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Physical Mechanism for the Generation of Filaments and Alfvén Waves by Ion Beam-Plasma Interaction XUEYI WANG, YU LIN, Auburn University, LIU CHEN, University of California at Irvine — Our previous simulations found that filaments, frequently observed in space plasmas, can form via the interaction between an ion beam and a background plasma. In this study, the fundamental mechanism for the generation of the filaments is investigated by a 2-D hybrid simulation, in which a field-aligned ion beam with relative beam density $n_b = 0.1$ and beam velocity $V_b = 10V_A$ is initiated in a uniform plasma. Right-hand nonresonant ion beam modes are found to be dominant in the linear stage of the beam-plasma interaction, consistent with the linear theory prediction. In the later nonlinear stage, two types of shear Alfvén modes form, with one propagating along the background field $\mathbf{B_0}$ and the other obliquely propagating. Meanwhile, filaments corresponding to field-aligned structures of magnetic field B and density are present. The filaments ($\mathbf{k} \perp \mathbf{B}$) are nonlinearly generated in a prey-predator fashion by the parallel and oblique ion beam modes, which also lead to the Alfvén waves. In the filament mode, fluctuations in the background ion density and temperature and the beam density are in-phase with those in B, whereas the significantly enhanced beam temperature is anti-phase with B. Both the parallel and the oblique beam modes are crucial in the production of the filaments, and thus their generation mechanism is different from other mechanisms such as the stimulated excitation by the decay of an Alfvén wave.

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