HRSC/SRC Imaging Results from the Phobos and Deimos Flybys

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3) Freie Universität, Berlin

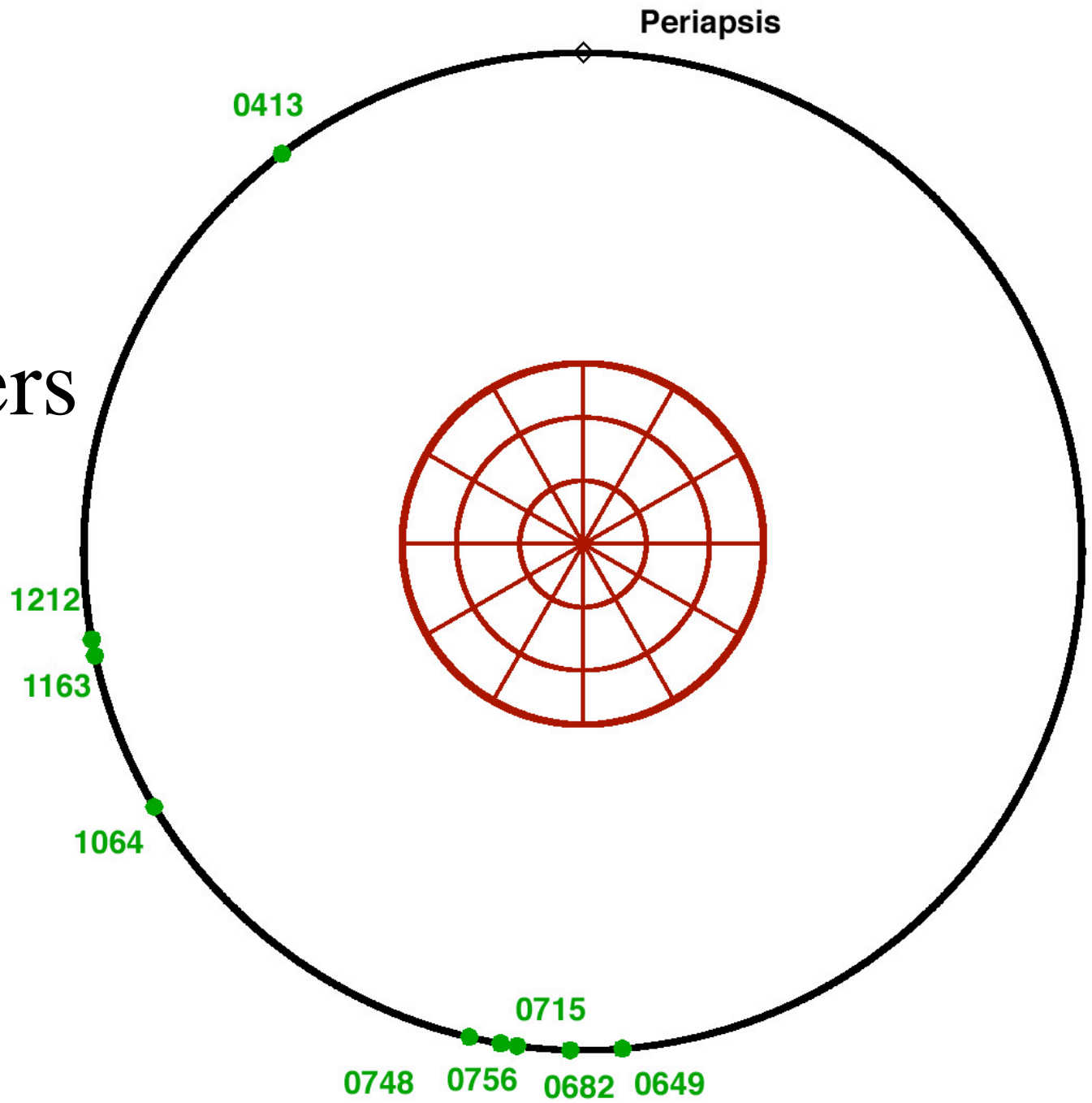
Phobos Parameters

Radius (km)	13.5 x 10.8 x 9.4
Mean distance from Mars (km)	9,380
Rotational period (days)	0.31910
Orbital period (days)	0.31910
Mean orbital velocity (km/sec)	2.14
Orbital eccentricity	0.01
Orbital inclination (degrees)	1.0

Phobos Flybys

Orbit No	Encounter Time	True Anomaly	Flyby Distance	Slew?
413	2004-05-18T08:34	37.7°	1883 km	No
649	2004-07-23T12:40	184.4°	1836 km	Yes
682	2004-08-01T18:35	178.5°	1469 km	No
715	2004-08-11T00:30	172.5°	1213 km	No
748	2004-08-20T06:25	167.0°	1247 km	No
756	2004-08-22T12:06	170.6°	149 km	Yes
1064	2004-11-16T14:22	121.5°	4676 km	No
1163	2004-12-14T08:06	102.9°	3835 km	No
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1558	2005-04-03T23:51	47.9°	3598 km	No
1574	2005-04-08T11:21	63.1°	3797 km	No
1607	2005-04-17T17:15	55.5°	3977 km	No
1679	2005-05-07T22:56	209.1°	2530 km	No

