific preference for MIRI back when the NASA Project instead opted for the more conservative passive cryostat technology. Additional mass savings are expected to result from switching to a bi-propellant spacecraft propulsion system, consolidating the NIRCam and NIRSpec electronics, and possibly saving on radiator area by raising the operational temperatures of the NIRCam and NIRSpec optical benches to ~40 K.

While the possible schedule impacts of these changes are not known at present, none of the modifications is expected to significantly impact any of the four JWST instruments proper (including the cryo-cooler for MIRI), the development of which are progressing steadily.

A decision was recently made to implement the analogue and clocking electronics of both the NIRCam and NIRSpec detector in low temperature ASICs (Application Specific Integrated Circuits) placed in the vicinity of the detector arrays, thereby significantly reducing the risk of electromagnetic interference and crosstalk in the ~4 meter long cable separating the detectors from the warm spacecraft. The prototype requisite "SIDECAR" ASICs have already been developed by Rockwell Scientific and will be delivered integrated to the NIRCam and NIRSpec detector arrays proper as part of the NASA near-IR detector contracts. The colder MIRI detectors will, however, still employ warm remote electronics and continue to pass analogue signals along the lengthy connection cable.

Present activities on NIRSpec focus on working with the Prime Contractor, Astrium EADS, on soliciting and selecting vendors for the various NIRSpec subsystems, including the grating and filter wheels, the refocus mechanism and the integral field unit. This process is progressing steadily, with a number of bids having been received in reply to the invitations to tender issued so far.

Full scale mock-up of the deployed 18-segment JWST telescope at the US prime contractor. To the right is a matching mockup of the deployed Sun Shield (Northrop-Grumman Space Technology).

7.2 GAIA: Michael Perryman

The project is in the final three months of the B1 study phase, with the two competing industrial contractors - Astrium and Alenia/Alcatel. The intention of the Projects Department (J. Louet) and Project Manager (R. Schmidt) is to release the industrial Invitation to Tender (ITT) for the Phases B2/C/D around 1 August 2005, with a proposal deadline at the end of

October 2005. The subsequent review process will be completed by the end of December, with resulting Adjudication Committee (AC) and Industrial Policy Committee (IPC) decisions expected by the end of February 2006, allowing the start of Phase B2 at that point. The current target launch date is December 2011.

The 460 M€ *target* financial envelope of GAIA is taken literally by the ESA Project without correcting for the inflation incurred since 2002 when this figure was presented to the SPC. Though this is a standard practice, which is consistent with the constant level of resources of the science programme, this strict interpretation of the financial envelope forces the two competing industrial contractors to investigate further options for containing the costs of the payload and spacecraft. In the existing highly competitive industrial environment, full details of these options will only be known once the responses to the ITT have been submitted by industry and evaluated by ESA (end 2005). However, positive indications are that acceptable cost (and mass) solutions versus scientific performance options will be proposed by industry, and then presented to the advisory committees.

Many enabling technical studies undertaken throughout the B1 phase are well advanced, notably the CCD and focal plane study (including radiation effects), thrusters, SiC mirrors, payload data handling, deployable sunshield, etc. None of the required technology is currently considered to be on a critical development path.

Planning for the construction of an overall Data Analysis Consortium is in progress. The Letter of Intent had a deadline of 20 March, by which date 177 proposals had been received, and are being assessed. The goal is to distil out of the suggestions submitted by the community, and from the deliberations of the Gaia Science Team over the last four years, a proposed overall structure for the Gaia data processing. This will be an element in the preparation of the overall science management plan, including the required scientific and computational contributions from ESA and from the community. The ESA contribution to the overall system architecture and continued development of a data analysis prototype will pick up in the second half of 2005 with the appointment of a small team (initially 3-5 full time equivalent) at ESAC.

The www site (www.rssd.esa.int/Gaia) maintains an up-to-date record of overall status, technical progress, working group meetings, etc. Further details are available under the Project Scientist's annual report "Gaia in 2004" available at the ESA Gaia www site.

