

An artistic rendering of the Mars Express satellite in orbit around Mars. The satellite is shown from a perspective that highlights its two large, blue solar panel arrays extending outwards. The central body of the satellite is white and features a prominent white parabolic dish antenna with the ESA logo. The background is the reddish-orange surface of Mars, showing various craters and geological features. The scene is set against a deep blue space filled with stars. Two thin yellow lines cross the frame diagonally, possibly representing orbital paths or data lines.

Mars Express investigations of Phobos

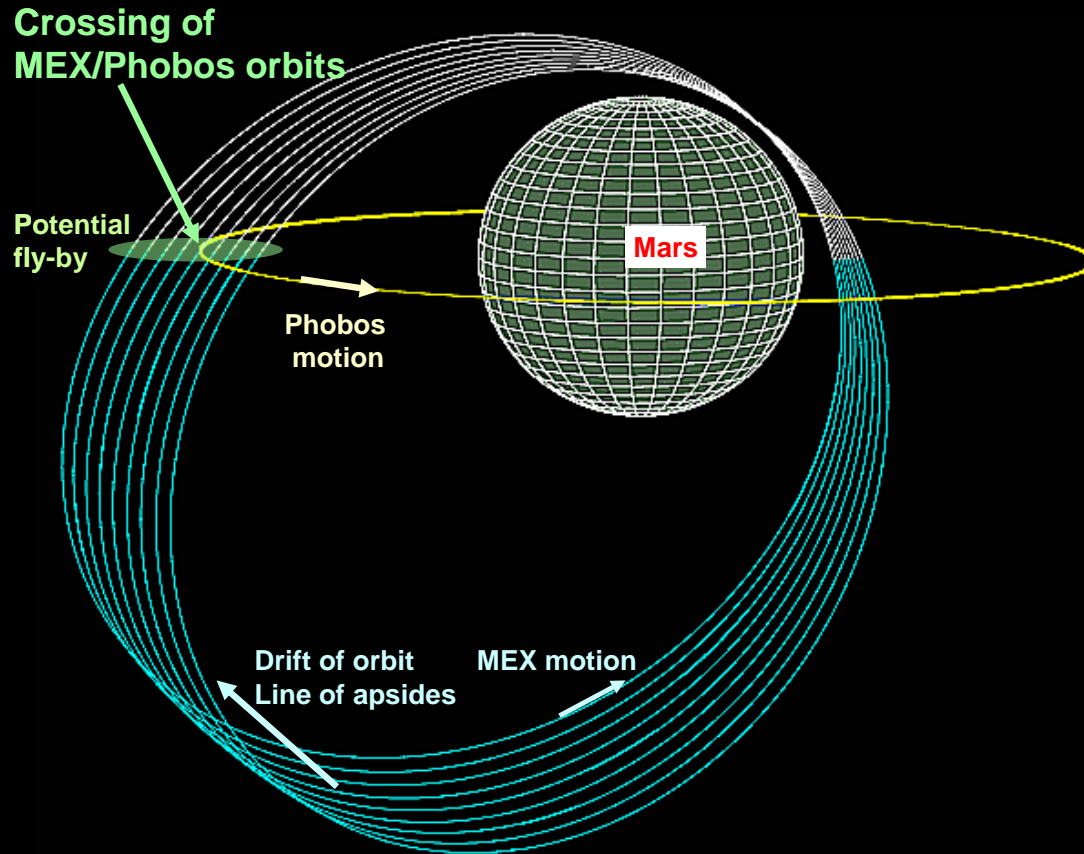
A small, inset image of the Martian moon Phobos, showing its irregular, cratered shape.

Olivier Witasse, Tom Duxbury
and all Mars Express teams

Outline

- Mars Express flybys
- A selection of results
- Future flybys

Mars Express flybys

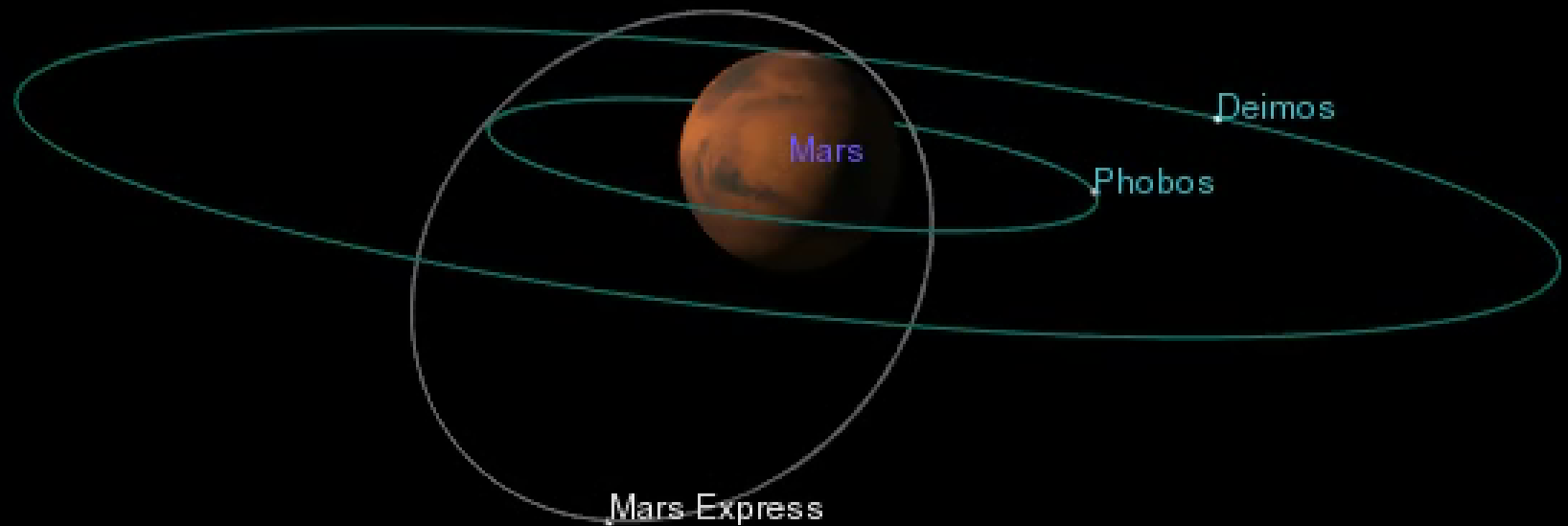


Phobos is a very interesting target for Mars Express for two reasons:

