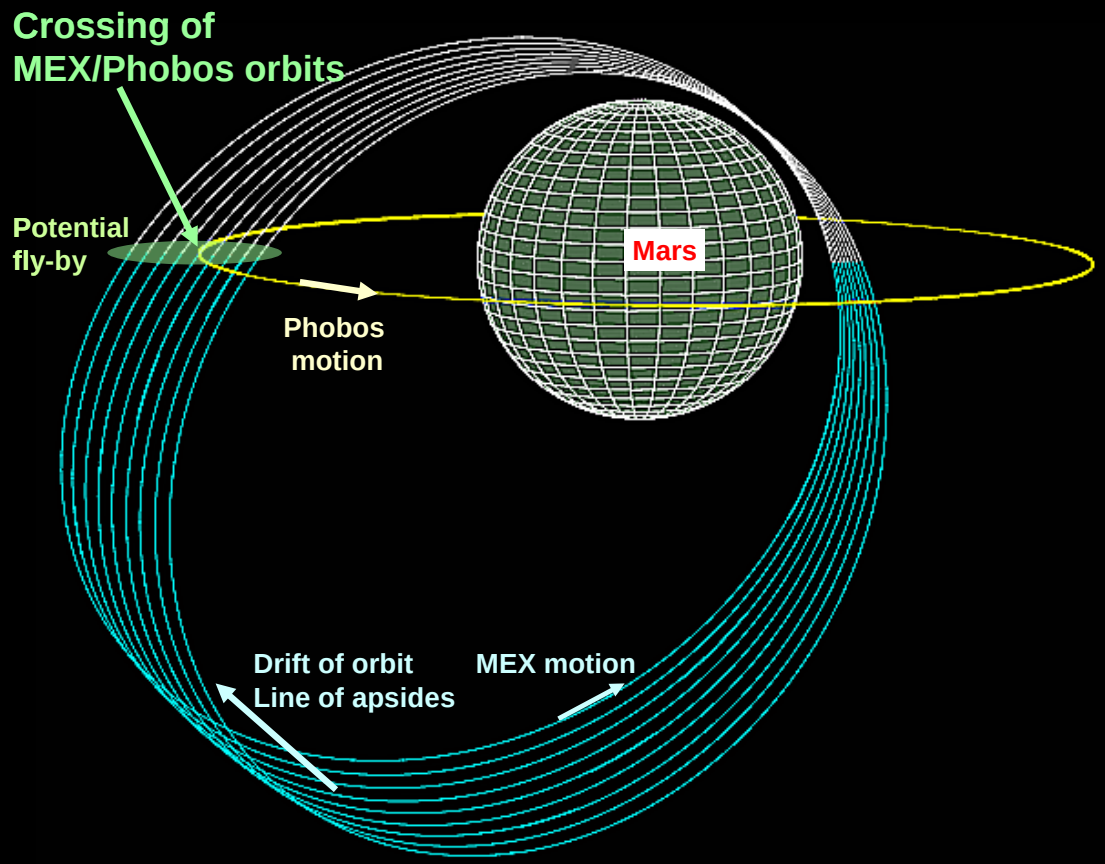
Mars Express investigations of Phobos

Olivier Witasse, Tom Duxbury
and all Mars Express teams

Outline

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

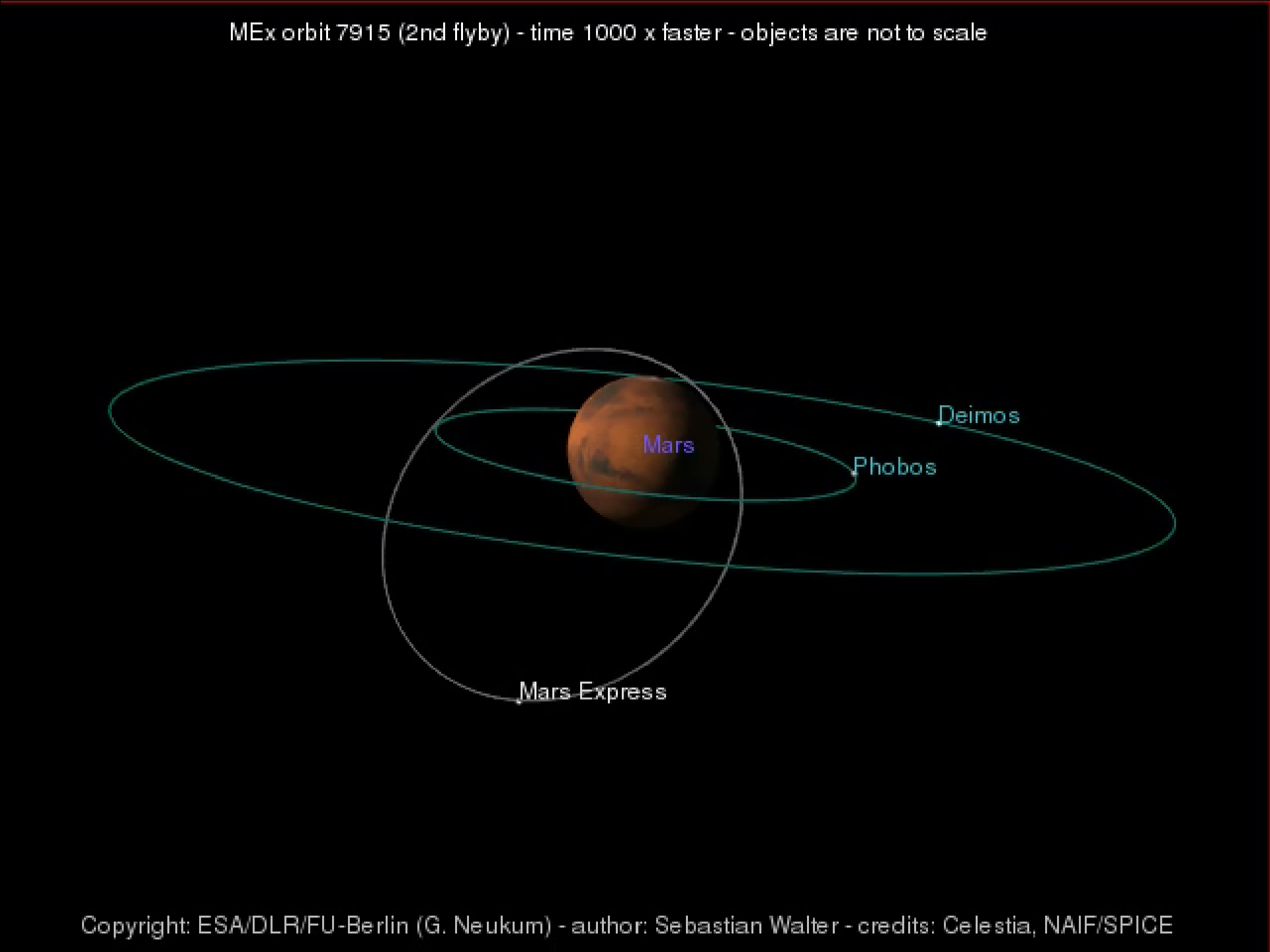
Mars Express flybys



