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Study of solar wind spectra by nonlinear waves interaction

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The nature of small-scale turbulent fluctuations in the solar wind (SW) turbulence is a topic that is being investigated extensively nowadays, both theoretically and observationally. Although recent observations predict the evidence of the dominance of kinetic Alfvén waves (KAW) at sub-ion scales with frequency below than ion cyclotron frequency, while other studies suggest that the KAW mode cannot carry the turbulence cascade down to electron scales and that the whistler mode is more relevant. In the present work, nonlinear interaction of kinetic Alfvén wave with whistler wave is considered as one of the possible cause responsible for the solar wind turbulence. A set of coupled dimensionless equations are derived for the intermediate beta plasmas and the nonlinear interaction between these two wave modes has been studied. As a consequence of ponderomotive nonlinearity, the pump KAW becomes filamented when its power exceeds the threshold for the filamentation instability. Whistler is considered to be weak and thus doesn't have enough intensity to initiate its own localization. It gets localized while propagating through the density channel created by KAW localization. In addition, spectral scales of power spectra of KAW and whistler are also calculated. The steeper spectra are found with scaling greater than -5/3. This type of nonlinear interaction between different wave modes and steeper spectra is one of the reasons for the solar wind turbulence and particles acceleration.

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