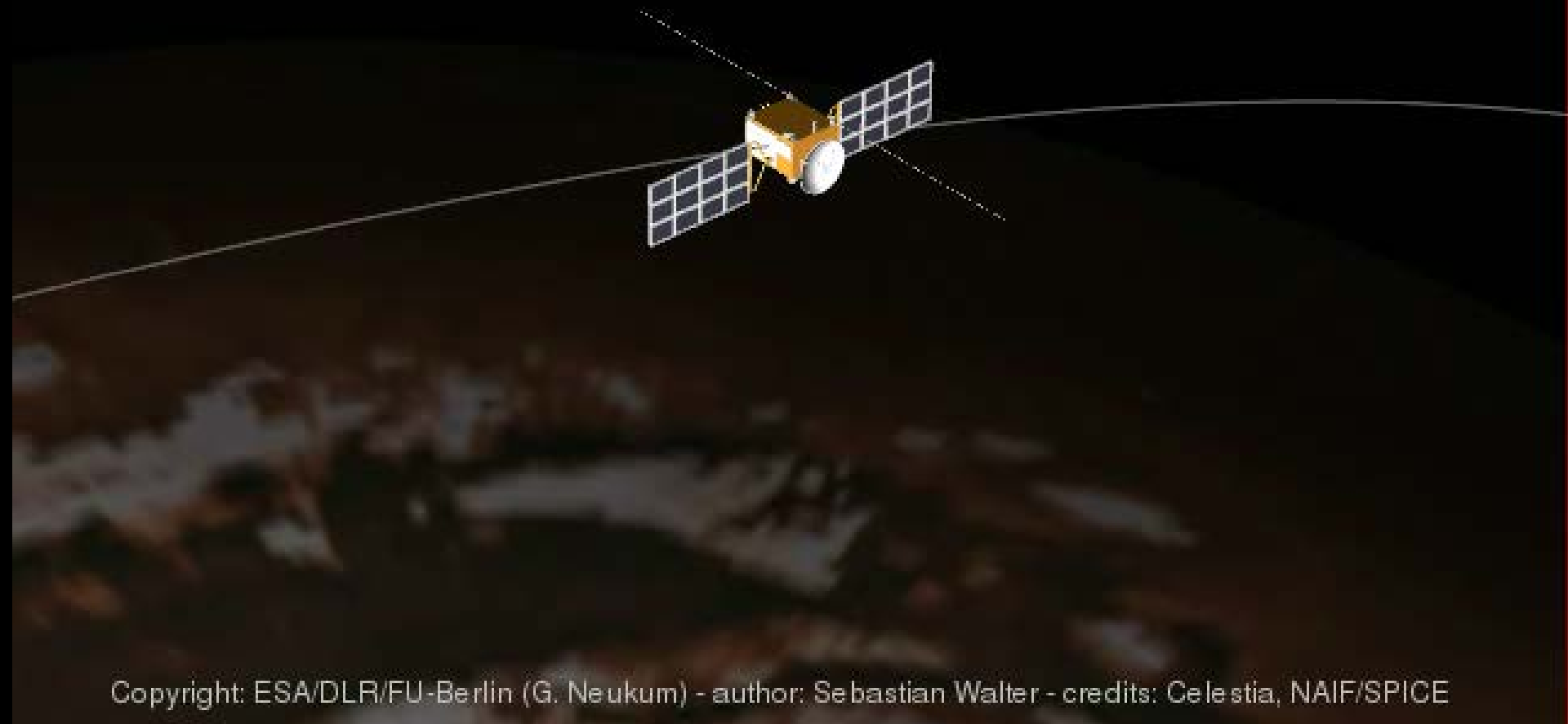
- Elliptical and polar orbit
- Instrumentation well suited

Flybys every 5 months - Closest flyby: March 2010, at 67 km from the surface

MEx orbit 7915 (2nd flyby) - time 1000 x faster - objects are not to scale



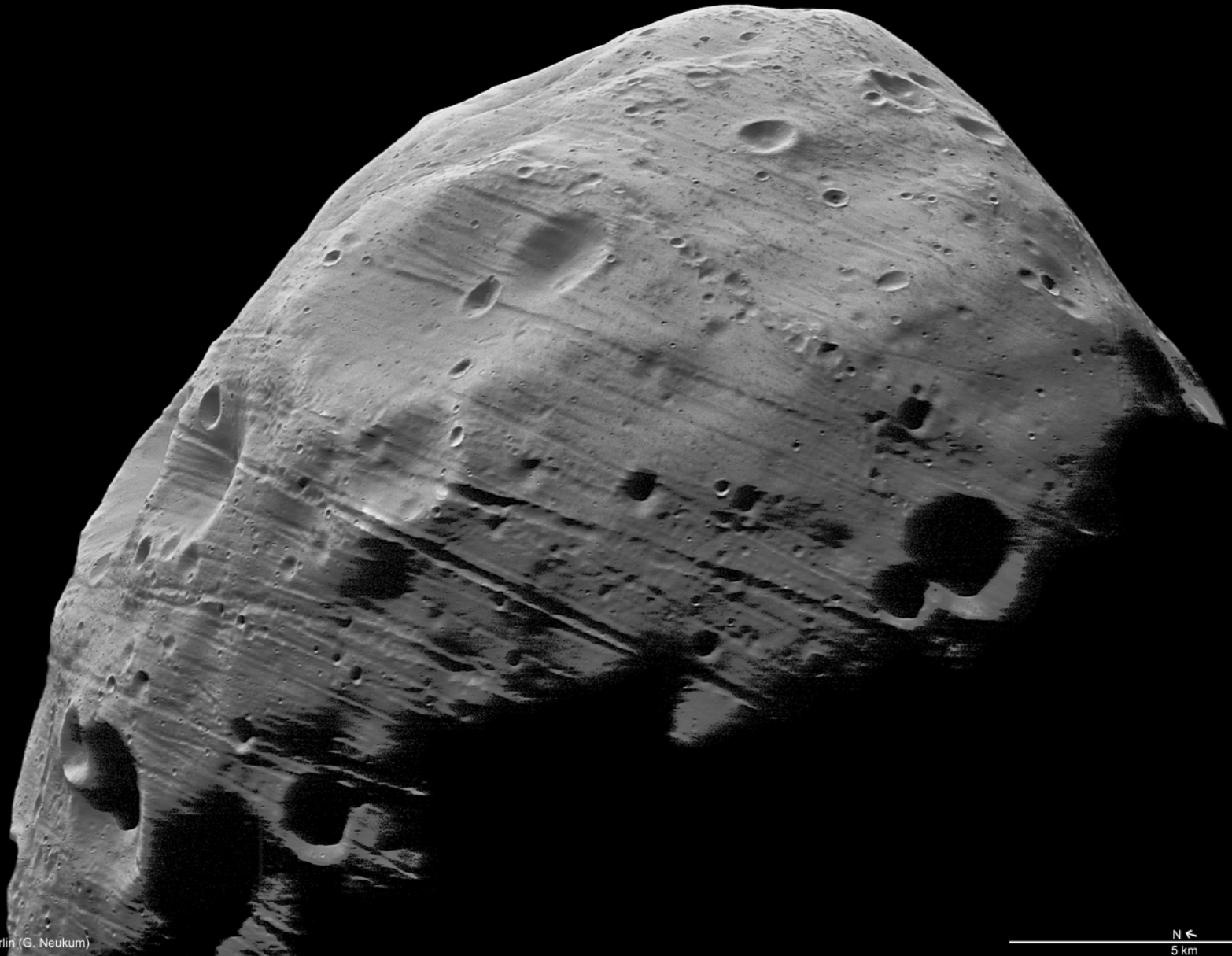
MEx orbit 7915 (2nd flyby) - time 100 x faster - objects are not to scale