7.3 Eddington: Fabio Favata

The Eddington focal plane demonstration study with MSSL is drawing to its conclusion, with a final presentation foreseen around mid-June. The last progress meeting took place at the end of March. The study is aimed at demonstrating the soundness of the focal plane concept defined during the competitive definition phase, from both the electronic and thermal point of view. A prototype focal plane is being built, which will also be used to assess the end-to-end noise performances of the system.

One major stumbling block has been the lack of space-qualified high-speed ADC components, a major requirement for Eddington as well as for several future missions. The opportunity has been grabbed to develop a solution in the framework of the present contract. Although still not 100% latch-free, the solution appears satisfactory and could be used for future flight instruments.

Once the contract ends, MSSL has expressed interest in re-using the hardware (electronics) for further studies of future ESA missions. Unless the Eddington situation changes dramatically, they will be permitted to do so.

8 Future Mission Studies

8.1 IRSI-Darwin: Malcolm Fridlund

The preparation for the Darwin industrial system level study has progressed. An Invitation To Tender (ITT) is almost ready and will be issued in May (TBC). It focuses on the four-spacecrafts configurations extensively studied within ESA. The two parallel industrial study contracts will run for 18 months, with the possibility of further extensions if necessary. An ESA technology development plan is being prepared in parallel. It foresees the study of a Formation Flying Ground test-bed with applications to both Darwin and XEUS. Mission analysis for the 2-Soyuz Fregat launch is nearing completion at ESOC, with a final presentation foreseen in May.

The revised Darwin configurations are based on 3-4 m class Herschel type telescopes, polished to normal optical quality (rms < □ / 10 @ 5000 Å). The scientific capabilities are significantly enhanced with respect to the 2000 Alcatel study configuration. Integration times for the 15 closest stars are increased, but the interferometer now reaches more distant targets as confirmed by extensive simulations based on the actual input star catalogue:

- Under the assumption that all target stars have exozodiacal dust emission levels comparable to that of our solar system, Darwin will be able to survey all 488 F, G, and K stars out to 25 pc during the 2 years search-phase, and to perform detailed spectroscopic observations of at least 50 systems during the 3-years follow-up phase, plus a number of nearby M-Dwarfs.
- Under the more conservative assumption of an exozodiacal dust emission level 10 times higher than in our solar system, Darwin can survey 165 F, G and K stars and follow-up in detail more than 15 planetary systems.

A negative result would permit to set a meaningful limit on the "uniqueness" of our solar system of ~2-6 10^{-3}.

Essentially all the Technology Research programs initiated since 2001 are either completed or well under way, with extremely promising results. Nulling, achromatic phase shifters, single-mode high-efficiency fibres operating in the 7-20 μm wavelength range have all been successfully demonstrated and/or breadboard models have been developed. There is currently no single technology identified as a "show-stopper", although essentially all of them are extremely demanding. Formation flying to cm precision does not appear to present insurmountable difficulties either. The real challenge of Darwin lies in its overall complexity and in ensuring that all the pieces of the system work together and collectively meet the specifications of the mission.

In December, Alcatel and Astrium made the final presentation of their respective GENIE design studies. The results are encouraging and suggest that GENIE will be able to measure levels of exozodiacal emission as faint as 50 zodi (integrated solar system zodiacal emission) in the Darwin target systems. Furthermore, 5 to 6 of the known exoplanets are also within reach of GENIE for spectroscopic study in the L' band at 3.6 μm. The results of the industrial studies have been fed into the ESA developed simulators and will be evaluated over the next few months. The final scientific capabilities of GENIE will ultimately depend on the actual performance of the ESO VLTI, in particular on the extent to which internal polarization of the

system can be controlled. A document describing the scientific case for GENIE was produced and delivered to ESO.

