Observations of Ion Cyclotron Emission on NSTX-U
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This paper presents the first observations of ion cyclotron emission (ICE) in spherical tokamaks originating from the vicinity of internal transport barriers. Frequency spectrum measurements of ICE on TFTR [1] and JET [2] showed frequency peaks consistent with ion cyclotron frequency emission from energetic particles located near the plasma edge. As in conventional tokamaks, the frequency of the emission corresponds to the ion cyclotron frequency of energetic fast ions, in this case deuterium beam ions. However, in NSTX-U the emission appears to originate from deeper in the plasma, rather than from the plasma edge as in TFTR and JET. In Fig. 1a are shown contours of the density profile (black contours), overlaid by the ion cyclotron emission spectrum mapped to major radius. At each point in time, the frequencies in the Mirnov coil spectrum are mapped to the local deuterium ion cyclotron frequency (red contours). The local ICE frequency peak roughly follows the contours of a strong local gradient in density, i.e., an apparent internal density transport barrier. The correlation with the strong density gradient is more clear in the time slice of magnetic fluctuation spectrum and density profile at 0.231s in Fig. 1b. The ICE emission apparently originates from approximately the half minor radius, far from the plasma last-closed flux surface. Direct measurements of the spatial coherence of the emission show that the emission is from a spatially coherent mode with toroidal mode number n=1, rather than, for example, incoherent emission such as the electron cyclotron emission (ECE). The emission has compressional polarization at the plasma edge.

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