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Mars Express results

1. Precise determination of the locations of the moons
2. Landing site characterisation
3. Radar sounding
4. Surface and volume characterisation
5. Accurate determination of the mass
6. Phobos - solar wind interaction

Precise location

[HRSC and radio-science]

- Flybys
- Shadow
- Special events
- Tracking data

Position known with an accuracy < 1 km now

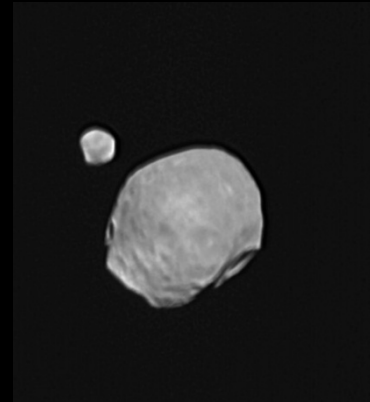
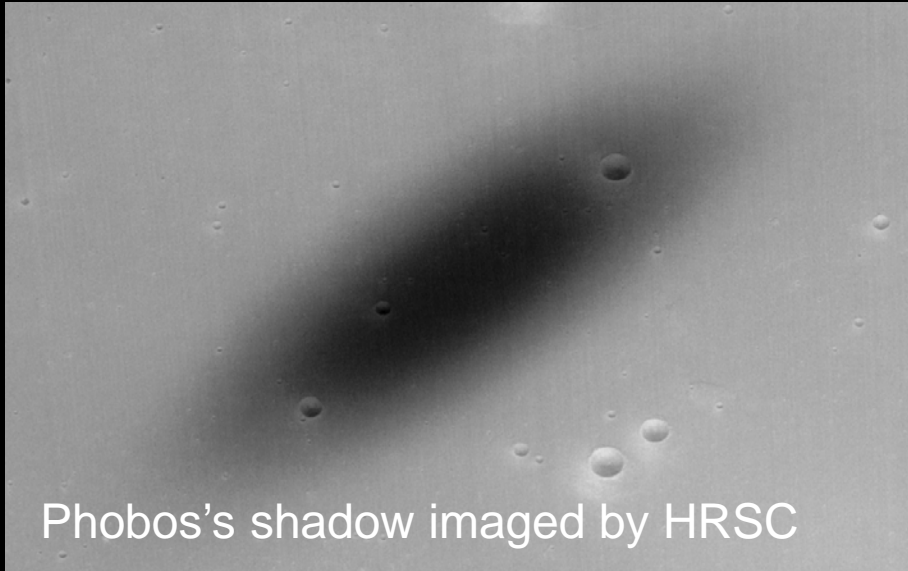


