Toroidal Alfvén Eigenmode Avalanches

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Experiments on the National Spherical Torus Experiment have increased the fast ion beta from quiescent plasmas through the thresholds for excitation of Toroidal Alfvén Eigenmodes (TAE) and TAE avalanches, which are a repetitive cycle of increasingly stronger bursts, each cycle culminating in a large, multi-mode burst and a drop in the neutron rate of ≈10% (Fig. 1). These strong bursts are identified as TAE avalanches [Nucl. Fusion **35** (1995) 1661]. In such an avalanche, the orbit perturbations of fast ions trapped in the multiple TAE wave fields have reached such a size that islands from multiple modes overlap, leading to greatly enhanced transport of the fast ions, and an increase in the drive for the modes. The mode structure is measured with a five-channel reflectometer system and compared to linear mode calculations with the NOVA code (Fig. 2). The comparison is to a virtual reflectometer post-processor to the NOVA code. Fast ion transport will be studied with NOVA and ORBIT, benchmarked on mode amplitudes measured with a multi-channel reflectometer array.

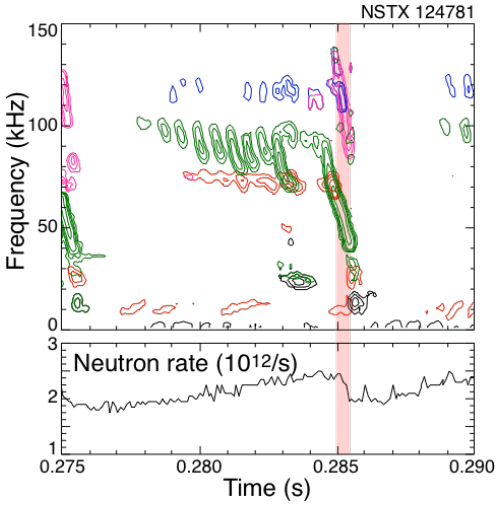

Fig. 1. Spectrogram showing avalanche cycle. Black, red, green, blue and magenta indicate toroidal mode numbers from 1 to 5, respectively. Second panel shows neutron rate with drop at avalanche.

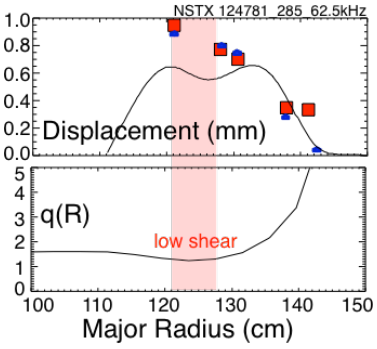

Fig. 2. Midplane mode displacement function simulated by NOVA, compared to measurements.

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