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Nonlinear instability of Alfvén waves in the interplanetary plasma

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Alfvén waves permeating the solar atmosphere and solar wind are thought to play an important role in particle energization therein. Nonlinear decay is one of main mechanisms proposed to dissipate the energy of Alfvén waves. Here we report some recent progresses on the nonlinear damping of Alfvén wave caused by the decay instability, including both MHD and kinetic kinds of nonlinear driving forces. It finds that the scalar and vector nonlinear effects dominate the decay of the long-wavelength and short-wavelength Alfvén wave, respectively, in the decay instability of the Alfvén wave decayed into the Alfvén and slow waves. The scalar decay has both local and nonlocal decay property, which can excite the kinetic-scale Alfvén and slow waves by the MHD-scale Alfvén wave. The vector mechanism displays the local decay property, and its nonlinear excitation rate reaches the maximum as the perpendicular wavelength is of the order of the ion gyroradius scale. In the solar wind, the nonlinear decay rate is of the order of 0.1 times the wave frequency for the decay of Alfvén waves.