

## ***Interactive comment on “Inferring the source regions of pulsating auroras” by Eric Grono and Eric Donovan***

### **Anonymous Referee #1**

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This manuscript demonstrates a new approach to infer the characteristic temporal properties of in situ chorus waves associated with pulsating aurora based on the along-track auroral brightness of pseudo THEMIS conjunctions, and then attempts to locate the magnetospheric source regions of the different types (APA, PPA and PA) of pulsating aurora by identifying the characteristic chorus packets in THEMIS measurements. The results suggest that the occurrence distributions of the short-lived (< 1 min) and longer-lived (1-5 min) chorus packets are associated with the APA/PPA and PA/PPA occurrence regions, respectively, at least on the nightside. Whereas this study has provided some valuable results for understanding the source and generation mechanism of pulsating aurora, for improvements I have some concerns and suggestions, which should be addressed before publication.

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Major comments:

(1) I'm a little confused about the definition of "patchy aurora (PA)", which is one of the three types of pulsating auroral patches categorized by Grono and Donovan (2018). Grono and Donovan (2018) defined "PA" as a pulsating aurora which is characterized by stable structures whose pulsations are limited to small regions. The original definition means that PA has more or less a luminosity pulsation. However, the definition seems to contradict what the authors say at Lines 50-51 of this manuscript, "PA is regarded as non-pulsating pulsating aurora". Could you explain more explicitly whether PA is pulsating or non-pulsating aurora? In my opinion, the term "non-pulsating pulsating aurora", which confuses readers, should be avoided. Also, if PA is just a diffuse, patchy aurora with no luminosity pulsation, I think that PA should not be regarded as a type of pulsating aurora.

(2) As many early studies reported, chorus waves are often modulated by ULF waves. In this manuscript, however, the authors have not discussed their results in terms of ULF modulation. Using the THEMIS data, is it possible to examine to what extent short-lived (< 1 min) and longer-lived (1-5 min) chorus packets are associated with the modulation by Pc3-Pc5 ULF waves? Otherwise, the authors should discuss the occurrence patterns of both chorus packets in terms of ULF modulation.

Minor comments:

(3) Lines 11-28: The first three paragraphs may not be necessary because the information is too general. So, the authors can remove them and start "Pulsating aurora is . . .", "Chorus waves are . . .", or something like that.

(4) Line 40: Pulsating aurora occurs not only on the nightside but also on the dayside. Although studies of dayside pulsating aurora are very limited, it would be better to refer to some early studies.

Brekke, A., and H. Pettersen (1971), Some observations of pulsating aurora at

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Spitzbergen, Planet. Space Sci., 19, 536–540, doi:10.1016/0032-0633(71)90171-1.

Craven, M., and G. B. Burns (1990), High latitude pulsating aurorae, Geophys. Res. Lett., 17(9), 1251–1254, doi:10.1029/GL017i009p01251.

Wu, Q., and T. J. Rosenberg (1992), High latitude pulsating aurorae revisited, Geophys. Res. Lett., 19, 69–72, doi:10.1029/91GL02781.

Vorobjev, V. G., O. I. Yagodkina, D. G. Sibeck, and P. Newell (1999), Day-time high-latitude auroral pulsations: Some morphological features and the region of the magnetospheric source, J. Geophys. Res., 104(A5), 10,135–10,144, doi:10.1029/1998JA900158.

(5) Line 180: The authors can delete "(Tsyganenko, 1989)" because it is already cited at Line 175.

(6) Line 218: How did you choose the lower limit (20 pT)?

(7) Lines 244-245: It would be better to discuss comparison of the occurrence distribution with dayside pulsating aurora stated above.

(8) Line 262-264: The authors suggest that APA and PPA could be associated with sequential short-lived chorus packets. However, the occurrence distribution of the short-lived chorus packets, being higher on the dayside than nightside, seems to be somewhat surprising result, because the distribution conflicts with the general pattern of pulsating aurora which occurs preferentially in the postmidnight to early-morning sector. Could the authors explain about that? Moreover, the occurrence rate tends to be higher in the inner magnetosphere (< 8 RE) on postmidnight-morning side, while it is higher in the outer magnetosphere (> 8 RE) on dayside. Do the authors have any interpretation regarding the MLT and L dependences of the occurrence rate?

(9) Lines 308-310: Could the authors see any difference in the mapping result between different magnetic field models (T89, T96, T01, TS07, etc.)?

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(10) Could the authors mention how the occurrence distributions of chorus packets varies depending on the intensity of substorm activity?

(11) The authors may also be interested in other recent papers on pulsating aurora:

Kawamura, S., Hosokawa, K., Kurita, S., Oyama, S., Miyoshi, Y., Kasahara, Y., et al. (2019). Tracking the region of high correlation between pulsating aurora and chorus: Simultaneous observations with Arase satellite and ground-based all-sky imager in Russia. *Journal of Geophysical Research: Space Physics*, 124, 2769–2778. <https://doi.org/10.1029/2019JA026496>

Nishimura, Y., et al. (2020), Diffuse and Pulsating Aurora, *Space Science Reviews*, 10.1007/s11214-019-0629-3, 216, 1.

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Interactive comment on *Ann. Geophys. Discuss.*, <https://doi.org/10.5194/angeo-2019-162>, 2020.

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