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First Measurements of the Stratospheric Thermal Structure of Uranus

Glenn Orton (1), Leigh Fletcher (2), Olivier Mousis (3), Cedric Leyrat (4), Therese Encrenaz (4), Mark Hofstadter (5), and Amanda Mainzer (5)

(1) Jet Propulsion Laboratory, Caltech, Pasadena, Calif. USA (go@orton.jpl.nasa.gov, 001 818 3934619), (2) Oxford University, Oxford, United Kingdom, (3) Observatoire de Besancon, Besancon, France, (4) Observatoire de Paris, Meudon, France, (5) Jet Propulsion Laboratory, Caltech, Pasadena, Calif. USA

Spitzer Infrared Spectrometer (IRS) observations of the disk-integrated thermal emission of Uranus in the 8-14 micron region showed substantial variability of stratospheric emission as a function of longitude, monitored using its lightcurve. In an effort to understand the origin of this variability, we imaged thermal emission from Uranus for the first time. Our strategy was to use the highest available spectral radiance emitted by a stratospheric constituent to which a discrete filter was sensitive. This was the narrow-band NeII-2 filter centered at 13.06 microns, tracking emission the wings of the 13.7-micron acetylene band. Images were obtained from the Gemini South Telescope T-Recs and Very Large Telescope VISIR instruments. No longitudinal variability of stratospheric emission was immediately evident. Either the cause of the variability is ephemeral, as is the case for (i) thermal waves in Saturn or (ii) Jupiter's auroral-related stratospheric polar hot spots, or the emission is strongly related to seasonal variability: the Spitzer IRS observations were made around the equinox of Uranus in December of 2007, nearly two years before the imaging observations. On the other hand, the latitudinal dependence of stratospheric emission was unexpected. Unlike zonal mean temperatures in the troposphere of Uranus, which are highest at low latitudes, the observed stratospheric thermal emission is minimal at low latitudes. This emission is a combination of the temperature and acetylene distribution fields; thus we cannot tell which of these is the primary cause of the observed field. Further observations of emission from different constituents will help this assessment.