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Léa Bonnefoy, Alice Le Gall, Marie Azevedo, Emmanuel Lellouch, Cédric Leyrat, Michael Janssen

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Lea E. Bonnefoy[1,2], Alice Le Gall[2,3], Marie Azevedo[2], Emmanuel Lellouch[1], Cédric Leyrat[1], and Michael A. Janssen[4]
[1]Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique (LESIA), Observatoire de Paris-Meudon, LESIA (Bât. 18), 5, place Jules Janssen, 92195 Meudon Cedex, France
[2]Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS), UVSQ /CNRS/Paris VI, UMR 8190, 78280 Guyancourt, France
[3]Institut Universitaire de France (IUF), Paris, France
[4]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA

1. Introduction

The surface of Dione, Saturn's fourth-largest moon, is affected by a variety of processes, both exogenic and endogenic, although the satellite does not seem to be active today [e.g., 1]. Like its neighboring mid-sized icy airless satellites Tethys and Rhea, it exhibits a leading/trailing dichotomy, observed at UV to IR wavelengths [e.g., 2].

This dichotomy has also been reported at 2.2 cm wavelengths, in the unique resolved observation acquired by the Cassini Radar on Dione [3, Fig. 1b]. The leading hemisphere is more radar-bright than the trailing hemisphere, implying greater water ice purity on the leading side. This asymmetry may be caused by the deposition of E-ring material on the leading side, and/or by contamination by a non-icy material on the trailing side.

Herein, we examine Cassini radiometry observations of Dione.

2. Dataset and Methods

The active radar observations of Dione conducted by the Cassini Radar have been presented and analyzed by [3–5]. Spatially resolved data were acquired during flyby DI163 in 2012, simultaneously in active (radar) and passive (radiometry) modes. The resulting images are shown in Fig. 1; the resolved radiometry data is deconvolved following the method described in [6,7]. A preliminary analysis of the resolved radiometry also points to a leading/trailing dichotomy. Indeed, the leading hemisphere, during late afternoon, should be radiometrically warmer than the trailing hemisphere, assuming uniform albedo, thermal inertia, and emissivity. The fact that the reverse is observed indicates variations in at least one of these properties.

Distant radiometry scans have been acquired during four flybys. These data and the disk-integrated antenna temperature they yield are summarized in Table 1. We note cooler disk-integrated temperatures at high latitudes. However, any further interpretations require the use of a thermal model.

We simulate the Cassini radiometry antenna temperatures using a combination of thermal, radiative, and emissivity models, similar to the method already applied to Iapetus [8], Enceladus [9], and

Rhea [7]. By fitting the simulated antenna temperatures to the observations, we hope to better constrain the thermal, structural, and compositional properties of Dione's leading and trailing sides. In particular, using the thermal model with the bolometric Bond albedo map derived by [10], it is possible to separate temperature variations caused by local time, albedo, and emissivity, and thus derive a partial emissivity map.

Table 1: Cassini radiometry observations of Dione

Observation ID	Date	Beam size (diameter)	Sub-spacecraft point (°E,°N)	Region observed	Local time (hh:mm)	Disk-integrated temperature (K)
DI016	11 OCT 2005	1.12	(-24,0)	Sub-Saturn	1:03	55.6
DI050	29 SEP 2007	0.63	(152,-13)	Anti-Saturn	19:52	53.6
DI163-1	27 MAR 2012	0.44	(-17,-1)	Sub-Saturn	19:54	55.3
DI163-2	27 MAR 2012	0.33	(-37,-1)	Sub-Saturn	18:53	55.1
DI177-1	22 DEC 2012	1.35	(-95,46)	Northern Leading	6:36	47.9
DI177-2	22 DEC 2012	1.37	(-94,49)	Northern Leading	6:51	47.5

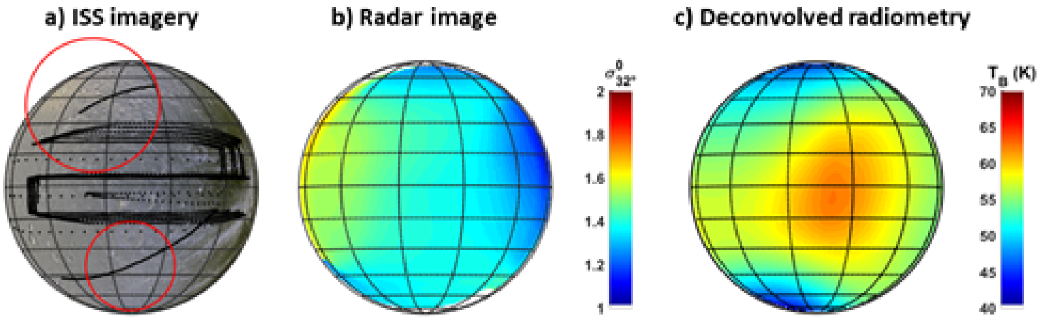

Figure 1: DI163-1 spatially-resolved Cassini radar and radiometry data. a) Color mosaic made from Cassini IR, UV, and visible data (PIA 18434; credit: NASA/JPL-Caltech/SSI/LPI). The antenna boresight is plotted in black for each observation, and the beamsize is shown in red at the beginning and end of the scan. b) Real Aperture Radar (RAR) image, corrected to an incidence angle of 32°. c) Deconvolved map of the observed brightness temperature. In all images, the (optically darker) trailing hemisphere is on the right, whereas the (optically brighter) leading hemisphere is on the left.

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