INVESTIGATING OF MULTI-SCALE INSTABILITIES IN EAST ION TEMPERATURE CENTRAL PEAK DISCHARGE

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Domesticating fast particles in tokamaks is vital for both the secure operation and the enhancement of plasma performance. For the first time on the EAST, with fully metal wall, the central ion temperature (Ti) can up to 9 keV, with combined of high power natural beam injection (NBI) and Ar injection. In this Ti peak internal transport barrier (ITB) regime, multi-scale instabilities are observed, such as fishbone (FB), long lived mode (LLM) and beta induced Alfvén eigenmode (BAE) and ion temperature gradient turbulence (ITG). A reduction of ITG and a flatten of current profile in the core are found in presence of FB and LLM. With the injection of Ar impurity, fast electron with energy around 40 keV to 100 keV is generated in the region with ρ~0.7. The fast electrons generated near ρ~0.7 will be played a role in core-edge integration at the EAST future high Ti high confinement discharges, since there will be a pedestal expected at the edge. This experiment has immediately implication for future reactors, since fast particles generated by high-energy alpha particles produced by fusion.

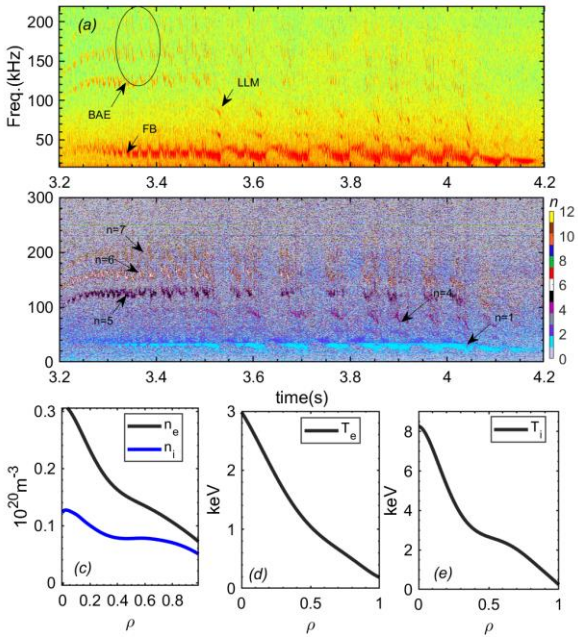

Fig.1 The key profiles of shot #136377 and the frequency spectrogram of macroscopic instabilities (a) frequency spectrogram of Mirnov coils, showing BAE with frequency range 100 kHz to 200 kHz, FB and LLM (b) the toroidal mode number of multi-scale mode (c) Ne and Ni (d) Te and (e) Ti

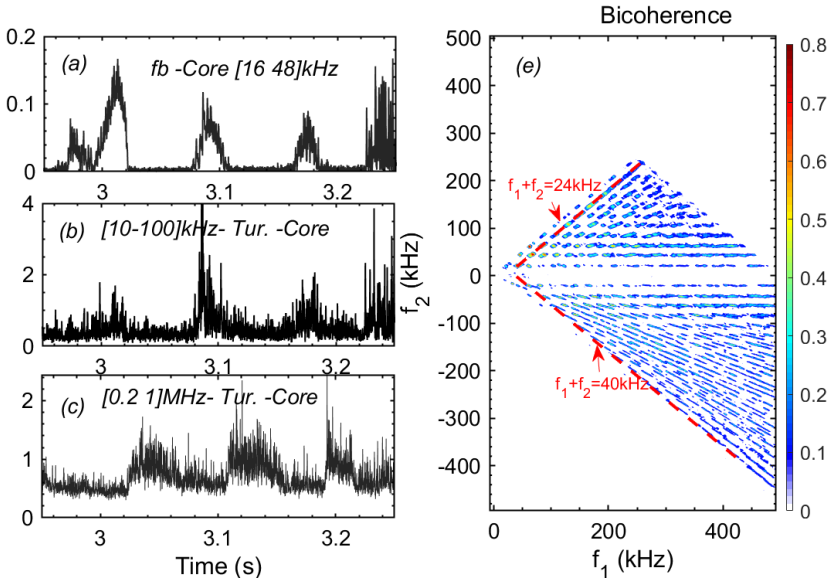

Fig.2 Detailed analysis of interaction between FB and turbulence. (a) evolution of FB amplitude and (b) the low frequency turbulence f= [10 100] kHz, (c) the high frequency turbulence f= [0.2 1] MHz, and (d) auto-bicoherence spectrogram of core SXR signal, bicoherence satisfying f1+f2 =40 kHz or f1+f2=20kHz (frequency of n=2 and n=1 fishbone).

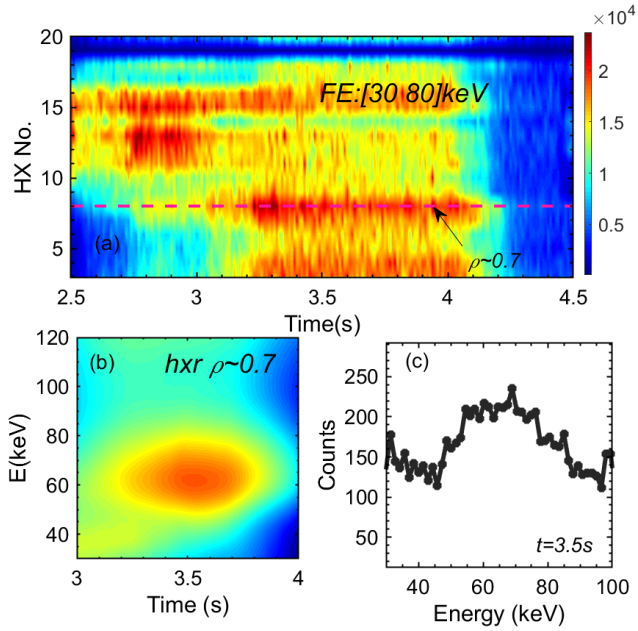

Fig.3 Fast electron dynamics after Ar injection. (a) contour plot of FE with E= [30 80] keV. (b) FE energy spectrum evolution near ρ~0.7. (c) FE spectrum at t=3.5s (ρ~0.7).

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