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Simulation of intermittent beam ion loss in a TFTR experiment

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Recurrent bursts of toroidicity-induced Alfvén eigenmodes (TAE) are studied using a self-consistent simulation model. Bursts of beam ion losses observed in the neutral beam injection experiment at the Tokamak Fusion Test Reactor [K. L. Wong *et al*., Phys. Rev. Lett. **66**, 1874 (1991)] are reproduced using experimental parameters. It is found that synchronized TAE bursts take place at regular time intervals of 2.9 ms, which is close to the experimental value of 2.2 ms. The stored beam energy saturates at about 40% of that of the classical slowing down distribution. The stored beam energy drop associated with each burst has a modulation depth of 10% which is also close to the inferred experimental value of 7%. Surface of section plots demonstrate that both the resonance overlap of different eigenmodes and the dissapearance of KAM surfaces in phase space due to overlap of higher-order islands created by a single eigenmode lead to particle loss. Only co-injected beam ions build up to a significant stored energy even though their distribution is flattened in the plasma center. However, they are not directly lost as their orbits extend beyond the outer plasma edge when the core plasma leans on a high field side limiter. The saturation amplitude is larger than would appear to be compatible with experiment. Physical arguments are presented for why the stored energetic particle response observed in the simulation is still plausible.

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