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Observation of spatiotemporal dynamics of high wavenumber turbulence in a linear magnetized plasma

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Plasma turbulence play a crucial role in varieties of nonlinear phenomenon in magnetized plasmas, such as anomalous transport, structure formation and particle energization. Experimental studies of ion scale turbulence including resistive drift waves is being well established so far [1-3]. However, there are few experimental studies of smaller scale turbulence, (i.e. from sub ion scale to electron scale turbulence). The smaller scale turbulence is more problematic to observe their dynamics because of their smaller spatial size, and smaller amplitude.

We conducted experiment oriented to observe smaller scale turbulence based on a simple idea that expanding the turbulence scale by controlling magnetic field strength in a basic laboratory plasma, PANTA. That is, by setting the ion effective Larmor radius is comparable to radius of plasma column, the ion scale turbulence no longer can be excited because of the dissatisfaction of the periodic boundary condition.

The spatiotemporal of turbulence is observed by an azimuthally aligned 64ch probe array. Figure 1 shows two-dimensional spectrum at different neutral gas pressure. Smaller scale turbulence than inverse ion effective Larmor radius including broadband turbulence, coherent edge mode, and ion cyclotron resonant mode, are clearly observed. In this talk, we will show the experimental results of high wavenumber turbulence and discuss the instability, transition phenomena and driving force of the observed fluctuations. This study could pioneer study of basic process of high wavenumber turbulence and contribute further understanding of smaller scale turbulence in space and fusion plasmas.

References

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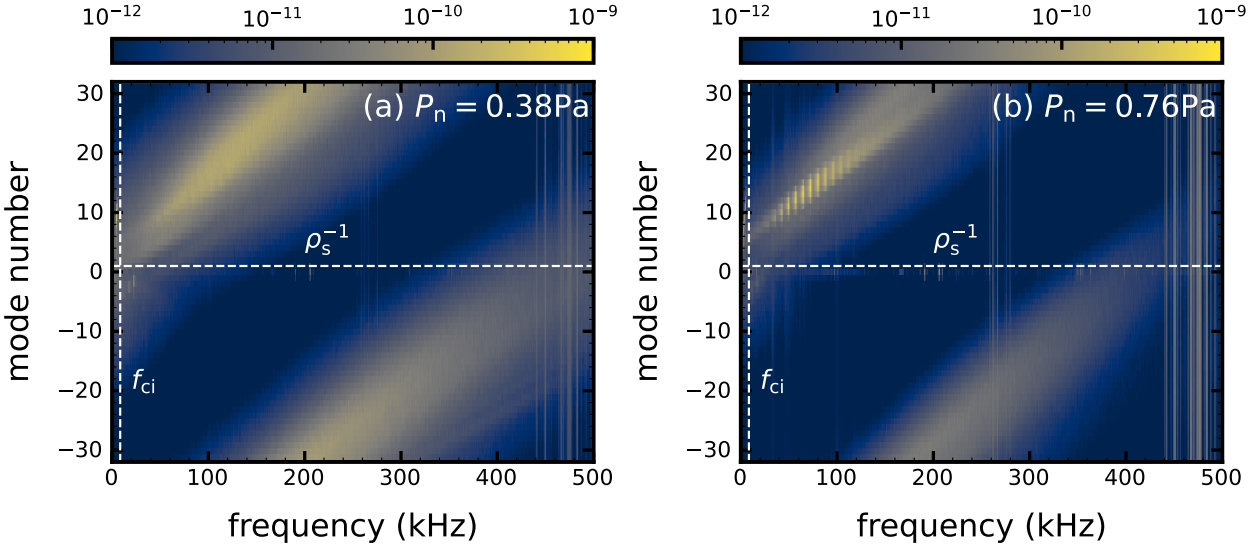

Figure: Two-dimensional spectrum in frequency and azimuthal mode number domain for (a) P_n =0.38 Pa and for (b) P_n =0.76 Pa. Horizontal lines and vertical lines represent inverse of ion effective Larmor radius and ion cyclotron frequency, respectively.