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Interactive comment on "Multi-channel coupling of decay instability in three-dimensional low-beta plasma" *by* Horia Comişel et al.

Anonymous Referee #1

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The authors of the manuscript "Multi-channel coupling of decay instability in three-dimensional low-beta plasma" discuss their numerical study of the parametric decay of circularly polarized Alfvén waves by means of hybrid plasma simulations. They investigate the role and evolution of oblique daughter waves generated by the decay instability and find an agreement between their results and analytical predictions. The manuscript is well written and describes the analysis in sufficient detail to be reproducible. Parametric decay is a candidate mechanism to explain the onset of plasma turbulence in the solar wind. This topic is of great interest to the solar, heliospheric, and geophysics communities. This work is thus highly suitable for publication in Annales Geophysicae. I identify a couple of minor shortcomings that require a revision of the submitted manuscript though. Until these comments have been addressed, I do not

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Discussion paper

recommend publication of this manuscript.

1) The Introduction section requires significantly more references both on beam instabilities and the parametric decay. As it stands, the manuscript does not provide the reader with sufficient context for the presented analysis.

2) On page 2, line 3: The authors refer to analytical treatments of parametric instabilities without giving references. It would be useful for the reader to have a couple of references that follow the analytical route described by the authors.

3) On page 4, line 17: The authors describe the decrease in amplitude of the oblique daughter waves. It would be interesting to discuss possible reasons for this behavior. Does this point relate to the development of a turbulent cascade that the authors describe in their Conclusions section?

4) On page 4, line 29: I recommend to write "\omega\sim k_{\parallel} v_A \sqrt{beta}\approx 0.05 \Omega_p" for the dispersion relation of the daughter wave at hand.

5) On pages 4 and 5, the authors refer to the model by Vinas and Goldstein as a "linear" analysis. This sounds a bit misleading since parametric decay is per se a nonlinear process. I recommend that the authors explain the "linear" nature of the Vinas & Goldstein analysis in some more detail.

6) On page 8, line 8, the authors give a dispersion relation for Alfvén waves. This expression clearly uses normalized definitions of k and omega. It would be good to give this normalization, or even better to re-write the equation using the normalization in terms of v_A and Omega_p. In a similar way, the dispersion relation given in line 13 requires an additional factor v_A on its right-hand side.

7) On page, line 21: The authors use the term "stochastic heating". I do not think the authors really refer to what is commonly described as "stochastic heating" at this point. It appears they refer to resonant wave-particle interactions and quasilinear diffusion

which are different from stochastic heating.

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