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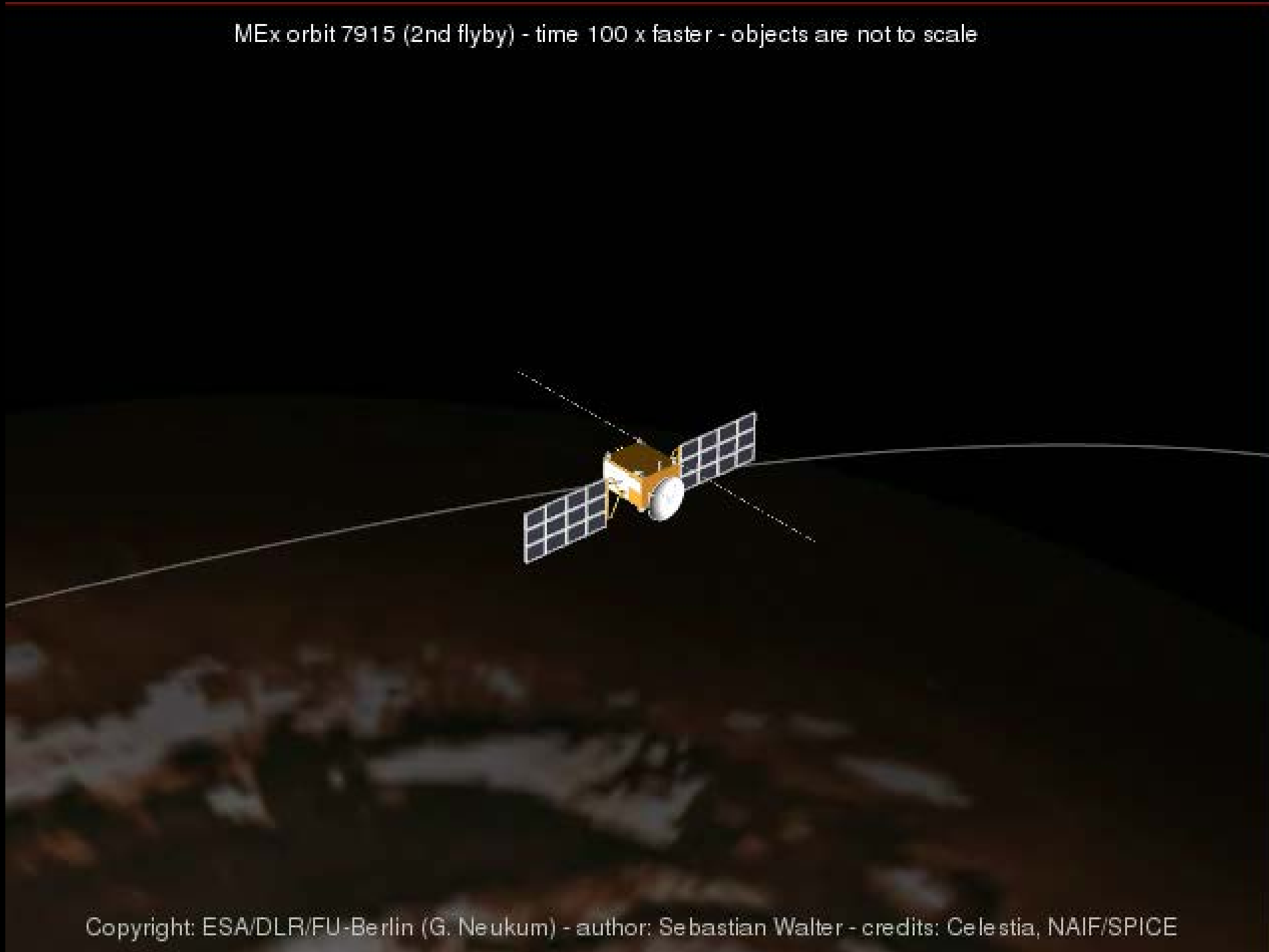
MEx orbit 7915 (2nd flyby) - time 100 x faster - objects are not to scale
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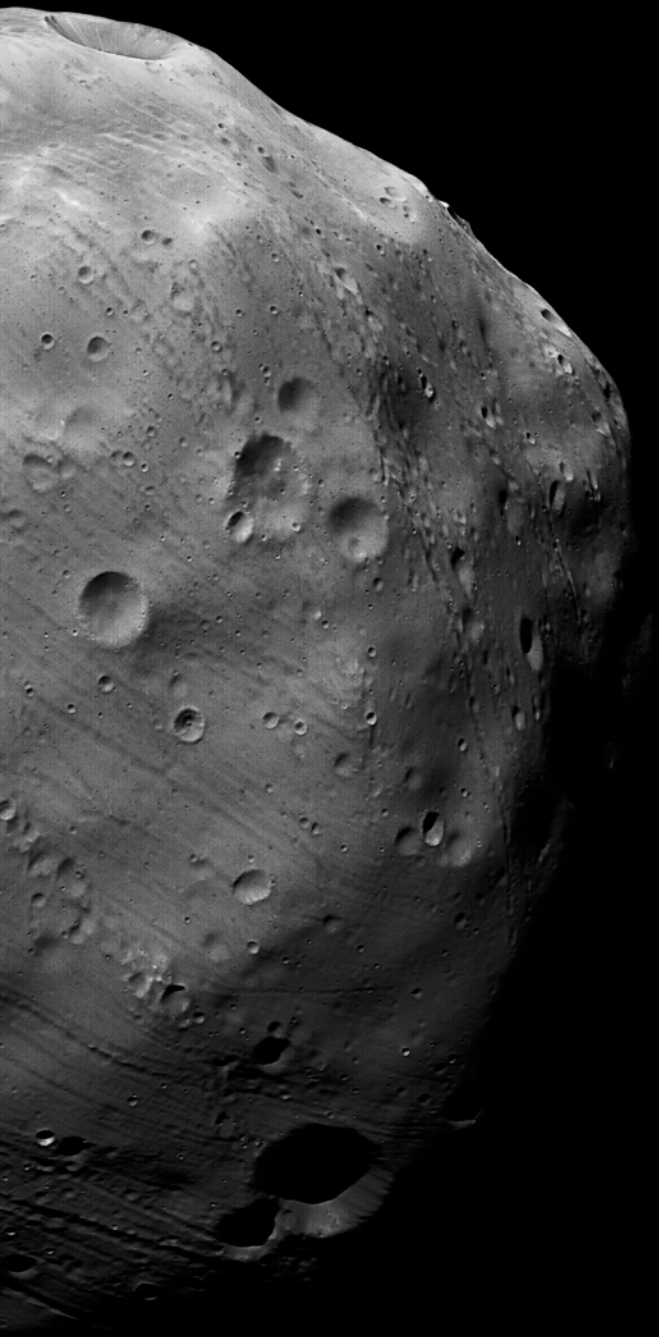

