Geophysical Research Abstracts
Vol. 21, EGU2019-17710, 2019
EGU General Assembly 2019

Porosity and non-locality of injection at the Earth's bow shock: Global simulation results

Markus Battarbee (1), Yann Pfau-Kempf (1), Urs Ganse (1), Lucile Turc (1), Thiago Brito (1), Maxime Grandin (1), Tuomas Koskela (1), Maxime Dubart (1), Minna Palmroth (1,2)

(1) University of Helsinki, Department of Physics, Helsinki, Finland (markus.battarbee@helsinki.fi), (2) Finnish Meteorological Institute, Helsinki, Finland

We study the interaction of solar wind protons with the Earth's quasi-parallel bow shock through a combination of hybrid-Vlasov and high-statistics test-particle simulations. We employ the high-fidelity Vlasiator global hybrid model to include effects due to bow shock curvature, tenuous upstream populations, and foreshock waves. We investigate the position of the bow shock by using multiple parametrizations, and propose a porosity measure to describe shock front non-locality. Our results support the notion of upstream structures causing patchwork reconstruction of the shock front in a non-uniform manner.

We show that in the context of the global bow shock, reformation and shock non-locality cannot be directly linked with temporal pulses of particle injection. Instead, we present data supporting the notion of acceleration non-locality, with energization taking place throughout a larger shock transition zone. We quantify the size of this zone
as porosity. Non-localized acceleration is found for shocks exhibiting both large and small porosity values.

We additionally show that the density of suprathermal particles upstream of the shock may not be a useful metric for the probability of injection at the shock, as large-scale foreshock dynamics have a greater effect on energetic particle accumulation at a given position in space. Our results have significant implications for statistical and spacecraft studies of the shock injection problem.