Inference of particle-velocity dependent transport from measurements of the ion two-point correlation function.

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Measurements of the two-point correlation function of the ion velocity distribution function, resolved in space and in particle velocity parallel to the fixed magnetic, field are performed in a weakly-collisional gas discharge plasma using laser induced fluorescence. The bandwidth of the measurement extends up to the ion cyclotron frequency and wavenumbers range from $10^{-3}<k_{\|}*\rho_s<1$. The two measurement points are aligned and separated along the straight magnetic field. The gas discharge runs continuously, and photon statistics fluctuations are quantified and suppressed by averaging techniques. The singly ionized Argon gas discharge of length 2.8 m and diameter 7.5 cm has a density of 10^9 cm-3, an electron temperature of 2 eV and an ion temperature of 0.1 eV

The fluctuation power is dominated by dissipative drift waves which can have a variety of spectra depending on plasma conditions. At the lowest neutral pressure (lowest collisionality) most of the fluctuation energy is concentrated in modes with m=1 and a range of radial and axial mode numbers such that there is a single broad peak in the spectrum. Further analysis shows that this peak consists of two components a long parallel wavelength component (which is independent of ion particle velocity) and a short wavelength component that has a parallel phase velocity comparable to the ion particle velocity. Nonlinear interactions are identified among the frequency components in the spectrum by means of bispectra and bicoherence calculations (with confirmed convergence).

The existence of multiple components and of ion-velocity dependent phase shifts in the correlation function suggests that transport phenomena (particle, momentum, and energy) are largely decoupled. The questions of how the short wavelength component is generated, what it consists of, and its importance in transport will be explored.