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Parametric instabilities of parallel propagating incoherent Alfvén waves

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Large amplitude Alfvén waves are ubiquitous in the solar wind, and are believed to play important roles in acceleration and heating of the solar wind plasma. The solar wind Alfvén waves are typically robust for linear ion-cyclotron damping (due to small wave frequencies) and also for linear Landau damping (due to small propagation angle relative to the back ground magnetic field). On the other hand, through parametric instabilities, they can transfer their energy into longitudinal waves, which subsequently heat the background plasma through the ion Landau damping.

The numerical experiments for parametric instabilities of incoherent Alfvén waves, which have a power-law type spectrum as actually observed in the solar wind, are carried out. The reason why the decay instability of incoherent waves can be explained in terms of that of the coherent wave is understood through the analysis on nonlinearly driven finite amplitude density fluctuations. Numerical results suggest the importance of modulational instabilities of left-hand polarized waves. Also, the finite ion temperature effects, which may be significant in the solar wind near the Earth, will be examined in detail.