Non-thermal electrons at quasi-perpendicular shocks observed by Cluster

Seki, Y (1), I. Shinohara (1), H. Hasegawa (1), M. Fujimoto (2), N. Shimada (3), S. Schwartz (4), E. A. Lucek (4), Y. Khotyaintsev (5), and H. Reme (6)

(1) Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, Kanagawa Japan, (2) Department of Earth and Planetary Science, Tokyo institute of Technology, Tokyo, Japan, (3) Blackett Laboratory, Imperial College, London, UK, (5) Swedish Institute of Space Physics, Uppsala, Sweden, (6) Centre d'Etude Spatiale des Rayonnements, Toulouse, France, (yseki@stp.isas.jaxa.jp / Fax +81 42 759 8456 / Phone +81 42 759 3170)

ISEE1 and 2 found suprathermal electrons up to 20 keV in the downstream of Earth's quasi-perpendicular bow shocks, but the acceleration process by which such high energy, suprathermal electrons are created is still uncertain. We have studied their statistical properties based on the GEOTAIL data, by restricting the events to quasi-perpendicular shocks (Theta_Bn$>$80).

Consequently, we found that the emergence of suprathermal electrons is controlled by such parameters as Ma (Alfven Mach number) and magnetic disturbance (delta_B/$|$B$|$): As Ma or Magnetic disturbance increases, the energy spectra become harder. However we could not understand the dominant controlling factor and the physical mechanism for electron acceleration at the shock transition layer, since GEOTAIL is a single spacecraft and does not have enough time resolution to investigate the shock transition layer.

We have found events in which non-thermal electrons are observed with Cluster in the bow shock. The multi-point measurement enables us to more accuracy estimate parameters associated with the shock, thus we carry out detailed event analyses of Cluster bow shock crossings on the basis of the results obtained by GEOTAIL. One event is characterized by high Ma and moderate magnetic disturbance, while another is characterized by low Ma and high magnetic disturbance. For these events, therefore, relation between electron acceleration and key parameters (Ma, delta_B/$|$B$|$) can be clarified.

We will also discuss effects of other factors, such as two- or three-dimensional structures of the shock, on the accelerated electrons.