Quiet-Time Suprathermal (∼0.1 - 200 keV) Electrons in the Solar Wind

Linghua Wang (1), Liu Yang (1), Jiawei Tao (1), Qiugang Zong (1), Gang Li (2), Robert Wimmer-Schweingruber (3), Jiansen He (1), Chuanyi Tu (1), and Stuart Bale (4)

(1) Institute of Space Physics and Applied Technology, Peking University, Beijing, China (wanglhwang@gmail.com), (2) Department of Physics and CSPAR, University of Alabama in Huntsville, Alabama 35899, USA, (3) Institute for Experimental and Applied Physics, University of Kiel, Leibnizstrasse 11, D-24118 Kiel, Germany, (4) Space Sciences Laboratory, University of California, Berkeley, CA 94720, USA

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. 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 $\kappa$ and effective temperature $T_{\text{eff}}$, 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 $\kappa$ and $T_{\text{eff}}$ for both strahl and halo electrons, and a strong positive correlation between the strahl density and halo density. In both solar cycles, $\kappa$ is larger at solar minimum than at solar maximum for both strahl and halo electrons. For the superhalo population, the spectral index $\beta$ ranges from ∼1.6 to ∼3.7 and the integrated density $n_{\text{sup}}$ ranges from $10^{-8}$ cm$^{-3}$ to $10^{-5}$ cm$^{-3}$, with no clear association with the sunspot number. In solar cycle 23 (24), the distribution of $\beta$ has a broad maximum between 2.4 and 2.8 (2.0 and 2.4). All the strahl, halo and superhalo populations show no obvious correlation with the solar wind core population. These results reflect the nature of the generation of solar wind suprathermal electrons.