Response to reviewer #1

We thank the reviewer for his/her detailed review and comments. All the comments raised by the reviewer have been taken into account, the responses and revisions to the manuscript are as following:

Comment A and **Response** see the **Partial response to reviewer #1**

Revision: The Fig.4 in the **Partial response** is inserted into the manuscript, and the corresponding interpretation is added to the text to describe the ion nonadiabatic signatures.

Comment B: Antisymmetric shear in the current sheet occurs due to field-aligned currents with a proper polarity and spatial distribution, i.e. Bx_By relation does not guarantee any shear but can be due to flaring effect (a coordinate system rotation). To prove that there is an antisymmetric shear, Authors should reconstruct the local coordinate system (LMN) and plot Bm(Bl) hodograph.

Response: According to the reviewer's suggestion, we plot the guiding field hodograph in the LMN-system for the first event in the time interval 06:35-06:55UT. The change is especially noticeable in Bm, which reverses its sign between adjacent crossings (Petrukovich et al. Ann. Geophys., 2006).

Revision: The Bm-Bl hodograph Fig.1 is inserted as an additional figure to the manuscript.

Comment C: The symmetrical shear means that By maximizes at the Bx reversal: : : I do not see this effect in the shown three events.

Response: To the authors' understanding, it seems that in the symmetrical case By minimizes at the Bx reversal (see Fig.4a in Malova et al. JGR, 2015).

Comment D: Note, there is no theory showing that the asymmetry of nonadiabatic ion sources can induce the flapping motion. Cited Malova et al. 2007 study describes the stationary asymmetric current sheet model and, to my best knowledge, there is no simulation showing that the flapping can appear in this model.

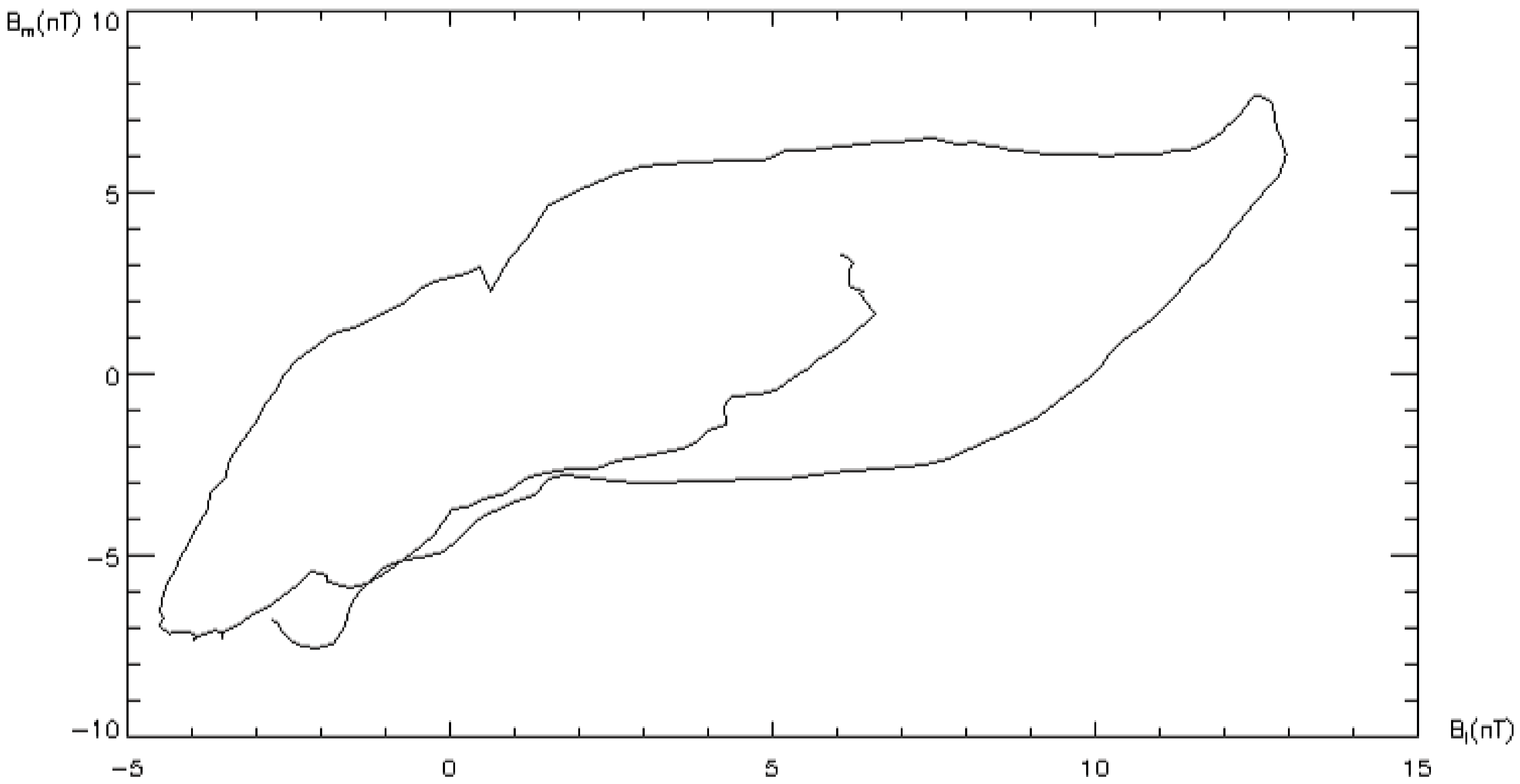
Response: As the reviewer pointed out, in the Malova model the current sheet is stationary and generally cannot induce a flapping oscillation, in which the asymmetrical ion sources don't self-consistently interact with the current sheet. In the scenario described in this paper, the asymmetrical ion sources are locally generated and interact with the self-organized local shear structures (Malova et al. JGR, 2015). Thus, the asymmetries are alternating and can maintain a full flapping circle.

Comment E: The discussion about By effects on the noadiabatic ion motion is based on several publications by Delcourt et al., but all these papers (as well as many other studied related to this topic) deal with the constant By: : : whereas Authors show observations with By strong varying and reversing around equatorial plane.

Response: As mentioned in the last response, nonadiabatic ions asymmetrically scattered by non-constant By and their self-consistent interaction with the current sheet was reported in Malova et al. 2015. To the authors' understanding, the non-constant By effects on the nonadiabatic ion motion is more general since the shear patterns are self-consistently formatted from some initial magnetic perturbation. Also, in the view of an impulse centrifugal force model which is applicable to describe ion behaviors with adiabaticity parameter κ~ 1-3 as in the case of flapping events, it is more convenient to investigate directly the magnetic line curvature rather than the guiding field itself.

Comment F: In the last event, the field Bz almost vanishes around the equatorial plane: : : how can one calculate kappa parameter for so small and fluctuating Bz? This is important to show that the curvature of magnetic field lines can be reliably estimates for such events.

Response: Theoretically, the estimation accuracy of the field line curvature depends on the characteristic scale of the Cluster spacecraft tetrahedron. When the curvature radii is larger than or comparable to the tetrahedron characteristic scale, the estimation results can be regarded as reliable. It is satisfied in this event, where the curvature radii is ~2000-4000km and is comparable to the tetrahedron characteristic scale ~2000km. Although the kappa estimate is approximate, it is used as an auxiliary method to identify the nonadiabatic ion population since we also check the ion nonadiabatic signatures in the distribution functions (see the **Partial response**).



B_m(nT)
B_l(nT)
10
5
0
−5
−10
−5
0
5
10
15