

Ann. Geophys. Discuss., author comment AC1  
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## Reply on RC1

James H. Lane et al.

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Author comment on "Dynamics of variable dusk–dawn flow associated with magnetotail current sheet flapping" by James H. Lane et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-32-AC1>, 2021

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We would like to thank the reviewer for their careful consideration of the manuscript and their valuable comments. The reviewer raises only two concerns which we believe are easily

addressed. Our responses are provided below.

**Comment 1:** *First, the case locates at the dusk side of magnetotail where magnetic fields have strong positive/negative Y component. So that is not good place to estimate the little IMF  $B_y$  effect on the process at the magnetotail*

**Response 1:** We agree with the reviewer that the effect of magnetotail flaring towards the

dusk-dawn flanks is apparent (Fig. 5 in the manuscript, and the C2-C4 data during the flapping interval). We haven't purposely chosen this location to try and estimate any IMF  $B_y$

effects. We are investigating an interval of current sheet flapping (occurring at this location)

and have considered that there might be an IMF  $B_y$  effect. Previous studies such as Pitkänen

et al. (2013, 2017) have investigated IMF  $B_y$  control of magnetotail flows at up to  $\sim 7 R_E$  towards the dusk-dawn flanks which revealed a clear dependence of the flows on IMF  $B_y$ .

Based on this, it was clear that we should consider the possible effects of IMF  $B_y$  on the convection observed at the location of Cluster in our study. According to the model data we

present (Fig. 5), there is definite evidence of IMF  $B_y > 0$  penetration (locally), highlighted by

the fact that the SC observed  $B_y = 0$  when  $B_x = 0$  prior to the flapping interval (lines 520-532).

Whether this is governing the nature of the convection (locally), however, is another matter

(discussed below in response to comment 2).

**Comment 2:** *Second, the IMF penetration and the polar convection are the process in global*

*scale, while the dusk- dawn flow associated with current sheet in this case is at much less*

*scale. So the analysis of IMF and polar convection can not support inconsistency between the*

*expected  $B_y$  in current sheet and the observed  $B_y$  during the crossing of current sheet.*

**Response 2:** In our study, the flows observed by C1 during the flapping would have been consistent with IMF  $B_y$  control if we had a situation where IMF  $B_y < 0$  penetration had occurred (lines 351-355). This motivates our reasoning for needing to look on a global scale,

so we use the IMF and SuperDARN data to demonstrate what the sense of the large-scale magnetospheric asymmetry is. This data tells us what (if any) sense of IMF  $B_y$  has penetrated into the magnetosphere, and conveys that it is definitely not IMF  $B_y < 0$ ; in fact,

it is consistent with IMF  $B_y > 0$ . This is a critical detail, because it means that the observed dusk-dawn flow associated with the current sheet flapping is therefore definitely not IMF  $B_y$

controlled. It is an important distinction that we do not use the IMF and polar convection data to interpret the dynamic behaviour of the plasma and magnetic field that is occurring in the current sheet. Instead, we separately examine whether the current sheet flapping might be responsible for driving the variable dusk-dawn flow. The negative  $B_y$

perturbations

observed by C1 during the flapping are consistent with perturbations in the dusk-dawn flow

(lines 280-281), and are clearly unrelated to any IMF  $B_y$ -effect.