MEX Phobos Encounters



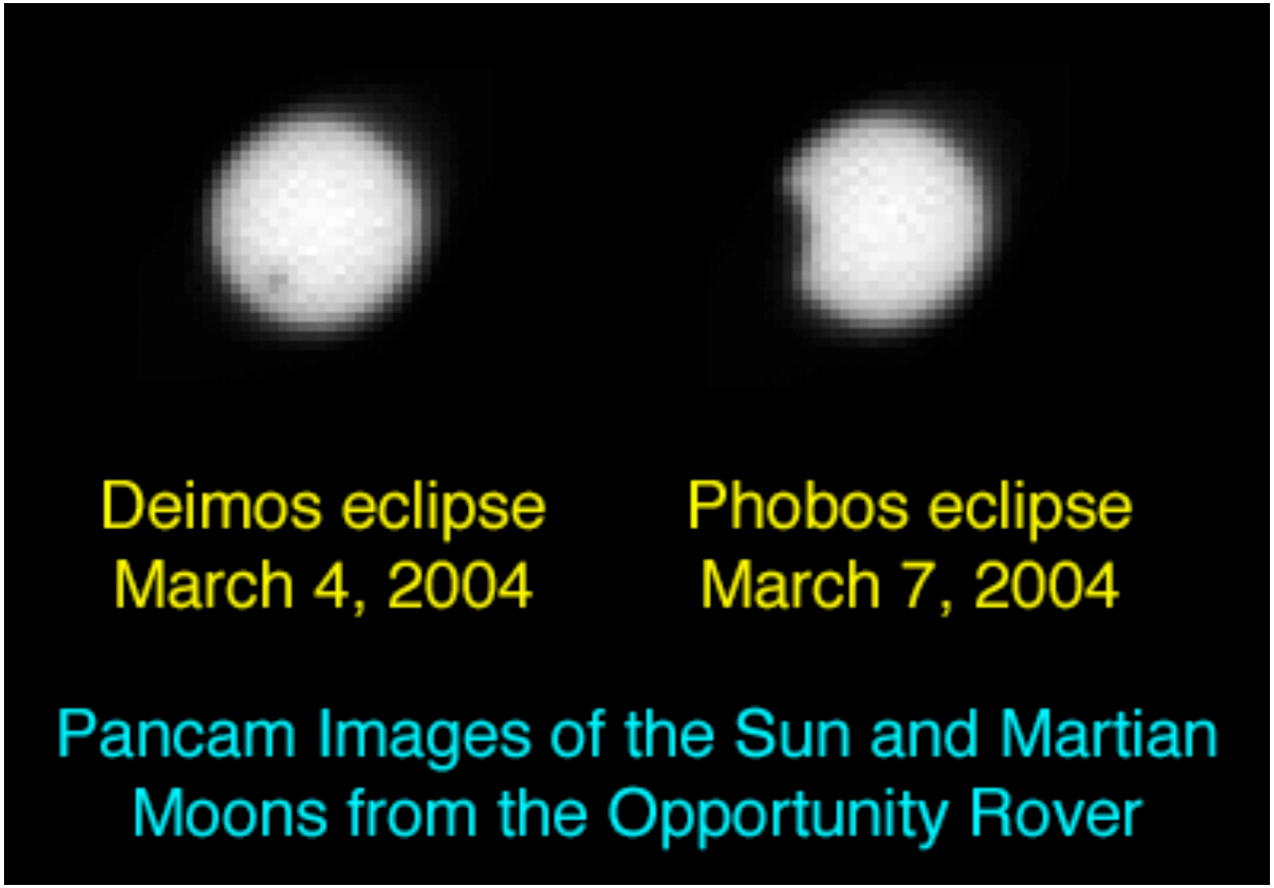
Expected Results ?

Many previous missions studying Phobos:
Viking, Phobos, Mars Global Surveyor

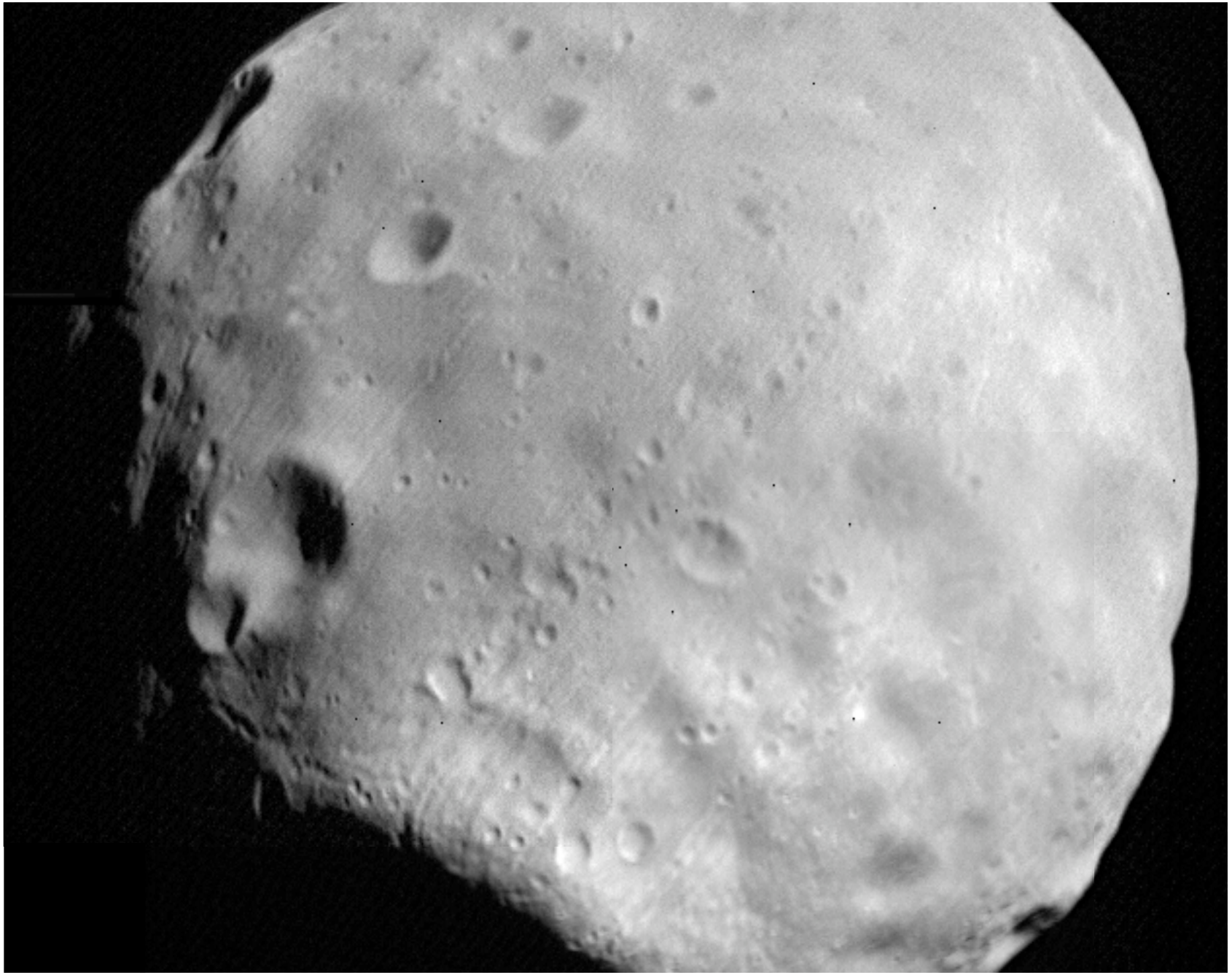
- Very high-resolution SRC camera
  == > Improve Phobos ephemeris
- HRSC stereo images
  == > Derive global shape and topography
- Once terrain models are available
  == > Study surface photometry, geology



