Report to the 150th Meeting of the Astronomy Working Group

This report has been compiled from inputs provided by the study and project scientists on 04 October 2012. It consists of three sections corresponding to items 11, 12 and 13 on the agenda of the 150th meeting of the AWG (ESA/AWG/OJ/150).

11 Status reports on M-class mission assessment studies

11.1 SPICA: Kate Isaak

Work has started with the E3SAT (ESA SPICA study science team) to update the SPICA Telescope Assembly (STA) science requirements document, such that the requirements are consistent with the performances that been shown to be achievable by industry during the industrial studies of the STA. This work is complemented by the activities of an ESA-led, joint ESA-JAXA-SAFARI telescope optical working group that is working to consolidate the technical requirements for the STA, including alignment procedures and contamination control.

The twice-yearly SAFARI consortium meeting was held in Leuven, Belgium. Progress was demonstrated in a number of areas including the TES detector chain. Work continues on updating and consolidating the SAFARI science requirements.

Work has started to confirm the baseline ESA contribution to the SPICA science ground segment (SGS). Tony Marston (ESAC, Herschel instrument/calibration scientist team lead) has replaced Johannes Riedinger as the ESA-responsible for SGS activities following the retirement of Johannes.

The first stage of the risk mitigation phase (RMP#1) – run by the ISAS-JAXA SPICA team - was completed in early August 2012. During this phase a number of critical aspects of the SPICA thermal design, pointing disturbance control, EMC and focal plane instrument design were studied by the ISAS-JAXA SPICA team, with support from ESA and the SAFARI team. A review of RMP#1 was undertaken by an independent team of engineers from the system engineering and project offices of ISAS: the RMP#1 was considered to be a success by the review team with most of the objectives met. An important result of work done during RMP#1 is that the thermal allocation given to SAFARI is now of the same order of magnitude as the needs to the instrument, something which has not been the case previously and that was seen as a major risk of the mission. The next step will be to consolidate the estimation made to build the allocation (concerning the harness and its shielding) and to establish margins at instrument level. A second risk mitigation phase (RMP#2) has started and will continue until April 2013. Activities to be undertaken during this period include consolidation of an end-to-end thermal design for the satellite (including SAFARI), as well as a number of breadboarding activities centred on technologies that are critical to the success of the SPICA mission (e.g., the main truss separation mechanism and the vibration isolation mechanism).

A small team from ESA comprising F. Safa, F. Favata, the study manager, and the study scientist travelled to Japan to discuss the outcome of the RMP#1 directly with

the ISAS-JAXA project team. ESA's participation in RMP#2 has been requested by ISAS-JAXA and discussion are continuing on the scope of any such participation.

The final stage of the SPICA FPI review ("delta" review) is about to start, with responses from the instrument teams expected on 9 October 2012. Members of the E3SAT will participate in the review through membership of the science and engineering panels. The review will conclude with a recommendation on the composition of the SPICA instrument suite in early 2013. SAFARI along with the MIR camera (WFC) and the MIR medium resolution spectrometer (MRS) are currently considered to be mandatory instruments, with the MIR high resolution spectrometer (HRS-L), the coronagraph and the FPC-S considered to be high-priority optional functions (note: a summary of the specifications of the SPICA instruments can be found at http://www.sci.esa.int/spica).

There was a strong SPICA presence at the recent SPIE meeting in Amsterdam, with a dedicated SPICA session comprising 29 contributions, of which 11 were specific to SAFARI.

11.2 EChO: Kate Isaak

Two working meetings of the EChO SST were held at ESTEC on 7-8 June and 3-4 September 2012. The primary task of both meetings was to continue refining the science requirements, including calibration requirements and definition of the mission reference sample. The requirement on photometric stability – one of the most challenging requirements for the EChO mission – has been redefined in terms of a maximum acceptable contribution to the radiometric noise budget, with a resulting relaxation in the stability needed for observations of faint targets. At both meetings, G. Tinetti presented the results of work to establish the signal-to-noise needed on key spectral features to achieve the science objectives of the EChO mission (written up in two papers submitted to journals in the last month). Work by G. Micela and I. Ribas is ongoing to confirm how well variability at IR wavelengths due to stellar activity can be corrected for through observations in the visible band: modelling suggests that a factor of 10 reduction in variability can be achieved.

The mission reference sample (MRS) was updated using the ESA radiometric model. One of the key aspects of the EChO mission is the need to cover a broad parameter space in terms of exoplanet and host star configurations. A hypothetical (statistically defined) sample, the MRS covers the full range of exoplanetary host systems that EChO can potentially observe according to current SNR requirements and conservative assumptions on instrument performance, illustrating the "maximal" parameter space available to EChO while providing a "minimal" number of targets to reach the scientific objectives. The MRS includes a significant number of gaseous planets and a smaller, but non-negligible, number of rocky planets.

An outline concept for the EChO science ground segment has been developed in the Science Ground Segment working group. The EChO open community workshop will be held on 1-3 July 2013.

Mid-term reviews were held for the instrument studies in mid-June: the two consortia each presented a baseline and back-up instrument concept. Critical interfaces between

the instrument and spacecraft are under review, including the data down-link budget and the division between on-board and on-ground data processing.

Technology development activities in the areas of European MCT detector characterisation at cryogenic temperatures, cryogenic fine steering mechanisms and hydrogen sorption coolers will start soon and will run in parallel with the EChO assessment study.

Mission baseline selection reviews (June) and progress meetings (September) were held with Industry: both industrial studies are progressing well with no "show-stoppers" identified. An off-axis afocal Korsch-like telescope in a horizontal telescope configuration has been selected as the baseline configuration, allowing a similar accommodation on the satellite to that found in Planck, including v-grooves and radiators. Optimisation of the design of the telescope optics is continuing.

