Geophysical Research Abstracts
Vol. 15, EGU2013-3726-1, 2013
EGU General Assembly 2013

QUIET-TIME INTERPLANETARY SUPERHALO ELECTRONS at SOLAR MINIMUM

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We present a statistical survey of ∼2-20 keV superhalo electrons in the solar wind measured by the SupraThermal Electron (STE) instrument onboard the two STEREO spacecraft, during quiet-time periods from March 2007 through March 2009 at solar minimum. The observed superhalo electrons have a nearly isotropic angular distribution and a power-law spectrum, $f \propto v^{-\gamma}$, with γ ranging from 5 to 8.7, with nearly half between 6.5 and 7.5, and an average index of 6.69±0.90. The observed power-law spectrum varies significantly on a spatial scale of $\gtrsim$0.1 AU and temporal scale of $\gtrsim$days. The integrated density of quiet-time superhalo electrons at 2-20 keV ranges from $\sim 10^{-8}$ cm^{-3} to 10^{-6} cm^{-3}, about 10^{-9} -10^{-6} of the solar wind density and it, as well as the power-law spectrum shows no correlation with solar wind proton density, velocity or temperature. The density of superhalo electrons decreases by approximately one order of magnitude between early 2007 and early 2009, probably reflecting the decay of solar cycle 23 and the approach to its unusually deep activity minimum, while the power-law spectral index γ has no solar-cycle variation. These quiet-time superhalo electrons are present even in the absence of any solar activity, e.g., active regions, flares or microflares, type III radio bursts, etc., suggesting that they may be accelerated by resonant wave–particle interactions in the interplanetary medium, or by nonthermal processes related to the acceleration of the solar wind such as nanoflares.