**Introduction:** Electrons emitted from the lunar surface include photoelectrons, cold secondary electrons, and backscattered electrons, all of which contribute to the surface-charging environment. Among these electron populations, secondary electrons have been well characterized by previous studies but not so much for the other two populations that make up the high-energy tail. Recently, we reported of oxygen Auger electron observations at the Moon by the ARTEMIS (Acceleration, Reconnection, Turbulence, and Electrodynamics of the Moon's Interaction with the Sun) spacecraft, which provides a unique feature to identify photoelectrons emitted from the lunar surface [1]. This Auger feature allows for the creation of empirical templates for photoelectrons and backscattered electrons to disentangle these two populations and examine their characteristics separately.

**Methodology:** By utilizing the Auger electron feature, we identify cases that are separately dominated by either photoelectrons or pure backscattered electrons and then create energy spectral templates for each population, when the Moon is immersed in the solar wind. With such templates, we then fit the total measured electron spectrum from the lunar surface as observed by ARTEMIS from mid-2012 to the end of 2020 and determine the relative contributions of the two populations. One of the successful fitting results is shown in Figure 1.

**Results:** For photoelectrons, we find that (1) Auger electron fluxes are correlated with solar X-ray photon fluxes as expected; and, (2) there is a dawn-dusk asymmetry in Auger electron fluxes, caused by a selection bias as downward electrons are mainly halo electron on the dusk side, lower in flux than strahl electrons on the dawn side. For backscattered electrons, we find the backscattering ratio (the flux ratio of backscattered electrons and downward electrons at the same energy) varies geographically due to different proportions of surface backscattered electrons and non-adiabatic magnetic scattering by crustal magnetic fields. In addition, for surface backscattering, the backscattering ratio decreases with increasing energies, ranging from <20% at 50 eV to <10% at 500 eV. Lastly, comparing the two populations, within the solar wind, backscattered electron fluxes are mostly higher than photoelectron fluxes and, thus, photoelectrons are not so frequently observed when the Moon is in the solar wind.

**Reference:**

![Image](https://example.com/image.png)

**Figure 1.** An example of downward (black dashed) and upward (black solid) electron energy spectra measured by ARTEMIS. The fitted electron energy spectrum (magenta) is the sum of the fitted backscattered electron spectrum (blue) and the fitted photoelectron spectrum (red). The fitting energy range is 50-500 eV.