A special session on EChO was held at the SPIE meeting in Amsterdam, at which nine oral/poster contributions were made by the two consortia.

11.3 LOFT: David Lumb

The instrument consortium mid-term review and industry mission baseline selection reviews have been successfully concluded, with no new major issues identified. Detailed issues which are being addressed in the second phase of the study include: accommodating a mock observing plan including a full range of science objectives in a baseline ~4 year mission (optimising the field of regard); subsequent analysis on temperature and stability, detailed orbit analysis and trade-offs in thermal performance, radiation damage, prompt radiation background, orbital maintenance and communications; system configurations analysis for the number and size of detector panels; cost scaling analysis of large number of repeated payload elements; Burst Alert system ground segment provision and on board processor requirements.

Prototyping of detectors, ASICS and collimators for the Large Area Detector are progressing well. Radiation damage testing of Si drift diodes reveals better than expected leakage current. The first tests with simulated micrometeorite impacts were encouraging – little effect was seen and the leakage current increase was small. Preparations for a technology development activity for a micro-channel plate collimator are progressing, but were delayed when it was decided that the ITT must be open competition as this complicated discussions on the cost and scope of work with the original preferred supplier.

Various science ground segment concepts are being discussed. The basic science requirements and functionality have been elaborated. A balance is being sought between providing a large amount of the functionality by the member state funded consortia, versus traditional core SOC functions provided at ESAC. Discussions with ESOC highlighted potential problems with data drops in the rainy seasons of Kourou and Malindi. This can be mitigated by the use of automated file transfer protocols. A big surprise was the likely non-availability of the Kourou X-band antenna. According to the ESATRACK evolution plans, the Kourou antenna will close once XMM-Newton operations cease and ESA will in the future rely on leased antennae for LEOP and commissioning activities. The lack of firm commitment to X-band capabilities

and commercial antennae locations in the period over a decade away make certain design decisions on LOFT operations rather difficult.

Following the decision to release a payload AO and extend the study, the industry contracts will be extended to July/August after a CCN is placed. The compilation of the AO data pack has dominated much of the ESA Study Team effort over the last two months. A major concern for both payload teams was the uncertainty if ESA has enough information on the payload interfaces (especially the thermal model) to be able to continue working over the next months of the open AO, where further communication is prohibited.

Substantial progress has been made on drafting the science case for the anticipated Yellow Book. However, the schedule has been delayed by the extension of the assessment study duration and the academic calendar of some of the external editors has caused further difficulties. Some work has been invested into understanding a way to execute the core science goals with different flavours of Key Project or Guaranteed Time. A method to use GT time within a prioritised OTAC recommendation has been proposed in the proto-Science Management Plan released with the AO pack.

A community Science Team meeting was held in Toulouse on 24-27 September, with the aim of further publicising the mission performance and creating an improved core science.

A number of instrumentation presentations were made at the SPIE meeting in Amsterdam.

11.4 STE-QUEST: Luigi Cacciapuoti

The atom interferometer consortium is working on the optimisation of the atomic source parameters to minimise the effect of the gravity gradient across the atomic cloud. The gravity gradient impact on the interferometer contrast visibility is being evaluated. The instrument resources budget (mass, power consumption and volume) has been recently reviewed and consolidated.

The design of the STE-QUEST links is progressing. A preliminary design of the optical and microwave links has been provided in the frame of an ESA TRP activity. The proposed designs are in line with the STE-QUEST requirements.

After successful completion of the Mission Baseline Selection Review (MBSR), industrial activities are refining payload design and instruments accommodation studies. Two abstracts have been prepared to request technology development activities on the STE-QUEST links (both optical and microwave). The ITT for development activities on the STE-QUEST lasers is about to be issued. Also, the STE-QUEST Instruments AO has been issued by ESA.

Roles and responsibilities at the STE-QUEST SOC have been discussed and clarified with ESAC. Input has been provided on the STE-QUEST proto-SMP prepared for the STE-QUEST Instruments AO. The STE-QUEST MAD has been iterated with ESOC.

The STE-QUEST SST has recently agreed to keep open the option of reusing the PHARAO caesium (Cs) clock. As a result, the STE-QUEST clock requirements have been relaxed. The possibility of using the PHARAO Cs clock "as is" (FM presently under development in the frame of the ACES mission) significantly reduces costs and development risks at the expenses of a modest loss in science (a factor 2-3 in gravitational redshift tests in the field of the Earth).

The single-shot sensitivity of the atom interferometer to differential acceleration measurements has been reconsidered (2.9×10^{-12} m/s^2 per single measurement cycle) to account for the loss of visibility due to the gravity gradient across the atomic clouds. Relaxation of short-term stability of the optical cavity as well as of the phase noise of the signal delivered by MOLO has been agreed with the clock consortium. Link requirements have been re-adapted to the requirements of the space and ground clocks resulting in a relaxation of their stability figures.

The STE-QUEST SciRD has recently been improved following MBSR results. The requirements on the rms of quasi-periodical accelerations at the atom interferometer and at the clock have been defined. The requirement on non-gravitational accelerations along the atom interferometer sensitive axis has been refined from 1×10^{-6} m/s^2 to 4×10^{-7} m/s^2. Requirements on spacecraft rotations (and pointing) have been clarified. A recipe for evaluating power spectral densities of the acceleration noise has been provided. The changes discussed above have been included in the STE-QUEST SciRD Issue 1, Rev. 4, recently issued for the Instruments AO.