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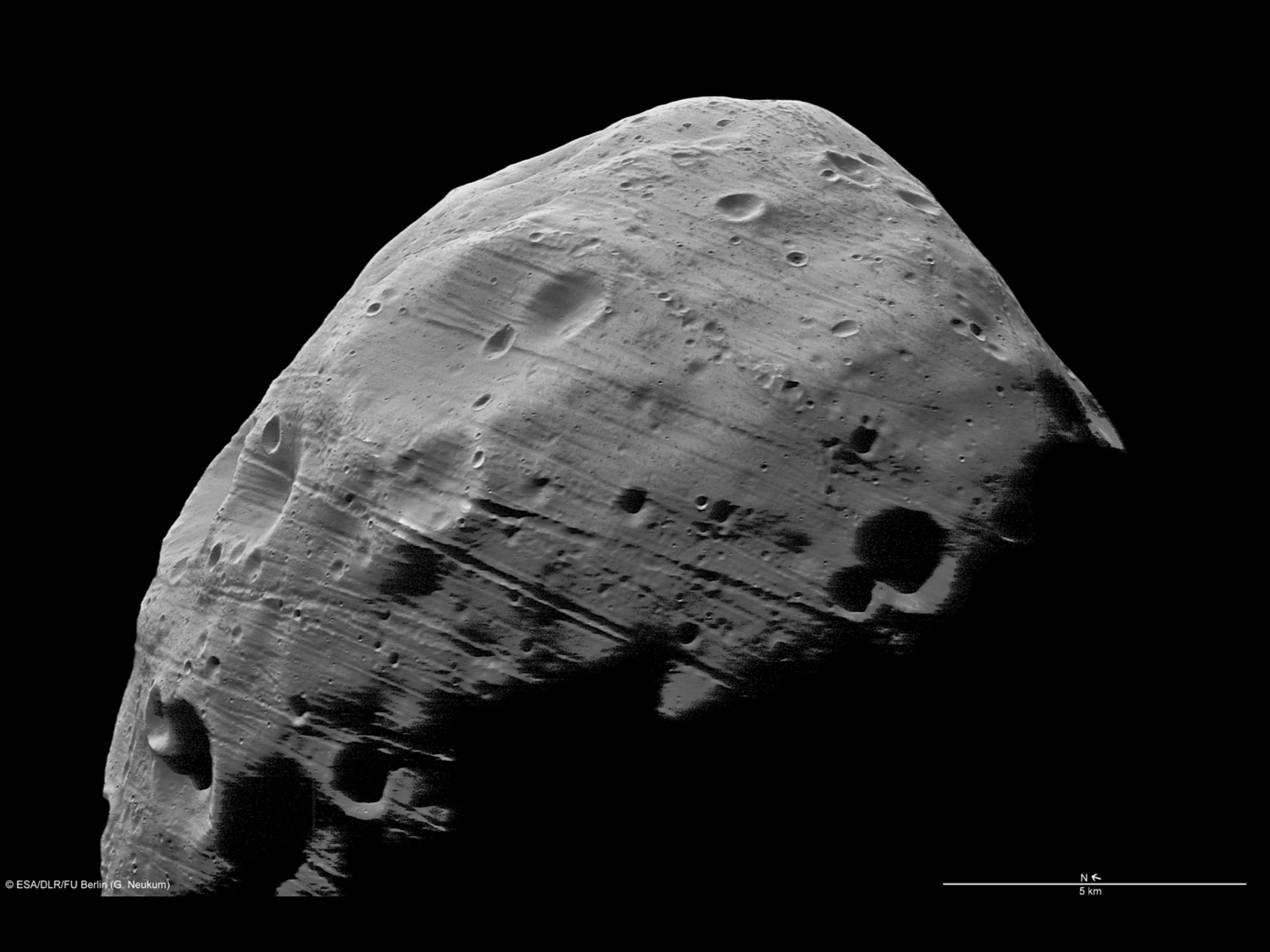
N ←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N
5 km

