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Theory of collective energy transfer from neutral beam-injected ions to fusion-born alpha-particles on cyclotron timescales[1] RICHARD DENDY, BENJAMIN CHAPMAN, Culham Centre for Fusion Energy, UK, BERNARD REMAN, University of Toulouse, France, JAMES COOK, Culham Centre for Fusion Energy, UK — Fast collective relaxation of neutral beam-injected (NBI) ion populations at the edge of magnetically confined fusion (MCF) plasmas has been inferred from recent observations of suprathermal ion cyclotron emission (ICE). Studies of ICE from NBI plasmas in the KSTAR tokamak (B Chapman et al, Nucl Fusion, submitted) and LHD stellarator (B Reman et al, Nucl Fusion, submitted), using particle-in-cell (PIC) codes, confirm that this ICE arises from the magnetoacoustic cyclotron instability (MCI) due to population inversion in velocity-space of the NBI ions at spatial locations close to their injection point. Here we report PIC studies addressing future scenarios where a minority population of fusion-born alpha-particles (either energetic, or Helium ash) is also present at this location. We identify a novel form of the MCI in which the dominant collective energy flow is from NBI deuterons to the alpha-particles, on cyclotron timescales. This energy flow is partly mediated by ICE-type electromagnetic fields which can also be excited, but whose amplitude is lower than when alpha-particles are absent. Physically, this new effect appears to arise from cyclotron resonant coupling enabled by the finite gyroradius, and identical gyrofrequency, of NBI deuterons and alpha-particles.

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