Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PEM030-P01 Room: Convention Hall Time: May 26 17:15-18:45

Reflected electrons as remote sensor of dynamic behaviour of collisionless shocks

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Dynamic behaviour of a collisionless shock is quite complicated. For instance, shock reformation is one of the most important characteristics of high Mach number shocks which has been investigated by using particle simulations. However, there have been essential difficulties in its observational proofs. First, a single spacecraft cannot distinguish temporal and spatial variations from time series data. Although cluster II formation flying satellites successfully showed shock front nonstationarity by utilizing the so-called timing method, periodic features of the reformation have not been captured yet. Here, a different approach paying attention to reflected electrons is proposed. Some of the incoming electrons are mirror reflected at the shock. Since electron inertia is very small, those reflected electrons should deliver detailed information of dynamic behaviour of a shock transition region. Careful observations of distribution functions of such reflected electrons may result in extracting temporal and spatial variations of the shock front. In this study possibility of remote sensing of dynamic behaiour of shocks by observing the reflected electrons is investigated by using test particle simulation data. First, behaviours of reflected electrons in a variety of stationary shock structures are examined. Then, effects of periodic variations of the shock structures are discussed.

Keywords: dynamic behaviour of shocks, shock reformation, reflected electrons, remote sensing