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Ionospheric photoelectrons: comparing Venus, Earth, Mars and Titan

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The sunlit portion of planetary ionospheres is sustained by photoionization. This was first confirmed using measurements and modelling at Earth, but recently the Mars Express, Venus Express and Cassini-Huygens missions have revealed the importance of this process at Mars, Venus and Titan respectively.
The primary neutral atmospheric constituents (CO2 in the case of Venus and Mars, and N2 in the case of Earth and Titan) are ionized at each object by EUV solar photons. This process produces photoelectrons with particular spectral characteristics. The electron spectrometers on Venus Express and Mars Express (part of ASPERA-3 and 4 respectively) were designed with excellent energy resolution (E/E=8%) specifically in order to examine the photoelectron spectrum. In addition, the CAPS electron spectrometer at Saturn also has adequate resolution (E/E=16.7%) to study this population at Titan. At Earth, photoelectrons are well established by in-situ measurements, and are even seen in the magnetosphere at up to 7 RE. At Mars, photoelectrons are seen in situ in the ionosphere but also in the tail at distances out to the Mars Express apoapsis ($\sim$3RM). At both Venus and Titan, photoelectrons are seen in situ in the ionosphere and in the tail (at up to 1.45 RV and 6.8 RT respectively). Here, we compare photoelectron measurements at Earth, Venus, Mars and Titan. We discuss their role as a tracer of the magnetic connection to the dayside ionosphere, and their possible role in enhancing ion escape.