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Secondary instability in the magnetosphere-ionosphere feedback coupling

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The Alfvenic coupling with the feedback mechanism from the ionosphere to the magnetosphere provides us a potential framework to describe spontaneous growth of auroral arc structures. The shear [1] (or kinetic [2]) Alfven wave is destabilized though the feedback instability, providing growth of auroral arc structures in the polar ionosphere. The spontaneous growth of auroral arcs is accompanied with enhancement of ionospheric density perturbations, localized field-aligned currents, and sheared ExB flows. When the feedback instability has grown to a large amplitude, a nonlinear mode coupling leads to deformation of the arc structure [3]. In the present study, we have made a perturbation analysis for the secondary unstable mode, numerically solving the initial value problem. It is shown that the secondary mode can be destabilized when the primary mode amplitude exceeds a critical level, and that the typical growth rate can be several times higher than that of

the primary one. We also discuss the secondary mode structure embedded in the linear eigenfunction of the feedback instability.

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[2] T.-H. Watanabe, Geophys. Res. Lett., 41, doi:10.1002/2014GL061166 (2014).
[3] T.-H. Watanabe, Phys. Plasmas, 17, 022904 (2010).