8.2 XEUS: Arvind Parmar

The results of the recent joint Constellation-X and XEUS internal studies at the ESA Concurrent Design Facility (and the NASA equivalent) are now available. Both studies were supported by participants from both teams and focused on areas of particular concern to each of the participants (ESA: design of the mirror spacecraft, NASA: design of the detector spacecraft). In summary, the conclusions are that a single Ariane-5 ECA launch of both spacecraft to L2 would provide a mirror area of 7 m^2 at 1 keV, but with a rather soft response as the inner mirror petals would need to be removed due to mass limitations. The instrument package could consist of a wide field semiconductor and narrow field cryogenic imagers only. Launching instead with a more powerful (NASA provided) Delta IV Heavy rocket would provide a mirror area of 11 m^2 at 1 keV with the desired high-energy response. The instrumentation could probably also include a second cryogenic imager, a hard X-ray camera, a high-time resolution spectrometer and a polarimeter.

A meeting was held at CfA between members of the European, US, and Japanese high-energy communities to investigate whether the scientific goals of all 3 communities could be met with a single mission. The meeting concluded that they probably could, with a mission that would look very much like the Delta IV Heavy launched XEUS version above with 2-5″ spatial resolution, possibly with the addition of a grating spectrometer. Further efforts to help focus and prioritise the requirements of the global X-ray community are continuing, but it is clear that the US community has realised the potential of the new ESA led high-precision pore optics (HPO) technology to revolutionize high-energy astronomy and the prospects for a combined mission appear promising. For memory, the 0.4 m^2 of XMM-Newton mirror area weighs 1 tonne and provides 15″ spatial resolution only.

The Science Advisory Group has converted the science goals that were proposed to the Cosmic Vision call-for-ideas into detailed requirements. These requirements will serve to define the baseline mission to be addressed in future industrial studies. Preparations are underway to initiate internal studies of the detector spacecraft payload accommodation, of the mirror optical bench accommodation and of the formation flying requirements and metrology. In addition, a 15-months contract to investigate the development of HPO is about to start. It will concentrate on improvements in wafer stacking technology and mounting, leading, by mid 2006, to a petal model containing probably 3 stacked (parabola + hyperbola-like) modules.

8.3 ISS payloads (Lobster and Rosita): Arvind Parmar

Lobster:
The Phase-A extension of the Lobster all-sky X-ray monitor has been completed. The Lobster study Board met and concluded that all open issues had been successfully closed and that Lobster was technically ready to proceed to Phase B. It was demonstrated in particular, that the safety and the contamination issues could be mitigated by the addition of shutters covering the optics. These shutters would have to be closed during astronaut extra-vehicular activities (EVA) and vehicle docking. The concerns about contamination discussed in the Rosita report below, are not thought to be a significant issue for Lobster due to the fixed thermal covers protecting the optics and the pore structure of the micro-channel plate optics.

Noting potential synergies between Lobster and LISA the Lobster science case has been updated. Lobster with its sensitive all-sky observations could act as an event monitor for LISA allowing gravitational wave observations to be correlated with transient X-ray events.

The likely retirement of the shuttle fleet in 2010 is clearly a concern for Lobster and alternative launch possibilities, including the Japanese HTV, a Russian launch and subsequent installation of Lobster on the Russian ISS module and a free-flying Russian spacecraft, are being actively pursued.

Rosita:
Rosita is an all-sky X-ray survey instrument designed to be flown on the ISS and take advantage of the Space Station "airplane-like" pointing attitude to perform great circle scans of the sky. As part of the preparation, specimens of X-ray mirrors and detectors were exposed for two years on the outside of the ISS and recently returned to Earth. Unfortunately, the samples came back highly contaminated, raising serious doubts about the possibility to use very sensitive X-ray mirrors in the environment of the ISS. Given this contamination issue and concerns about the likely retirement of the shuttle fleet in 2010, the PI (G. Hasinger) has written to D/SCI requesting that the approved joint D/SCI – D/HME Phase-A study not be conducted and that a free-flyer option for Rosita be considered instead.

A free-flyer could ideally combine the two important scientific goals of an all-sky survey to detect ~50000 obscured active galactic nuclei and two deeper pointed raster scan surveys to discover ~10000 distant clusters of galaxies and to study dark energy. Russian scientists at IKI are very interested in collaborating on a free-flyer Rosita as part of a smaller re-born Spectrum X-Gamma mission. Possibilities may also exist for cooperation with China.