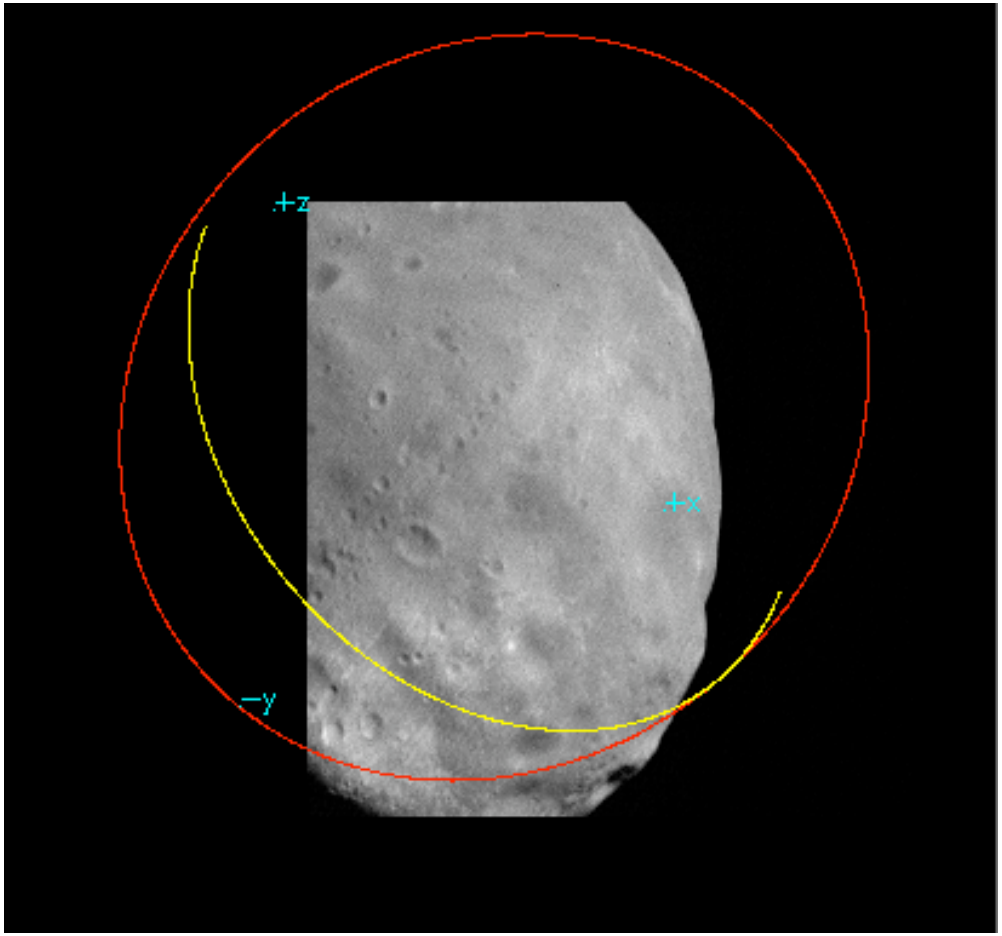
Phobos Orbit



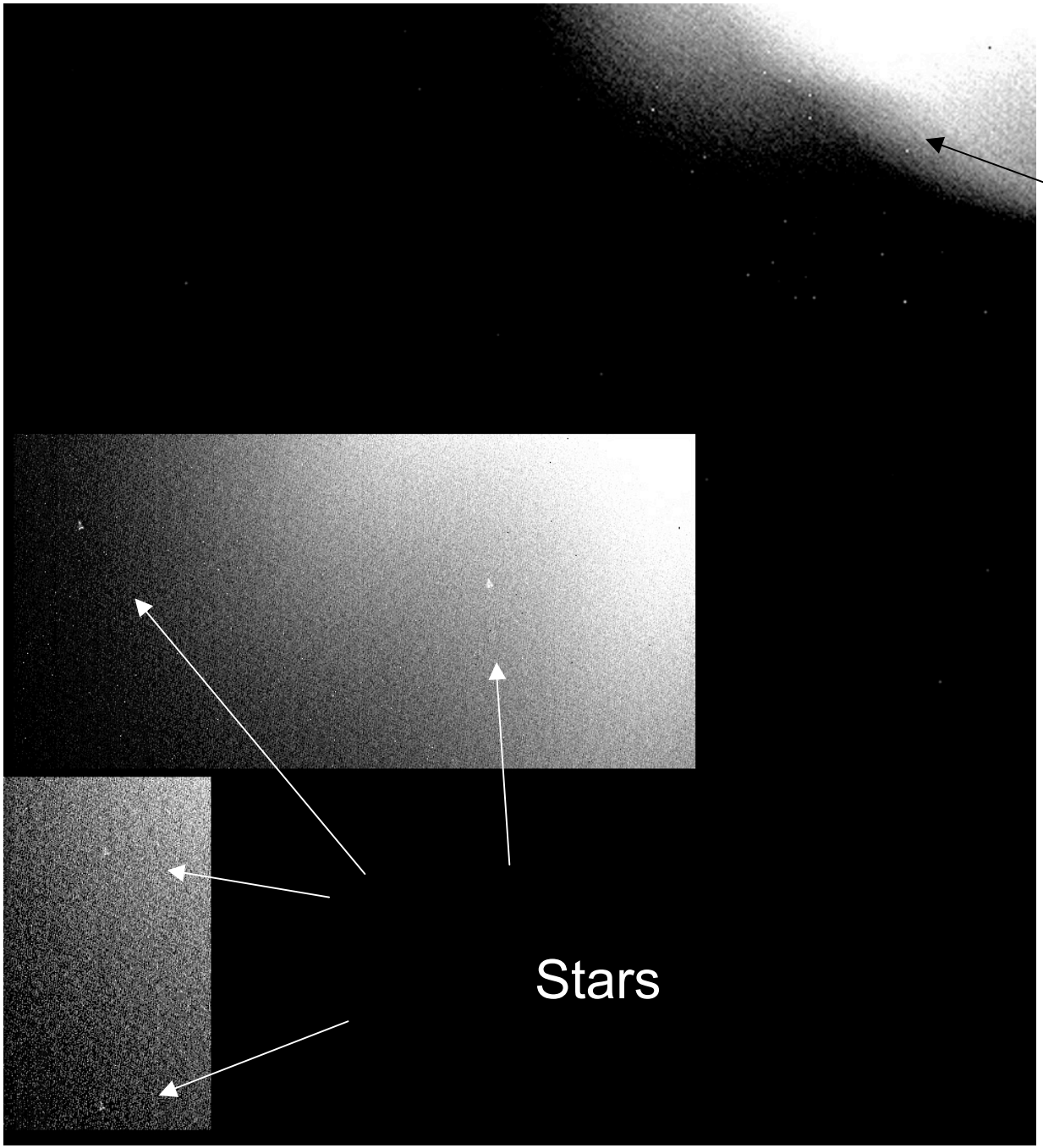
(„Phobos ahead of its predicted orbital position by approx. 1 radius“, Bell, Duxbury, et al., Nature)



