Plasma instabilities in application to anisotropic perpendicular fast shocks

D. F. Vogl [1], N. V. Erkaev[2], D. Langmayr [1], H. K. Biernat [1], C. J. Farrugia [3], S. Mühlbachler[1], H. Lammer[1], and M. Leubner[1]

[1] Space Research Institute, Austrian Academy of Sciences, Schmiedlstrasse 6, A–8042 Graz, Austria
[2] Institute of Computational Modelling, Russian Academy of Sciences, Krasnoyarsk, Russia
[3] Institute for the Study of Earth, Oceans and Space, University New Hampshire, USA

Most magnetospheric/ionospheric phenomena are connected to energy conversion processes, consequently driven by the solar wind. Classical examples in this context are the heating process at the bow shock, the conversion of kinetic to magnetic energy at the magnetopause, or energy exchange via collisions in the ionosphere, respectively. Considering anisotropic plasma conditions, we concentrate in this paper on the variations of the plasma and field parameters across the bow shock. In particular, we introduce the threshold condition of the mirror instability and that of the ion–cyclotron instability as bounding conditions to the jump equations to estimate all relevant physical quantities in the downstream region (magnetosheath) as functions of upstream parameters (solar wind). Since the ion–cyclotron mode a priori does not give a well defined range of solutions, a “combination” of the two plasma instabilities is used to obtain the most critical parameter of the ion–cyclotron mode, i.e., the wave frequency. Assuming the shock to be stable with respect to the mirror mode, the wave frequency is derived via the density variation across the shock.