The science team has provided algorithms that allow for a complete evaluation of the orbit performance against the STE-QUEST mission objectives. ESOC is now developing a code able to take this input into account in the orbit optimisation process.

12 Projects under development

12.1 Gaia: Timo Prusti

All the flight hardware for Gaia has been procured. The Service Module (SVM) Thermal Balance/Thermal Vacuum (TB/TV) testing has been completed. Retrofitting of some SVM units where components need to be exchanged continues. The Deployable Sunshield Assembly (DSA) has been dismounted after successful testing. The DSA will be stored and later transported to the launch site for a final opening test and integration into the spacecraft.

The Payload Module (PLM) has successfully gone through the mechanical testing. After the mechanical tests it was possible to test the Basic Angle Monitoring (BAM) device in ambient conditions. Despite the ambient conditions, BAM fringe patterns were seen, confirming the functioning of the device. At the moment, the PLM is at CSL in preparation for the TB/TV test.

At a late stage, a high spatial frequency inhomogeneity was discovered on the Radial Velocity Spectrometer (RVS) filter. The impact on the spectral resolution would have been significant and thus a new filter was manufactured. The new filter has a flatter transmission curve with steeper edges. Most importantly, the high spatial frequency

inhomogeneity has been removed. The new filter has one disadvantage at the red end of the spectrum. Instead of a cut-off at 874 nm, the turnoff of the transmission curve now sets in around 871 nm. This has no impact to the calcium triplet lines, which are key for the radial velocity determination. However, there are lines that will be lost, including the only two magnesium lines in the RVS wavelength range. Nevertheless, the recovery of the spectral resolving power is more important than the magnesium lines and the decision to change the filter to the new one has been made. The filter replacement will be completed before the start of the PLM TB/TV tests.

The development of the ground segment is progressing well. A specific operations rehearsal exercise was conducted successfully to process three (typical) days of simulated data from the spacecraft. The next operations rehearsal will take place in December 2012 with more challenging simulated data sets. The standard SVT runs have been conducted between the spacecraft Avionics Model and ground segment demonstrating good functioning of the interfaces.

The Gaia Data Processing and Analysis Consortium (DPAC) chair, Francois Mignard informed the consortium in the spring that he would not be seeking a new three-year term for the post. As a consequence the DPAC has had to search for a new chair. After completing the selection procedure, DPAC unanimously proposed Anthony Brown as the new DPAC chair. The Gaia DPAC Steering Committee, where the national funding agencies have seats, endorsed the DPAC selection and designated Anthony Brown as the new DPAC chair as of 1 October 2012.

12.2 LISA Pathfinder: Paul McNamara

Following the first part of the Qualification Review, the spacecraft and propulsion module were put into hibernation. The spacecraft hibernation period has been somewhat shortened due to the activities required to install the new micro-propulsion system (see below). The *wake-up* activities are now scheduled to begin in April 2013.

Much of the recent effort of the prime contractor and ESA has been concerned with the micro-propulsion system. At the time of last reporting, the Field Emission Electric Propulsion (FEEP) thruster system had undergone a successful thruster emitter test, demonstrating, for the first time, the full LPF lifetime requirements. However, in a subsequent test of another thruster, it again failed, and the test had to be prematurely terminated. This most recent failure led the project to make a decision to change the baseline thruster architecture from the FEEPs to cold gas micro-thrusters. The cold gas system is an off-the-shelf solution (having been developed for Gaia), which, even with the changes required to the spacecraft, reduces both the schedule and risk.

The final architecture of the cold gas system is still under study. The current proposal calls for two sets of six thrusters (prime and redundant) mounted on the spacecraft in clusters of two thrusters each. In a change from the FEEP layout, all thrusters are mounted so as to act against the solar radiation pressure on the spacecraft: the thrusters are angled to allow 5 degrees-of-freedom control, with the 6th degree-of-freedom being provided by the solar radiation pressure. A similar scheme was proposed and studied for the LISA mission.

The detailed design of the cold gas implementation is being made by the prime contractor (Astrium, UK), with the Critical Design Review (CDR) scheduled for March 2013. After the CDR, the relevant spacecraft panels will be removed, and integration of the cold gas system will begin.

The integration of the payload is delayed due to a failure of a brazed interface during the vibration testing of the electrode housing, when the guard ring surrounding the electrodes broke free. No damage was done to the electrodes; however, the qualification status of the brazing as a means to hold the guard ring in place has been brought into doubt. A Tiger Team will be established to investigate the failure and propose solutions that not only mitigate the problem, but also minimise the schedule impact. The electrode housing is now on the critical path of the mission. Delivery of the LTP Core Assembly to the prime contractor is scheduled for March 2014.

The science team have been heavily involved in the analysis of the data from the system test campaigns. The main focus of attention is the on-station thermal test, in which performance tests of the Optical Metrology System (OMS) were performed. The analysis shows that the system performance exceeds requirements, in some cases by ~two orders of magnitude. The vast improvement in performance of the integrated system over lab test campaigns is due primarily to the monolithic flight fibre injectors on the optical bench and the stable thermal environment provided by the spacecraft. Analysis of the data is continuing, primarily to understand all the features of the data, but also to adapt and extend the data analysis algorithms to deal with real (non-stationary) data.

In June 2012, the Science and Technology Operations Centre (STOC) held the first in a series of operations simulation campaigns; a three day event involving ~30 scientists. The simulation involved both the STOC team (with PI support) at ESAC, and an external group of scientists located at the APC in Paris. All who took part considered the simulation a great success. A second simulation campaign will take place at the end of November 2012.