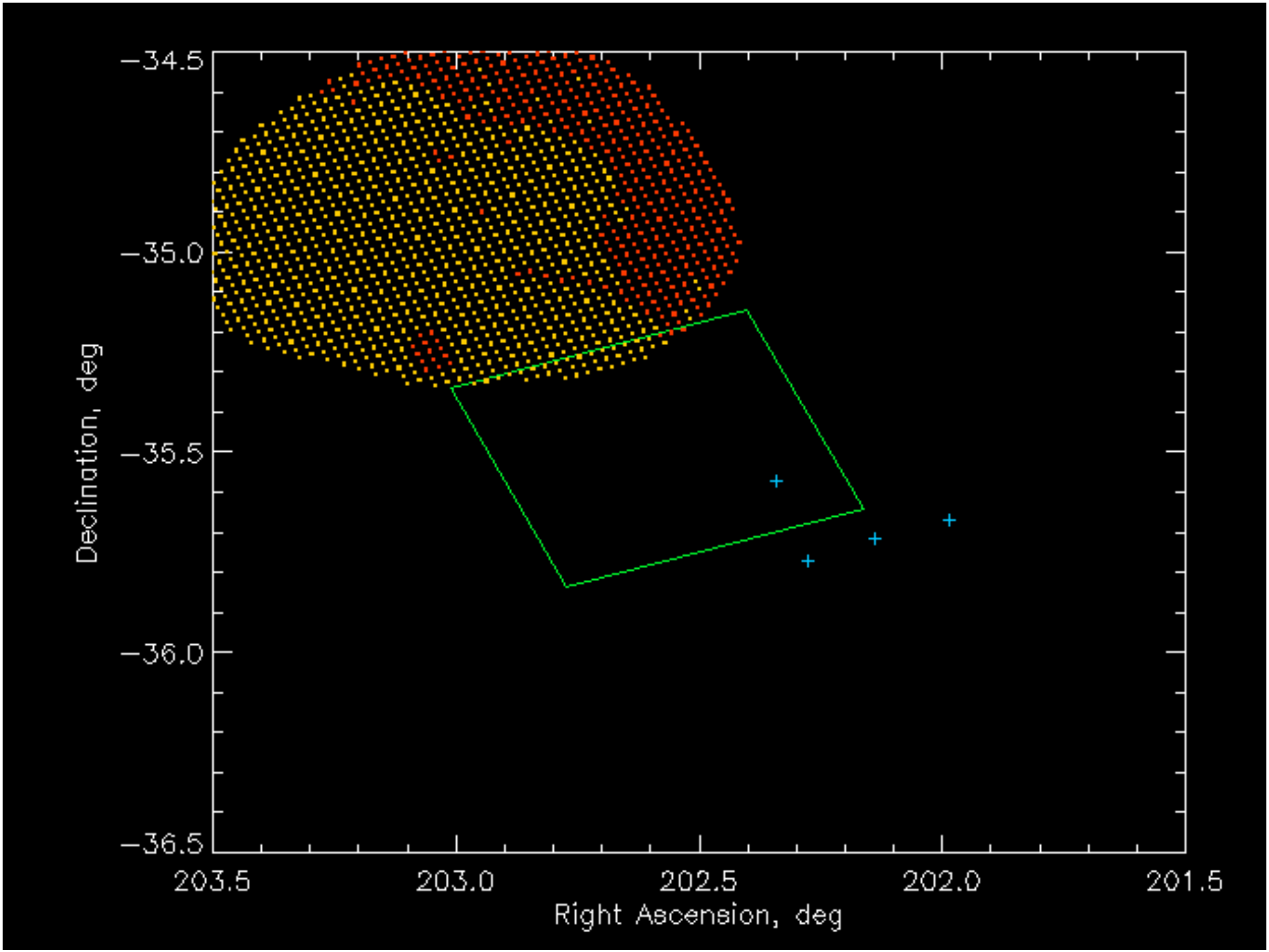
Early Limb Analysis (Orbit 413)

