Investigation of the Signal from the Limb Obtained by the Neutral Particle Imager and Possible Implications

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We report on the progress of our study using the data obtained from the Neutral Particle Imager (NPI) on board ASPERA-3. NPI has observed a signal coming from the direction of the limb with varying intensity and distribution. While the scanning motion of the instrument is currently disabled, preventing instantaneous sampling of the global limb distribution, we use several eclipse passes of the Mars Express (MEX) spacecraft to determine the statistical distribution of the signal. Milillo and Mura have indicated in previous studies a higher intensity when MEX is located in the northern ecliptic portion of the umbra. Brinkfeldt et al. showed that the limb signal displayed high intensity variation that they hypothesized could be temporal. We investigate three different source mechanisms for the signal:

(1) Photons scattered (or resonantly reradiated) in the upper atmosphere;
(2) Solar-wind hydrogen ENAs scattered in the upper atmosphere;
(3) Atmospheric ENAs produced by charge exchange between outflowing heavy ions such as O^+ and the exosphere.

Specifically we assemble statistical distributions ordered in inertial directions (e.g. sunward). While no quantitative conclusions can be made at this stage we assess the physical implications for these mechanisms. Mechanism (2) provides a method for investigating the solar-wind ENA precipitation onto the dayside upper atmosphere. We use this method to estimate the energy input to the dayside and compare it to the energy input given by the solar photon flux. The relative importance of neutral particle precipitation at Mars is compared to the conditions at Titan using recent ENA observations obtained by the Ion and Neutral Camera (INCA) on board the Cassini spacecraft. The atmospheric effects are investigated using a data-driven atmospheric circulation model applied to Titan. We aim at investigating mechanism (3) further by comparing the distribution of the NPI signal with ion observations from the Ion and Mass Analyzer (IMA).