The science team have also continued the study of using LISA Pathfinder to investigate alternative theories of gravity around the Sun-Earth L1 saddle point. Initial investigations look promising, with the Astrium UK mission analysis team providing solutions to allow the spacecraft to transit back towards the Earth and to pass through the saddle point region, while the science team have refined the data analysis techniques to optimise the signal-to-noise in the event of a positive signal.

LISA Pathfinder was well represented at several conferences over the summer, including a dedicated session at the 39th COSPAR assembly held in Mysore.

12.3 JWST: Pierre Ferruit

During the last six months, the JWST project has passed several high-visibility milestones. First, the manufacturing, polishing, and coating of all the JWST mirrors has been completed, including the primary segments, secondary, and tertiary. Second, two out of the four JWST instruments were delivered to NASA Goddard Space Flight Center (GSFC): the MIRI optical module arrived at the end of May and was followed by the FGS/NIRISS instrument in July 2012. They will be integrated in the

"Integrated Science Instrument Module" (ISIM) and will participate to the first ISIM cryogenic test campaign in Spring 2013. The remaining two instruments (NIRSpec and NIRCam) will be delivered in 2013 for integration in the ISIM, and will participate in the subsequent ISIM test campaigns.

The "re-integration" of NIRSpec on the FM2 bench is proceeding well and will be completed toward the end of October. The results from the end-to-end testing of its optical performances at ambient temperature are well within requirements (wave front errors and distortion). The main cryogenic test campaign, which includes major characterisation and calibration activities, has been moved forward and will start in mid-November. It will be followed first by vibration and acoustic testing and then by a second, short cryogenic campaign. Delivery to NASA is now planned for mid-2013.

An increase of more than 10% in the total number of permanently closed micro-shutters in the NIRSpec flight Micro-Shutter Array (MSA) was discovered during early cryogenic testing in July 2012. This is an important issue and NASA has appointed an anomaly review board. In parallel to the board investigation, NASA has decided to restart the micro-shutter manufacturing chain with the goal of having a full spare MSA available in 2014 when the NIRSpec detectors will be replaced. This will give an opportunity to put this spare MSA into NIRSpec, if necessary.

The work for the replacement of the degrading near-infrared detectors (a mission-wide effort across all near-infrared instruments) is on track. The first short-wavelength parts have been manufactured and are being tested. The manufacturing of the first lot of long-wavelength parts for NIRSpec has started.

12.4 ASTRO-H: David Lumb

There has been a successful delivery of ESA-supplied hardware items to JAXA include all BGO crystals and liquid heat pipes. The high voltage power supplies required new non-ITAR operational amplifier replacements and reworking of some PCBs. After thermal testing some NCRs were reported, but pending final agreement with JAXA, are likely to be used as-is. Radiation testing performed at CEA on JAXA ASICS revealed a small level of latch-ups, so a further test campaign will be conducted to characterise the exact energy threshold.

Load analysis using the ASTRO-H mathematical model was used to refine the vibration levels to be used on the STM. Pending the confirmation of levels, JAXA were unwilling to sanction a launch with another satellite passenger, and therefore a single launch has been selected for ASTRO-H on an H2-A202 rocket.

Critical tests are continuing to confirm the system design, including thermal deformation test, testing of the Thermal Test Model (TTM), Mass Test Model, and micro-disturbance tests. EM functional tests are only commencing but teams have already started making some components for the FM. It has taken almost four months to integrate the TTM, since most of the structures of the TTM model such as the base plate, fixed optical bench, side panels and MLI, are already FM and hence the TTM had to be integrated with great care.

Earlier concerns about science instrument performance have been alleviated with measurements of prototype SXI CCD imager and the SGD gamma instrument performance improving significantly towards the promised specifications. The first optical measurements of integrated telescope shells are better than specification.

A proposal from the ISDC (Geneva) for the ASTRO-H Science Support Centre was received and after some delay a contract has been placed. ISDC team members will be supporting user software testing subject to arrangements with JAXA and NASA/GSFC over software release dates.

As part of the annual EWASS meeting held in Rome, a special session on ASTRO-H was arranged with presentations from JAXA, ESA, and participating national institutions. The meeting was well attended and the wide range of scientific topics that will be addressed by ASTRO-H observations was presented. The session was organised by the ISDC ASTRO-H user support team.

An ASTRO-H science team meeting was held in July in Cambridge UK. Major discussions about the white papers regarding key science projects were conducted.

12.5 Euclid: Rene Laureijs

On 19 June 2012, Euclid received final SPC approval to move into the full construction phase, leading to its launch in the third quarter of 2020. The SPC also formalised the multi-lateral agreement with European funding agencies to develop Euclid's two scientific instruments and the large distributed processing system needed to analyse the data they produce. Finally, the SPC agreed on a Memorandum of Understanding (MoU) that will see NASA help to provide infrared detectors. As part of the MoU, a science team of at most 40 US scientists will become an integrated part of the Euclid Consortium. One of these US scientists will become a member of both the Euclid Science Team, chaired by the ESA Project Scientist, and the Euclid Consortium Board, chaired by the Euclid Consortium Lead. A NASA Research Announcement was issued for US scientists and lead scientist, with closing date of 31 August 2012. The selection should be completed by the end of October.

A Euclid Project Team at ESTEC has been formed, headed by the Project Manager, G. Racca. The project team will support the next phases of the mission until the spacecraft commissioning after launch. The project team has started with the procurement of the payload module (PLM). The PLM includes the telescope and the instrument mechanical and thermal accommodation. As soon as the PLM contractor has been selected in December 2012, an invitation to tender will be issued for the industrial prime contractor for the Euclid system and the spacecraft service module. The kick-off of the prime contract is foreseen in July 2013. As part of the Euclid Project, teams at ESAC, supporting the science operations centre, and at ESOC, supporting the mission operations centre, have also been formed.