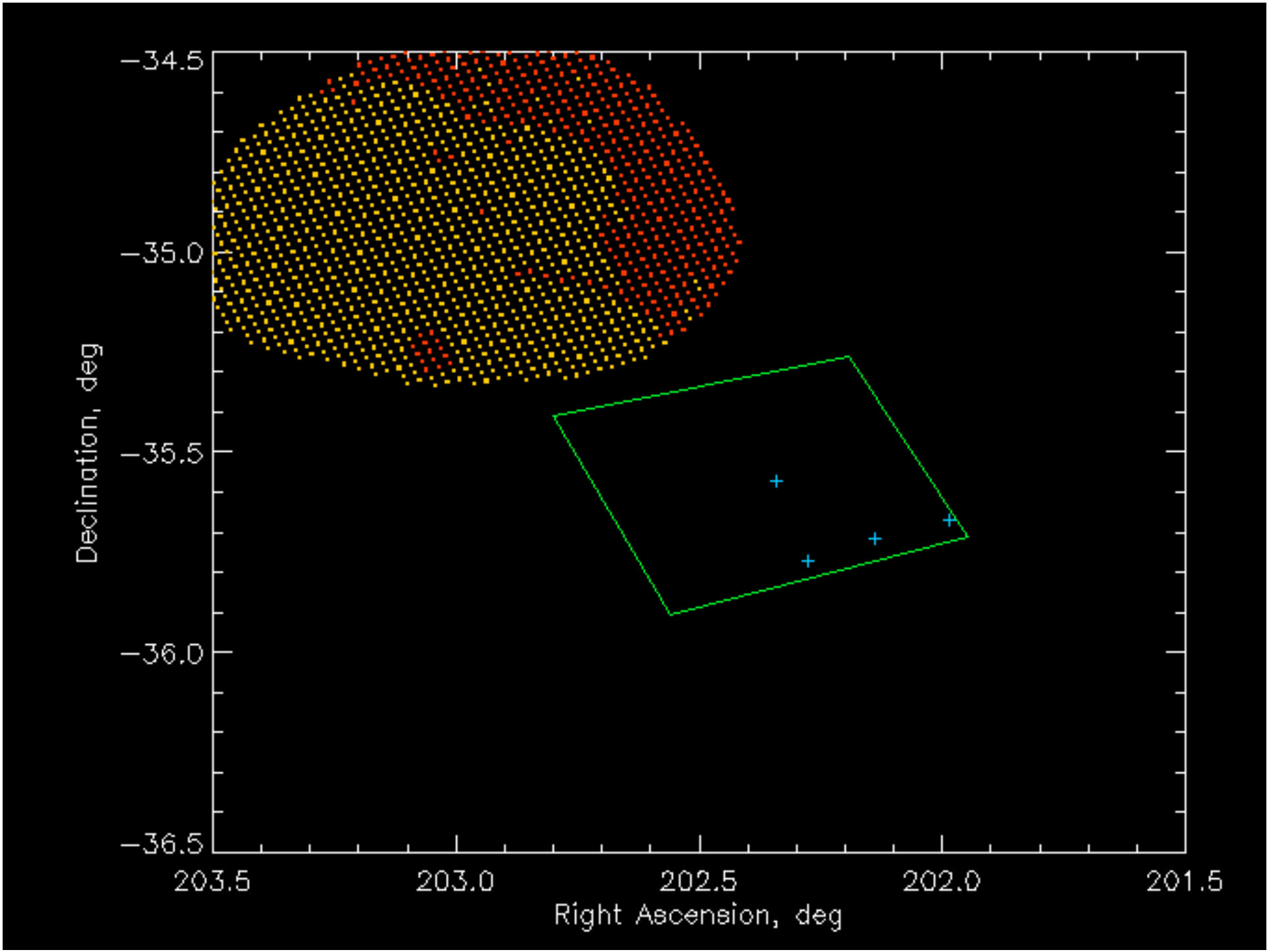


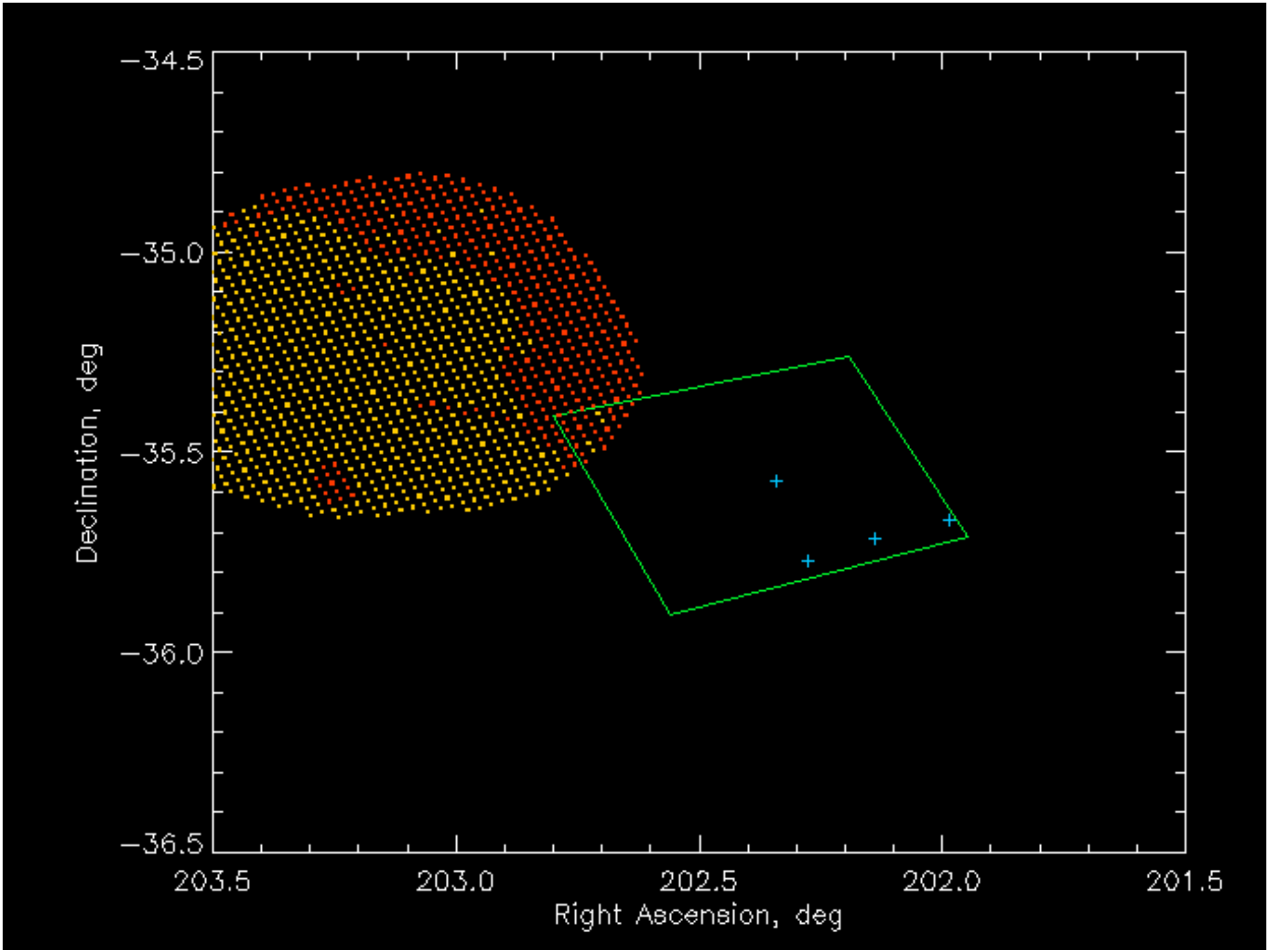
- Predicted limb and terminator positions from nominal Mars Express/Phobos orbit, and camera pointing (screenshot, MEX SOA)
- Ellipsoidal shape assumed for Phobos
- Obvious mismatch



