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Author: Dr. Paolo Ferri
European Space Agency (ESA), Germany

Mr. Andrea Accomazzo
European Space Agency (ESA), Germany
Mr. Sylvain Lodiot
European Space Agency (ESA), Germany
Ms. Armelle Hubault
Vega GmbH, Germany
Mr. Roberto Porta
Vega GmbH, Germany
Mr. Jose-Luis Pellon-Bailon
European Space Agency (ESA), Germany

ROSETTA ENTERS HIBERNATION

Abstract

The International Rosetta Mission was launched on 2nd March 2004 on its 10 years journey to comet Churyumov-Gerasimenko. Rosetta will reach the comet in 2014, orbit it for about 1.5 years down to distances of a few kilometres and deliver the Lander Philae onto its surface.

Following the fly-by of Asteroid (21-)Lutetia in 2010, Rosetta continued its travel towards the planned comet encounter in 2014. In this phase Rosetta became the solar-powered spacecraft that reached the largest Sun distances in history of spaceflight, up to an aphelion at 5.3 AU. At distances above 4.5 AU the spacecraft's solar generator power is not sufficient to keep all spacecraft systems active. Therefore in June 2011 the spacecraft will be spun-up to provide gyroscopic stabilisation, and most of its on-board units, including those used for attitude control communications, will be switched off for a period of 2.5 years. Over this "hibernation" phase the spacecraft will keep a minimum of autonomy active to ensure maintenance of safe thermal conditions.

After Lutetia flyby, flight controllers had to tackle two anomalies that had significant impacts on the mission operations. A leak in the reaction control subsystem was confirmed and lead to the re-definition of the operational strategy to perform the comet rendezvous manoeuvres planned for 2011 and 2014. Anomalous jumps detected in the estimated friction torque of two of the four reaction wheels used for attitude control forced the rapid adoption of measures to slow down the wheels degradation. This included in-flight re-lubrication activities and changes in the wheels operational speed regime.

Once the troubleshooting of the two anomalies was completed, and the related operational scenarios implemented, the first large (790 m/s) comet rendezvous manoeuvre was executed, split into several long burns in January and February 2011. The second burn was unexpectedly interrupted due to the anomalous behaviour of two thrusters, causing attitude off-pointing. Flight controllers modified the thrusters operation parameters in the on-board software and managed to re-start the sequence of burns and successfully complete the manoeuvre. After the manoeuvre, preparation for the critical spin-up and hibernation entry activities, planned for June 2011, began.

This paper presents the activities carried out on Rosetta in the final year before hibernation entry. The major anomalies and the related troubleshooting and workaround solutions are detailed. Lessons learned

from the operation of the first spacecraft operating with solar power at Jupiter-like distances from the Sun are presented and discussed.