Imaging Key Aspects of Fast Ion Physics in the DIII-D Tokamak

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Abstract.

Visible imaging has been used to provide the 2D spatial structure and temporal evolution of the profile of high-energy neutrals introduced by neutral beam injection, the fast ion profile, and a variety of plasma instabilities in DIII-D plasmas; the combination of these techniques form a comprehensive fast ion physics diagnostic suite. The injected neutral profile is imaged in Doppler shifted D_α light induced by collisional excitation. Fast ion profile information was obtained through imaging of Doppler shifted fast ion D_α light (FIDA) emitted by re-neutralized energetic ions. Time evolved measurements of the detailed 2D poloidal structure of rotating tearing modes were obtained using spectrally filtered fast imaging of broadband visible bremsstrahlung emission, a method which is capable of imaging with high resolution the structure of coherent oscillations in the core of current and next-step fusion plasma experiments and can be applied to virtually any mode with a finite perturbed bremsstrahlung emissivity and frequency in the laboratory frame. Measurements are also presented of the $n = 0$ energetic particle geodesic acoustic mode (EGAM) which were made for the first time using a camera based beam emission fluctuation diagnostic.