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Titan's photoelectron energy peaks: A statistical overview and comparison to Mars and Venus

A. Wellbrock (1,2), A. J. Coates (1,2) and G. H. Jones (1,2)
(1) University College London, Mullard Space Science Laboratory, Space and Climate Physics, Dorking, United Kingdom (a.wellbrock@ucl.ac.uk) (2) The Centre for Planetary Sciences at UCL/Birkbeck, London, UK

Abstract

Cassini's CAPS Electron Spectrometer (ELS) has observed discrete energy peaks at 24.1 eV in the electron spectra in Titan's ionosphere. These electrons are believed to be photoelectrons generated due to the ionisation of N_2 by the strong solar He II (30.4nm) line. They are generally observed in Titan's dayside ionosphere, because this is where neutral N_2 particles can be ionized by solar radiation. Coates et al. (2007) discuss initial observations of these photoelectrons in Titan's distant tail during the Titan encounter 'T9'. Wellbrock et al. (2012) describe three other case studies where these photoelectrons were observed at large distances from Titan. The photoelectrons are unlikely to have originated at these locations because of low neutral N_2 densities. The most likely explanation for their existence at these locations is that they travelled along magnetic field lines to the observation sites from the dayside ionosphere, where they were created. Hybrid modelling results support this idea (Wellbrock et al., 2012). We continue the study of photoelectron energy peaks at Titan here and present results from a statistical overview of observations in Titan's ionosphere and exosphere.

Similar photoelectron energy peak observations at Mars and Venus due to the ionisation of CO_2 and O have been studied (Frahm et al., 2006, Coates et al., 2008, 2011). We compare our results at Titan to such studies at Mars and Venus, and discuss implications on the ionospheric and exospheric morphology of these unmagnetised objects with an atmosphere. We also investigate how photoelectrons can be used as tracers of magnetic field lines in order to improve our understanding of these complex magnetic environments.