

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

Daniel K. Whiter et al.

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Author comment on "Fine-scale dynamics of fragmented aurora-like emissions" by Daniel K. Whiter et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2020-95-AC1>, 2021

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We thank the reviewer for their careful reading of the manuscript and useful comments. We have copied the review below and inserted our responses to each point in bold text.

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This is a very well written and clear manuscript describing a new type of optical observation associated with the polar auroras. Although the authors have not been able to unambiguously identify the mechanism, they have explored plausible possibilities. This manuscript can be accepted for publication subject to a few minor revisions, described below:

Abstract: Define the acronym EIC.

### **Thank you, fixed.**

L23: Spelling error "assumed".

### **Thank you, fixed.**

Figures 1 and 3: Please show the ASK field of view on the all-sky images. Also, please indicate the magnetic field direction on the ASK images.

We have added the ASK FOV to the all-sky images from event 2 in Figure 3.

**Unfortunately the focus of the all-sky camera images during event 1 is not sufficient to resolve stars and therefore they cannot be accurately geometrically calibrated, and so it is not possible to mark on the position of the ASK field-of-view in Figure 1. We have added a sentence to the manuscript to explain this limitation.**

**Since ASK is pointing at magnetic zenith (co-aligned with the EISCAT radar), the magnetic field is straight into the image, with adjacent field lines pointing radially out from magnetic zenith in the 2D image plane (c.f. auroral corona). It is therefore not straight-forward to mark the magnetic field direction on the images, and we believe attempting to do so may introduce confusion.**

L169 and L175: Please justify the apparently randomly assumed emission altitude of 112.5 km. The only other thing that appears related is the Es layer at ~113 km.

**We have removed this assumption from the manuscript (see also below answer relating to L230 and L240).**

L202-204: There are other auroral phenomena that do not display field-aligned structures, e.g. pulsating and black auroras, which are associated with particle precipitation. Hence, the lack of field-aligned structures does not completely exclude the possibility of particle precipitation. This possible contradiction should be acknowledged.

**A lack of field-aligned extent has been used as evidence against a precipitation mechanism for other emission features such as the streaks discussed by Semeter et al. (2020) – we wish to point out that the same argument could apply to FAEs, although we agree that alone this is not sufficient evidence against a precipitation mechanism; the lack of OI 777.4 nm is much stronger evidence. We have amended the sentence on lines 202-204 to emphasise the comparison with other unusual emission features, and added a sentence to concede that high energy precipitation can produce structures with little field-aligned extent: “It should be noted that high energy precipitation can result in thin emission layers barely exhibiting any perspective effect (e.g. Ivchenko et al., 2005); however, even in the case of monoenergetic high energy precipitation, locally excited atomic oxygen emissions are observed co-located with the molecular emissions in the thin layer (Dahlgren et al., 2012), which is not the case for the FAEs.”**

L230 and L240: Here the height is assumed to be 100 km when previously the optical emission was assumed to be 112.5 km and the Es layer appears at ~113 km. Please justify the chosen altitude.

**The apparent discrepancy is because we had assumed an emission altitude of 112.5 km for the auroral arc but 100 km for the FAEs, although we agree this is confusing. The 112.5 km estimate was only used to convert the speed of the arc from degrees/s (directly related to pixels/frame in the camera FOV) to m/s, but this conversion is irrelevant for the analysis of the FAEs, for which pixels/frame is the important number. We have therefore removed the arc speeds in m/s from the manuscript to avoid confusion.**

L289: The authors may wish to emphasize here their belief that the FAEs are not produced by collisional impact due to particle precipitation.

**We have added “non-precipitation” to the sentence.**