ASTRO(2005)4
Noordwijk, 22 April 2005

EUROPEAN SPACE AGENCY

ASTRONOMY WORKING GROUP

Recommendations on the implementation of the Herschel Mission and the

adoption of the revised Herschel Science Management Plan

At its 122nd meeting held on 21-22 April 2005 at ESTEC, Noordwijk (NL), the Astronomy Working Group (AWG) was briefed by the Herschel Project Scientist and the Herschel instrument PIs about the current status of the mission. The AWG commends all those involved for the substantial progress that has been made towards building the flight hardware and ground segment for Herschel. The AWG reaffirms that the scientific programme of Herschel is of outstanding quality and expects that the mission will have a tremendous impact on many important topics in different fields of astronomy.

1) The AWG is very concerned about the delayed delivery of key hardware components, especially the instrument control computers. This appears to be caused to a large extent by contractual rather than technical difficulties and the AWG urges that the parties concerned resolve these issues as soon as possible.

2) The AWG is also very concerned that schedule pressure from (1), or other sources, will reduce the thoroughness of testing and calibration of the Herschel flight hardware in the critical period prior to instrument delivery. While the AWG is keenly aware of the adverse effects that any further delay of the Herschel/Planck launch would have on the overall ESA Science Programmme, the AWG emphasizes that pressure to maintain the launch schedule must not lead to enhanced risk of loss of scientific capability.

3) The AWG also discussed the possibility that pressure to maintain the launch schedule may not allow satisfactory solution of technical difficulties that may emerge in the future, leading to decisions that result in a significant degrading of Herschel's overall scientific capabilities (examples being deletion of an instrument mode or arm, under-population of focal plane arrays, use of components that are not fully flight-qualified, etc.). The AWG emphasizes that decisions that result in major changes of Herschel's scientific capabilities should be taken only after appropriate scientific review, including an evaluation by the AWG itself.

4. The AWG notes with satisfaction that its previous recommendations (ASTRO(2004)4) on the implementation of Key Programmes and on the policies regarding guaranteed time, have been followed in revisions to the Herschel Science Management Plan. The AWG endorses the inclusion of additional data reduction tasks, most importantly the generation and archiving of higher-level data products, in this Plan. **The AWG therefore unanimously recommends approval of the revised Science Management Plan for the Herschel mission.**

5. The AWG recommends that the Announcements of Opportunity for Herschel observations should clearly articulate the policies regarding potential duplications of targets and/or science areas and that these policies should be based on the general principles laid out in the Science Management Plan.

ASTRO(2005)2
Paris, 22nd March 2005

EUROPEAN SPACE AGENCY

ASTRONOMY WORKING GROUP

122nd Meeting

to be held on

21-22 APRIL 2005

*(commencing at **09.00 hrs on the 21st** and foreseen to end at 13.00 hrs on the 22nd)*

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

Draft AGENDA

1. Adoption of Agenda (ASTRO(2005)2)

2. Approval of report of 121st Meeting (ASTRO(2005)3)

3. Status of Cosmic Vision 2015-2025 exercise

4. Herschel
   - 4.1 Status report
   - 4.2 Science objectives
   - 4.3 PI reports
   - 4.4 Update of Science Management Plan
   - 4.5 Mission Scientists reports

5. Satellites in orbit
   - 5.1 HST
   - 5.2 ISO
   - 5.3 XMM-Newton
   - 5.4 INTEGRAL

6. Projects under development
   - 6.1 Planck
   - 6.2 Astro-F
   - 6.3 Corot

7. Projects in preparation and ongoing studies
   - 7.1 JWST
   - 7.2 GAIA
   - 7.3 Eddington

8. Future Mission Studies
   - 8.1 IRSI-Darwin (including GENIE status)
   - 8.2 XEUS
   - 8.3 Lobster, Rosita

9. Report on ESA-ESO working groups on Exoplanets and Herschel/Alma

10. Any other matter

11. Date and place of next meeting(s)

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