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Velocity-Space Studies of Fast-Ion Transport at a Sawtooth Crash*

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Ever since their discovery in the 1970s, tokamak sawteeth have stimulated a flurry of experimental and theoretical investigations. Among them, observations of energetic-ion transport during the crash phase of the sawtooth cycle have been documented in almost every major tokamak. Furthermore, sawtooth-induced transport can redistribute fast ions onto loss orbits causing significant loss fluxes. DIII-D is equipped with a suite of core fast-ion diagnostics that can differentiate among trapped and passing particles. It has been observed on the DIII-D tokamak that, on average, *trapped* ions experience about 18% reduction in the core density, while the depletion in the core *passing* ion density is nearly double, about 35%. While many factors (such as orbit widths, drifts, and particle-mode resonances) may contribute to the measured difference, the dominant mechanism on DIII-D is likely the variation in the toroidal drifts among trapped and passing particles. To test this theory, the transport process is modeled using a numerical approach to the drift kinetic equation. The simulation reproduces the characteristic that circulating energetic ions experience the greatest levels of internal transport.

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