# Measurements of fast-ion transport by mode-particle resonances on DIII-D

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**Abstract.** Magnetohydrodynamic (MHD) instabilities in tokamak plasmas manifest in a variety of ways, characterized by different scale sizes and mode frequencies. MHD activity can cause significant degradation of plasma performance, leading to particle, energy, and current transport. Populations of energetic particles can also dynamically interact with MHD instabilities, resulting in reduced heating efficiency. Among the many different types of MHD, arguably fishbones, sawteeth, and Alfvén eigenmodes (AEs) are observed to cause the largest transport of fast ions. DIII-D's expansive suite of diagnostics makes it possible to rigorously characterize these instabilities and study their interaction with fast ions. This review article first presents an overview of the recent additions to DIII-D's collection of fast-ion diagnostics. The extended diagnostic capabilities are employed in a series of experiments to investigate fast-ion interactions with fishbones, sawteeth, and AEs. Results from these seemingly unrelated studies are highlighted, and they show that mode-particle resonances play the central role in the observed deterioration of fast-ion confinement.