CASSINI CIRS OBSERVATIONS OF IAPETUS' THERMAL EMISSION. J. R. Spencer[1], J. C. Pearl[2], M. Segura[2] and the Cassini CIRS Team, [1]Southwest Research Institute, Dept. Space Studies, 1050 Walnut St. Suite 400, Boulder CO 80304, spencer@boulder.swri.edu, [2]NASA-Goddard Spaceflight Center, Mail Code 693, Greenbelt, MD 20771.

Introduction: Cassini's Composite Infrared Spectrometer (CIRS, [1]) mapped Iapetus' thermal emission from 7 to ~300 µm during the spacecraft's December 31st 2004 flyby of the satellite. Short-wavelength spectra were obtained with the CIRS "FP3" (10 - 17 µm) and "FP4" (7 - 10 µm) detector arrays, each consisting of 1 x 10 pixels with a spatial resolution of 0.29 milliradians, while longer wavelength observations used the "FP1" detector, with a single-aperture detector with 4 milliradian diameter. The detectors are scanned across the target to build up an image cube with two spatial dimensions and one spectral dimension. CIRS daytime observations covered the dark terrain of Cassini Regio, except for high northern latitudes which were occupied by bright terrain, while nighttime observations covered a mixture of bright and dark terrain. The 120,000 km flyby distance provided a maximum spatial resolution of 35 km in the FP3 and FP4 detectors, and 500 km in the FP1 detector.

10 – 17 µm (FP3) Observations: Figs. 1 and 2 show Iapetus' daytime thermal emission as mapped by the FP3 detector. Temperature images are determined by fitting a blackbody curve to the spectrum at each location in the image cube. The thermal signature of the large impact basins near the disk center and terminator are apparent in the thermal image, with topographically-controlled temperature contrasts of a few degrees K. The temperature contrast between the bright and dark terrains is less obvious, and is obscured by the latitudinal gradient– higher latitudes are colder both due to higher albedo and reduced insolation.

In contrast to Phoebe [2], which has a similarly low albedo, nighttime temperatures on Iapetus are too low to be detected by the FP3 detector, which has a sensitivity limit of about 70 K.

17 – 300 µm (FP1) Observations: The FP1 detector has much lower spatial resolution than FP3 and FP4, but much greater sensitivity to low temperatures because of its longer wavelength coverage, and can thus detect Iapetus's nighttime thermal emission. Nighttime temperatures are remarkably low, about 45 K on the bright terrain at mid-latitudes, with a minimum detected nighttime temperature of about 40 K at 75 N on the bright terrain. Even colder temperatures undoubtedly occur closer to the pole but could not be spatially resolved by the FP1 detector on this flyby.

Thermal Modeling: Combining the FP3 daytime temperature maps with the FP1 dusk observation, we can constrain the thermal inertia of Iapetus' dark material. Thermal inertia is remarkably low even compared to other airless icy satellites. The diurnal temperature profiles of Europa, Ganymede and Callisto can be fit with thermal inertias near 5×10^4 erg cm^{-2} s$^{-1/2}$ K^{-1}, [3,4], but Fig. 3 shows that a lower thermal inertia of ~3×10^4 erg cm^{-2} s$^{-1/2}$ K^{-1} is needed to match Iapetus' daytime and evening temperatures. Phoebe also has a low thermal inertia (2.5×10^4 erg cm^{-2} s$^{-1/2}$ K^{-1}, [2]), which we tentatively ascribed to its rapid rotation rate (rotation period = 9 hours) compared to the icy Galilean satellites, so that the diurnal wave sampled the least-compacted upper layers of the surface. However, this explanation does not work for Iapetus (rotation period = 79 days), indicating that the dark terrain may have a more porous surface than even the superficially-similar Callisto.

Future Work: The CIRS Iapetus data were received only 1 week before this abstract was written. Much work remains to be done, and results are very preliminary. We will provide more details at the meeting.

References: [1] Flasar, F. M. (2005) *Space Science Rev., in press.*. [2] Flasar, F. M. et al. (2005) *Science., in press*. [3] Spencer, J. R. et al. (1999) *Science* ***284****, 1514.* [4] Spencer, J. R. (1987) PhD Dissertation, U. Arizona.

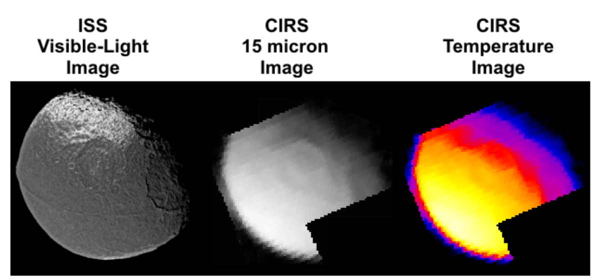

Figure 1 Comparison of Iapetus' appearance at thermal IR and visible wavelengths (left, ISS press release, with similar scale and orientation). Phase angle for the CIRS observation is 52°, and the subspacecraft point is at 32 N, 69 W. Refer to Fig. 2 for the color-coded temperature scale.

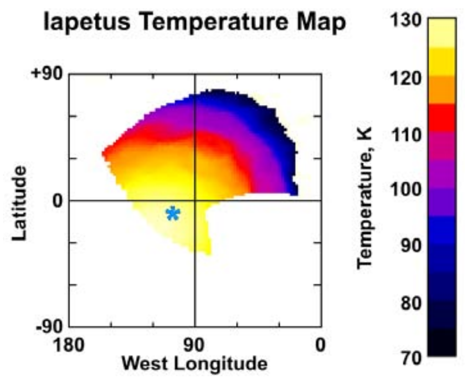

Figure 2 Map of Iapetus temperatures derived from the observation in Fig. 1. The subsolar point is marked by a blue asterisk.

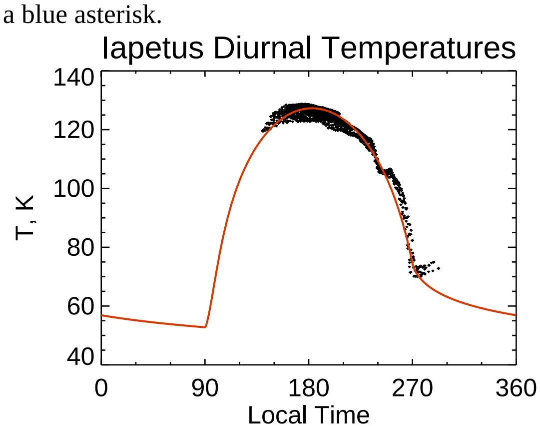

Figure 3 Iapetus diurnal temperature profile, derived from FP3 10 – 17 µm data (dots) and a single FP1 sunset measurement. The temperature profile derived from simple homogeneous thermal model is shown, with a best-fit thermal inertia of 3 x 10^4 erg cm^{-2} $s^{-1/2}$ K^{-1} (red).