European Space Agency

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No. 17 - Ion Engine Switched Off and Commissioning Begins

04 Feb 2004

Spacecraft Status

The spacecraft is now in its 207th orbit, in good status and with all functions performing nominally. As in previous weeks, the ion drive has only generated thrust around the perigee point to fine-tune the altitude of the apogee point. This strategy has produced a noticeable increase in apogee height, see plot below, which is necessary to minimize the duration of eclipse periods that will occur during March.

The total cumulated thrust so far is more than 1705 hours, consuming 27.1 kg of Xenon, has provided a velocity increment of about 1220 ms^{-1} (equivalent to 4392 km per hour). In this period the electric propulsion engine's performance, periodically monitored by means of the telemetry data transmitted by the spacecraft and by radio-tracking by the ground stations, have been nominal.

The spacecraft subsystem continue to function well despite the known problem of the hot star trackers. This can overload the star tracker computers, because in these conditions they "see" many more stars and the search for the correct constellation becomes heavier. In one case this overload caused a loss of synchronisation between the star tracker time with the spacecraft time.

The software patch, required to recover from the flame-outs, has been prepared and will be uploaded to the spacecraft as soon as the electric propulsion engine is operated again.

After four months of continuous travelling through the Earth's radiation belts the electric propulsion engine was switched off on 30 January. The engine will remain dormant for a period of three weeks to allow the instrument teams to switch on and test their instruments.

Commissioning Activities

After the last SMART-1 Science and Technology Working Team (STWT20) at ESOC, 15 January 2004, the payload operation preparation activities have accelerated between PI teams, project, STOC and ESOC.

AMIE
AMIE acquired its first image of a crescent moon on 18 January.

On 29 January, between 20:00 and 21:19 UT, images of the first quarter moon were taken through several filters. The result is a small, but impressive, image revealing, clockwise from the top: Mare Serenitatis, Mare Tranquillitatis, Mare Fecunditatis and Mare Nectaris, with Mare Crisium also visible near the limb.

The result is very encouraging as the spacecraft is still over 300 000 km from the Moon. The camera appears to have survived its journey through the high radiation environment with no apparent reduction in performance. Taking images is also an excellent test of the pointing ability of the spacecraft.

EPDP and SPEDE
The plasma diagnostic experiments have been operational since the first week of the mission and

have measured the spacecraft environment during both periods of electric thrust and no electric thrust. Discussions about these early results took place at a workshop held at ESTEC on 20 January.

KaTE
On 29 January, at around midnight, a test of the X-band downlink capability of the KaTE transponder took place with the ground station in Perth, Australia. The signal was successfully located and displayed with a good lock at the station.

Planned Instrument Activities

5 – 10 February 2004

AMIE	Targeted images
EPDP	Instrument calibrations
KaTE	Further tests with ground stations
SIR	Health check and scan of lunar infrared spectra
SPEDE	Instrument calibrations

11 – 18 February 2004

AMIE	Alignment calibrations with startrackers and SIR
KaTE	Tests with ground stations
SIR	Alignment calibrations with AMIE

19 – 20 February 2004

D-CIXS	Test when spacecraft at apogee

Planned Spacecraft Activities

March 2004

There will be a period of EP thrusting and long eclipses, which will limit the payload to simple operations at apogee. Once this period has finished, normal operations can resume and an extended commissioning and cruise science phase will operate from April-June during the coast arcs.

Long Term

A series of lunar resonance gravity assists will take place on 20 August, 16 September and 14 October. The STWT20 agreed to have only one lunar swingby, on or around 9 November, before lunar capture takes place in early December. After capture and down spiral, the xenon fuel reserves will lower the apolune to the final science orbit.

Orbital/Trajectory information

The ESOC specialists periodically compute the osculating orbital elements. These elements define the so-called "osculating orbit" which would be travelled by the spacecraft if at that instant all perturbations, including EP thrust, would cease. Therefore, it is an image of the situation at that epoch. In reality, the path travelled by the spacecraft is a continuous spiral leading from one orbit to another. The most recent osculating elements are as follows:

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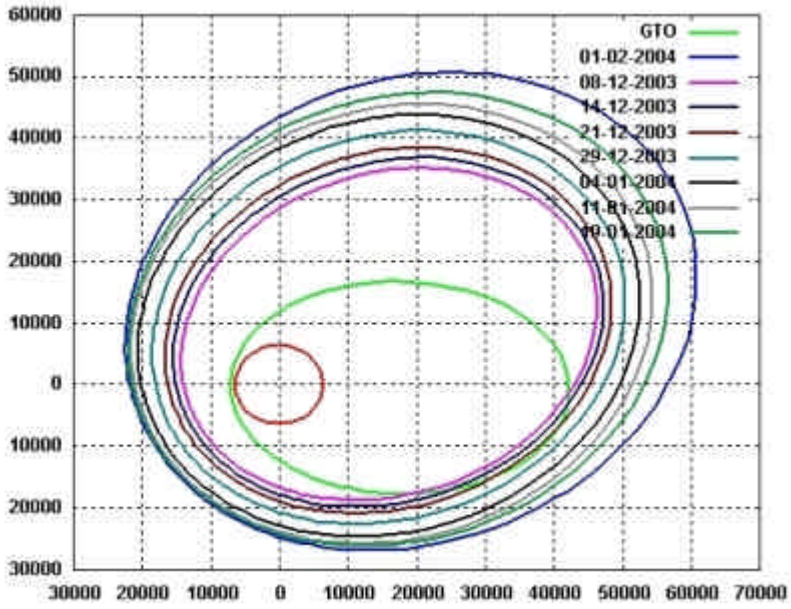
Elements WRT Earth (J2000)	
Pericentre Distance (km)	20 690.564436
Apocentre Distance (km)	65 869.221941
Semi Major Axis (km)	43 279.893189
Eccentricity	0.521936

Inclination (deg)	6.906311
Asc. Node (deg)	150.042887
Arg. of Pericentre (deg)	211.902998
True Anomaly (deg)	179.991681
Osc. Orbital Period (h)	24.890737

Displayed in the plot are the osculating orbits at launch (GTO) and at different times throughout the mission. Since the start of the mission the electric propulsion engine has changed the orbital parameters as follows:

- Semi-major axis of the orbit increased by 18 650 km
- Perigee altitude from 656 km to 14 312 km
- Apogee altitude from 35 844 km to 59 491 km
- Orbital period from 10 hours 41 minutes to 24 hours and 53 minutes



Contact Points

Giuseppe Racca
SMART-1 Project Manager
ESA/ESTEC - SCI-PD
Keplerlaan 1- 2200 AG Noordwijk, The Netherlands
E-mail: Giuseppe.Racca@esa.int

Bernard H. Foing
SMART-1 Project Scientist
ESA/ESTEC - SCI-SR
Keplerlaan 1- 2200 AG Noordwijk, The Netherlands
E-mail: Bernard.Foing@esa.int

For further information please contact: SciTech.editorial@esa.int