Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2020-45-AC1, 2020

Annales Geophysicae Discussions

Interactive comment on "Fragmented Aurora-like Emissions (FAEs) as a new type of aurora-like phenomenon" *by* Joshua Dreyer et al.

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Received and published: 21 October 2020

AR: We thank the referee for providing their helpful feedback! In the following, we respond (Authors' Response, blue) to each of the referee's comments (black) individually.

General Comments

The paper is well-written and organized. It presents interesting observations of short living small scale aurora-like structures of high scientific interest. The presented first summary for characteristic features of the discussed Fragmented Aurora-like Emissions is important for future follow-up studies. Instrumentation, observations and methods are well explained. The paper presents images and spectral data for FAEs strongly

supporting the author's hypothesis for a low energy generation mechanism with an upper energy limit between ∼8–11 eV which excludes a formation caused by precipitating electrons. The authors clearly state that the exact generation mechanism remains unclear. Their finding that FAEs are associated with elevated electron temperatures points to Farley-Buneman instabilities as a potential energy source and sets an important base for follow-up studies. I have only a few minor comments for the authors to consider a few minor additions prior publication.

AR: The above statement captures the aim of the present study very well and we are grateful that the referee acknowledges the scope of the paper as a "first report" to characterise the main characteristics of FAEs.

Specific comments

Major comments: No major comments.

Minor comments:

- It would be helpful to add a video showing an example for a category 2 FAE.

AR: We agree, but unfortunately we do not have an ASK video observation of category 2 FAEs at this time.

- L. 29–30: I recommend to add references for the following papers all presenting strong arguments against the hypothesis that precipitating electrons are responsible for picket fence structures below the purple arc of STEVE (Nishimura et al., 2019). Paper 1: Gillies D. M. et al. (2019). First Observations From the TREx Spectrograph: The Optical Spectrum of STEVE and the Picket Fence Phenomena, Geophysical Research Letters, 46 (13), 7207–7213. Paper 2: Mende S. B. & Turner C. (2019). Color Ratios of Subauroral (STEVE) Arcs, Journal of Geophysical Research: Space Physics, 124 (7), 5945–5955. Paper 3: Mende S. B., et al. (2019). Subauroral Green STEVE Arcs: Evidence for Low-Energy Excitation, Geophysical Research Letters, 46 (24), 14256–14262.

AR: We will add this argumentation and suggested references 2 and 3 against precipitation-caused picket fence structures to the revised manuscript for a more balanced discussion on this point. We would like to note that the suggested reference 1 (Gillies et al., 2019) does not conclude this and rather suggests that the picket fence structures are caused by particle precipitation, with typical auroral OI emissions dominating at 557.7 nm. This paper could thus be added as an additional reference for the viewpoint that the picket fence is likely an auroral feature.

- L. 47–48: The authors mention that similar structures (FAEs) have been sighted on Svalbard at other days. I recommend to mention on how many days FAEs have been identified.

AR: FAEs were observed at least on three other dates. Since we are not able to systematically search for these features in, for example, EISCAT data or optical images yet, identification of further events is currently based on manually reviewing auroral images. One of the main goals of the present study is to derive the main characteristics of FAEs to hopefully make the identification of further events easier, as the referee has correctly pointed out.

- L. 53–56: [...The images were taken using an exposure time of 4 s and an ISO of 16000 at a cadence of 11 to 12 s, with a mean interval length of 11.8 s. This variance is due to variations of the read-out time to the attached computer, with the camera exposure time set to 10 s...] Contradicting exposure times. What is correct, 4 s or 10 s? Please clarify.

AR: We apologize for this obvious error. The exposure time is 4 s, the longer cadence of $\sim$11.8 s is due to a readout delay between the camera and the third-party software on the connected computer. This will be corrected in the revised manuscript.

- Figure 4: This figure shows a mark for the zenith. Is this the local magnetic zenith? Please clarify.

AR: The marked zenith is not referring to the local magnetic zenith, but rather to the geographic zenith (centre of the ASC image). This was mainly used during the analysis to derive the pixel scale of the ASC images using an equisolid projection, as the fisheye lens will result in larger pixel-to-km-ratios further from zenith, which need to be accounted for. We will add a sentence to explain this in the revised manuscript.

- Figure 6 and 7: [...Data points with errors $>$ 50% of the values were removed...] What are the errors for the shown data points? Are they close to 50% or significantly less? Please clarify.

AR: The errors for the shown data points are mostly significantly less than 50%, further decrease of the filtering range (for example to $>$30%) does not remove significantly more data, none of which is at the time of the FAE passing. The errors for the period between 18:20–18:23 up to the FAE passing and above 100 km (which is the most relevant part for our analysis) are less than 20% of the values. We will add a similar concise statement to the revised manuscript.

Technical corrections: None

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