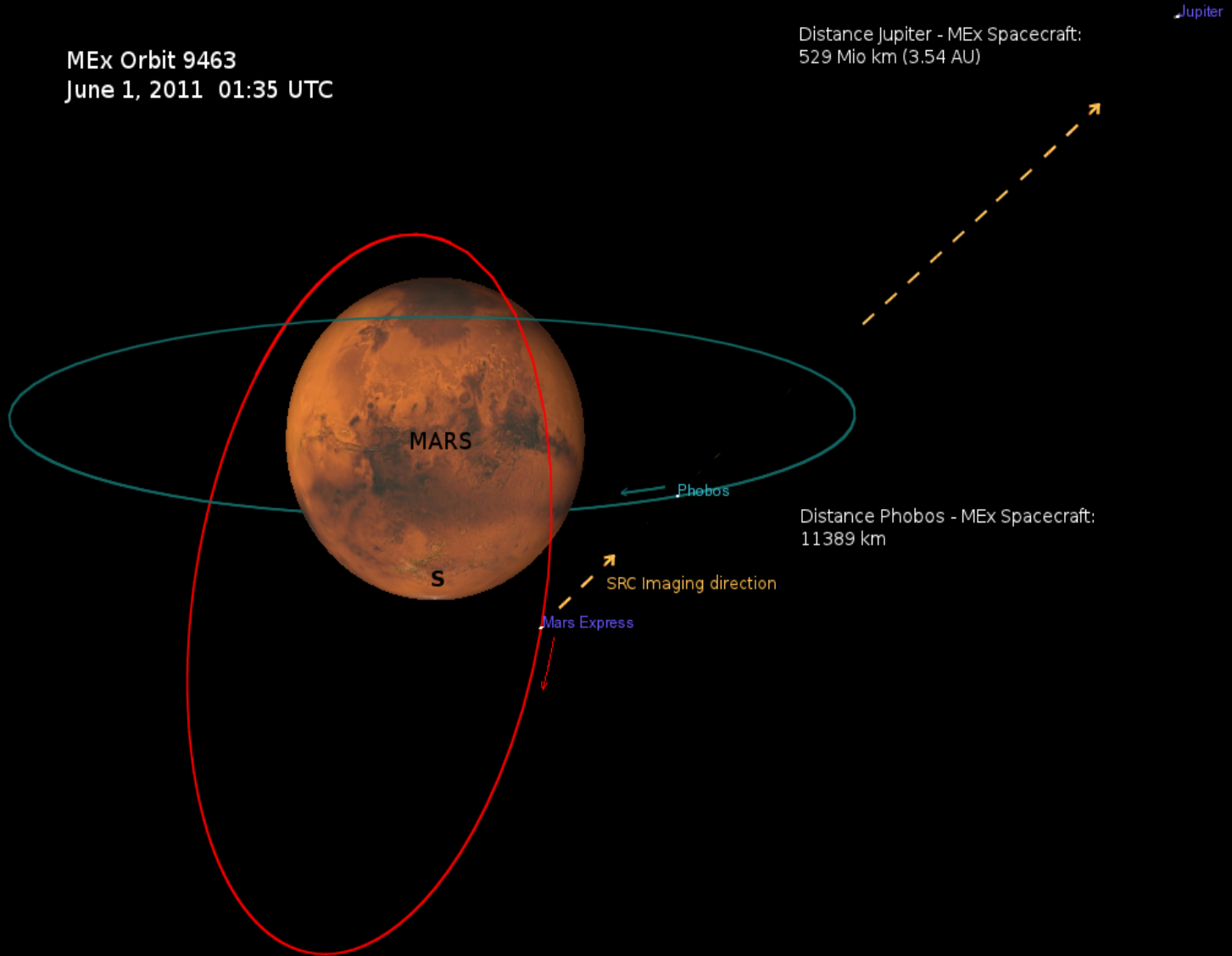
Image taken on
5 November 09

Evolution of the orbit, crash of Phobos on Mars in a few Myears

Imaging Phobos ... and Jupiter

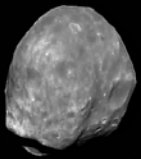
MEx Orbit 9463
June 1, 2011 01:35 UTC

Distance Jupiter - MEx Spacecraft:
529 Mio km (3.54 AU)

