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Characteristics of high-wavenumber turbulence in a patially magnetized plasma

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Plasma turbulence plays a crucial role in various nonlinear phenomena in magnetized plasmas, such as anomalous transport, structure formation, and particle energization. Experimental studies of ion-scale turbulence, which has a comparable scale to the ion Larmor radius, have been well established[1,2]. However, there have been few experimental studies of smaller-scale turbulence, including those at the electron skin depth scale and the electron Larmor radius scale, despite smaller-scale turbulence being predicted to be a factor in anomalous electron energy transport [3].

To investigate smaller-scale, high wavenumber turbulence in a basic plasma device, we created a partially magnetized plasma through magnetic field control. We successfully suppressed ion-scale turbulence but unintentionally excited high-wavenumber turbulence [4]. The spatiotemporal structure of the high-wavenumber turbulence was measured using an azimuthally aligned 64-channel probe array. The bottom figure depicts the spatiotemporal evolution of ion-scale ($k_y \rho_s \ll 1$) and smaller-scale turbulence ($k_y \rho_s \gg 1$). We successfully observed the fine structure of the smaller-scale turbulence, which exhibited one-tenth of the amplitude of ion-scale turbulence. Furthermore, we investigated the parametric dependency of the high wavenumber characteristics with respect to neutral gas pressure and ion mass [5-6].

This study represents a pioneering exploration into the fundamental processes of high-wavenumber turbulence, offering insights that can significantly enhance our understanding of anomalous electron transport and energization in both space and fusion plasmas. In this talk, we will showcase the experimental results of the spatiotemporal structure of high-wavenumber turbulence and parameter dependency.

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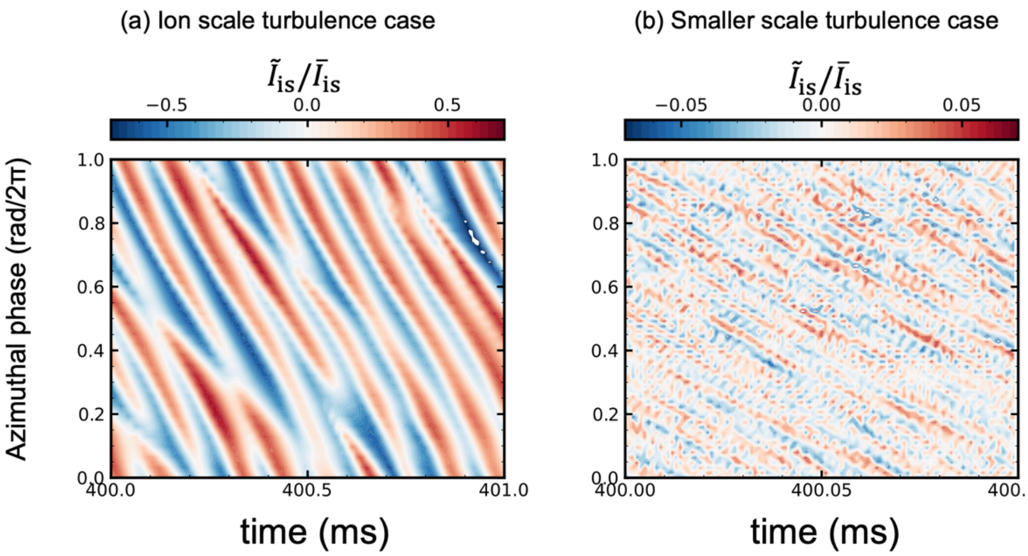

Figure: Spatiotemporal evolutions of normalized ion saturation current for (a) ion scale turbulence case and (b) smaller scale turbulence case