THE FIRST SIX MONTHS OF *IAPETUS* OBSERVATIONS BY THE CASSINI ISS CAMERA.
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Abstract/ Introduction. Since Saturn arrival in June 2004, Iapetus has been studied intensively by the Cassini ISS camera [1] at various ranges. The first of two relatively close flybys in the primary mission occured on Dec 31, 2004 at an altitude of ~123,400 km over the northern leading hemisphere, resulting in images with a minimum pixel scale of 740 m. Detailed results of this flyby are given in [2], while this abstract covers the observations obtained earlier. Among the most important discoveries are: (a) Four giant impact basins with diameters between 390 and 550 km were detected, three of them are located in the dark terrain [3]. (b) Data revealed a >1300 km long ridge that marks exactly Iapetus' equator within the dark terrain. Individual mountains within the western part of the ridge reach heights of ~20 km over surrounding terrain [3]. (c) Impact craters were confirmed to be the main geological feature within the dark terrain and at high southern latitudes. (d) There are numerous craters with dark walls roughly facing towards the central parts of the dark hemisphere [3]. (e) Almost all parts of Iapetus have been imaged at least at low resolution (< 60 km/pxl).

Iapetus imaging history: Voyager. From Voyager data (up to 8.5 km/pxl over northern trailing side in 1981), it was learned that the dark hemisphere is roughly ellipse-shaped, and centered at the center of the leading side. It extends partly on the trailing side on equatorial regions, while the bright terrain extends to the leading side at high latitudes [4]. The bright surface is heavily cratered and ancient [5], and scarps were among the rare geologic features with other origins [6]. Dark-floored craters were detected on the trailing side [5], but no structure at all was discerned within the dark area named Cassini Regio; this was attributed to the low signal-to-noise in the data [4, 5]. Later work revealed craters near the edge but still within the dark terrain, an irregular (non-spherical) shape of Iapetus, evidence for dark crater rims roughly facing towards Iapetus' apex of motion, and seven giant, high-albedo, possibly more than 20 km tall mountains within the dark terrain between 185°W and 215°W [7, 8].

Cassini July 2004 data (pre-conjunction). Just one day after Saturn orbit insertion, a huge, ~550 km diameter basin was clearly visible at ~15°N/30°W in 18 km/pxl data [3, 9]. This is probably the largest impact structure on Iapetus. It's shape is polygonal rather than circular. Single wispy streaks of unknown morphology were also seen in the dark terrain. One of them is roughly running along the equator in the dark terrain, others appeared to be correlated to the huge basin.

Cassini July 2004 data (post-conjunction). Cassini observed high southern latitudes and the south pole for the first time; best image resolution was 15 km/pxl. These data revealed a second large impact structure (at ~15°S/120°W, diameter is ~390 km), also with a polygonal shape, which is more difficult to discern [3, 9]. Dark crater rims facing towards Iapetus' apex of motion were clearly identified [3]. Color measurements suggest two end members, with wide parts of Cassini Regio homogeneously reddish, and the poles and trailing side spectrally neutral [3]. Numerous craters within the dark terrain were visible near the terminator, but not at low to medium incidence angles. The southern transition zone was found to run parallel to the equator at ~30°S to ~50°S over almost the entire leading hemisphere. It's character is dominated by impact craters with partial dark material coverage. At mid- and high-southern latitudes, no brownish material was seen west of the 180°W meridian. Furthermore, as in Voyager data of northern latitudes, dark crater rims west of 180°W seem to be absent.

Cassini low-resolution data from August 2004. Low-resolution (>54 km/pxl), high-phase (>110°) images show a huge impact structure within the bright terrain at ~45°S/240°W [3]. With a size of ~500 km, it is probably Iapetus' second largest impact structure.

Cassini data from October 2004. For the first time, data with pixel scales better than Voyager 2 (as good as 6.7 km) were acquired. Interestingly, craters are still not visible deep within the dark terrain under high-sun conditions. On the anti-Saturn hemisphere, a mountain near 215°W was measured at a minimum height of ~10 km. The observation geometry was not favorable enough to see possible evidence for dark eastern flanks on the bright mountains. A peculiar wispy streak which runs almost exactly along the equator within the dark terrain towards the eastern limb was detected. It appears to cross the limb at an elevation.

The eastern part of the large basin on the trailing side is visible in high-phase images. It has a large central elevation, which appears to be a common property of large basins on Iapetus. The observation campaign also included imaging of the trailing side in Saturnshine at up to 9.3 km/pxl. These data revealed the best view yet of the "moat", a ~300 km circular structure on the sub-Saturn side at ~10°N/ 330°W first seen in Voyager 1 images [4]. At this location, dark material extends hundreds of kilometers

into the trailing hemisphere and shows a complex albedo pattern. Numerous small craters are located in the bright terrain. Some of them might exhibit dark floors, but no large dark-floor crater has been found in this region.

Cassini OPNAVs from December 2004 (before probe release). Images with the primary purpose of optical spacecraft navigation ("OPNAVs") show the "moat" at ~20 km/pxl near the terminator. Under these illumination conditions, it was identified as a big central-peak crater with a size of ~250 km.

Cassini post-Huygens-release imaging. Low phase (~22°) images were obtained during a 3-day period (Dec. 25-27) at "better-than-ever" pixel scales of 6.2, 5.2, and 4.3 km, resp. These data led to the discovery of the enigmatic "bellyband" of Iapetus, a ridge or chain of mountains that follows Iapetus' equator precisely over at least 1300 km [3]. The highest measured peak rises ~20 km over the surroundings, or ~28 km over a reference radius of 718 km [10]. However, as in Voyager data [8], a good reference ellipsoid cannot be found because of the unusual irregular shape of Iapetus. A preliminary, triaxial limb fit result from these and earlier data is 732, 726, and 722 km for three radii.

The ridge coincides with the faint equatorial streak observed in the October and even July data. The slope of the southern flank achieves a gradient of up to 20°, the northern flank ~30°. The ridge itself appears to be located on a broader bulge, extending a few hundred km in southern and northern directions. Another discovery in these data was a fourth large basin, centered near 35°N/ 80°W. Its diameter is ~400 km [3]. No bright-floor craters in the dark terrain are visible in these data.

References. [1] Porco, C.C. *et al.* (2004) *Space Sci. Rev*. 115, 363-497. [2] Denk T. *et al.* (2005) LPSC XXXVI. [3] Porco C.C. *et al.* (2005) *Science*, under review. [4] Smith *et al.* (1981) *Science* 212, 163-191. [5] Smith B.A. *et al.* (1982) *Science* 215, 504-537. [6] Croft S.K. (1991) *NASA Tech. Mem.* 4300, 101-103. [7] Denk T. *et al.* (2000) *LPSC XXXI*, abstract #1596. [8] Denk T. *et al. (2000) 32nd DPS*, 43.03. [9] Denk T. *et al.* (2004) *36th DPS*, abstract 4.08. [10] Davies M.E. and F.Y. Katayama (1984) *Icarus* 59, 199-204.

Figures. Top: July data (detection of ~550 km basin, observation of southern hemisphere).

2nd row: August low-resolution data (detection of trailin side basin).

3rd row: October 2004 data (7.3 and 6.7 km/pxl; anti-Saturn hemisphere).

4th row: October Saturn-shine image (right) and December OPNAVs; crater morphology of the "moat".

5th row: OPNAV from 26 Dec 2004 (5.2 km/pxl), different contrast enhancement. The equatorial ridge and all three large impact basins within Cassini Regio are visible.

Last row: Color image from 27 Dec 2004 (4.3 km/pxl) of leading hemisphere.