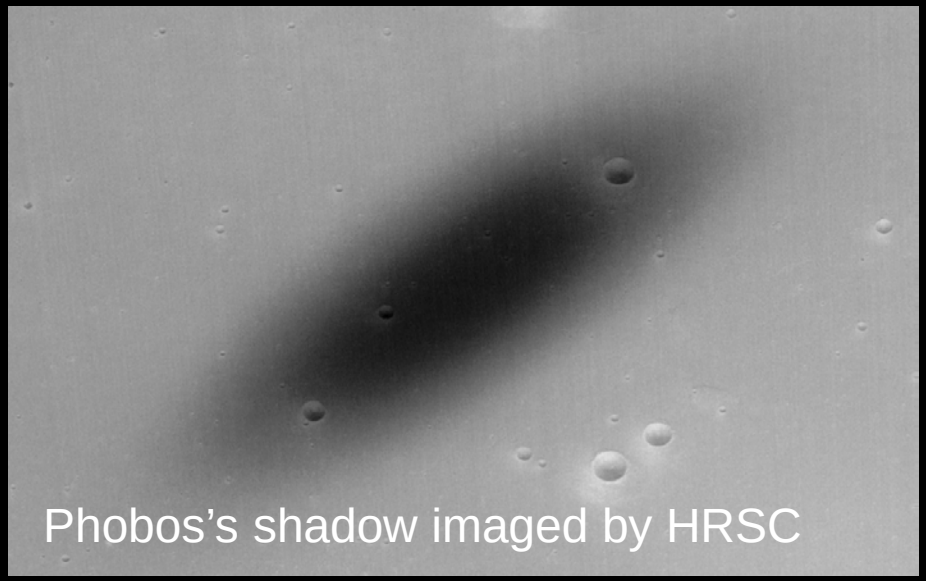
Mars Express results

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

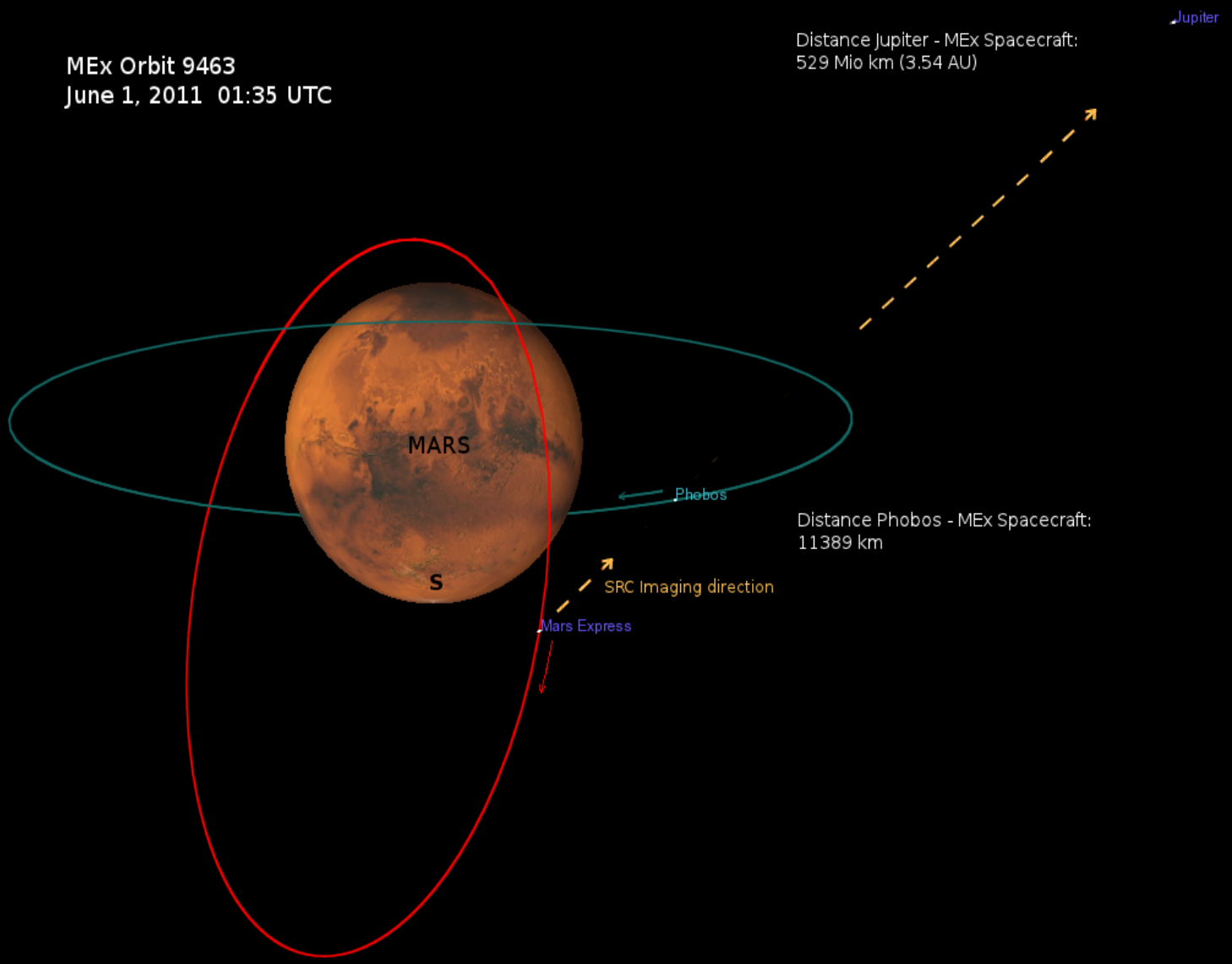


Phobos's shadow imaged by HRSC

Image taken on
5 November 09

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

