

The injection problem at pickup proton-rich quasi-parallel interplanetary shocks

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Hybrid simulations of quasi-parallel shocks, where pickup ions were included self-consistently, have resulted in very high injection efficiencies for pickup ions as compared to solar wind ions into a shock acceleration mechanism (Scholer and Kucharek, *Geophys. Res. Letters* 26, 29, 1999). This is due to the fact that the shock potential is able to reflect approximately that half of the pickup ion shell in velocity space which has in the shock frame a velocity between zero and solar wind velocity. We have extended these simulations in order to derive the reflection efficiency in the outer heliosphere, where pickup hydrogen can be a major component. As expected, an increase of the pickup proton density results in a drastic decrease of the reflection and injection efficiency for pickup protons at a quasi-parallel shock. The change in the shock structure and in the nature of the upstream waves leading to the reduced reflection rate will be investigated.