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The role of electrons at the solar wind termination shock and beyond

Hans-Jörg Fahr and Mark Siewert
(hfahr@astro.uni-bonn.de)

Though the solar wind termination shock in more recent studies is described as a multi-fluid MHD Rankine-Hugoniot structure, electrons are generally not treated in this context as an individual, separate fluid, instead they are normally described as simply being in thermodynamic equilibrium with solar wind protons, i.e. with equal densities and temperatures. If, however, as recognized in the past years, suprathermal pick-up ions are involved in the shock dynamics, this concept is fairly questionable. Analysing the specific kinetic conditions for electrons and ions at their shock crossing, we find that electrons react substantially different from protons at their shock passage thereby undergoing an over-adiabatic heating due to conversion of electrically induced overshoot energies into downstream thermal energies. We show that in case of an electron-proton two-fluid plasma, the electrons constitute the dominant contribution to the downstream thermal plasma pressure. They consequently determine the resulting shock compression ratio. We show that taking into account this over-adiabatic electron heating, will then automatically deliver a correct representation of all relevant shock data that have been recently registered by VOYAGER-2 at its termination shock shock passage.