Camera Pointing Analysis


−34.5
−35.0
−35.5
−36.0
−36.5
Declination, deg
203.5
203.0
202.5
202.0
201.5
Right Ascension, deg

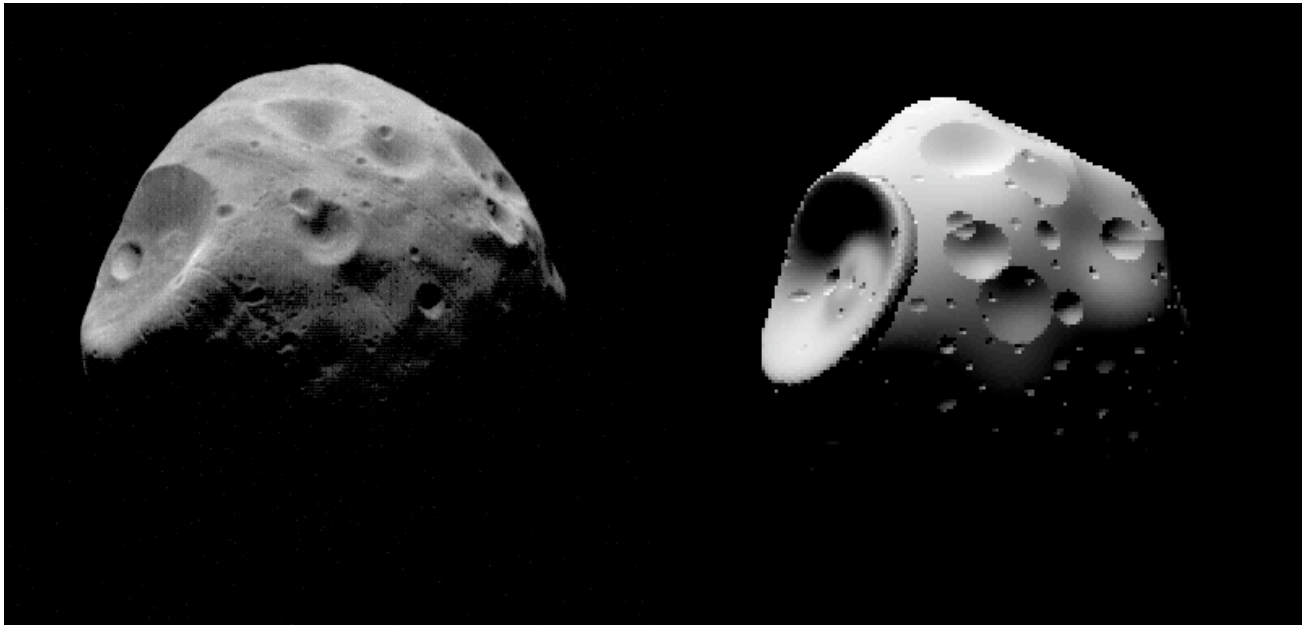

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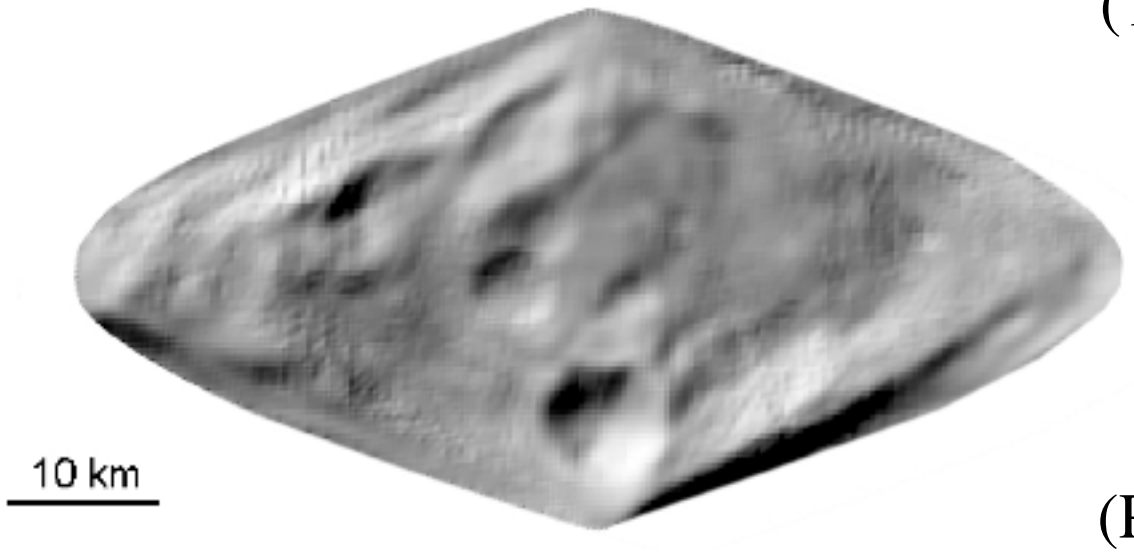
Phobos Orbit: Result

