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Anomalous Doppler instability in tokamaks: first principles simulation and observations in MAST[1] RICHARD DENDY, Culham Centre for Fusion Energy, ALAN LAI, SANDRA CHAPMAN, Warwick University — The evolution in velocity space of minority suprathermal electron populations undergoing the anomalous Doppler instability (ADI) is investigated using fully nonlinear particle-in-cell simulations (W N Lai et al, Phys. Plasmas 20, 102122 (2013); and submitted (2015)) that self-consistently evolve particles and fields in a magnetized plasma. Electron trajectories during different stages of the ADI are captured, and are analyzed in relation to the excited electric fields and the overall velocity distribution of electrons. The time-evolution of the moments of the perpendicular electron distribution function is studied to test the range of applicability of analytical approximations that involve a quasilinear wave-driven diffusion operator. For some electrons, trapping and mirroring are observed during the saturation phase. Recent measurements of microwave and X-ray emission during edge localized mode (ELM) activity in the MAST tokamak imply acceleration of electrons parallel to the magnetic field combined with rapid acquisition of perpendicular momentum. This suggests (S J Freethy et al, Phys. Rev. Lett. 114, 125004 (2015)) that the ADI is operating on electrons accelerated by inductive electric fields generated by the initial ELM instability.

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