Imaging Phobos … and Jupiter




HRSC orbit 9463
src frame 0075
src frame 0055
src frame 0031
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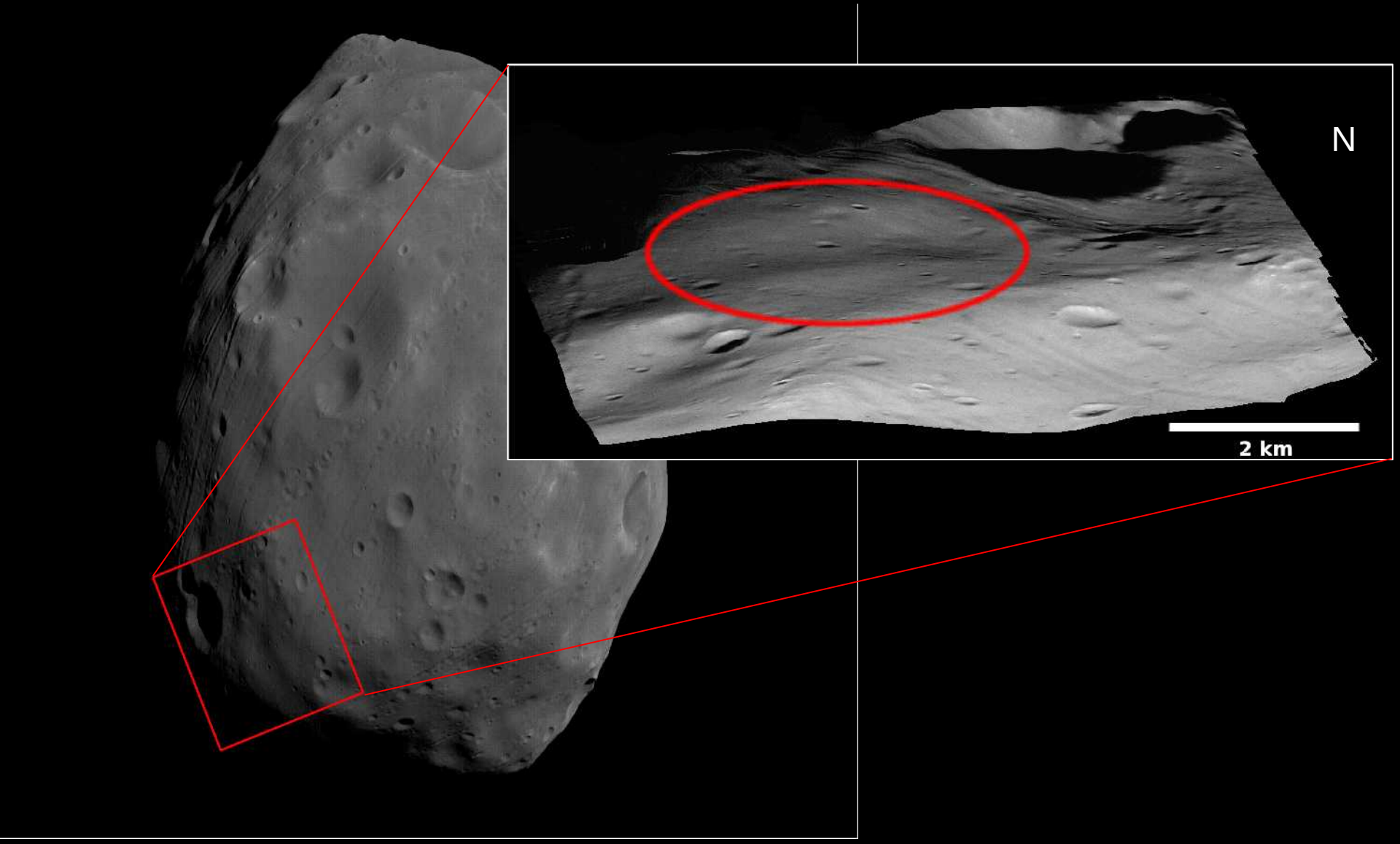
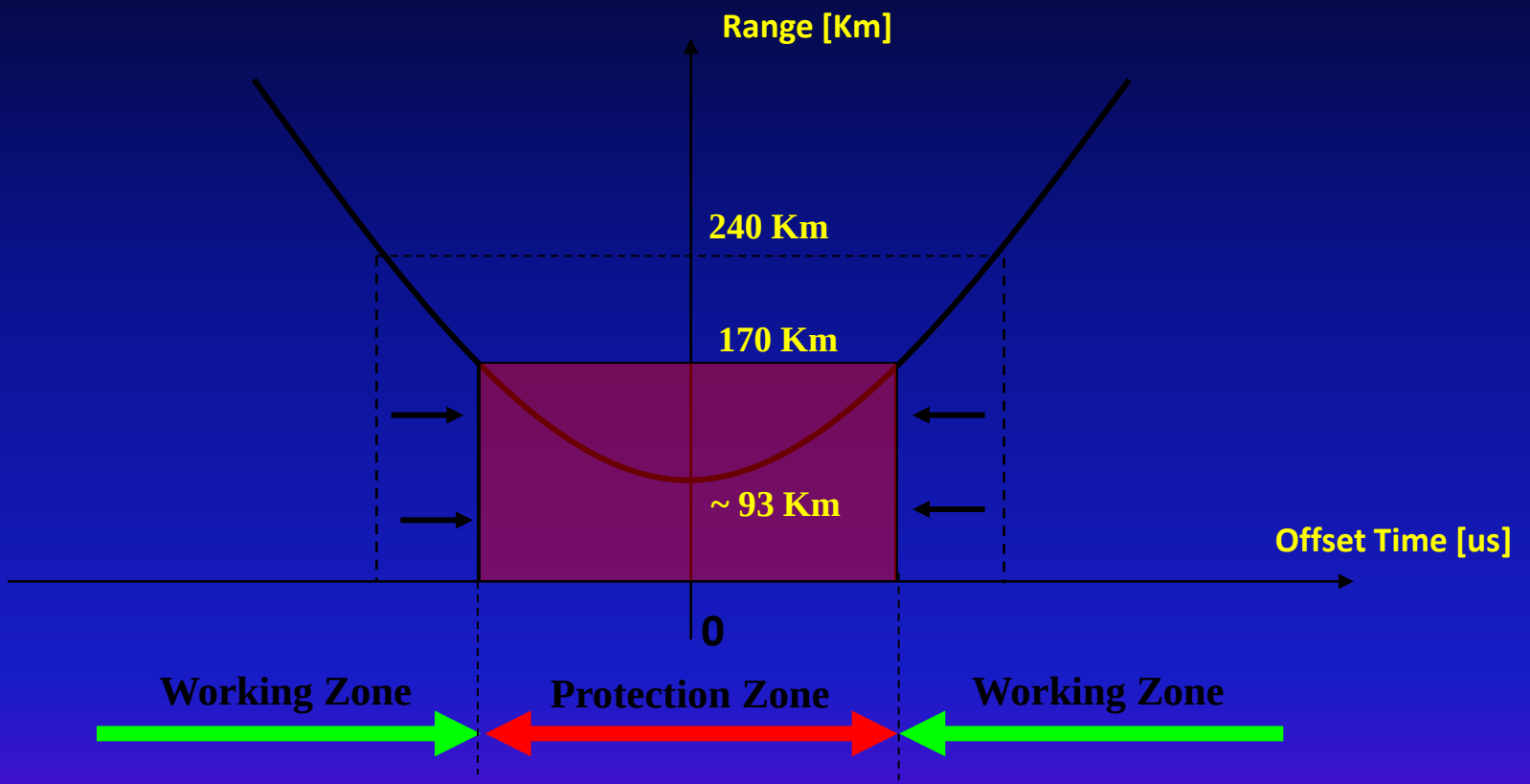
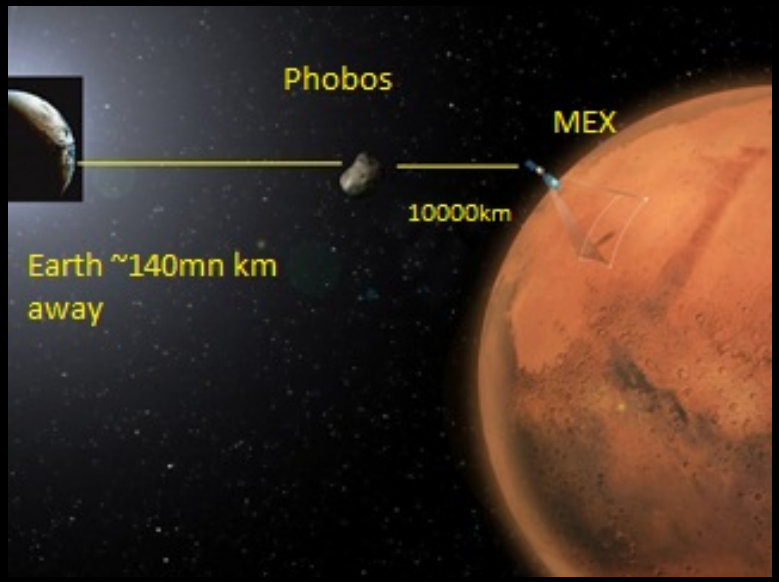
Landing site imaging

