Non-linear Wave-Particle Interactions and Fast Ion Loss Induced by Multiple Alfvén Eigenmodes in the DIII-D Tokamak

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Abstract. A new non-linear feature has been observed in fast-ion loss from tokamak plasmas in the form of oscillations at the sum, difference and second harmonic frequencies of two independent Alfvén eigenmodes (AEs). Full orbit calculations and analytic theory indicate this non-linearity is due to coupling of fast-ion orbital response as it passes through each AE — a change in wave-particle phase $k \bullet r$ by one mode alters the force exerted by the next. The loss measurement is of barely confined, non-resonant particles, while similar non-linear interactions can occur between well-confined particles and multiple AEs leading to enhanced fast-ion transport.

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