Safe mode versus survival mode

Courtesy of M. Nesbit
CLOSE FLYBY

NAVIGATION ISSUES

Date 02-04-2015
Distance from comet 384 km

Direction to the Sun
Hi Rosetta!
Greetings from Home!

Yours, Earth

Rosetta
67P/Churyumov–Gerasimenko
SPACE
Date 13-04-2016
Distance from comet 104 km

CLOSE FLYBY

Direction to the Sun
# Instruments - Orbiter

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
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<tr>
<td>ALICE</td>
<td>Ultraviolet imaging Spectrograph</td>
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<tr>
<td>MIRO</td>
<td>Microwave Instrument</td>
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<tr>
<td>OSIRIS</td>
<td>Science camera</td>
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<td>VIRTIS</td>
<td>Visible and Infrared Thermal Imaging Spectrometer</td>
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<td>CONERT</td>
<td>Comet Nucleus Sounding Experiment by Radio-wave Transmission</td>
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<td>RSI</td>
<td>Radio Science Investigation</td>
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<td>ROSINA</td>
<td>Rosetta Orbiter Spectrometer for Ion and Neutral Analysis</td>
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<tr>
<td>COSIMA</td>
<td>Cometary Secondary Ion Mass Analyser</td>
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<tr>
<td>MIDAS</td>
<td>Micro-Imaging Dust Analysis System</td>
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<tr>
<td>GIADA</td>
<td>Grain Impact Analyser and Dust Accumulator</td>
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<tr>
<td>RPC</td>
<td>Space plasma package</td>
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<tr>
<td>SREM</td>
<td>Standard Radiation Environment Monitor</td>
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<td>NAVCAM</td>
<td>Navigation Camera</td>
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Remote sensing

<table>
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<th>In situ</th>
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<tr>
<td>“spacecraft” instruments</td>
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Rosetta Science Operations Scheduling Legacy Workshop 2017
Instruments – remote sensing

- MIRO
- Alice
- VIRTIS-M & VIRTIS-H
- OSIRIS Narrow-Angle Camera (NAC)
- OSIRIS Wide-Angle Camera (WAC)
Instrument operation considerations - NAVCAM
Instrument operation considerations - MIRO

Map of coma – 3 hours – ¼ comet rotation period
Instrument operation considerations - ALICE

Feldman et al., 2015
Instruments – in situ

- COSIMA
- ROSINA
- GIADA
- MIDAS
Insitu instruments

Distance from comet

Time or mass

abundance

abundance

data

noise
Insitu instruments

Radial profile provides information on more global structure of comet environment, but can confuse temporal and spatial changes.

abundance

Time ~ distance

Distance from comet
Insitu instruments

Latitude and longitudinal position also have an effect on signal (as we found with star trackers 😊)
Pointing constraints

Some measurements of same quantity need different pointing depending on instrument – example – flow/velocity measurement

Remote sensing –
Detect flow best when measuring orthogonal to direction of flow

In situ -
Measure in direction of flow
Pointing constraints

When in situ instrument requires “quiet” stare of nucleus – impacts coma or nucleus mapping capability of remote sensing instruments.

Cost function used to analyze this
In the extreme, dedicated Nadir only periods were implemented
Pointing constraints - off pointing -

Significant off pointing required in some cases – calibration of instruments using stars
Measurements of dust outflow in broad coma
Plasma measurements of solar wind.
Albedo ~ 4-6%
Organic rich

Goesmann et al., 2015, Capaccioni et al., 2015, Wright et al., 2015, Bieler et al., 2015, Fray et al., 2016, Gulkis et al., 2015, Bardyn et al., 2017
• Mix of compact, rubble piles and clusters of particles
• Compact + Fluffy Particles
• Mass = 10 billion tonnes
• Density ~ 1/2 water ice
• Average Dust to ice ratio = 8.5 - icy dust ball
• Porosity > 70-75%

Schulz et al., 2015, Rotundi et al., 2015, Fulle et al., 2015, 2016, Della Corte et al., 2016, Langevin et al., 2016, Mannel et al., 2016, Bentley et al., 2016, Jorda et al. 2016, Kofman et al., 2015, Paetzold et al., 2016, Lethullier et al., 2016, Spohn et al., 2015, Carlietti et al., 2016 Schloerb et al. 2015
Consolidated/fractured regions
“smooth” dusty regions

Dusty regions - smooth?
Smooth? - ground truth needed
Rotation Period

12h20m

12h

August 2014

August 2015

August 2016

Feb 2015

Jun 2016

50 m
Smooth plains

rounded features

layers

103P/Hartley

81P/Wild

103P/Hartley

NASA - NSSDC

ESA/Rosetta/NAVCAM El-Maarry et al., 2015

NASA/JPL-Caltech/UMD
Comet seasons

C67P ~6.5 years orbit period
De Sanctis et al, 2015.
July 10 2015
Outburst in Seth region