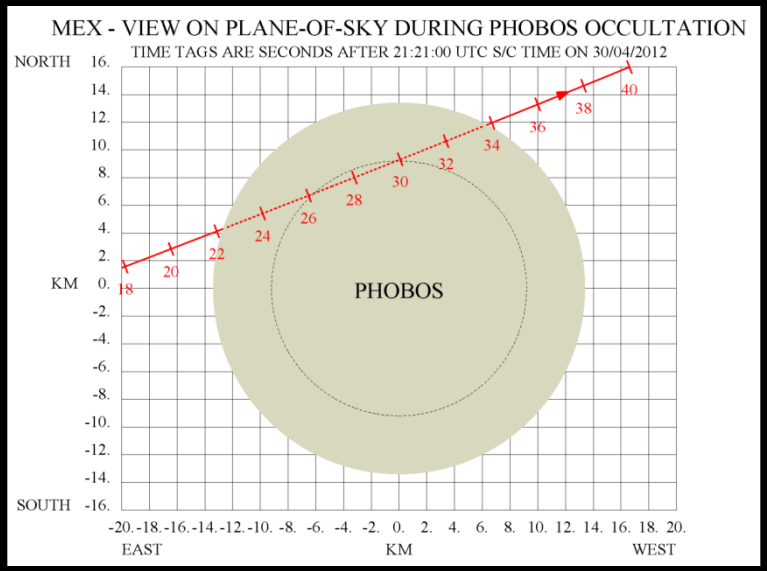


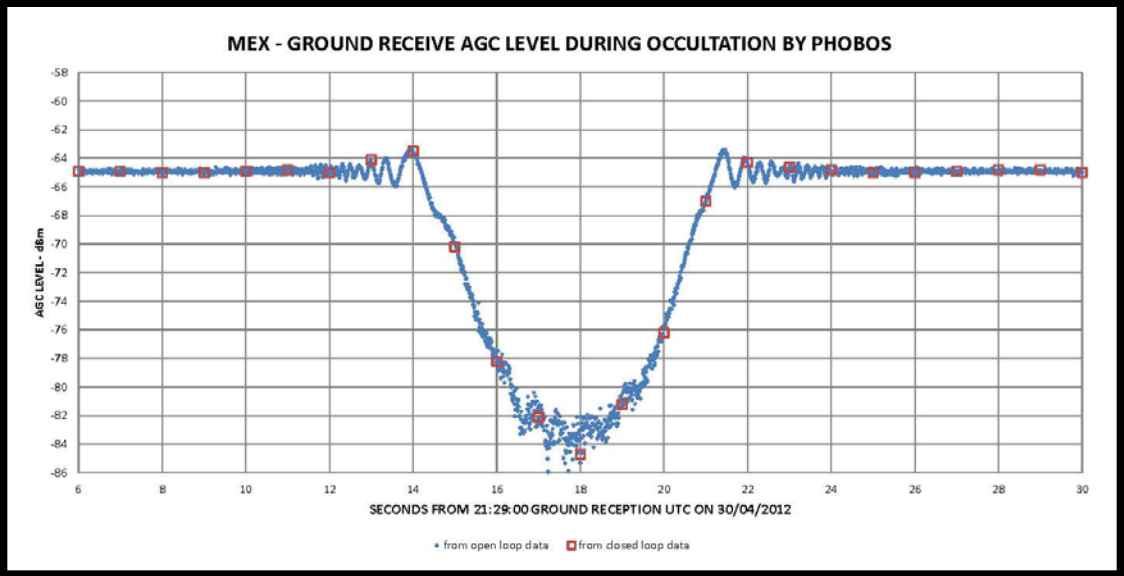
2.1 MARSIS Range Consideration on Phobos – minimum detectable Range –



MEX occulted by Phobos, on 30/04/12



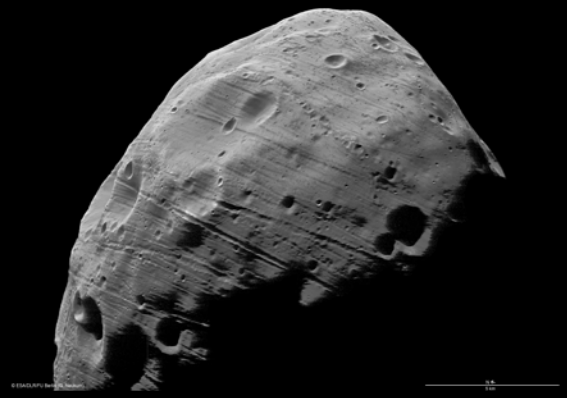




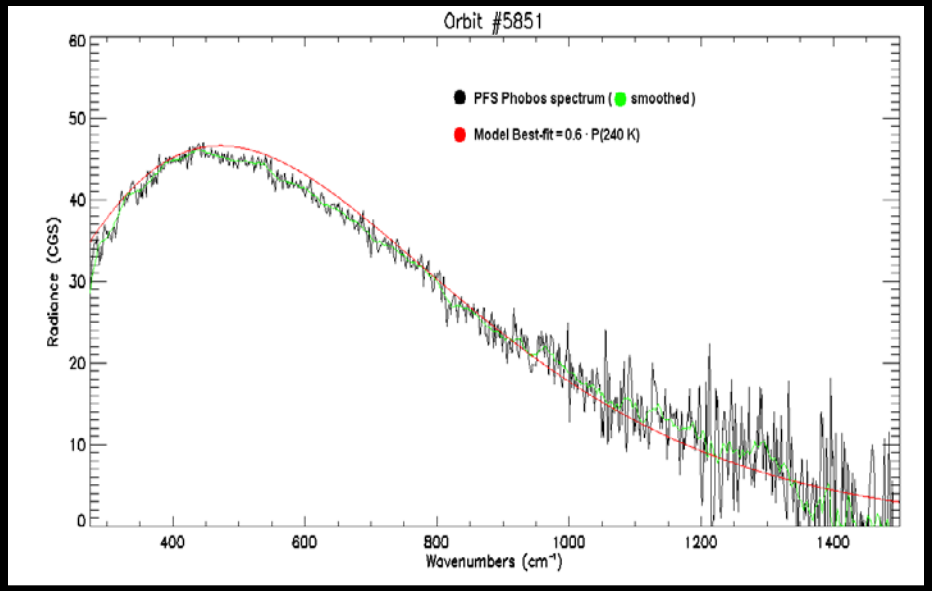
Rare opportunity to confirm the position of Phobos, and to even improve the moon ephemerids.