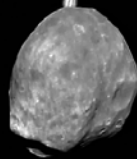


HRSC orbit 9463

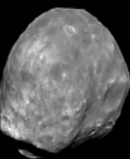
src frame 0075



src frame 0055

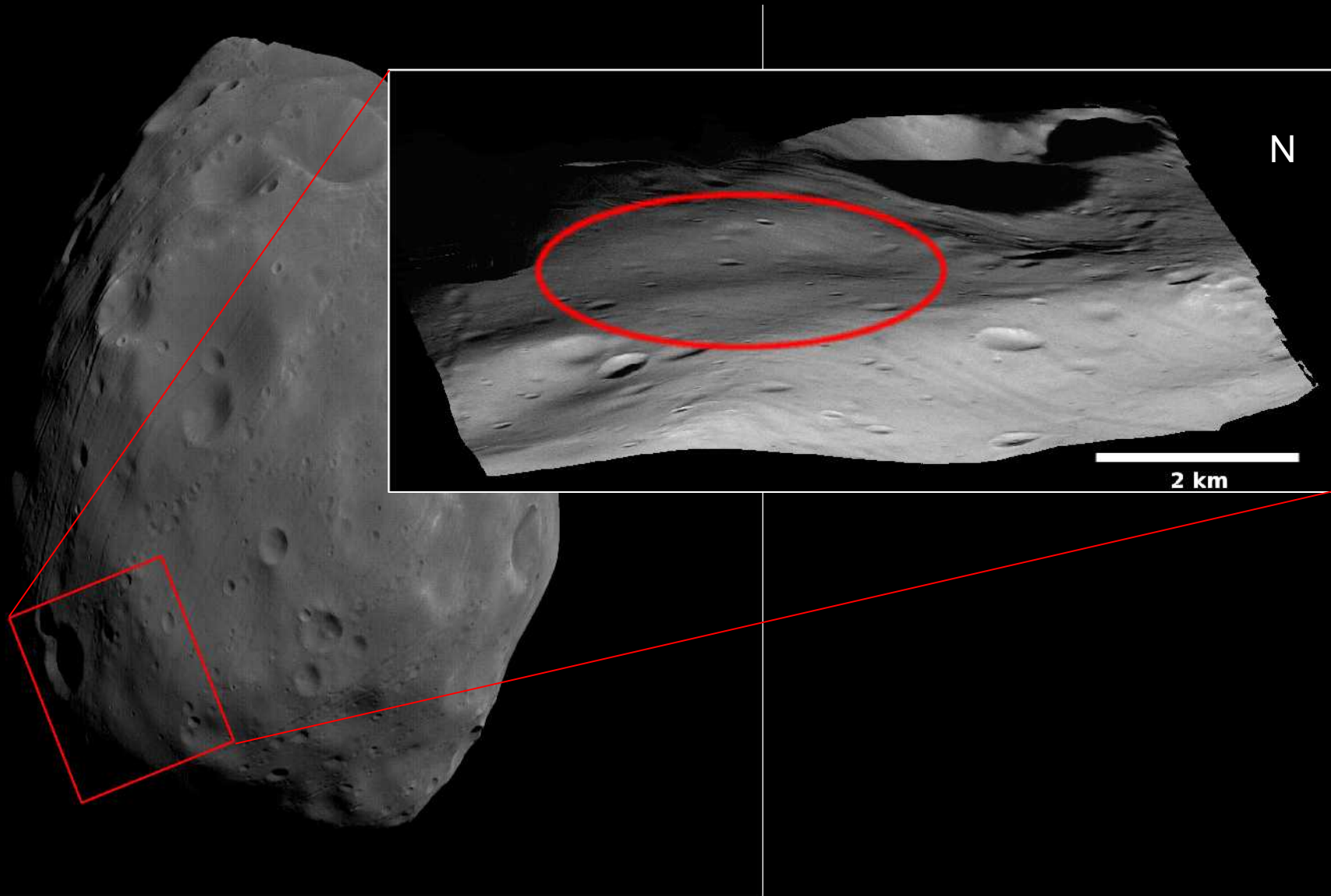


src frame 0031



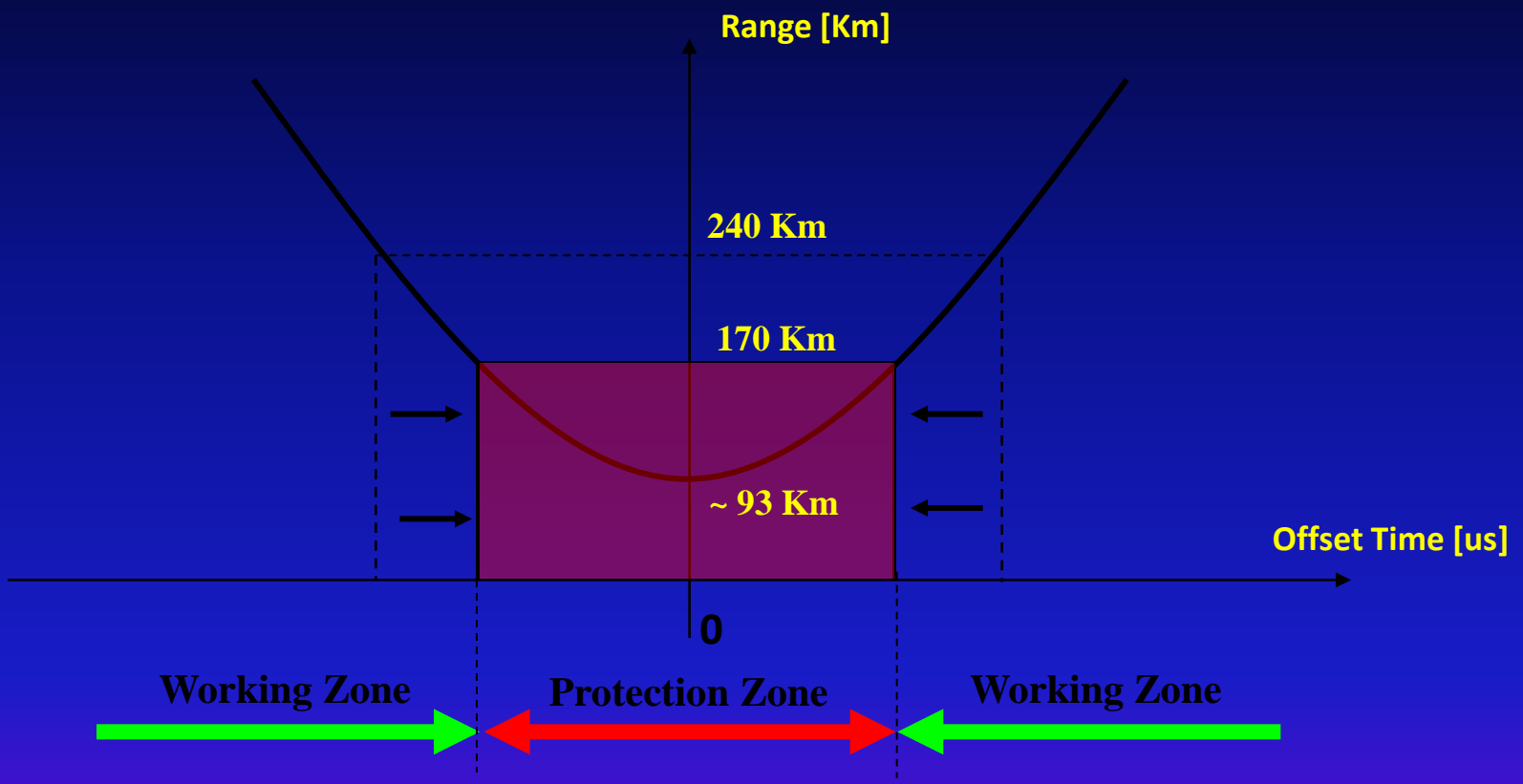


Landing site imaging

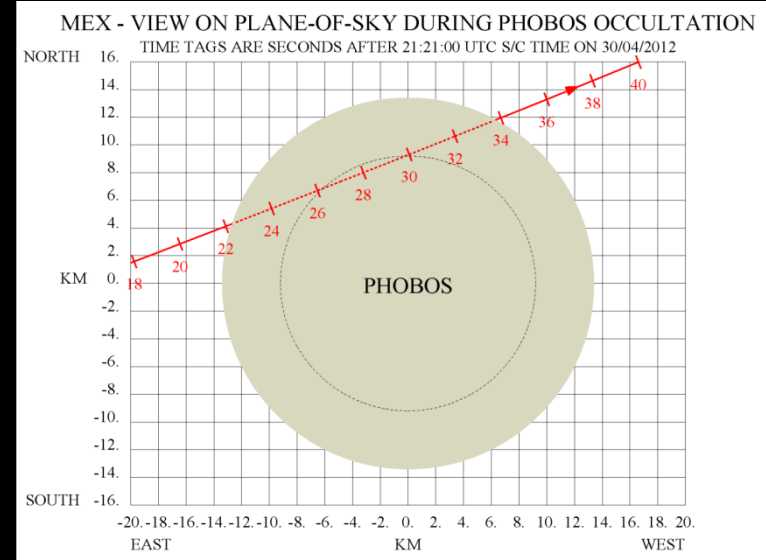
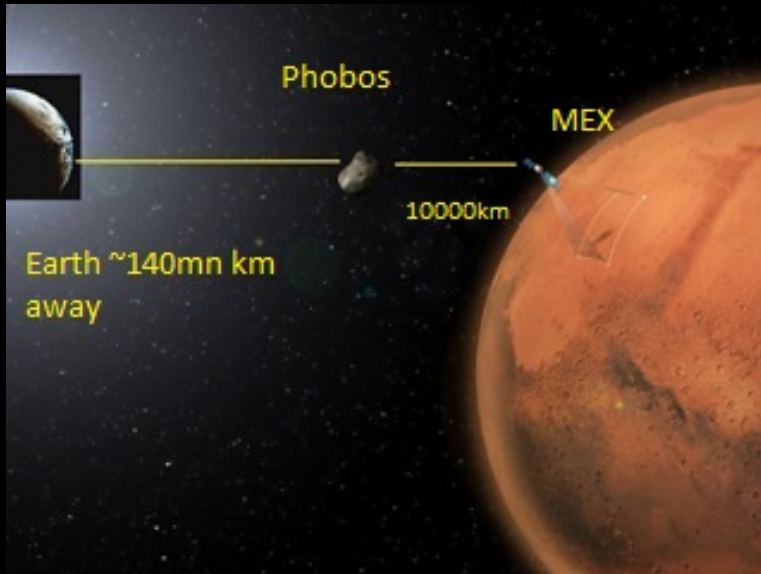


