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8.13 Ion cyclotron emission (ICE) study on the ASDEX Upgrade tokamak

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Ion cyclotron emission (ICE) is a commonly observed feature of magnetized toroidal plasmas in the presence of fast ions. It is generally agreed that this emission is caused by an inverted velocity distribution of confined fast ions originating from either neutral beam injection (NBI), fusion reactions, or acceleration by waves in the ion cyclotron range of frequencies (ICRF). As a result, ICE can provide a non-perturbing measure of the state of confined alpha particles in a deuterium-tritium fusion device, such as ITER or DEMO. The ICE diagnostic on ASDEX Upgrade (AUG) is capable of detecting ICRF fields emitted by plasma. It consists of a pair of fast digitizer channels (125 MHz sampling rate), which are connected to a pair of B-dot probes inside the AUG torus, on the low field side (LFS). These probes are oriented such that the wave number and the mode polarization can be estimated. The frequency spectra reveal the radial location of ICE origin: the most common ICE originates from the LFS plasma region and is likely to be due to fast NBI ions. Signals consistent with fusion proton-driven emission are also observed, most commonly originating in the edge. However, under certain conditions, core ICE is also detected, with the fusion protons being the likely emission driver.

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