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Sub-microsecond time evolution of edge density inferred from ion cyclotron emission measurements during ELMs in KSTAR plasmas[1]
B CHAPMAN, S C CHAPMAN, Warwick University, R O DENDY, K G MCCLEMENTS, Culham, G S YUN, M H KIM, S THATIPAMULA, Postech, Y U NAM, NFRI Korea, KSTAR TEAM — Spectrally structured ion cyclotron emission (ICE) is detected alongside ELMs in KSTAR deuterium plasmas. For KSTAR ICE where the separation of spectral peak frequencies is close to the proton cyclotron frequency at the outer plasma edge, orbit calculations suggest that the driver may be a subset of centrally-born fusion protons on passing orbits. We report 1D3V PIC code modelling of this scenario for KSTAR ICE. We simulate the self-consistent nonlinear full orbit dynamics of energetic and thermal ions and electrons, in combination with the electric and magnetic fields. Multiple simulation runs enable us to infer the theoretical dependence of ICE spectral structure on bulk plasma parameters, notably density. It is observed on KSTAR that the cyclotron harmonic structure of the ICE spectrum usually chirps down, on sub-microsecond timescales, during an ELM crash; upward chirping is observed in a few cases. By matching these observations to the dependence of ICE on local density that we infer from our PIC simulations, we obtain sub-microsecond resolution of the evolving edge density during the ELM crash. The downward ICE chirps reflect the density collapse during the crash, while the rare upward chirps may be due to locally rising edge density associated with ELM filaments.

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