2. PI Science Objectives of future MTPs

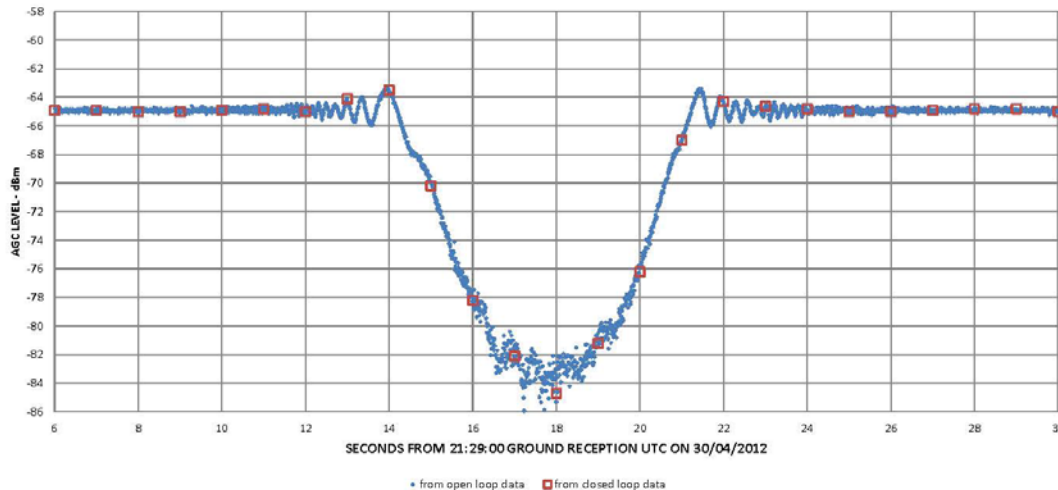
2.1 MARSIS Range Consideration on Phobos – minimum detectable Range



MEX occulted by Phobos, on 30/04/12



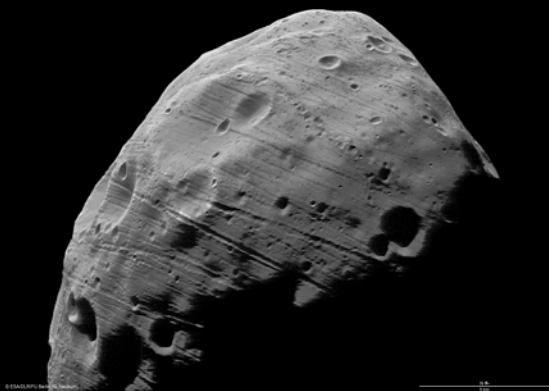
MEX - GROUND RECEIVE AGC LEVEL DURING OCCULTATION BY PHOBOS



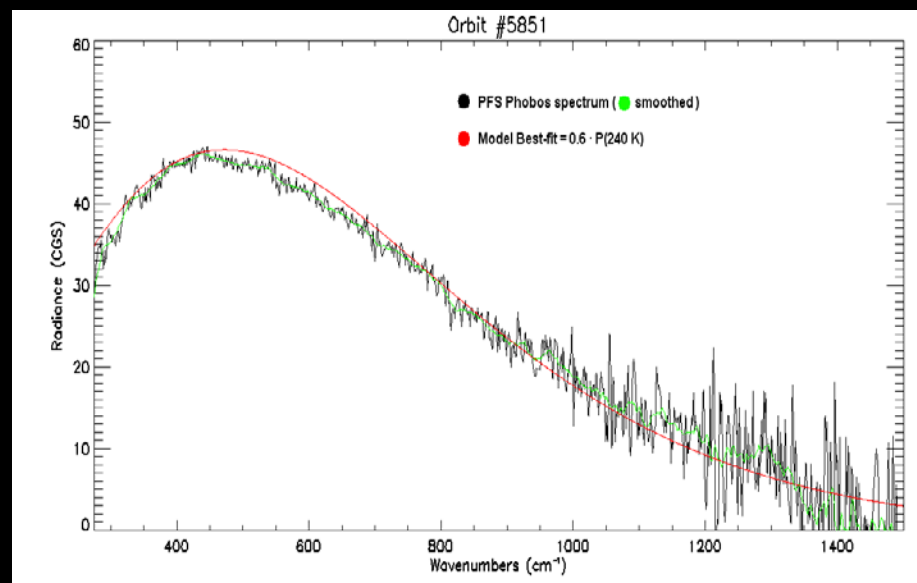
Rare opportunity to confirm the position of Phobos, and to even improve the moon ephemerids.

Surface and volume characterization [HRSC, OMEGA, PFS, SPICAM]

- Sharpest images ever (1 m/pixel with SRC)
- Atlas of the surface, shape and volume
- New evidence on the origin of grooves
- Spectrum from 0.1 up to 35 microns



100 km distance



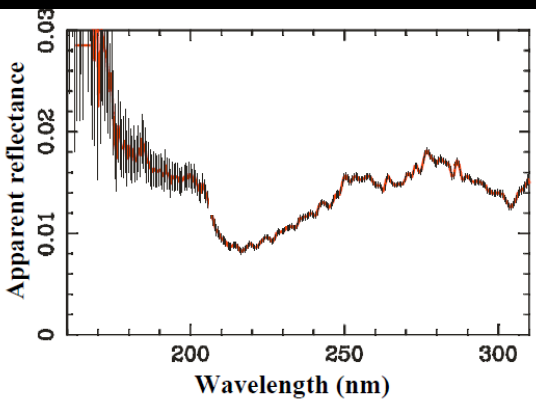
Surface temperature determination

Best wavelength range to know the surface composition?