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



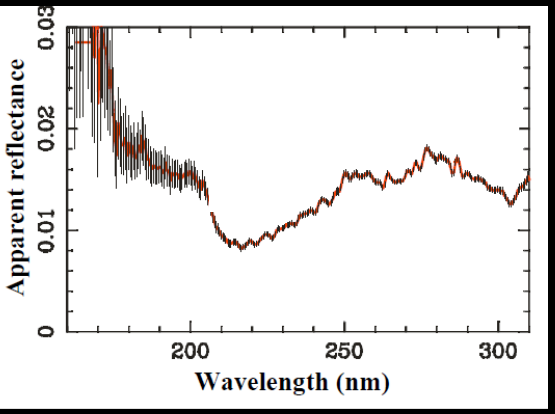
100 km distance

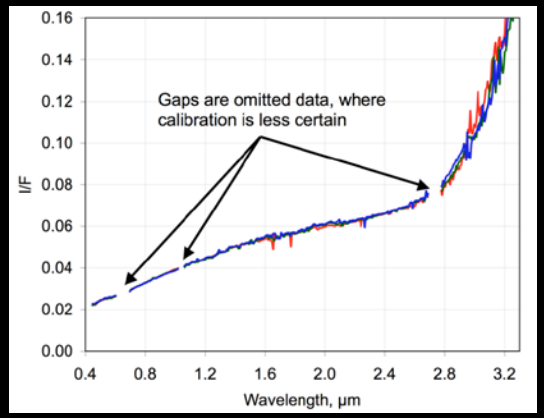


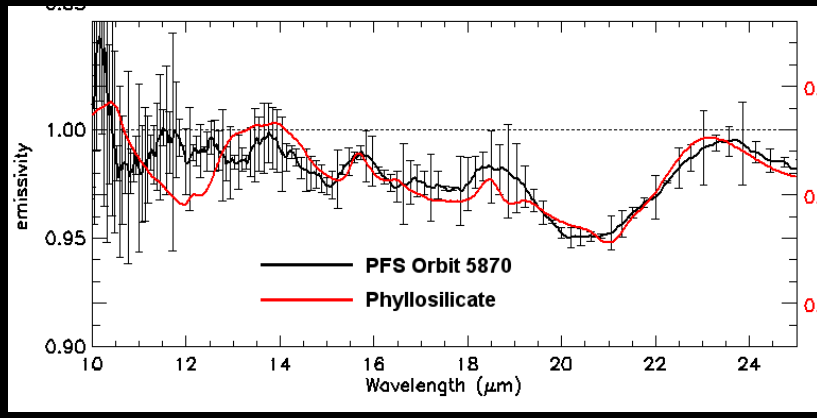
Surface temperature determination

Best wavelength range to know the surface composition?

