Overview of ion cyclotron emission detection and explanation in EAST tokamak

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A passive high-frequency B-dot probe diagnostic system has been designed and developed for the measurement of ion cyclotron emission (ICE) in EAST Tokamak. Based on the diagnostic system, the classic edge ICE from neutral beam injection (NBI) heated plasma at low magnetic field side are often observed. In addition, the ICE, with the spectral peaks of which match the cyclotron frequencies of beam ions near the magnetic axis are also detected. The characteristic of fast beam ions velocity distribution that excited ICE is investigated by TRANSP/NUBEAM code as ICE is probably excited by non-thermal ions velocity distribution. In EAST Tokamak, we found that the evaluated fast beam ions distributions have strong pitch-angle anisotropy both at low field side and near the magnetic axis. In the case with ICE excitation, a relatively peaked bump-on tail structure in the energy direction is formed. Based on the fast ion distribution function obtained from TRANSP/NUBEAM code, together with a linear analytical theory of the magnetoacoustics cyclotron instability (MCI), we also found that the excitation mechanism of ICE driven by sub-Alfvenic beam ions in EAST is MCI as the time evolution of MCI growth rates is broadly consistent with measured ICE amplitudes. ICE also observed from the plasma only heated with low hybrid wave and electron cyclotron resonance heating in EAST Tokamak, as shown in figure 1, the physical mechanism of this kind of ICE will be investigated further in the near future.

References

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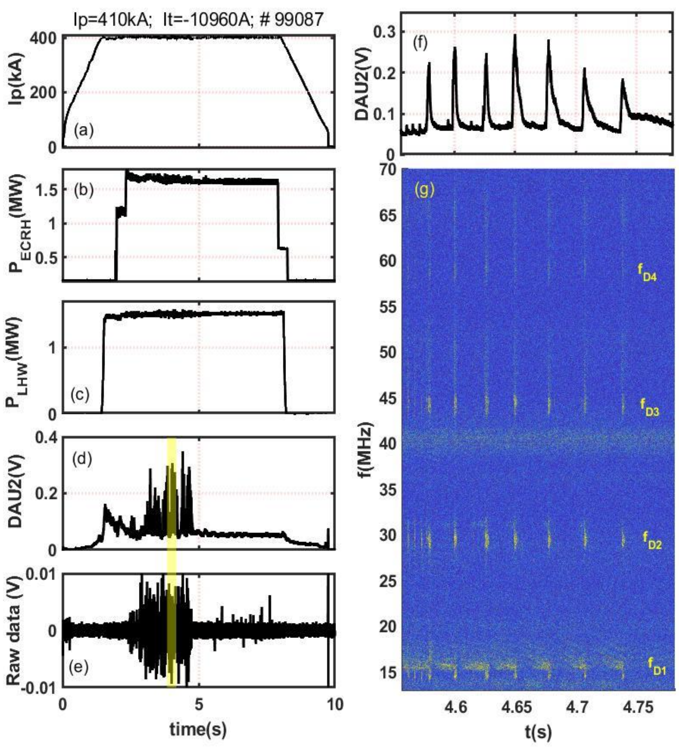

Figure 1. ICE observed from the plasma only heated with low hybrid wave (LHW) and electron cyclotron resonance heating (ECRH) in EAST Tokamak. (a) Plasma current; (b) ECRH power; (c) LHW power; (d) D_α signal intensity; (e) Initial B-dot probe signal; (f) time span from figure (b); (g) Spectrum of B-dot probe signal from figure (e)