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Modulational instability of kinetic Alfven waves in a low-beta plasma

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The amplitude modulation of nonlinear kinetic Alfven waves (KAWs) in an intermediate low-beta magnetoplasma is studied by considering a set of fluid equations coupled to the Maxwell's equations. Using the multiple-scale expansion technique, a nonlinear Schrodinger equation is derived which governs the evolution of KAW envelopes. It is shown that the modulated KAWs can evolve into bright envelope solitons or can undergo damping depending on whether the characteristic ratio of the Alfven to ion-acoustic speeds remains above or below a critical value. The growth rate of modulational instability, as well as the frequency shift and the energy transfer rate, are obtained and analyzed. The results can be useful for understanding the existence and formation of bright and dark envelope solitons, or damping of KAW envelopes in space plasmas, e.g., interplanetary space, solar winds.

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