Current-based experimental determination of inter-ELM pedestal MTMs

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We conduct a series of dedicated experiments on the DIII-D tokamak to identify and explain the time-dependent behavior of pedestal-localized microtearing modes (MTMs) in an H-mode discharge. In this work, large, fast vertical plasma jogs are employed to introduce current perturbations in the steep gradient region of the H-mode edge. While these transient edge current perturbations leave the core plasma unaffected, they directly influence the edge q profile and inter-ELM pedestal profile evolution. This has the important effect of decoupling the resonant location and instability drive of pedestal-localized MTMs. We exploit this perturbative approach to track the dynamical frequency evolution of MTMs in the pedestal region, providing a compelling validation of established MTM models. In particular, the MTM frequency is calculated as a function of time from profile measurements at rational q=m/n surfaces, showing remarkable agreement with chirped frequency behavior of n=3, 4 and 5 modes detected with fast magnetics. Supporting measurements of mode saturation, propagation direction and transport fingerprints are in agreement with the dynamic frequency determination. MTMs are in prime consideration as one of the main transport mechanisms responsible for controlling electron heat flux through the plasma edge. As such, this experimental determination of pedestal-localized MTMs can be used to assess and qualify predictive models of the H-mode pedestal. The presented results indicate that any reduced models of pedestal transport must include electromagnetic effects and should be constructed with accurate calculations of MTM stability in mind in order to accurately capture dynamics of the electron temperature pedestal profile.

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