Airglow on Titan During Eclipse

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Magnetospheric or cosmic ray charged particle precipitation into Titan's atmosphere is a potential energy source for driving chemistry and may contribute to airglow and energy balance. Estimates of the significance of these processes vary widely and thus far have been only poorly constrained because of the dominance of XUV radiation in stimulating UV airglow. To address these issues we observed Titan when it was deeply embedded in Saturn's shadow in 2009. We obtained EUV and FUV spectra with the Cassini Ultraviolet Imaging Spectrograph (UVIS) and images with the Cassini Imaging Science Subsystem (ISS) at visible wavelengths. For the first time, nitrogen emissions were seen in the spectra in the absence of XUV stimulation, although with insufficient spatial resolution to do limb profiling. The emissions are about a factor of ten smaller than peak dayside emissions observed with UVIS at closer range (from Stevens et al., , *J. Geophys. Res*., **116**, A05304, doi10.1029/2010ja016284). Hydrogen emissions are also observed, consistent with the idea that precipitating protons and oxygen ions are responsible for part of the emission. The visible images from ISS contribute because they resolve the disk well. No auroral structures are seen. Rather, there is a very faint airglow seen on the limb between about 300 and 1000 km and a stronger intensity coming from the region of the haze at 300 km altitude. Although the limb glow is near the noise limit, the radial profile appears to be inconsistent with ionization profiles expected for precipitating electrons, protons, or oxygen ions which are expected to produce strong limb brightening. The stronger glow from the haze region was unexpected. Its origin is not understood but deeply-penetrating cosmic ray ionization and chemiluminescence are candidates that deserve additional scrutiny. . Part of this work was performed by the Jet Propulsion Lab, Cal. Inst. of Tech. under contract with the National Aeronautics and Space Administration.