Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11966, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11966
EGU General Assembly 2008

Kinetic treatment of the quasi-parallel magnetohydrodynamic solar wind termination shock

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As a special case of astrophysical MHD shock waves the solar wind termination shock is typically treated using the MHD jump conditions by Rankine and Hugoniot. For a more detailed view on the governing processes and to obtain a deeper understanding of the plasma behaviour a kinetic analysis becomes, however, necessary. In the case of a parallel shock only an electric field can be considered as the main process decelerating the solar wind ions. For the electrons this field leads to a strong acceleration due to the other sign of their charge and the much smaller mass of the electrons in comparison to the ions. This situation enforces a two-stream instability, which is considered to be compensated by wave-particle interactions with electrostatic plasma waves. These two processes (electric field and wave-particle interaction) yield to a decelerated subsonic solar wind on the downstream side of the termination shock showing some new features in the ion distribution function, such as a double-hump structure and a comparatively large amount of reflected ions. Within these considerations, an estimation of the spatial size of the shock region is obtained.