Report on Solar System Missions in Operations

SSEWG, 30/31 May 2011, ESTEC

In general all spacecraft and their payloads were nominal during the reporting period continuing to provide science data for the community.

<u>Ulysses</u>

The work in the post-operational phase continued according to schedule. The work on the legacy archive has been planned in greater detail. All data products will be available at ESTEC later this year and than ingested into the system at ESAC, which eventually will host the legacy archive.

<u>SOHO</u>

The payload and spacecraft performed nominally during the reporting period. Nominal quarterly spacecraft manoeuvres were performed on 19 January and 22 April.

On 12 April 2011 at 23:22:31UT, after successful completion of the cross-calibration with SDO/HMI, MDI was commanded to stop taking science data. MDI has operated exceptionally well for more than 15 years and has produced data that form the basis of 1500 papers in the refereed literature.

Cluster and Double Star

The four Cluster spacecraft and ground segment continue to operate nominally. Once every orbit (2.5 days) the spacecraft enter into eclipse and, at their exit, are reconfigured by the flight control team. The eclipse season will last up to July 2011. Two anomalies were experienced on the payload. The first one occurred in March on the Wave Experiment Consortium (WEC) on C3. The anomaly seems to be caused by the relays that give the power to the 5 instruments that would have stayed on after an anomalous switch-off. At subsequent switch-on, the 5 instruments that are then starting simultaneously instead of sequentially use too much current and are switched-off by the latch current limiter. A possible way forward that was discussed with ESTEC, ESOC, industry and instrument experts is to switch-on both the main and redundant power lines quasi-simultaneously. A test carried out on 25 May confirmed that there is no short-circuit in the instruments - a second test to switch both power lines is scheduled for 1 June.

The second payload anomaly occurred on the CIS (ion) instrument on C1. A special "solar wind" mode was using too much current and will not be used in the future. The "magnetospheric" mode will be used on that instrument from now on. Additional on-board monitoring will also be put in place.

The 13th Cross Calibration meeting was held 13-15 April in Uppsala. This is a unique activity pushing for the highest quality data for the Cluster Active Archive (CAA). A presentation was made by each instrument team on their progress with cross

calibration activities and also on some dataset activities such as flags to identify data issues. A Double Star Archiving meeting was held at the end of the cross-calibration meeting. Telemetry errors and data re-processing were discussed and methods of data spike removal implemented by the CAA team to clean the fluxgate magnetometer (FGM) data were presented. Other teams are investigating how to produce a data set to reflect telemetry errors in the house keeping and science datasets and how to then flag these issues to users of the final data products.

As of April 2011, the CAA has 1198 registered users, with 26 new users in March (for user statistics, see http://caa.estec.esa.int/caa/user_stats.xml). The total monthly download rate was 740 Gigabytes on average since February 2011.

Hinode

The spacecraft and payload are nominal with data downlink through S-band. However, also the Ground Segment of Hinode was hit by the power outages Japan suffered after the devastating Tsunami in March. Regular scheduled command uploads couldn't be performed for a short period. By mid – April nominal operations were recovered.

All Hinode data (and usage statistics) are available to the community through the Hinode Science Data Centre Europe: http://sdc.uio.no/sdc/

At its meeting on 11 May 2011 the IPC approved the procurement proposal for the 'Downlink and Science Data Centre Support to JAXA's Hinode Mission'. The contract will foresee that the final European Data Archive for the Hinode mission will be implemented at ESAC.

Mars Express

Spacecraft and payload are nominal.

The Phobos flyby that took place early-2011 at a very close distance (108 km) was very successful both scientifically and as communication event. Immediately afterwards the spacecraft successfully passed through a period of no (science) operations due to a solar conjunction.

The conjunction blackout period was directly followed by a successful cold reset of the SSMM (Solid-State Mass Memory) on 21/22-Feb-2011 to cure a 'double error' count issue in one of the SSMM memory banks. This returned the SSMM to nominal status. As part of an ongoing extensive campaign to (re-)qualify all redundancy on-board Mars-Express, the spacecraft has been operating for two weeks (May-2011) on the full redundant transponder chain. All the elements required for this have extensively been tested over the past few years.

Due to a clear atmosphere and excellent illumination conditions, the HRSC instrument has recently generated much more data than expected. To prevent onboard data overwriting a number of HRSC observations have temporarily been stored in the OMEGA storage area. We now have to find the additional capacity required to downlink the data.

Effort has been invested in a study on upgrading the MELACOM instrument to perform the MSL support requested by NASA. Progress has been made in repairing a

test unit which is crucial in working on some of the desired MELACOM S/W upgrades.

<u>Rosetta</u>

Spacecraft and payload operations were nominal.

The active cruise phase of Rosetta has been completed and the spacecraft has been prepared to enter its over 30 months of hibernation on 8 June. The spacecraft will be programmed to exit the Deep Space Hibernation Phase on 20 January 2014. Rendez-vouz Manoeuvre #1 (RVDM#1) was successfully completed with a small trim manoeuvre on 17 February. The spacecraft is now on an encounter orbit with comet 67/P Churyumov - Gerasimenko in summer 2014. Without any future orbit correction it would fly by the comet at a distance of 50000 km.

