

## ***Interactive comment on “Non-locality of the Earth’s quasi-parallel bow shock: injection of thermal protons in a hybrid-Vlasov simulation” by Markus Battarbee et al.***

### **Anonymous Referee #1**

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The manuscript by Battarbee et al. has discussed the proton injection issue with results obtained by global hybrid-Vlasov and test-particle simulations. I think the quality of the paper is more than enough for publication. I have a few comments and suggestions that the author might want to address before the paper should be published.

The word "non-locality" is a little bit confusing. I think it is more or less similar to the thickness of the shock (although not necessarily the same). It might be better to add some explanation for this as it is not in the standard terminology.

According to the description of the simulation parameters, the spatial resolution (228 km) is larger than the ion inertial length (125 km). It may not be so bad for modeling

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global phenomena, but one must be careful for doing accurate simulations of collisionless shocks. In particular, since the authors followed test particle trajectories on top of their simulation results to discuss the particle interaction with the shock, the resolution can be an issue. I guess that it is not easy to perform a convergence study for this particular application in a reasonable amount of computational resources. However, the authors may caution to the readers that there is potentially a numerical resolution issue. The disagreement between the Vlasov and test-particle results in table 1 may also arise from the same reason.

It is no surprise to me that the non-locality is not an important factor to affect the injection as the ions have long interaction time with the shock and can travel for a long distance along the shock surface before being reflected or transmitted. The fate of the particles should be determined by the integral of electromagnetic fields as seen by them.

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