- Pointing data sometimes in error, must be accounted for
- Phobos estimated to be off from its nominal (JPL ephemeris) orbit position by 6 s (approx. 12 km) along-track
- Mars-radial and out-of-plane position errors < 1km

Viking-based Global Shape Models

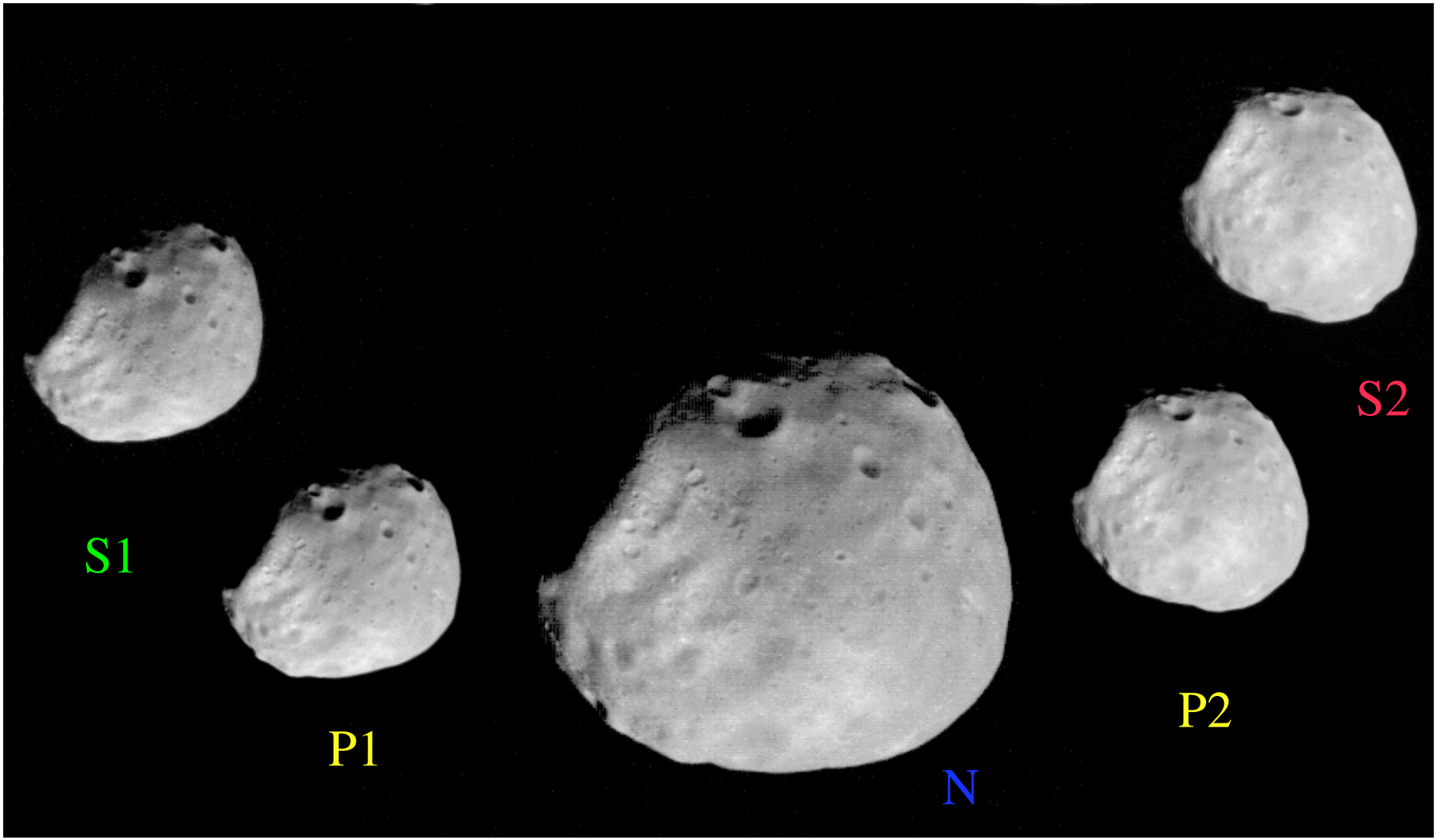


(T. Duxbury, JPL)