UV VISIBLE INFRARED





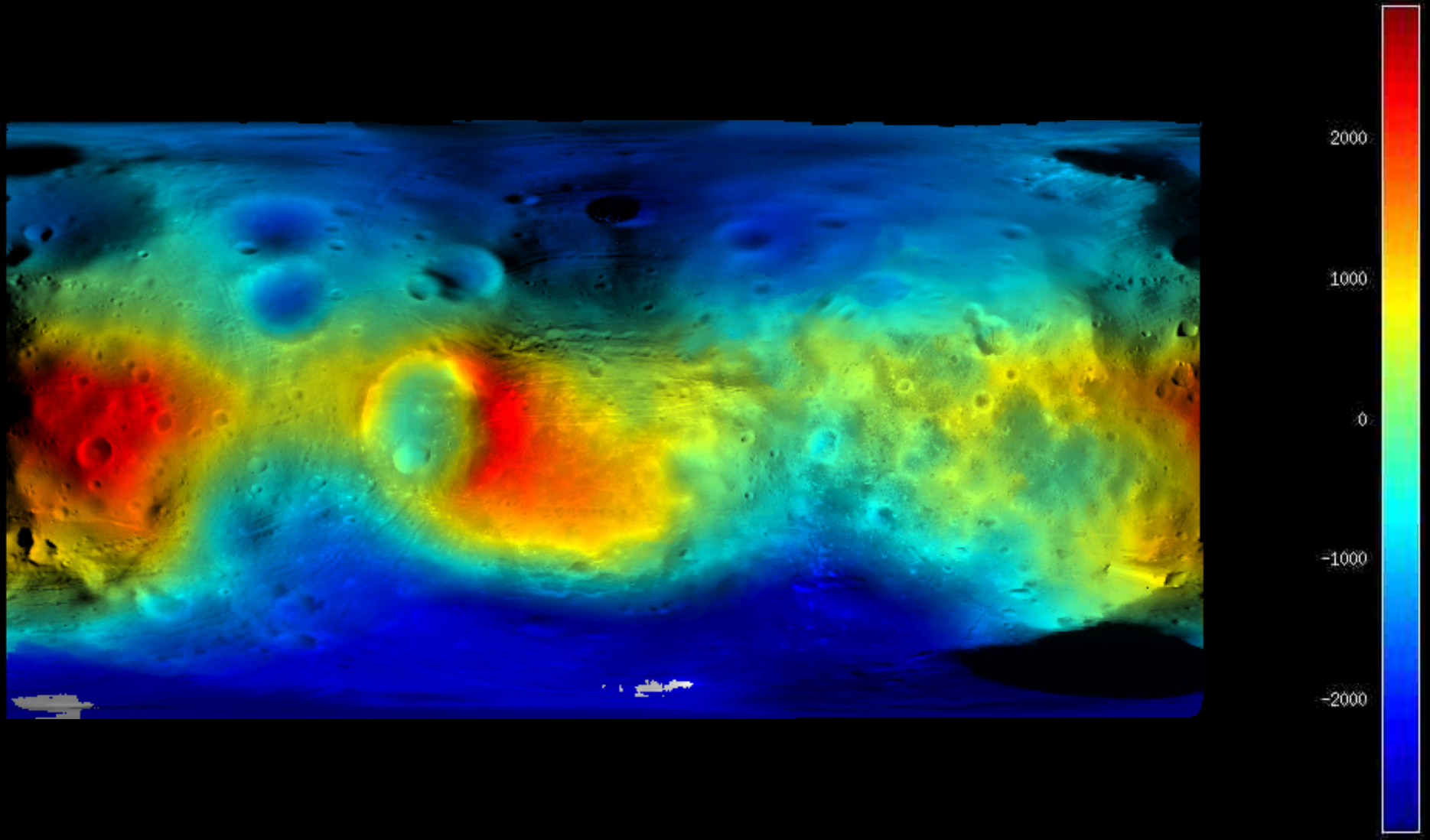


Features

No features

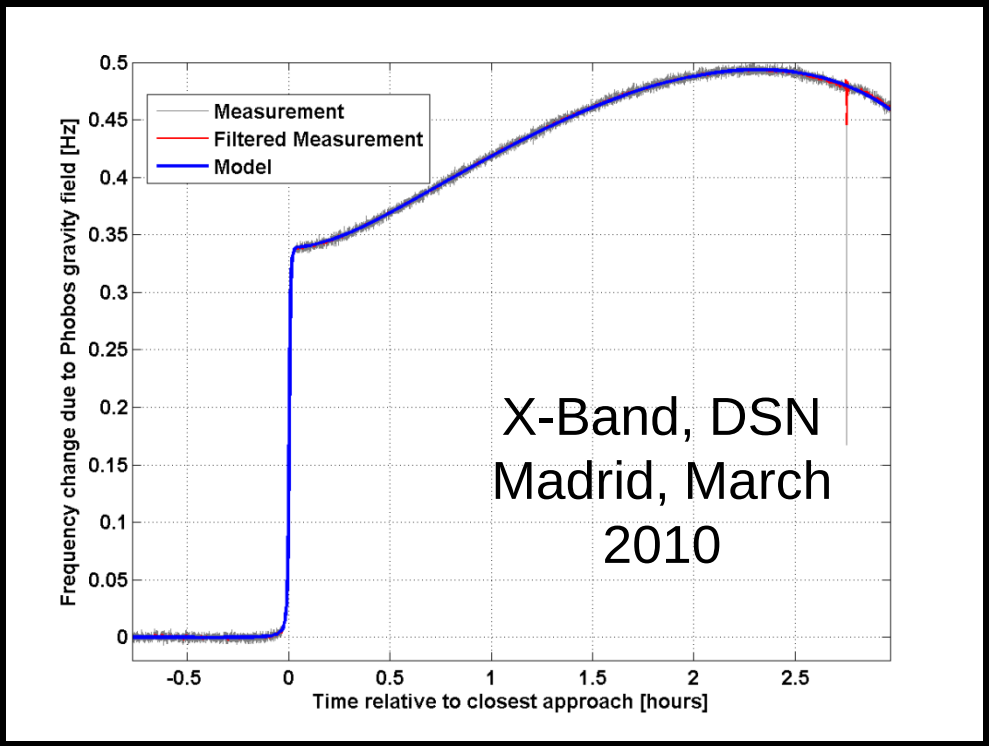
Features

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_{Phobos} = 1.072 x 10^{16} kg ± 0.3%

ρ_{Phobos} = 1.87 ± 0.03 g/cm3

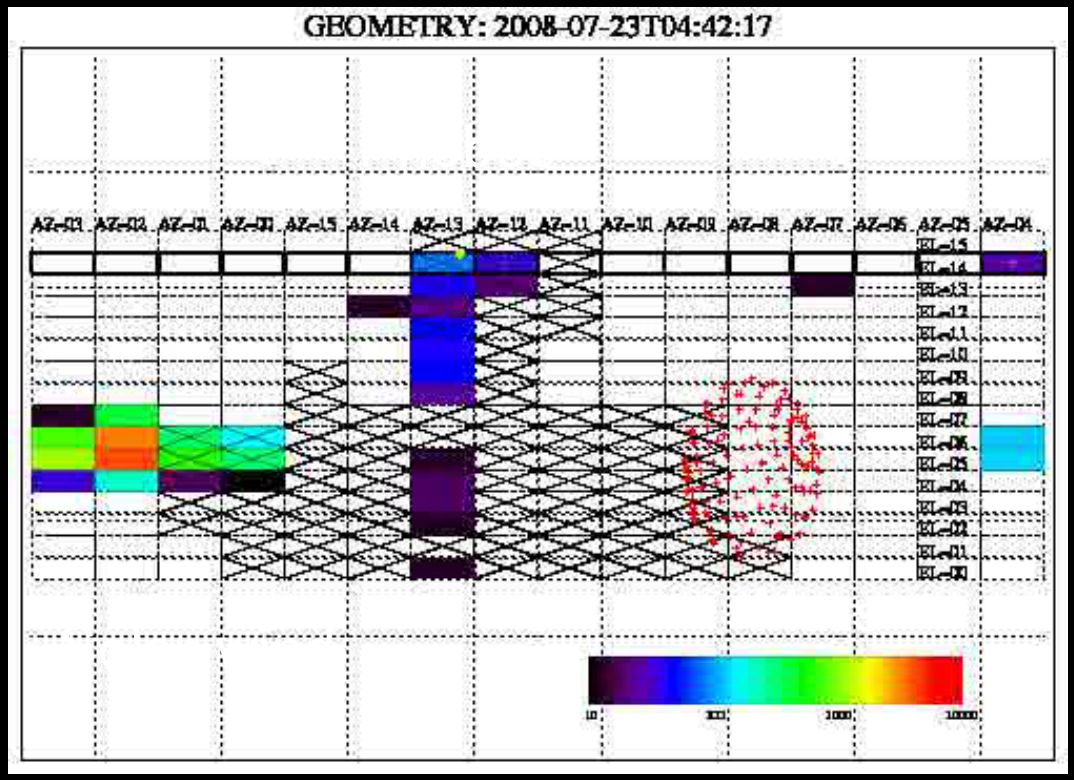
Phobos - solar wind interaction
[ASPERA]

•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



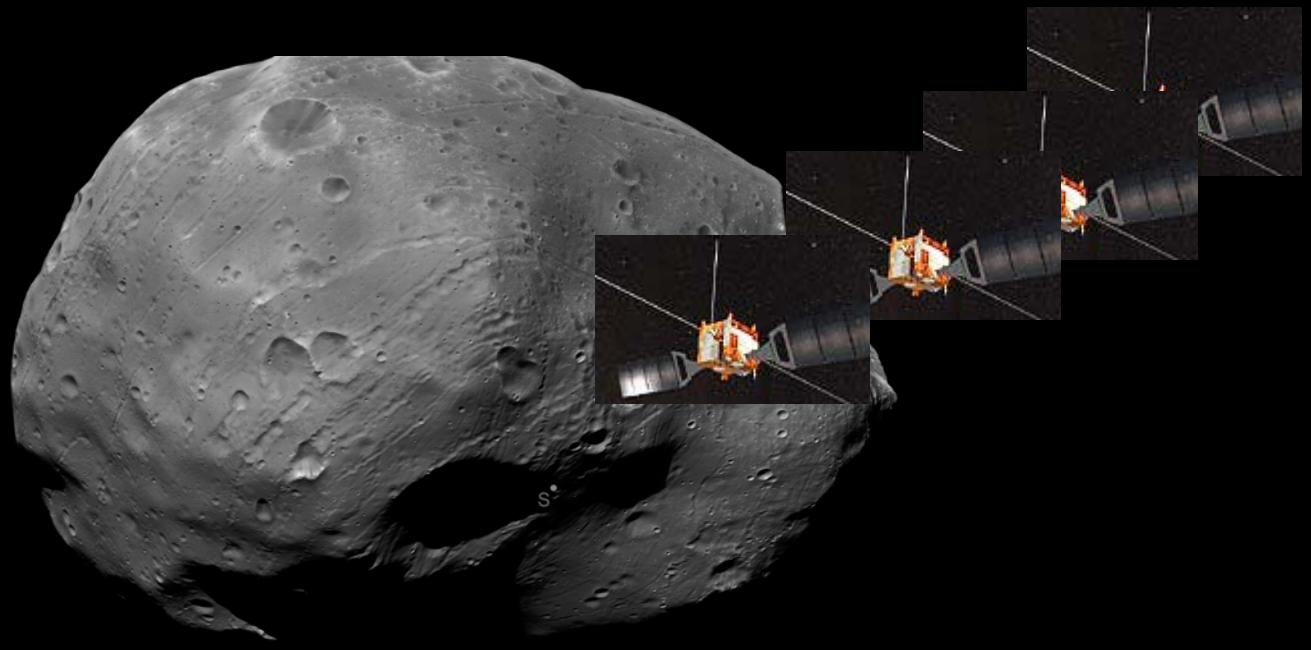
Ion detected coming from Phobos

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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