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Cross-body comparison of photo-ionisation rates

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Abstract

Solar photons from the soft X-ray to Extreme UltraViolet (EUV) range, referred as XUV (0.1 – 100 nm), are energetic enough to ionize atoms and molecules in the upper atmosphere or exosphere of planets and moons. Photo-ionization of the atmospheric neutrals yields the production of photoelectrons and ions. XUV solar radiation is the prime source of ionization – outside the auroral regions – and yields the formation of an ionosphere. It is critical to assess the photo-ionization rates and photoelectron characteristics, as they drive the calculation of the secondary ionisation rate – associated with electron-impact – and the calculation of the ionospheric density and composition.

We will review the magnitude and variability of the peak photoelectron rates at different Solar System bodies. At a given Solar System body, the largest variability comes from the solar activity ranging from short timescales (e.g., flares) to longer timescales (e.g., solar cycles). Another key parameter is the planetary eccentricity, as illustrated at Mars. Between different bodies, the peak photoelectron production rate primarily scales with the distance from the Sun to the Solar System body. We will furthermore highlight fundamental differences driven by gravity. For example, the absence of significant gravity affects the atmospheric profile – resulting in the peak photo-ionisation rates being increased by several orders of magnitude. Such findings have serious implications for extrapolating a photo-ionisation rate from one body to another in the Solar System.