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Solar Wind Suprathermal Electrons

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Solar wind surpathermal particles carry important information on the common particle acceleration/transport processes at the Sun and in the interplanetary space. We present a statistical survey of the energy spectrum of solar wind suprathermal (~0.1-200 keV) electrons measured by the WIND 3DP instrument at 1 AU during quiet times at the minimum and maximum of solar cycles 23 and 24. All the strahl, halo and superhalo electron populations show no obvious correlation with the solar wind core population. The observed energy spectrum of both (beaming) strahl and (isotropic) halo electrons at ~0.1-1.5 keV generally fits to a Kappa distribution function with an index $\varkappa$ and effective temperature T_{eff}, while the observed energy spectrum of nearly isotropic superhalo electrons at ~20-200 keV generally fits to a power-law function, $J \sim E^{-\beta}$. We find a strong positive correlation between $\varkappa$ and T_{eff} for both strahl and halo electrons, and a strong positive correlation between the strahl density and halo density. In both solar cycles, $\varkappa$ is larger at solar minimum than at solar maximum for both strahl and halo electrons. For the superhalo population, the spectral index β ranges from ~1.6 to ~3.7, with a broad maximum between 2.4 and 2.8 (2.0 and 2.4) in solar cycle 23 (24). The integrated superhalo density has no clear association with the sunspot number. These results reflect the nature of the generation of solar wind suprathermal electrons.