Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2018-22-RC2, 2018

Annales Geophysicae Discussions
Open Access

Interactive comment on “Cavitons and spontaneous hot flow anomalies in a hybrid-Vlasov global magnetospheric simulation” *by* Xochitl Blanco-Cano et al.

Anonymous Referee #2

Received and published: 12 April 2018

The manuscript investigates properties of the ion foreshock, in particular cavitons and spontaneous hot flow anomalies using a 2D global hybrid-Vlasov simulation. The authors present new interesting new results, the work presents an incremental advance, the presented results confirm previous results and include more detailed analysis of cavitons and spontaneous hot flow anomalies and their effects on the shock and the magnetosheath. The manuscript is acceptable for publications in AG after some relatively minor corrections, see below:

The manuscript needs a small reorganisation, presentation of results and discussions ought to be well separated.

Note that foreshock is not the same thing as the upstream region. Usually, electron/ion foreshocks are distinguished; these are regions where there exists populations of electrons/ions reflected off the shock. The region magnetically connected to the bow shock is almost the same as the electron foreshock but the ion one is rather different.

What the upstream ion/electron betas? What are the resulting Mach numbers? It is necessary to include basic plasma/shock parameters in theoretical units.

"... and due to a realistic proton mass and charge, kinetic effects are simulated on physical instead of renormalized scales" What does it mean?

"The spatial cells are 300 km (1.3 solar wind ion inertial lengths) cubed ..." cubed?

The grid size is relatively large (generally larger than the local ion inertial length and likely also larger than the ion gyroradius). This may strongly affect the shock structure; the typical size of the shock front is rather a small fraction of the on inertial length.

"As shown in Pfau-Kempf et al. (2018), kinetic proton phenomena are successfully reproduced even when the ion inertial ranges are not resolved, though spatial resolution does limit gradients, steepenings and thus possibly amplitudes of phenomena." This belongs to section 4. Note that this claim is quite questionable: It is more or less clear that only some kinetic proton phenomena could be successfully reproduced even when the ion inertial ranges are not resolved. Some phenomena are strongly affected or even inhibited by an insufficient resolution (eg. generation of ion whistler waves). Also this reference to the unpublished manuscript of Pfau-Kempf et al is not sufficient, it is necessary to include some summary of their results.

It would be useful to discuss effects of the global structure (shock curvature). It is not clear if only the movement along the shock front is important, a change of the reference frame just remove it. With respect to the results of Omidi et al (2012) the size of the magnetosphere is relatistic, is it? The observed size of cavitons and SHFAs is relatively small with respect to the global scale of the shock. This may justify a local approach that may allow a better resolution and extension to (spatial) 3D.

Other limitations of the work (2D geometry) needs to be discussed. "In a 3-D run, the total number of these structures in the whole foreshock would most likely be larger." is too speculative.

Figures: it may be better in some cases to show relative values (e.g., with respect to their upstream values) of different quantities or denote the upstream values in color scales. It would be also useful to use in some cases (eg. Figs. 3, 7, 9) "theoretical" units (c/omega_pi, Omega_i) along with the "physical" ones in order to facilitate comparisons of the presented results with results of previous numerical simulations (eg. Omidi et al 2013). Also a table with parameters of the simulation in physical as well as theoretical units would be useful.

Figs. 3 and 7 are quite confusing (especially the shaded areas); it may be better to separate the three different times/cuts.

Fig. 6: At what position in v_y these cuts are taken?

Fig. 7: Is the pitch angle calculated with respect to the local magnetic field?

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2018-22, 2018.