Analysis of Voyager Observed High-Energy Electron Fluxes in the Heliosheath Using MHD Simulations

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Abstract

The Voyager spacecraft (V1 and V2) observed electrons of 6-14 MeV in the heliosheath which showed several incidences of flux variation relative to a background of gradually increasing flux with distance from the Sun. The increasing flux of background electrons is thought to result from inward radial diffusion. We compare the temporal electron flux variation with dynamical phenomena in the heliosheath that are obtained from our MHD simulations (Washimi et al., MNRAS 2011). Because our simulation is based on V2 observed plasma data before V2 crossed the termination shock, this analysis is effective up to late 2008, i.e., about a year after the V2-crossing, during which disturbances, driven prior to the crossing time, survived in the heliosheath. Several electron flux variations correspond to times directly associated with interplanetary shock events. One noteworthy example corresponds to various times associated with the March 2006 interplanetary shock, these being the collision with the termination shock, the passage past the V1 spacecraft, and the collision with the region near the heliopause, as identified by W.R. Webber et al. (JGR, 114, A07108, 2009) for proton/helium of 7-200 MeV. Our simulations indicate that all other electron flux variations, except one, correspond well to the times when a shock-driven magneto-sonic pulse and its reflection in the heliosheath either passed across V1/V2, or collided with the termination shock or with the plasma sheet near the heliopause. This result suggests that variation in the electron flux should be due to either direct or indirect effects of magnetosonic pulses in the heliosheath driven by interplanetary shocks.