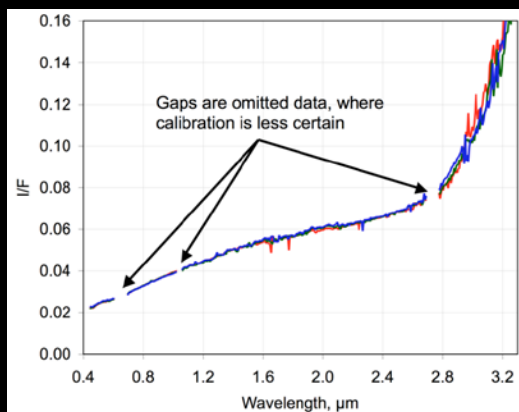
UV

VISIBLE

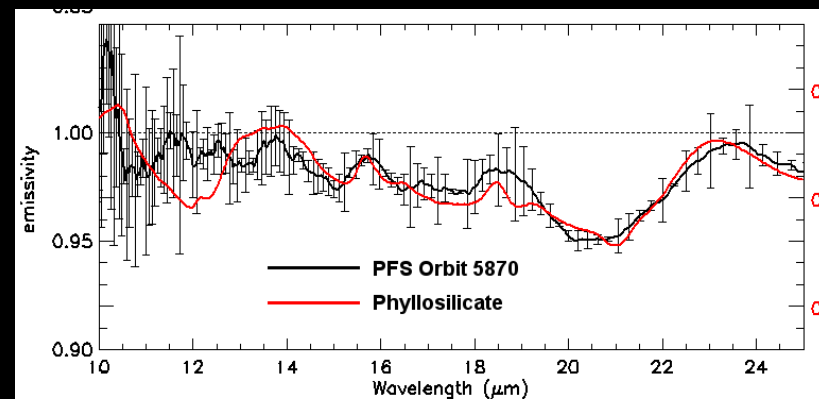
INFRARED



Features

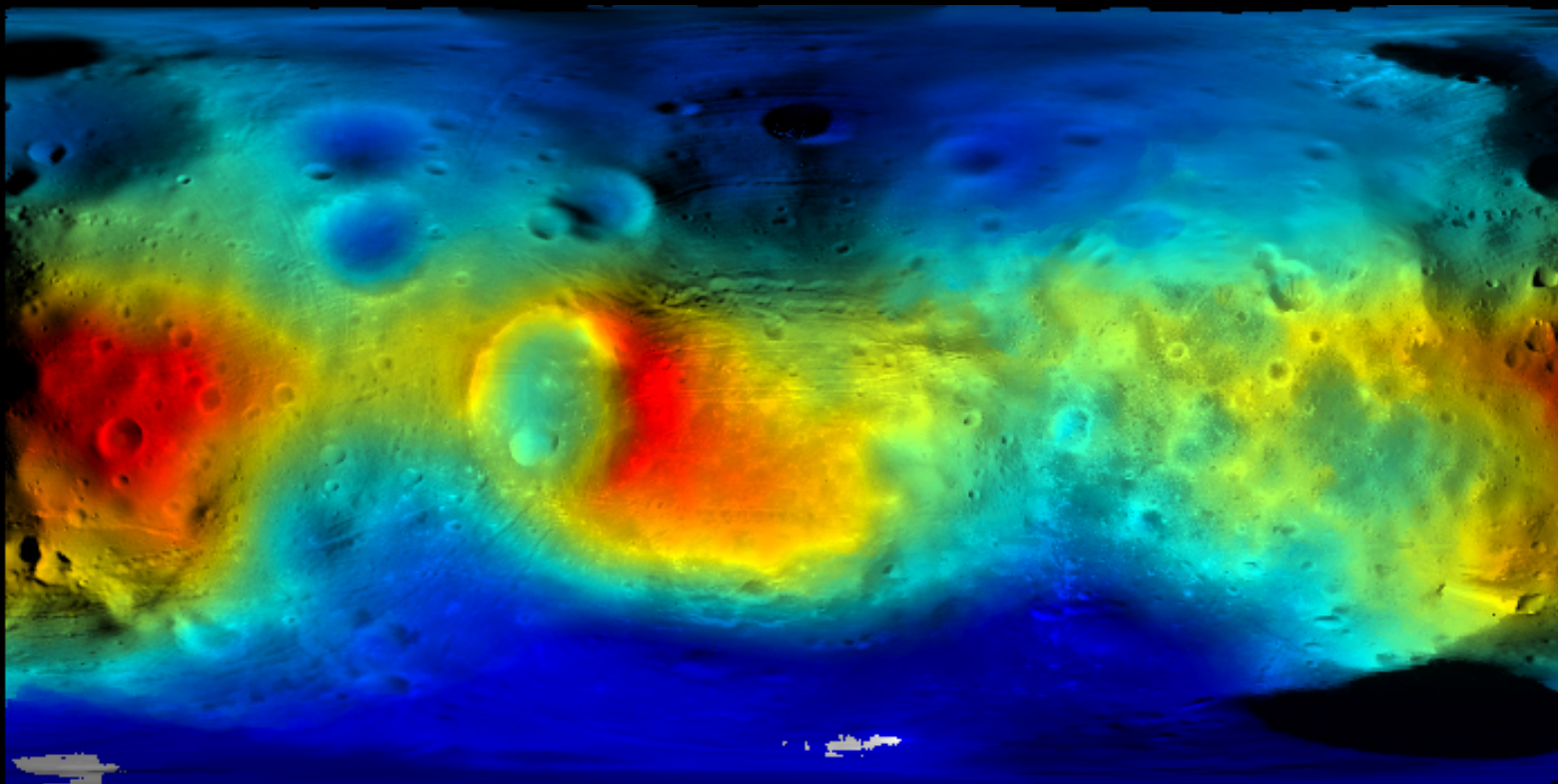


No features



Features

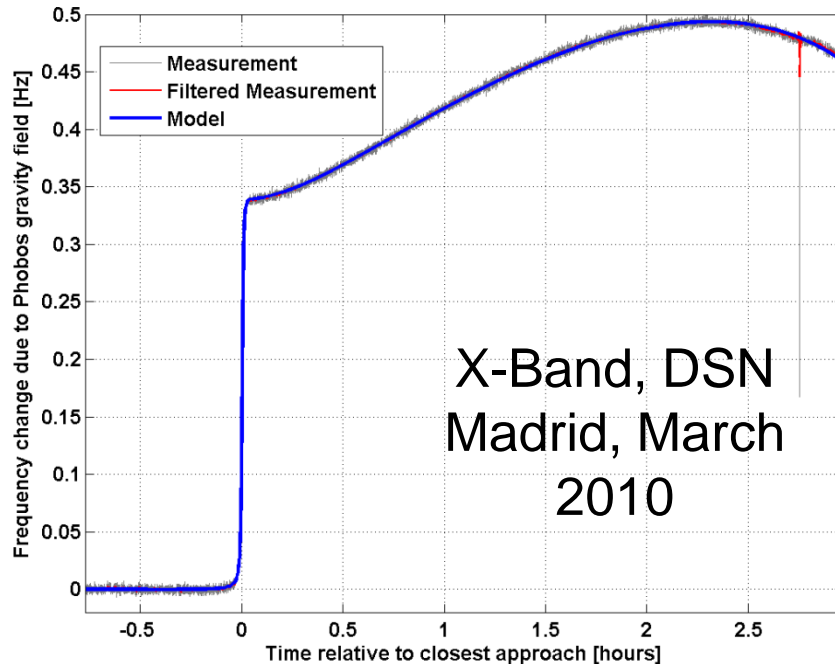
MEX elevation model



Gravity experiment

[Radio-science]

Change in the MEX trajectory due to the gravity of Phobos is detectable and allows the determination of the gravity field.

