

Interactive comment on “A New Perspective and Explanation to the Formation of Plasmaspheric Shoulder Structure” by Hua Zhang et al.

Anonymous Referee #1

Received and published: 1 January 2021

General comments:

The authors proposed a new theory to explain the formation of the plasmaspheric shoulder structure. The authors presented an event study using a combination of observations from the EUV/IMAGE and Test Particle Model (TPM). The authors suggested that the shoulder was created by (1) “a dawn-dusk convection electric field intensity, sharp reduction and spatial nonuniform manifested,” and (2) a different plasmaspheric corotation rate. The theory to explain the formation of the plasmaspheric shoulder is interesting. However, the English in the present manuscript is not of publication quality and requires significant improvement. The evidence provided in the current manuscript is not sufficient to support the main conclusions. It is recommended that the authors carefully proofread the manuscript and provide further evidence to support

C1

their conclusions. Please see the detailed comments below.

Specific comments:

1. The manuscript is poorly written, and the expressions in many sentences are confusing. These mistakes made the manuscript hard to understand. However, it is highly recommended that the authors carefully proofread the manuscript.
2. Figure 3 illustrates the comparison between the observations and the TPM model, which is essential to the main conclusions. However, the authors provided only the processed plasmopause location (red curves) every 3 hours. It is recommended that the authors (1) show the raw images from the EUV/IMAGE observations for comparison, (2) show the simulations at higher temporal resolution (e.g., 1 hour) so that the evolutions are clear.
3. The authors discussed the formation of the double Plumes in the TPM model. However, they did not provide any observations to validate the existence of the double Plume.
4. The proposed theory of the plasmaspheric shoulder involved the dawn-dusk convection electric field. It is recommended that the authors provide the comparisons between the Weimer electric field and the EUV/IMAGE observations and the TPM model, which is essential to support the conclusion.
5. Captions for Figures 2 and 3 need further improvement. The red circles in Figure 2 are barely visible. The definition of the black/white filled contours in Figure 3 are missing. Some legends are missing from Figure 3 (e.g., Plume2 in line 158).
6. Line 191-197 and Figure 4 are very confusing. Are these test particles placed in a static electric field at a specific time (the same as Figure 1)? Or are the electric field changing during the substorm event (from 0600 UT to 2100 UT)? Is the x-axis time-dependent (UT) or location-dependent (MLT)?
7. Figure 4b is very confusing and hard to understand. I suggest that the authors

C2

consider a contour plot (w/w) with the x-axis (either UT or MLT) versus the y-axis (L shell).

8. Line 277-281 (conclusion 3): The third point is more of a result from the TPM model rather than a scientific conclusion. The authors should provide (1) a scientific intensive in the introduction section, (2) provide observational evidence to support the formation and evolution of the Plume (or double Plume, or second-Plume), and (3) show a comparison between the observations and the simulation to support their conclusion.

9. Line 119-120. The reasons also include the limitation in the TPM model and the unrealistic Weimer electric field model.

Technical corrections: 1. Confusing sentences or grammatical errors:

- 1) 'a', 'an', 'the' are missing throughout the manuscript.
- 2) The sentence in lines 16-18.
- 3) The sentence in lines 73-74
- 4) The sentence in lines 79-80
- 5) Line 105: Word->World
- 6) The sentence in lines 79-80
- 7) Line 109: run->runs
- 8) Line 110: which-> whose
- 9) The sentence in lines 148-150
- 10) Line 156: the infantile Plume2. What does 'infantile' mean?
- 11) The sentence in lines 168-169
- 12) The sentence in lines 148-150

C3

- 13) The sentence in lines 175
- 14) The sentence in lines 184-187
- 15) The sentence in lines 208-210
- 16) The sentence in lines 218-220
- 17) The sentence in lines 239-240
- 18) The sentence in lines 244-246
- 19) Line 255: downside->dawnside
- 20) The sentence in lines 218-220

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2020-86>, 2020.

C4