Using neutral beams as a Light Ion Beam Probe*

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Neutral beams that ionize near the plasma edge supply an *in situ*, known source of fast ions. These born trapped particles can traverse the plasma core on the inner banana leg. By arranging the particle first-orbits to pass near a distant detector, the beam ions probe internal fluctuating fields in a manner similar to a heavy ion beam probe. Orbital displacements (the forces on fast ions) caused by internal instabilities appear as modulated loss at an edge detector. Adjustments in the equilibrium fields and plasma shape (e.g. the outer gap) that determine the first orbit, as well as the relative position of the source and detector, enable studies under a wide variety of plasma conditions. This diagnostic technique can be used to probe the impacts on fast ions of various instabilities, e.g. Alfvén eigenmodes (AEs) and neoclassical tearing modes, and of externally-imposed 3D fields, e.g. the test blanket module and ELM suppression magnetic perturbations (MPs). To date, displacements by AEs and by externally applied MP fields have been measured using a fast ion loss detector. Comparison with theoretical predictions will be shown. In addition, non-linear interactions between fast ions and independent AE waves are revealed by this technique. In an alternative application, by arranging the first orbit to pass through the sightlines of an optical diagnostic, the edge neutral density can be inferred from measurements of Doppler-shifted D-alpha light.

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