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# First observation of ion cyclotron emission during low hybrid waves and electron cyclotron resonance heating in EAST Tokamak

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The ultimate goal of the tokamak design is to house a plasma that produces so much nuclear fusion that the excess energy both generates electricity and keeps the plasma hot enough to continue high fusion rates without additional input power. This so-called burning plasma would have a large density of 3.5 MeV energy alpha particles within the ~20 keV plasma. Those alpha particles need to be confined long enough that they deposit most of their energy into the background plasma to keep it at fusion temperature. Without producing large quantities of fusion-alphas, the EAST tokamak enables studies of how energetic particles interact with the base plasma using neutral beams to inject 60-80 keV ions into plasmas with temperatures below 10 keV. Beam ions often excite electromagnetic waves at ion cyclotron frequencies and higher harmonics (5 - 100 MHz) in the 2 Tesla confining magnetic field, and there is renewed interest in turning this emission into a quantitative diagnostic measuring the velocity space distribution of the energetic particles. Observations of ICE at frequencies corresponding to the core of the tokamak are particularly interesting for applications to ITER.

Our study reports the first measurement and identification of ion cyclotron emission (ICE) during low hybrid wave and electron cyclotron resonance heating in the EAST tokamak. The spectra obtained from that heating discharge show strong emissions at deuterium cyclotron harmonics, providing compelling evidence for the presence of ICE in the deuterium plasma.

Figure 1. shows ICE spectra in different shots with different background magnetic field. In those three shots, it is deuterium plasma heated by LHW and ECRH only. The background magnetic field in shot 115994 is 2.5 T with ICE frequency of 15 MHz; The background magnetic field in shot 115996 is 2.4 T with ICE frequency of 14.6 MHz; The background magnetic field in shot 115995 is 2.3 T with ICE frequency of 14 MHz. Compared with the resonance frequency of deuterium ions, it is clear that the emission location of ICE is similar.

References

[1] Lunan Liu et al 2019 Rev. Sci. Instrum. 90, 063504

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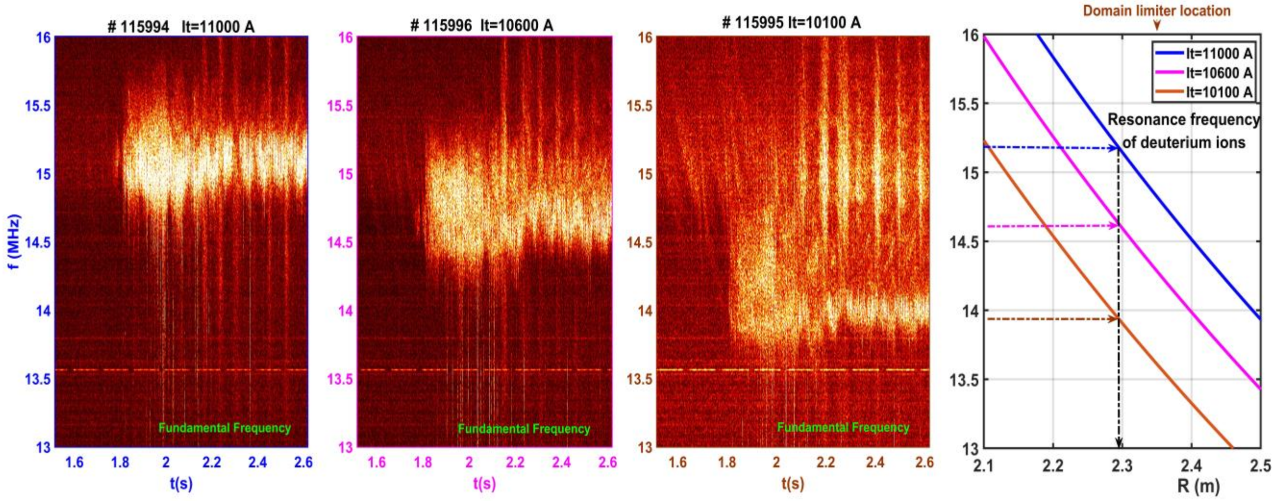


Figure 1. ICE spectra in different shots with different background magnetic field. In those three shots, it is deuterium plasma heated by LHW and ECRH only.