ESA has also started the procurement of the near-infrared detectors for the near-infrared spectrometer photometer and the CCDs for the visual imaging instrument. The Euclid Consortium, who will eventually receive the detectors from ESA, is closely involved in this process. The detector contracts include an industrial evaluation and characterisation phase, followed with the production phase for the

manufacturing of the flight detectors. Timely production and delivery of the detectors is necessary to ensure that the delivery of the payload instruments is in line with the overall project schedule.

The PLM procurement and the preparation of the prime contract involved a major update of the requirements documentation, making it more suitable for industry to respond with competing proposals. The Euclid Consortium and ESA have put a large effort into understanding the science requirements and the lower level engineering requirements, which should flow from them.

The Euclid Consortium organised a full week of lectures for engineers at the Institut D'Astrophysique de Paris, to bring new ESA Euclid staff up to speed on the science, the experiment, and the overall technical organisation of the Euclid mission.

13 Satellites in orbit

13.1 Herschel: Göran Pilbratt

Herschel generally continues to operate very well and is producing high quality science data. As of 28 September 2012 (end of OD#1233), Herschel had executed >99% of the KPGT, KPOT, and GT1 observations, approximately 86% of the GT2, 95% of the OT1, 65% of the OT2 priority 1 observations, as well as a limited amount of priority 2 observations. This information is updated weekly and publicly made available to the community on the Herschel Latest News webpage (http://herschel.esac.esa.int/latest_news.shtml).

The established long-term track record of an average execution of 19 hour/day of HOTAC approved science observations is being maintained (19.0/19.4 hour for last 6/12 months until OD#1197), and there is no trend with respect to 'lost time' which is of order 3%, usually due to single event upsets (SEU's) in the instrument warm electronics. At the 50th meeting of the Herschel Science Team (see below), the PI's were requested to state whether they are aware of any 'ageing' effects in their instruments or in the (spacecraft) environment in which they are operated. With the exception of a well-known degradation of an internal HIFI calibration signal, the response was that no such 'ageing' has been observed.

It is expected that 'all' non-priority 2 observations will have been executed by the end of 2012, barring a limited number of exceptions based on target visibility and straylight considerations, as well as rescheduling of some failed observations. The predicted end of helium (and thus of performing science observing; there is no 'warm phase') is March 2013, at which time Herschel will have produced in excess of 20,000 hours of science observing.

The Post-Operations Phase (POP) plan documentation is being brought to review status. The plans have been presented to the HUG and the HST in their September meetings. The datapack is now being prepared for release on 15 October 2012, the formal 'POP Readiness Review' with a day of presentations and deliberations is to be held on 30 October 2012 in ESAC.

Discussions regarding the final 'disposal' of the Herschel spacecraft are taking place led by ESOC. The baseline is to put the Herschel spacecraft in a heliocentric orbit,

away from the Earth. However, a science-driven proposal for lunar impact has been received and circulated. ESA flight dynamics have confirmed the overall feasibility of such a lunar impact. Example impact trajectories for both lunar poles have been computed: leaving the current operational orbit at the end of April 2013 lunar north pole impact could occur around midsummer, or south pole impact at the end of July 2013. The proposal was due to be presented and discussed by the SSEWG in their meeting to be held on 8-9 October 2012 in ESTEC.

Reprocessing of all Herschel observations in the Herschel Science Archive (HSA) up to and including OD#1061 was completed in early August 2012. A higher level of processing – level 2.5 or 'extended processing' – to combine multiple AOR's for PACS and SPIRE has been introduced and completed as well, concluding the HIPE 8 bulk reprocessing activities. The performance has been greatly in excess of what has been achieved earlier for bulk reprocessing. In the meantime, HIPE 9 is operational and the next bulk reprocessing is planned to commence shortly.

The systematic 'wrap-up' telecons with all 42 KP consortia continue; to date, telecons with 24 consortia have taken place, and are considered by all parties involved as very constructive.

The 5th Herschel User Group meeting (HUG#5) took place on 6-7 September 2012, and them 50th Herschel Science Team meeting (HST#50) took place on 20-21 September 2012, both at ESAC. The Post-Operations Phase plans were presented for discussion and feedback to both committees. The minutes with recommendations from all HUG meetings are posted on the HUG webpage at http://herschel.esac.esa.int/HUG.shtml.

On the initiative of the Herschel Project Scientist and together with Mission Scientists, the entire Herschel set of approved science has been assessed for 'holes', or observations that 'must' be done but which are not currently in the system. The community was invited (through a mass-mailing conducted on 25 May 2012) to provide suggestions; 58 were received. A meeting was held on 25-26 June 2012, and a shortlist of potential 'Must-Do' observation programmes was produced, later reduced to seven programmes for a total of about 106 hr. The shortlist of potential 'must-do' observation programmes, submitted as a DDT request, has been approved. The AOR's for the seven programmes are being implemented in the operational database, and the first observations have been scheduled. The list will be publicly posted shortly.

For all Herschel webstories published on the ESA Portal and/or SciTech websites, see the HSC website listing at http://herschel.esac.esa.int/Press_Releases.shtml.

At the time of writing, 504 Herschel papers have been published in the refereed literature since launch, 228 in 2010, 98 in 2011, and 178 so far in 2012. The publications list is maintained and updated about twice monthly, and publicly available from http://herschel.esac.esa.int/ScientificPublications.shtml.

