SM13F-3370 - Modeling of the Photoelectron Space-Energy Distribution Based on a Contemporary Coupled Photon-Electron Transport Approach

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Moscone South - Poster Hall

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Abstract

Photoelectrons produced by solar EUV fluxes are a major contributor to ionospheric heating at high altitudes. Modeling of photoelectron heating relies strongly on their space-energy distribution, which in turn depends on the accuracy of the description of EUV sources and complex photon-electron transport. The source of EUV fluxes is solar radiation emitted from the whole solar disk and corrected for atmospheric absorption. Measured EUV fluxes consist of numerous integrated bands and the emission line intensities, which have high (~50%) variability, even for similar levels of solar activity (Heroux, 1972). We analyze the sensitivity of photoelectron production to the EUV sources by comparing results calculated based on a direct EUV flux measurement in the wavelength region 1220-52 Å from(Heroux, 1972), and the EUVAC model developed by Phil Richards (Richards et al., 1994). Our preliminary results show that the accuracy of the EUVAC model in the calculation of the photoelectron space-energy distribution is comparable to that based on direct EUV flux measurements.

Photoelectron production caused by EUV flux involves a complex physical process of primary (photons) and secondary (electrons) interactions. It relies on cross-section libraries and tabulated distribution functions for secondary particle production and energy losses, implemented in the MCNP6 general-purpose Monte Carlo solution, and utilized in our coupled photon-electron transport calculations. The solution takes into account all fundamental photo- and electro-atomic transport processes, including sub-shell electro-ionization that affects the atomic relaxation process for energies down to one eV. The most significant improvement is made by including all atomic electron subshells that affect the atomic relaxation process for these energies. Data structures include subshell binding energies, ground-state electron populations, and the number of possible relaxation transitions. Photon transport enhancements are based on a new dataset specific to atomic subshells and incorporated into MCNP6, and completion of form factor data for coherent and incoherent scattering. These results will be applied to ionospheric electron temperature measurements from Langmuir probes on board the European Space Agency's Swarm satellite mission.

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