

The 'proton assisted' generation process of whistler waves at interplanetary shocks

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The acceleration process of non-relativistic electrons at collisionless shocks is not fully understood, and thus the direct observations of heliospheric shocks are important for comprehensive understanding. In this report, we show the results of analyses of 6 interplanetary shock (IPS) events observed by the Geotail satellite, focusing on acceleration process of non-relativistic electrons. In all events, we have identified the evidence of diffusive electron acceleration and the existence of whistler waves, which are considered to play the role of resonant scatterers for electrons. While Shimada et al. (1999) reported existence of intermittent whistler wave bursts (1-4 Hz) in the upstream region of a moderately strong IPS on 21 February 1994, we here report observations of a more-or-less continuous whistler component correlating with lower frequency Alfvén waves, which were most likely generated through the resonant interaction with shock-accelerated protons. It is noted that among 6 events analyzed the intermittent whistler bursts were identified for the half of the events while the latter continuous component was seen in all the events. We will discuss the physical implications of these observations in terms of the possible 'proton-assisted' diffusive shock electron acceleration.