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Interactive comment on "Roles of electrons and ions in formation of the current in mirror mode structures in the terrestrial plasma sheet: MMS observations" *by* Guoqiang Wang et al.

Anonymous Referee #2

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Wang et al. investigated the roles of electrons and ions in the formation of the current in the mirror mode structures in the plasma sheet using by the MMS observations. They found that the electrons and ions play a different role in the different sizes of mirror mode structures: the current carriers are mainly the electrons in small size mirror mode by magnetic gradient-curvature drift, and the ions in large size mirror mode by the ion diamagnetic drift. This study sheds new light on formation of currents in the mirror modes, and is worthy of publication in AG after moderate reversion.

In the discussion section: MMS consists of four identical spacecraft, and could provide the simultaneous measurements of four points. Why the authors use the plasma

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Discussion paper

measurements and magnetic field to estimate the time series of magnetic gradient curvature drift, electron diamagnetic drift, ion diamagnetic drift, and other terms. I think this is useful to estimate these different terms and then compare them.

Line 18 It would be better to replace “data ” to “instruments”, or remove “data”.

Line 47-49 Actually the sizes of magnetic holes can be less than ion cyclotron radius in the magnetosheath. Such magnetic holes, named as kinetic-size magnetic hole or electron vortex magnetic hole, are widely observed using by MMS (doi:10.3847/1538-4357/ab0f2f, doi:10.1002/2017JA024415, doi.org/10.3847/1538-4357/aac831, doi:10.1002/2016JA023858).

Line 54-56 The small-size magnetic holes, below one ion cyclotron radius, are also detected in the plasma sheet (doi.org/10.3847/1538-4357/ab0f2f). These magnetic holes are always accompanied with electron scale instabilities, such as whistler waves.

Line 61-63 Dipolarization fronts are widely investigate in many literatures (doi:Âă10.1002/2015JA021083, doi:10.1029/2012GL051784, doi:10.5194/angeo-30-97-2012), and they play an important role in the energy conversion, mass transport, particle accelerations, and wave activities.

Line 72-75: I suggest the author give the motivation of this paper to help the readers to better understand their work.

Line 80-83 (Russell et al., 2014) should be corrected to (Russell et al., 2016) . If the author did not use the burst mode data in this paper, I suggest the authors remove the introduction about the resolution of burst mode in this part.

Line 115-117 Why are the data performed low-pass filtered before the timing analysis? I suggest the authors give some descriptions here.

Line 120 “tends to be larger” “increases” or “has a peak”?

Line 131: how to calculate the local ion gyro radius? Which time interval? Please give the details in the text.

133-135 Why the range of the scale and the angle are inconsistent with those in table 1? The "rotation angle" is the "shear angle"?

Line 155: As the authors know, the separation of the four MMS spacecraft is very small. Thus, one can use the curlmeter method to estimate the current density basded on the magnetic field from four spacecraft. Why not the author use this method to calculate the current and compare with the current derived from the plasma measurements?

Line 192 JN should be corrected to JM.

Line 216: "Ion velocities" should be "Ion velocities Vi_md"?

Line 230-235 The pileup region usually exists behind the DFs, not ahead of the DFs, for example the definition of flux pileup region in the paper (doi:10.1029/2012JA018141). In addition, the mirror mode structures are observed after the detection of DF. Why the authors thought they originate from the pileup region ahead of the DF?

Line 243 Please indicate at which time "The amplitude of the bipolar jN in MM1 is ∼2nA/m2 ".

Line 247 It would be better to add "in MM5" after "electron velocity " Line 271-272 The authors can try to use the magnetic field from four MMS spacecraft to estimate the curvature radius of mirror modes.

Line 286-187 Did the authors ever calculate the magnetic gradient drift velocity in MM5? It would be necessary to compare the magnetic gradient drift velocity and the Vi_N.

Line 304-307 Did the authors compare the normal directions calculated by MVA and timing method to ensure the accuracy of the results.

Line 307-309 Please indicate which MMS? 1 or 2 or 3 or 4 after "trajectory of MMS". How to deduce the possible trajectory of MMS, please give details in the text.

Line 316 Please add a colorbar in Figure 5.

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