

The fly-by of Steins - stretching Rosetta's limits

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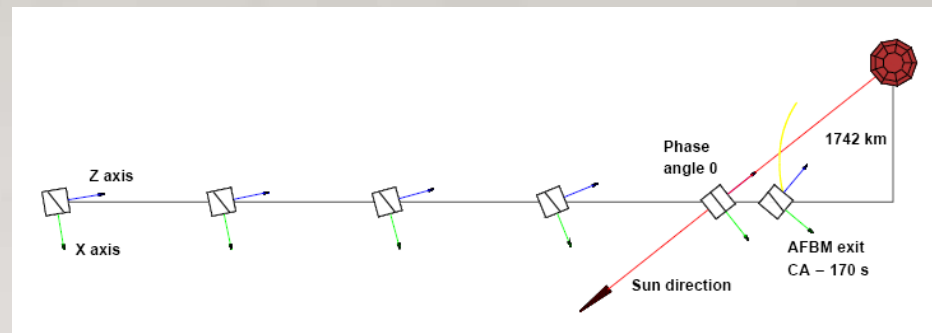
Rosetta Steins fly-by Press Conference
Darmstadt, ESA/ESOC, 6 September 2008

Steins fly-by: facts

- first asteroid fly-by for a European spacecraft
- flying at 800 km from an object of 5 km diameter with a speed of 31000 km/h
- first optical navigation for a European spacecraft
- targeting the asteroid with an accuracy better than 2 km over a distance of more than 350 million km from the Earth
- autonomous on-board tracking of asteroid

Steins fly-by: the requests

- Original mission baseline for Steins fly-by was:
 - to reproduce the fly-by dynamics of the much bigger Lutetia (as a dress-rehearsal)
 - to stop observations before closest approach due to thermal limitations of the spacecraft (illumination of 'cold' face)



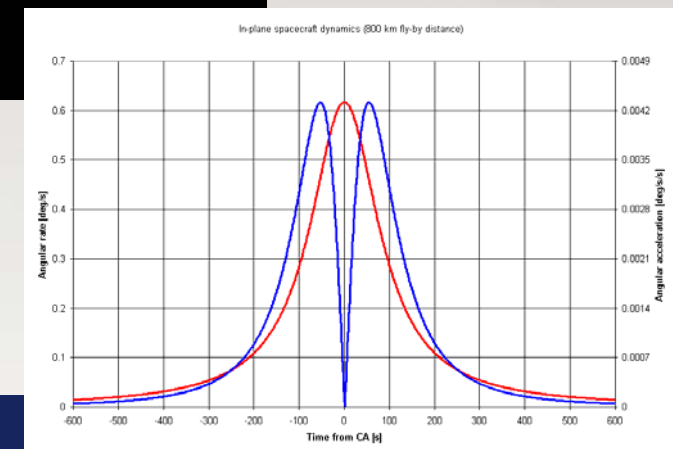
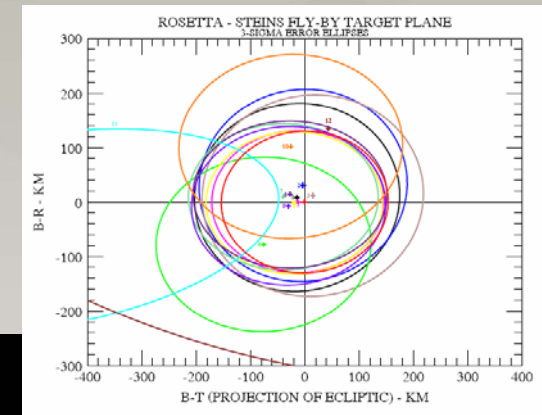
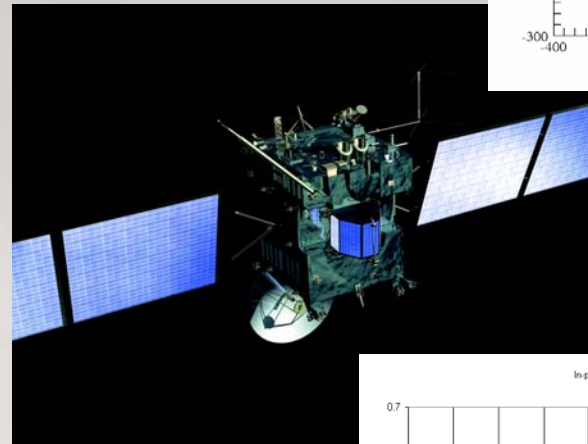
- ... but scientists expressed great interest in:
 - good illumination conditions and through the point where the Sun is exactly behind the spacecraft (i.e. phase angle 0)
 - observe at closest possible distance
 - continuous observation before, during, and after closest approach
 - 'good' pointing and synchronisation of payload operations with flight events

Stretching the limits: challenges and constraints

For the operations team this meant:

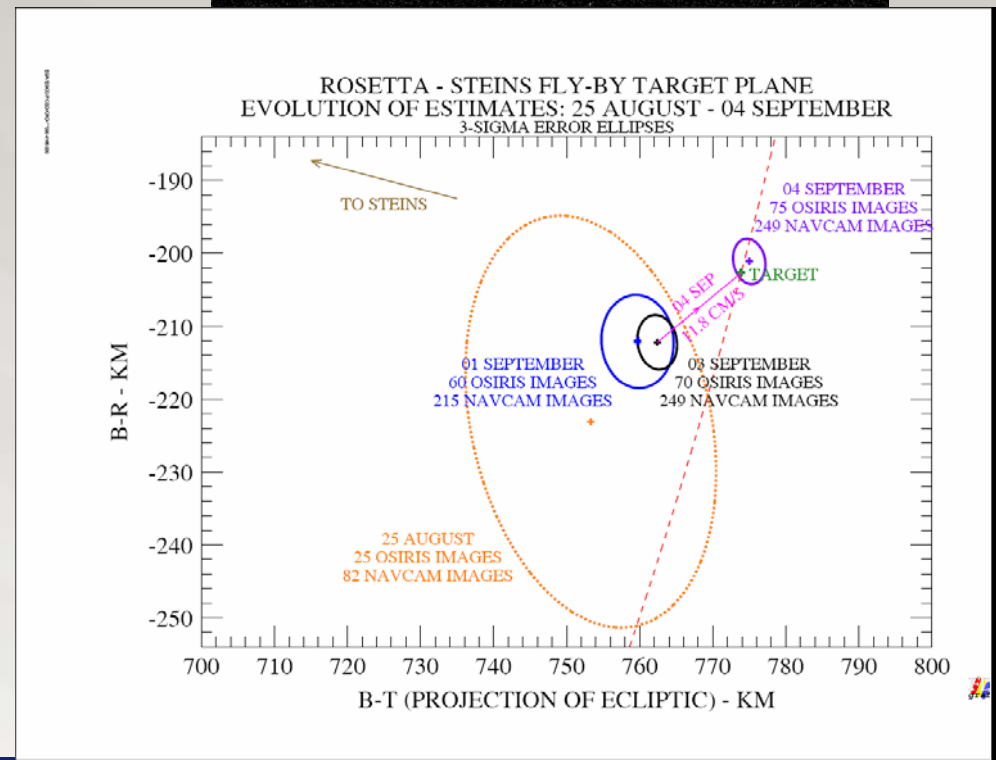
Change of mission scenario

- As a consequence we had to cope with:
 - orbit determination accuracy versus large uncertainties on Steins orbit
 - exposure to the Sun of spacecraft 'cold' faces
 - rapid attitude changes with reaction wheels driven to their limit
 - increased attitude pointing accuracy

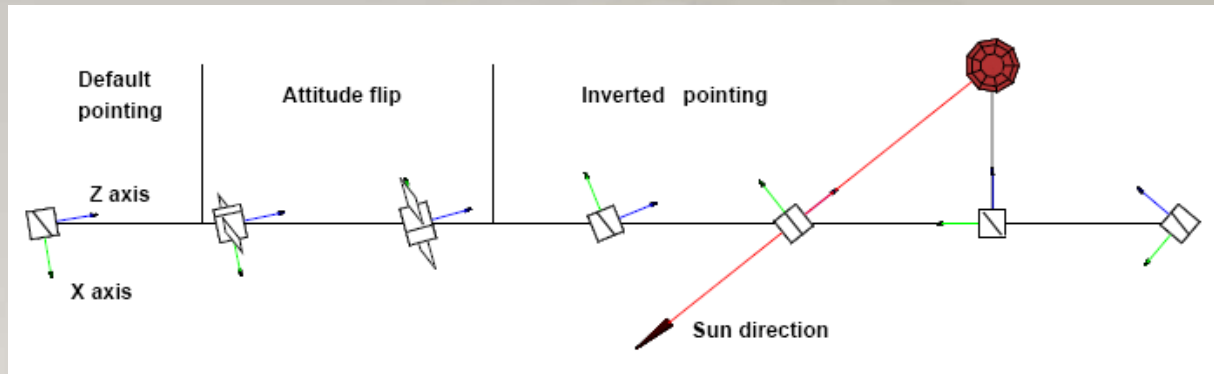


Target on sight: 1st ESA optical navigation

- Orbit determination process integrated the traditional radiometric data with images from the Navigation Cameras and the scientific OSIRIS camera
- 1st Asteroid detection at 26 million km on 4th of August
- 2 trajectory correction manoeuvres allowed very accurate control of fly-by distance (< 2 km)



Final fly-by scenario: a complex matter



- Spacecraft performance limited the fly-by distance to 800 km
- An attitude flip manoeuvre with respect to the Sun allowed the spacecraft to track the asteroid for longer time. The manoeuvre had conflicting requirements:
 - late enough to limit as much as possible Sun exposure of cold faces
 - early enough to limit the asteroid pointing error when the autonomous tracking began
- A race against time: final GO for close loop tracking given only a few hours before event

The fly-by event and ... beyond

- Yesterday Rosetta
 - flipped its attitude between 19:58 and 20:18
 - started autonomous tracking of asteroid Steins at 20:19
 - stopped transmitting data to the Earth at 20:28 (signal loss seen at 20:48 on Earth)
 - reached its closest distance to Steins at 20:38:20 (precise time will now be reconstructed with recorded data)
 - resumed data transmission to Earth at 21:54 (signal received on Earth at 22:14)

All times reported in CEST spacecraft time (= ground received time – 20 minutes)

- Science data downlink began 2 hours after closest approach over NASA DSN Goldstone and ESA New Norcia ground stations and will continue for the next 5 weeks
- Rosetta will reach the maximum distance from the Sun of its current orbit on the 17th of December (2.26 AU) to head back to Earth for the next and last swing-by on the 13th of November 2009