13.2 Planck: Jan Tauber

Planck continues to operate very stably. Satellite operations are very smooth and generally uneventful. The LFI continues to operate normally and is now starting its 7th full sky survey. While not obtaining astronomical data any longer, HFI nevertheless remains in operation as it is needed to operate the 4K cooler and maintain the temperature of the LFI's reference loads. Furthermore, since December 2011, HFI is acquiring technical data on each of its bolometers that allows estimation of the effects of a non-linearity arising in on-board analogue-to-digital converters. These data, important for gain calibration, are quite laborious to acquire. This activity will continue until at least November of this year.

Since the publication of the special issue of Astronomy & Astrophysics in December 2012 dedicated to early scientific results from the Planck mission, 10 additional papers have been submitted by the Planck Collaboration to A&A. Eight of these papers are on cluster physics, one on statistical analysis of IR sources, and one on the so-called "Galactic Haze".

The due data for delivery to ESA of Planck data products (maps etc.) is on 1 December 2012 and the PI teams intend to keep to this date. However, the preparation of associated scientific papers is late with respect to this date. It is proposed that both data and papers will be simultaneously released to the public at a PR event on, or around, 15 March 2013. The release will take place about 2 weeks before the start of a large conference to take place at ESTEC, whose main purpose is to showcase the data and results to the community. The conference is entitled "The Universe as seen by Planck", and will take place between 2–5 April 2013. The organisation is well advanced and pre-registration should open on 15 October.

An acceptance review for the upcoming delivery of Planck products will take place at ESAC on 29 October. Its purpose is to evaluate the readiness for delivery and its subsequent release to the public.

13.3 HST: Antonella Nota

The HST mission continues nominally. Observatory scheduling efficiency remains high (~50%) and all observatory subsystems continue to function well.

The demand for Hubble time remains very high. The Hubble Time Allocation Committee (TAC) met at the STScI on 21-25 May 2012 to assess the proposals submitted in Cycle 20. Out of more than 100 participants, twenty one European astronomers were involved in the selection process as panel members, panel chairs and TAC members. In the general observer category, the oversubscription was 5:1 in terms of proposals and 6:1 in terms of orbits. Principal Investigators from ESA member states were remarkably successful in this cycle, obtaining ~20% of the successful proposals, and ~27% of the orbits allocated. This is the highest percentage ever allocated to ESA member states astronomers. ESA scientists also represented ~28% of the total number of Co-Investigators.

Hubble outreach activities continue to engage scientists and the public at large. Recently, the completion of the very successful *Hidden Treasure Contest* was announced. Hubble has made over a million observations since launch, and only a

small proportion of these are attractive images — an even smaller number are ever actually seen by anyone outside the small groups of scientists that publish them. But the vast amount of data in the archive means that there are still many hundreds of beautiful images scattered among the valuable scientific data that have never been enjoyed by the public. These pictures are called “Hubble’s hidden treasures”, and recently, the public were invited to look through Hubble’s science archive to help find them.

The response was impressive, with almost 3000 submissions. More than a thousand of these images were fully processed: a difficult and time-consuming task. The best images are already showcased in the Hubble Picture of the Week series.

Hubble has allowed astronomers to see changes in the upper atmosphere of a faraway planet. Lecavelier des Etangs (CNRS-UPMC, France) et al. (A&A 543, L4, 2012) observed the atmosphere of exoplanet HD 189733b during two periods in early 2010 and late 2011, in transit against its parent star. The observations were carried out in order to confirm what the team had previously seen once before in a different planetary system: the evaporation of an exoplanet’s atmosphere.

HD 189733b is a gas giant at about 5 million km from its star. Even though its star is slightly smaller and cooler than the Sun, the planet’s climate is exceptionally hot, at above 1200K, and the upper atmosphere is battered by energetic extreme-ultraviolet and X-ray radiation. As such, it is an excellent candidate to study the effects of a star on a planetary atmosphere. The first set of observations showed no trace of the planet’s atmosphere at all. But the follow-up observations, made in 2011, showed a dramatic change, with clear signs of a plume of gas being blown from the planet at a rate of at least 1000 tonnes per second.

It appears that, despite the extreme temperature of the planet, the atmosphere is not hot enough to evaporate at the rate seen in 2011. Instead the evaporation is thought to be driven by the intense X-ray and extreme-ultraviolet radiation from the parent star, which is about 20 times more powerful than that of our own Sun. Combined with the proximity of the planet to the star, the X-ray flux is roughly 3 million times higher than the Earth. Evidence to support X-ray driven evaporation comes from simultaneous observations of HD 189733A with Swift. A few hours before Hubble observed the planet for the second time, Swift recorded a flare from the surface of the star, in which it briefly became 4 times brighter in X-rays. The authors believe that this flare is likely to have driven the evaporation seen shortly after.

13.4 XMM-Newton: Norbert Schartel

A total of 111 scientists participated on the XMM-Newton SOC organised workshop “Galaxy Clusters as Giant Cosmic Laboratories” from 21–23 May 2012 at ESAC. The conference reflected the huge progress made in the physical understanding of clusters of galaxies and their evolution over cosmic time scales, and the use of clusters as cosmological probes of space structure formation. The new findings were primarily based on X-ray data, now significantly complemented by Sunyaev-Zel’dovich and optical measurements. The refereed proceedings of the workshop will be published in the Astronomical Notes.

The 12th XMM-Newton SAS training workshop was held at ESAC from 11–15 June, with 16 participants, all indicating that they were very happy with the provided lectures and hands-on sessions.

