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Millimeter and submillimeter continuum observations of Asteroid (21) Lutetia with MIRO instrument on the ESA Rosetta Spacecraft

Samuel Gulkis (1), Stephen Keihm (1), Lucas Kamp (1), Seungwon Lee (1), Mark Hofstadter (1), Michael Janssen (1), and Jacques Crovisier (2)

(1) Jet Propulsion Laboratory, California Institute of Technology, Astrophysics and Space Sciences, Pasadena, CA, United States (samuel.gulkis@jpl.nasa.gov, 818-354-8895), (2) Observatoire de Paris, Paris, France

The European Space Agency (ESA) Rosetta spacecraft made a close flyby of asteroid (21) Lutetia on July 10, 2010. The spacecraft carries a dual-band radiometer/spectrometer instrument, named MIRO, which operates at 190 GHz (1.6 mm) and 560 GHz (0.5 mm). During the flyby, the MIRO instrument recorded subsurface temperatures of Lutetia continuously throughout the encounter. Because the spin axis of Lutetia lies approximately in the plane of the ecliptic (like the planet Uranus) with the sub-solar direction near 47 degrees N at the time of the flyby, the MIRO instrument was able to measure the temperature of Lutetia in both the seasonally sun-lit and dark hemispheres. Temperatures in the subsurface (depths from $\sim$ 2 mm to 2 cm beneath the surface) ranged from $\sim$ 193 K on the sunlit hemisphere to $\sim$ 50 K on the dark hemisphere. Thermal modeling and radiative transfer calculations have been compared to the observations, and indicate the top $\sim$2 cm of the surface material has very-low thermal inertia (20 J/(K m2 s0.5)). It also appears that there is a significant increase in thermal inertia below that depth. These properties match those of the uppermost surface of the Moon, which has a low-density ($\sim$1250 kg/m3) and low thermal-inertia layer in its uppermost 1-2 cm, overlying a more compacted, higher-inertia region.