Test Particle Simulation of Solar Wind Approaching the Earth's Bow Shock

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Particle acceleration at shocks is one of the most studied topics in astrophysics. Both theory and observations suggest that a particle must have a threshold energy in order for acceleration to occur. Several models have been proposed for this phenomenon, which incorporates the plasma waves upstream and the magnetohydrodynamic turbulence downstream. While these models capture some features of particle acceleration, they are rather complicated. In this work, we propose a test particle simulation of solar wind particles approaching the Earth's bow shock. The simulation will make use of a simple kinetic model, wherein the motion of the particle is governed by a stochastic differential equation. The particle acceleration will be observed by looking at the changes in the distributions of the solar wind upstream and downstream. The simplicity of the model allows for an easier implementation of the numerical algorithm and could perhaps provide insights into the phenomenon that the other models have not explained.