Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2018-124-RC2, 2019

Annales Geophysicae Discussions
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Interactive comment on "The current sheet flapping motions induced by non-adiabatic ions: case study" *by* Xinhua Wei et al.

Anonymous Referee #2

Received and published: 1 January 2019

This is an observation-based study with claims that the authors analysed magnetic field line curvature and find two kinds of shear structures of the flapping current sheet (symmetric and anti-symmetric) in association with the so-called bouncing ion populations in the sheet center. Actually they show some data and provide some discussions of these plots, but no actual proofs of NS asymmetric plasma sources or related ion sub-populations were provided (see comm.1) and no deep analyses of current sheet structure have been done (see also comment 2). Also, there was no attempt to summarize quantitative theory predictions and compare them systematically and quantitatively with the observed parameters. I can not recommend this paper for the publication.

1. A trivial consequence of flapping plasma sheet is that , in the presence of up/dawn kink motions of the plasma sheet , an alternative up/down net flux of the plasma ions

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exists, related to corresponding VZ component of the bulk flow. (Alternating convective VZ have been demonstrated many times since first Cluster studies of flapping phenomenon, e.g., Sergeev et el., 2003 etc). Neither in previous paper (Wei et al. GRL 2015) nor in the submitted paper, I was able to find any proofs that demonstrated ion flux asymmetry is related to smth else but VZ-related shifts of the ion distributions, or that it is related to some specific localized ion sub-population. No real analyses of distribution functions is provided, and the flux asymmetry effect is actually very weak (which is due to small VZ amplitude, I suppose). The authors have to demonstrate explicitely that a specific ion population exists on top of up/down convecting plasma sheet distributions, otherwise this is a mere speculation and discussion of non-existing things.

2. A success in the understanding often depends much on proper methods and proper choice of the reference system. This is often neglected throughout this study. The examples are:

(a) Considerable part of paper contains discussions of magnetic curvature variations. However both current and magnetic field (also curvature) are displayed in GSM coordinates, neglecting such things as the large tilts of current sheet normals (towards dusk or dawn,etc), tail flaring effects (with magnetic field planes diverging downtail) etc. LMN-type coordinate systems could be a better choice (but they may vary between subsequent neutral sheet crossings). GSM is not a proper reference system in such kind of analyses, the observed GSM variations are not easily interpreted, and they are hard to compare with any model predictions. (b). Previous studies of current carriers showed that protons are not typically the main current carriers, and that electric drifts are important players in this game (see e.g. Runov et al. AnnGeo 2005, Artemyev et al AnnGeo 2009, etc). Therefore, it is important to analyze the ion distributions in the plasma frame. This was already discussed in the comment 1, and another example is your finding of ion population moving dawnward, which was exposed as specific new result of this study but really it can be related to the dawnward plasma convection in

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this particular episode. Note also that theoretical models are always formulated in the plasma frame. —end review

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