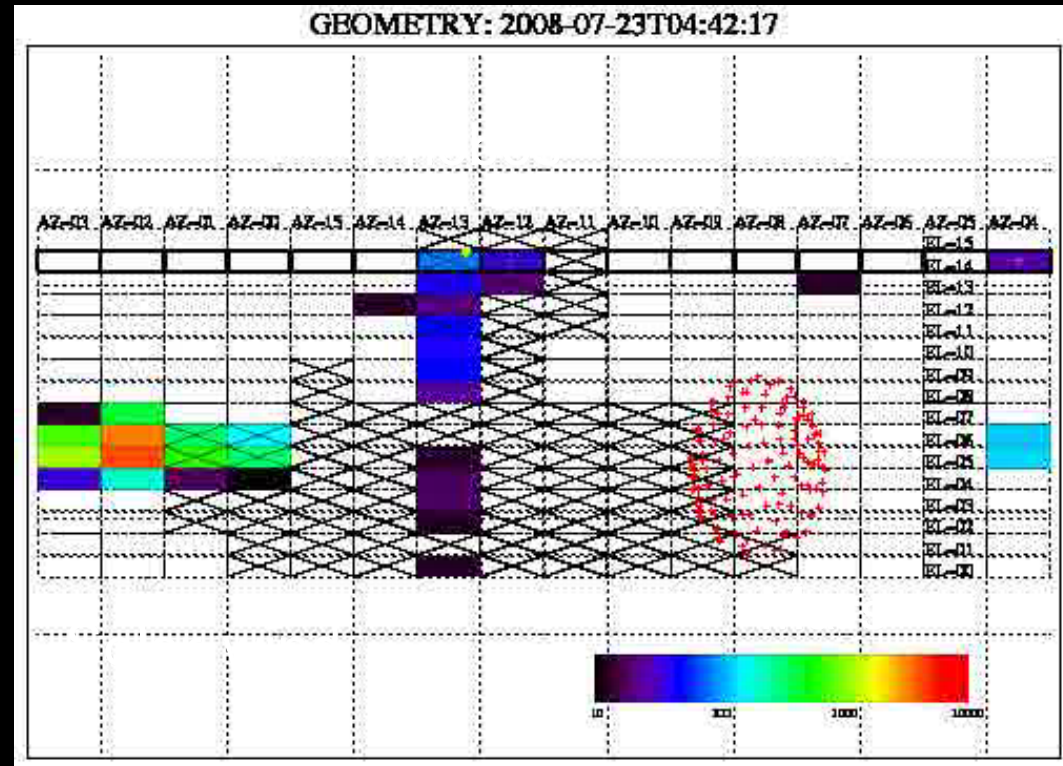


$$m_{\text{Phobos}} = 1.072 \times 10^{16} \text{ kg} \pm 0.3\%$$

$$\rho_{\text{Phobos}} = 1.87 \pm 0.03 \text{ g/cm}^3$$

Phobos - solar wind interaction [ASPERA]

- In the vicinity of Phobos, protons with energy slightly less than the solar wind were observed (3 events)
- Observation of backscattered solar wind protons from the Phobos surface, as a result of the solar wind interaction.
- Phobos interacts strongly with the solar wind reflecting ~0.1-1% of the solar wind protons
- The phenomenon is similar to the Moon



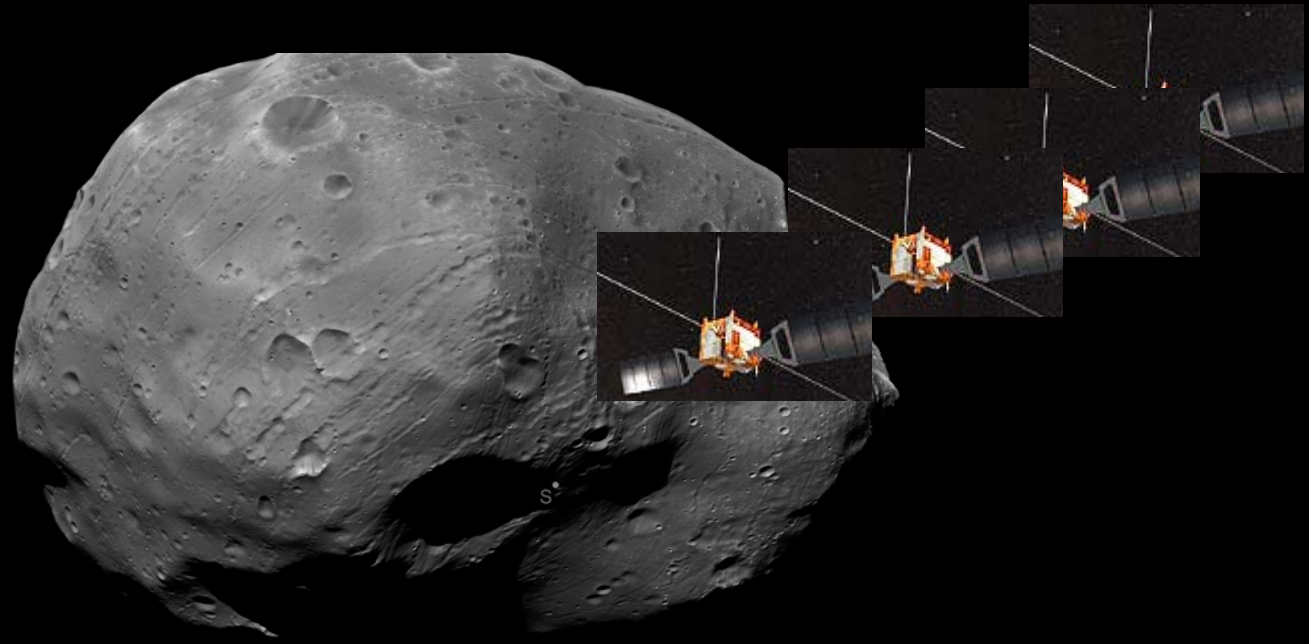
Ion detected coming from Phobos

Next Mars Express flybys:

December 2013 and
October 2014:

Distance from the surface less
than 50 km

End of mission: a new crater on Phobos!



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