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On oblique decay of field-aligned Alfvén waves in low beta plasmas

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The three-wave coupling processes developed by the parametric decay of a large-amplitude circularly-polarized Alfvén wave with direction of propagation parallel to the mean magnetic field are investigated by numerical hybrid simulations. The linear analysis based on the dispersive two-fluid model and arbitrary angles of propagation for the daughter modes predicts oblique decay instabilities with growth rates close to the field-aligned decay in low beta plasmas. By using three-dimensional hybrid simulations we find out that the decays of the Alfven pump wave conduct to a parallel-propagating daughter wave accompanied by obliquely-propagating daughter waves at moderate angles of propagation with respect to the mean magnetic field. At higher oblique angles, the parametric decay ceases and a modulation-like process drives electromagnetic compressive waves following the Alfvén pump wave. The actual study suggests that parametric instabilities excited by a field-aligned circularly-polarized Alfvén wave are sources of obliquely-propagating daughter waves in low beta plasmas. Consequences on the plasma dynamics involving the domination of the Alfvén pump wave over the entire spectrum of daughter waves as well as the effects on the particle heating are discussed.