

Interactive comment on “Thermal electron anisotropy driven by kinetic Alfvén waves in the Earth’s magnetotail” by Alexander Lukin et al.

Anonymous Referee #2

Received and published: 12 January 2021

This manuscript presents measurements from the Magnetospheric Multi-Scale mission of electromagnetic fields and electron distributions embedded within fast flows in the vicinity of the magnetotail neutral sheet. The anisotropy of the electron flux relative to the averaged magnetic field direction is compared with the magnitude of the wave electric field using a kinetic Alfvén wave model. This comparison is performed as a function of electron energy normalized by the wave potential and the electron temperature. The resulting distribution of field-aligned electron anisotropy is consistent with that expected from the theory of electron interactions in kinetic Alfvén waves. Similar results are found for case study and statistical treatments of the measurements. I recommend publication with a few queries for the authors to consider.

1. I am a little surprised at the large size of the parallel electric fields (Figure 4). It

C1

has been demonstrated from observations by authors on this manuscript that phase space holes are prevalent in filamentary currents carried by KAWs in the magnetotail. It might be worthwhile to provide a description of how these fields (which will not follow the KAW relations given) were removed from the measurements.

2. In the neutral sheet, where the background magnetic field is weak, and the Alfvén speed is small, I am a little concerned about the use of a fixed scale background magnetic field applied across all scales or spacecraft frame frequencies. This may be a contributing factor mixing field-aligned and transverse variations if the wave field amplitudes are a significant fraction of the background. Just an idea, but it might be worth checking given the deviations in the statistics from the local wave model in Figure 9.

3. Line 112, Is ω here the plasma frame wave frequency or the spacecraft frame frequency? I think in Equation 4 ω is the plasma frame wave frequency which I am not sure can be measured. Please explain.

4. Figure 1 - no date. Might also be good to make the grey lines showing the averaged field a bit darker to improved visibility.

5. There is a recent study by Hull et al. GRL 2020 in the inner edge of the plasma sheet that also links electron anisotropy to KAWs. This work is sufficiently close in topic and method that perhaps it should be cited in this work.

6. Can I suggest that one of the native English speaking authors edit the text to improve the expression. It is understandable, but a little rough in places, and could be improved without too much effort.

Some examples I noted:

line 24 'what' should be 'that'

line 115 'zeros' should be 'zero'.

C2

line 221 - 'perspective' should perhaps be 'likely' or 'probable'

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2020-76>, 2020.