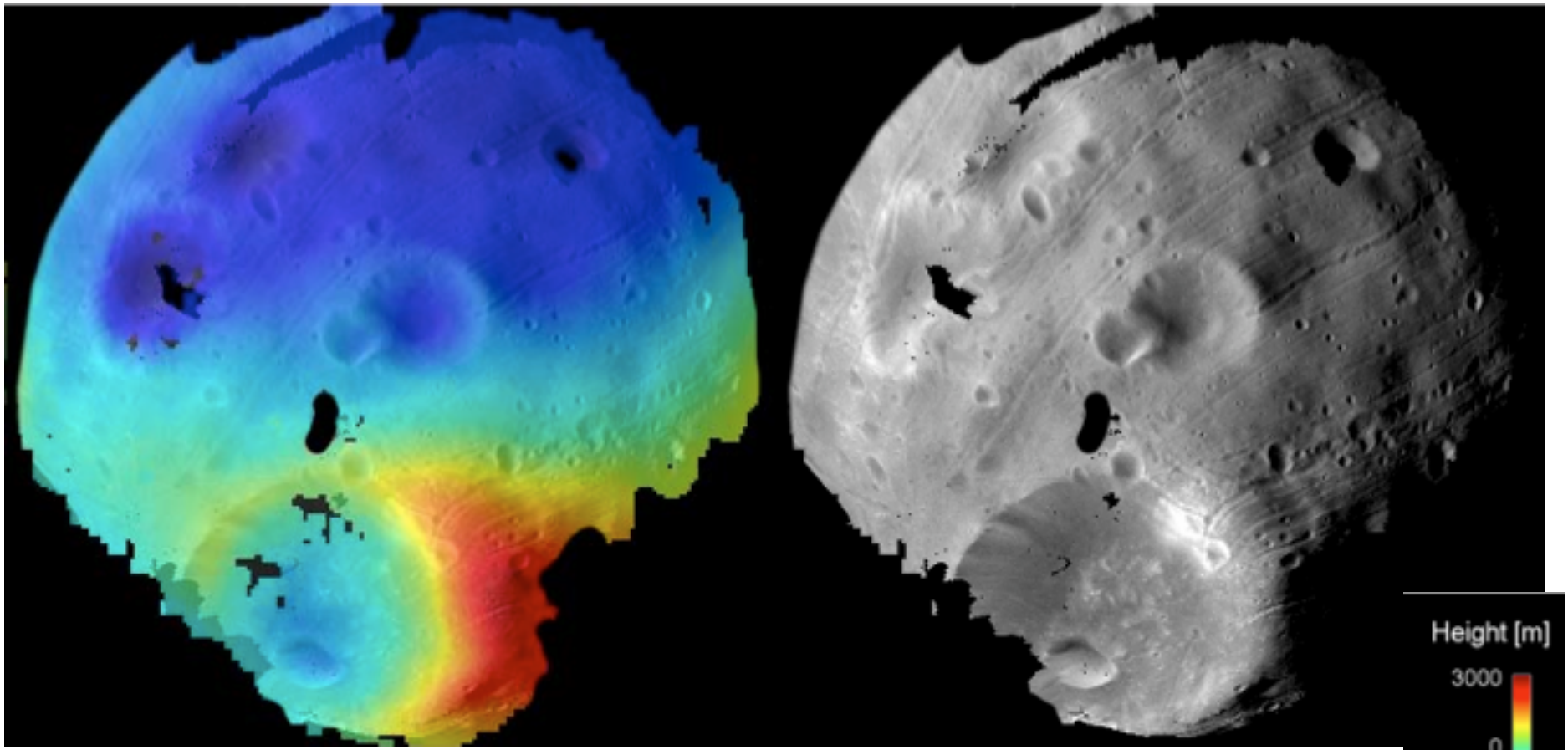


(P. Thomas, Cornell)

HRSC Stereo Observations

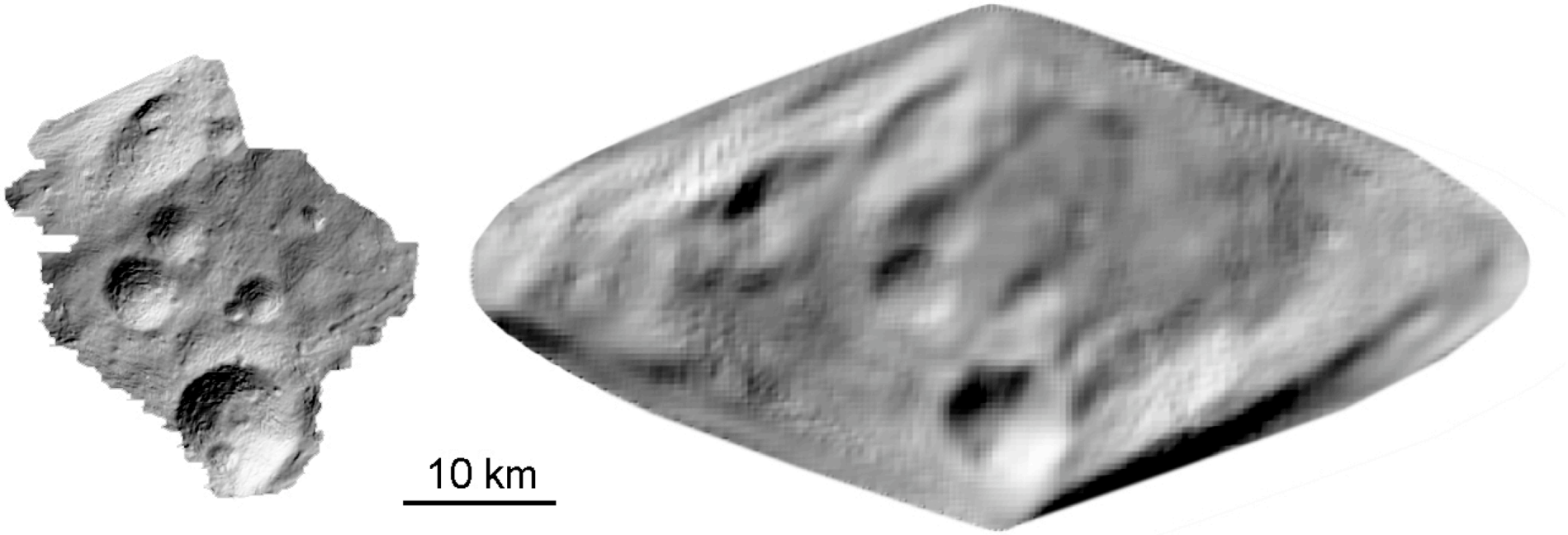


Phobos Topography



- Model resolution, horizontal: 100 m, vertical: 2-25 m

Phobos Models Comparison



MEX/HRSC (P.Thomas, Viking-based model)

- Model resolution, horizontal: 100 m, vertical: 2-25 m

Results

- Phobos estimated to be off from its nominal orbit position by 6 s (approx. 12 km) along-track; across-track position errors < 1 km
- Topographic model for Phobos with resolution of 100 m and vertical resolution of 2 - 25 m. Model is limited in coverage, but higher in resolution than previous Viking models.
- Expect that future flybys will yield more constraints on the Phobos orbit, and more stereo coverage.

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