



European Space Agency

Science & Technology

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No. 12 - 68 hours of uninterrupted firing of the ion engine!

23 Dec 2003

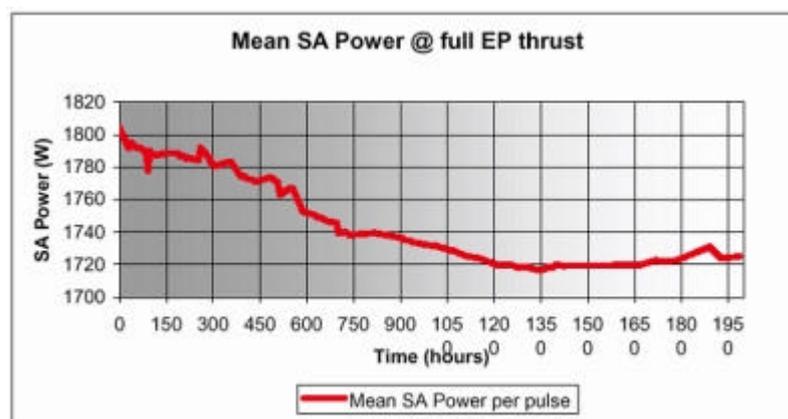
Overall status, current activities and planned activities

The spacecraft is now in its 158th orbit, in good status and with all functions performing nominally. Since the procedure to automatically re-start the engine after a flame-out has been uploaded to the on-board software, the spacecraft has been continuously operated in electric propulsion mode even at orbital altitudes below 10 000 km.

During the last week a new record was set: the spacecraft fired the engine continuously for more than four orbits (so far the longest thrust arc) for a total of 68 hours. This was interrupted on Friday evening by the first flame-out event to occur since the software patch. The flameout actually occurred outside ground coverage. Operators were unaware that the flameout recovery procedure apparently did not work properly and resulted in a memory scrub overrun and ultimately caused a warm reset of the main computer. The spacecraft reacted well, went through detumble to safe mode and acquired the Sun safely. While the malfunction is being investigated, and in order to avoid further problems, the flame-out recovery procedure has been disabled.

The total cumulated thrust so far of more than 1173 hours, consuming 18.7 kg of Xenon, has provided a velocity increment of about 830 ms^{-1} (equivalent to slightly less than 3000 km per hour). 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, continues to show a small over performance in thrust, varying from 0.8% to 1.0% over the last week.

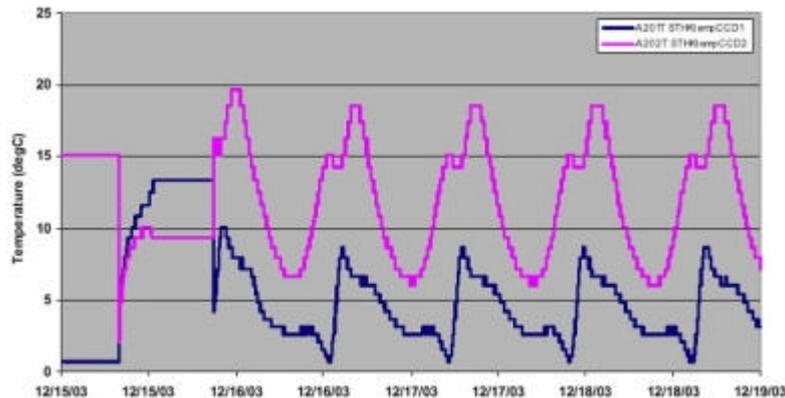
The degradation of the electrical power produced by the solar arrays has now ceased. As a matter of fact the power available has remained virtually constant for more than 30 days and again, as last week, a further slight increase of 3 Watts has been noticed. This means that the degradation by radiation is basically nil and the solar array power reflects the increase of solar irradiance due to the nearing of the Earth's perihelion (to be reached on 3 January 2004).



This graph shows the measured power produced by the solar arrays when the EP is operating at full power, starting from the beginning of mission.

The communication, data handling and on-board software subsystems have been performing well in this period. The loss of on-board time synchronisation between the main computer and the star tracker occurred on December 13th is still being investigated.

The thermal subsystem continues also to perform well and all the temperatures are as expected. This week the spacecraft was rotated back to nominal attitude and hence the star tracker optical head #2 was experiencing high temperatures again up to 18 °C, while the optical head #1 was always staying below 10 °C. The results are plotted in the graph below.



Temperature of the two optical heads as a function of time.
(Blue line: Optical head #1, and pink line: optical head #2)

Orbital/Trajectory information

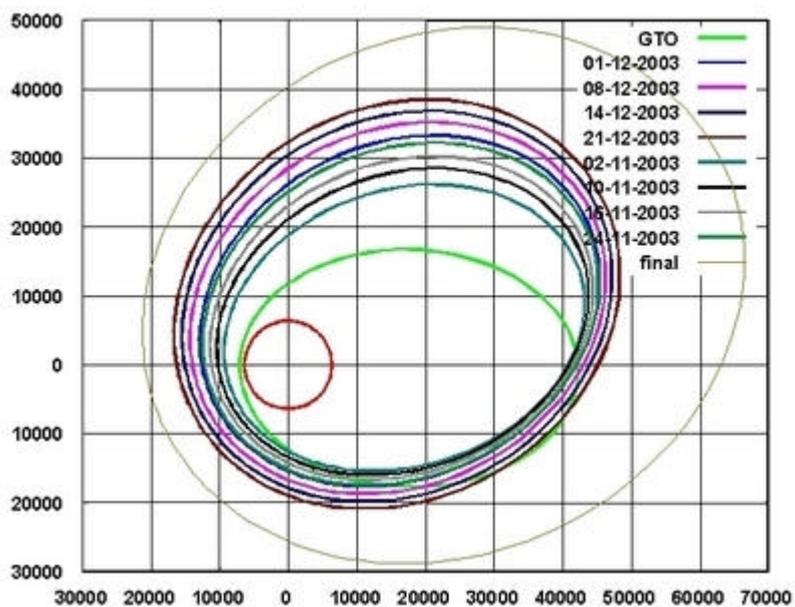
The osculating orbital elements are periodically computed by the ESOC specialists. These elements define the so called "osculating orbit" which would be travelled by the spacecraft if at that instant all perturbations, including EP thrust, would cease. So it is an image of the situation at that epoch. 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) | 15 536.139072 |
| Apocentre Distance (km) | 51 802.554094 |
| Semi Major Axis (km) | 33 669.346583 |
| Eccentricity | 0.538567 |
| Inclination (deg) | 6.825592 |
| Asc. Node (deg) | 151.994164 |
| Arg. of Pericentre (deg) | 209.140555 |
| True Anomaly (deg) | 180.000107 |
| Osc. Orbital Period (h) | 17.078924 |

In this diagram the osculating orbits at launch (GTO) and at different times are plotted. The large orbit, marked 'final', is the one we expect to achieve at the end of the radiation belt escape (pericentre larger than 20 000 km) in about two weeks time. From the start, the electric propulsion system has managed to increase the semi-major axis of the orbit by 8500 km, increasing the perigee altitude from the original 656 km to 9158 km and the orbital period by 6 hours and 23 minutes, from the initial 10 hours 41 minutes, to the present 17 hours 4 minutes.



Contact Point

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

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

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