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Comment on angeo-2021-66

Anonymous Referee #2

Referee comment on "Are drivers of northern lights in the ionosphere?" by Osuke Saka,
Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-66-RC2>, 2022

This paper attempts to explain the formation of rotational motion seen in the aurora, from small-scales (curls, ~ 1 km) up to spirals (~ 100 km), using a single mechanism.

I must admit that I do not completely follow the proposed mechanism, but it seems to essentially use oppositely directed $E \times B$ drift in the ionosphere on either side of an auroral arc as a means of rotating the structure. While I agree that $E \times B$ drift is indeed usually oppositely directed on either side of arc, I do not think the proposed mechanism agrees with observations of auroral spirals forming. Figure 2 of the manuscript shows the formation of an auroral spiral whereby the outer "ends" of an arc rotate a full 180 degrees in the magnetic field-perpendicular plane. However, observations of auroral spirals show that they do not form like this. Overall the arc stays roughly E-W aligned, with the part of the arc at the centre of the spiral rotating as the spiral winds up (see for example Partamies et al., 2001, and Keiling et al., 2009). Auroral curls (also called rays in the submitted manuscript, although note that these are different, see Ivchenko et al., 2005) have an opposite rotation to auroral spirals (Trondsen and Cogger, 1998) which would seem to be inconsistent with the formation mechanism proposed. The fact that the mechanism does not reflect observations is a major flaw.

A comparatively minor issue is that the title is much too general, and does not accurately represent the content of the manuscript.

References

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