Formation of long-lived phase space structures by high frequency Alfvén Eigenmodes through the Doppler-shifted cyclotron resonance E. D. Fredrickson, N Gorelenkov, E Belova, N. Crocker[1], PPPL, Princeton, NJ 08543,[1]UCLA, CA 90095-----This paper presents evidence of Global Alfvén Eigenmode (GAE) avalanches and concomitant fast ion redistribution, including measurements of the internal structure as measured with an array of fixed frequency, quadrature reflectometers. Super-Alfvénic ion populations, like the fusion-α's on ITER, can excite instabilities extending from low frequency Energetic Particle Modes (EPMs), through Toroidal Alfvén Eigenmodes [TAE] to Global and Compressional Alfvén Eigenmodes [GAE and CAE] in the frequency range of roughly $0.1\omega_{ci}$ to $0.7\omega_{ci}$. The resonance condition for the higher frequency Alfvénic modes (GAE and CAE) is predominantly through a Doppler-shifted cyclotron frequency resonance, although short wavelength CAE have been excited through a simple parallel resonance. There is evidence that the GAE, and possibly CAE, create relatively long-lived, phase space structures, suggesting fast-ion trapping in the wave field. The strong gradients in mod(B) intrinsic to low aspect ratio devices like NSTX, and the large orbit excursions of fast ion raise the question of how resonances may be maintained for many wave periods when the cyclotron frequency varies substantially over fast ion orbits. The question is investigated by looking at the resonant fast ions found in non-linear simulations of the mode with the initial value code HYM.
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