The XMM-Newton Users' Group met at ESAC on 19–20 April 2012. The Users' Group thanked the XMM-Newton collaboration, including the project and the external teams, for the overall excellent work in conducting observatory operations. The Survey Science Centre (SSC) consortium was congratulated and thanked for the service provided to the project during so many years. The Users' Group recommended (1) maintaining the reached status of the calibration and to improve specific issues which would allow addressing unique science; (2) ensuring that expertise on all baseline calibration activities is maintained; (3) implementing the four Reaction Wheel Drive option, (4) implementing / continuing joint programmes and cross-calibration; (5) continuing with generation of source catalogues by the SSC in cooperation with the XMM-Newton SOC; (7) improving the handling of mosaic observations with SAS and in the pipeline, and (8) the mission extension.

The 12th call for observing time proposals was issued on the 21 August 2012 with a deadline of 5 October 2012 (12:00 UT).

Reis et al. (Science 337, 949, 2012) reported the detection of a 200s quasi-periodicity following the tidal disruption of a star by a dormant supermassive black hole. XMM-Newton monitored the tidal disruption event, Swift J164449.3+573451, with twelve 25ks observations as the longest ToO programme performed so far. The authors found a ~200s quasi-periodic oscillation (QPO) which is detected in the first two XMM-Newton observations. The oscillation is also seen in an early Suzaku observation. This is the second QPO detected from a supermassive black hole.

Kargaltsev et al. (Science 337, 946, 2012) reported the first detection of absorption features in the X-ray spectrum of an ordinary radio pulsar. The majority of known non-accreting neutron stars (NS's) are rotation-powered radio and/or γ-ray pulsars. So far, their spectra have all been satisfactorily described by thermal and non-thermal continuum models, without spectral lines. Spectral features have, however, been found in exotic NS's and were thought to be a manifestation of their unique properties. The authors report the detection of absorption features in the XMM-Newton and Chandra X-ray spectra of an ordinary rotation-powered radio pulsar, J1740+1000. The findings bridge the gap between the spectra of pulsars and other, more exotic, NS's, suggesting that the features are more common in the NS spectra than have been thought so far.

At the time of writing of this report (24 September 2012), 3152 papers which make direct use of XMM-Newton data have been published in the refereed literature, of which 200 are from 2012.

13.5 INTEGRAL: Christopher Winkler

The spacecraft, payload and ground segment are performing nominally. Due to strong solar flares, safe modes for the payload were triggered on 17 May 2012. The SPI annealing #19 was successfully performed in June.

INTEGRAL triggered two “Emergency Sun Acquisition Modes” (ESAM’s) on 7 June and 16 August 2012. They were caused by “Single Event Upsets” of the Reaction Wheel Drive Electronics (June) and by a loss of the star tracker’s guide star during a closed loop slew (August). The MOC team did very well to perform a quick recovery, which were completed in both cases in less than 24 hours. During its entire orbital life (10 years, so far), INTEGRAL has triggered four ESAM’s in total.

Scientific observations have been executed according to the AO-9 long-term plan. During the INTEGRAL observations in the direction of IGR J17544-2619 and the galactic bulge performed on 16–17 September 2012, a bright new transient was detected (ATEL # 4381). The location of the INTEGRAL source is consistent with the newly discovered transient, Swift J174510.8-262411. Because of the rapid flux increase, the high value of the energy cut-off and the absence of thermonuclear bursts, it can be argued that Swift J174510.8-262411 might be a new (long-awaited, bright) black-hole transient. A ToO follow-up observation (1 Ms, PI: Tomaso Belloni) was approved by the Project Scientist on 18 September, and observations began in the evening of the same day. Following a request by the PI, all scientific data will be made public and immediately available to the scientific community.

Three GRB’s were detected in the FOV during the reporting period: GRB 120512A, GRB 120711A (see ‘science highlights’, below) and GRB 120821A. The omni-directional SPI anti-coincidence subsystem is detecting about 1 GRB per 3 days.

INTEGRAL conducted a new series of public Earth/Cosmic X-ray Background (CXB) observations on 9–10 May, and 28 August 2012. Another set of these observations through Earth occultation of the FOV was planned for 27 September 2012. More observations will be performed in AO-11 (2013) and beyond. This is a public programme, building on initial observations in 2006 (Churazov et al., A&A 467, 529, 2007; Türler et al., A&A 512, 49, 2010), where the INTEGRAL spacecraft will be commanded to a special attitude to let the Earth drift through the field of view of the INTEGRAL instruments. Results from these observations will help in separating the cosmic and instrumental backgrounds, and so ultimately lead to improved background subtraction. Scientifically, the main goals are to measure the spectral shape of the diffuse CXB emission above 20 keV and to study any high-energy emission from the Earth during storms in auroral regions.

At 02:44:48 UT on 11 July 2012, an extremely bright and long GRB was triggered by INTEGRAL. It had a T90 duration of 113 seconds as measured by SPI in the 20–200 keV band, and it was detected by SPI up to 8 MeV. The IBIS/ISGRI light-curve of the prompt emission was strongly affected by telemetry gaps. The burst consisted of a hard precursor followed by a long multi-peaked pulse with a peak flux of ~32 ph/cm^2/s in the 20-8000 keV band, slightly less intense than INTEGRAL’s brightest burst to date, GRB041219A. Most unusually, however, the burst also showed a long tail of emission, lasting at least up to ~1200 sec after the trigger time and detected by both IBIS and SPI in the 20-50 keV energy range. There is no evidence for periodicity in the tail. Other telescopes rapidly followed up the burst. Fermi/LAT detected tail emission up to 2 GeV, while robotic optical telescopes detected a rapidly brightening and decaying optical counterpart, peaking at magnitude ~12 (R and V bands) while the burst was still in progress. A tentative spectroscopic redshift of 1.405 has been made using Gemini-S, while a photometric determination of z~3 has been made by

GROND. XMM-Newton has carried out 2 follow-up observations of the source. This burst provides us with a perfect storm of characteristics such as intensity, spectral hardness, exceptionally long-lived tail, prompt and bright optical emission and GeV detection of the tail, to enable a rich analysis and interpretation.

