What can Hall-MHD simulations tell us about the transition region in the solar wind proton density spectrum?

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Similarly to the power density spectrum of magnetic field fluctuations in the solar wind, the spectrum of density fluctuations also shows multiple spectral slopes. Both of them present a spectral index varying between \(-3/2\) and \(-5/3\) in the inertial range and close to \(-2.8\) between the proton and electron gyrofrequencies.

Despite these similarities, the spectrum of density fluctuations has a significant difference with respect to the magnetic and velocity fluctuations spectra: it shows a transition region between the inertial and the kinetic ranges with spectral index typically around \(-1\).

We have combined the results of compressible Hall-MHD numerical simulations and measurements of the BMSW instrument onboard Spektr-R satellite to study the possible causes of the flattening in the density spectrum. Both numerical and experimental approaches point towards an important role played by Kinetic Alfvén Waves.