The nominal plan had been to execute this large manoeuvre (ΔV about 800 m/sec) in 5 burns; due to problems encountered 7 burns were required. During the first two burns the spacecraft showed a very unstable attitude behaviour that ultimately led to safe mode during the 2nd burn. This behaviour could be directly associated to a very unstable thermal behaviour of 2 thrusters and their thrust level. After consultation with an expert team it was decided to run the thrusters with an adjusted 'On modulation time', which provided a much more stable performance and a successful completion of the sequence of manoeuvres. The small delay in completion of the manoeuvres had a negligible impact on the fuel budget and on the arrival time at the comet.

During the comet observation and sky characterization activities, which were execution as part of the preparation for the comet approach phase a large unexpected DV (about. 6 mm/s) was observed. Further testing has shown this to be an effect of the evaporation of deposits on the spacecraft –Z face during the large RDVM#1. This will occur again at RDVM#2 in May 2014. Proper "spacecraft clean-up" will have to be planned to provide an as clean as possible spacecraft environment for the payload, especially for ROSINA, the gas mass spectrometer. The solar array performance has been thoroughly tested in view of the deep space phase operations. A new array out put model was developed by experts in ESTEC based on the flight results and the results of the Lander arrays test campaign. It reproduces quite well the observed performance and predicts positive margins (as compared to the design cases) for the remaining mission phases.

By end of March all instrument tests had been completed successfully and the payload was configured for the deep space hibernation phase. All instruments were declared ready for the comet science phase.

In parallel to the spacecraft activities the preparation of the science operations for the comet phase took up momentum in close cooperation between the Science Ground Segment (SGS) at ESAC, Mission Operations and Flight Dynamics at ESOC and the PI teams. Flight Dynamics has started to define in detail the orbit strategies for the near comet phase, which enables the SGS to prepare representative plans for the science operations for the different comet science phase. Detailed scenarios were presented and discussed with the Rosetta Science Working team at its 30th meeting, 18/19 May at ESOC. The SGS presented tools to visualize prototype orbits and to support the skeleton planning for the various close comet science phases.

The Preliminary Design Review for the Rosetta Science Ground Segment is planned for June/July 2011 and will include participation of reviewers from the Lander and payload teams.

Venus Express

The outbound quadrature phase came to an end (Feb-2011), and operations have returned to nominal. Preparations for the August 2011 superior conjunction season have started.

During the preparations for the 5th aerodrag campaign (torque measurements using solar arrays in differentially rotated mode) it was noted that the Venus atmosphere was much denser than expected. A default procedure was put in place to cope with potential impacts on the spacecraft operations.

A successful Venus Express Science Working Team meeting was held in Paris 23-25 March 2011. The annual VMOC-VSOC coordination meeting will be held at ESOC on 19-May-2019.

PROBA 2

The spacecraft, payload and the Ground Segment operated nominally during the reporting period.

On February 15 at 02:00 UT, the SWAP and LYRA detectors observed a X2.2 flare, the largest flare since 2006. Space weather alerts were given by the Solar Influence Data Centre (SIDC) - that also base their predictions on SWAP and LYRA data. No storm conditions took place due to the northerly direction of the arriving interplanetary magnetic field lines, detected on 20110218T01:00 UT.

On 10 March 2011, the release of the LYRA calibrated data was announced. Since that date, SWAP and LYRA engineering, quick look and calibrated data are available to the scientific community within 1 hour after each of the ten daily downlink passes.

After the end of the yearly eclipse period, a thermal increase was observed over the first year in orbit of up to 5 degrees Celsius. The thermal increase is caused by the additional consumers operated continuously as compared to just after launch and by degradation of the coating material (paint). An analysis at instrument level confirmed that data quality and nominal operations are not compromised.

Early March the PROBA2 pages at the ESA Science Portal were finalized and published.

The 2nd call of the PROBA2 Guest Investigator program was announced begin of May at the web portals of ESA and the Royal Observatory of Belgium.

Status of the Archive Activities:

Mars Express is in routine archiving phase – the situation has generally improved due to many deliveries and ingestions during the last quarter. Most experiments are now up to date. Several teams have started to prepare calibrated data for delivery. A

Data Workshop is being organised at ESAC for PFS this summer in combination with the SOIR instrument on VEX.

Venus Express archiving has improved significantly in the last months. Data from all instruments are now publicly available. SOIR are developing high-level data products for delivery later this year. VIRTIS data require updates from the PI team before ingestion, the delivery is expected in early Summer 2011. A Data Workshop is being organized at ESAC for SOIR this summer in combination with the PFS instrument on MEX.

Rosetta data up to Cruise Phase 2, i.e. before the Steins encounter, are released. The Steins data release is being prepared for ALICE, RPC-MAG, MIRO and OSIRIS in June/July. Steins data from other instruments are still pending re-deliveries after the review. The Lutetia science data products review is pending data delivery from most teams. NAVCAM data production is complete and the data sets are in review with PDS.

Huygens The DTWG data set has been re-delivered and is pending ingestion after agreement with the Project Scientist.

Chandrayaan-1 activities are almost closed. All data sets for the 3 European instruments were produced by the team at ESAC and delivery of SARA data is just pending final checks by the science team.

Cluster discussions continue for the transfer of the CAA to CFA (Cluster Final Archive).