The AO-10 for "data rights proposals" was released on 3 September 2012 as planned (proposal deadline: 28 September).

Prof Giorgio Palumbo (U. of Bologna) retired and stepped down as Mission Scientist of the INTEGRAL Science Working Team (now INTEGRAL Users' Group). Giorgio had been INTEGRAL Mission Scientist since 1995.

The scientific programme of the 9th INTEGRAL workshop (15–19 October 2012, Paris) was published in July, including 22 invited and review talks, 62 contributed talks, and about 90 poster presentations.

A number of ESA web stories based on INTEGRAL science results were published during the reporting period and others are in preparation.

The total number of INTEGRAL refereed scientific papers published since launch up to the end of July 2012 is 696, with 37 in 2012.

13.6 SUZAKU (ASTRO-E2): Arvind Parmar

Suzaku, the Japanese-US X-ray astronomy mission, was launched in July 2005 and has been successfully performing astronomical observations with its X-ray CCD cameras and hard X-ray detector for more than seven years. During this time the power output of the solar panels has been degrading more or less as predicted. Recently, the power output has decreased to a level at which operations have started to be affected. Currently, all non-critical hardware has been turned off and the range of allowed Sun angles has been reduced from 65–110^{o} to 70–110^{o}. If the degradation continues at the same rate, it is expected that by around February 2014, it will not be possible to use all the instruments simultaneously, as at present.

Observations from the current announcement (EAO-7) should be completed by the end of March 2013 and JAXA has decided to issue another AO noting that some of the instruments may have to be switched-off before the end of the AO. They also note that a rapid reduction in solar panel output may result in the mission being terminated within the AO. The corresponding European Suzaku Announcement (AO-8) opened on 1 October 2012 with a deadline of 16 November 2012 at 16:00 CET. The AO solicits proposal for observations to be conducted between April 2013 and March 2014, with the caveats mentioned above. As before, JAXA/ISAS has kindly offered scientists from institutes located in the ESA Member States 8% of the open observing time. European proposers are expected to involve one, or more, Japanese co-investigators. More information can be found on http://www.rssd.esa.int/Suzaku.

Scientists from institutes located in the ESA Member States appear as authors of 165 refereed papers based on Suzaku observations. The data for many of these papers have been obtained through the annual European Suzaku Announcements of Opportunity.

13.7 CoRoT: Malcolm Fridlund

After more than 2100 days in orbit, CoRoT continues to operate nominally, although without DPU#1 which failed in 2009. This leads to the loss of half the field-of-view, but since more bandwidth becomes available, more data can be packed into the resulting field. Further, it has been shown that in order to maximise the output of CoRoT, the optimum integration time on a given field (due to magnitude limitations and detectable transit depth limitations), is <100 days. This means that CoRoT can observe twice as many fields as originally foreseen. The science loss due to the DPU is thus minimal. Instrument and performance trends remain within requirements.

Based on the proposal prepared by the CoroT Science Committee, consisting of representatives of all the CoRoT partners (CNES, ESA, Austria, Brazil, Belgium, Germany and Spain), The CNES COmmite de DIRection (CODIR) decided on June 29, 2012 to extend the mission from 2013 to 2016. The program intended for the following three years is at http://smsc.cnes.fr/COROT/PDF/CoRoT_III_programme.pdf. The lifetime of CoRoT is not significantly constrained by consumables and performance degradations have been negligible so far. It is expected that after the mission ends (earliest in 2016), the satellite will be deorbited using remaining fuel.

On 1 October 2012, the LRc10 run was stopped after which the satellite were reversed and pointed in the anti-centre direction for the winter observations. The first target field this winter is LRa09 and the asteroseismology observations commenced on 2 October. This was followed by the start of the exoplanet observations on 4 October 2012. This first winter run of the 2012–13 season is expected to end on 7 January 2013. The priority for the asteroseismology segment during this winter is to follow an assemblage of ~10 O-type stars under a long time (> 100 days).

Two recent published papers (Colon et al. 2012, MNRAS, 426, 342; Santerne et al. 2012, A&A, 545, A76) both suggest that the false positive rate of NASA's Kepler mission is significantly higher than previously stated, bringing Kepler results into better agreement with the results from CoRoT.

Escobar et al. (A&A 543, A96, 2012) present a detailed analysis of the seismic data for the solar type star HD 52265 which was followed by CoRoT for 117 days. This G0V star has a known 0.5 Jupiter mass planet in a P=119 day orbit. The solution to the retrieval of the asteroseismological parameters of the host star are mass = 1.24 +/– 0.02 solar masses, radius = 1.33+/–0.02 solar radii, and age = 2.6 +/–0.2 Gyr.

Although the stellar mass is now known to 1.5%, unfortunately this accuracy cannot be directly transferred to the planet, as the latter is non-transiting and an inclination angle uncertainty remains. Nevertheless, this observation again (as with previous reported CoRoT and Kepler results) demonstrates what can be done with simultaneous asteroseimology and transit observations.

The total number of refereed scientific articles based on CoRoT data published in 2012 is 54. The number of confirmed planets is 29. About 6 more planets are in the final stages of confirmation/publication.