Investigating fast-ion transport due to sawtooth crashes using Collective Thomson Scattering

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Sawtooth crashes redistribute heat, particles, momentum, and large populations of fast ions radially outwards. As this can modify heating and current-drive profiles and potentially increase fast-ion losses, the impact of sawteeth on confined fast ions is a subject of particular interest for future fusion devices. A key challenge is to understand how the redistribution depends on fast-ion energy and pitch as well as on plasma parameters and the sawtooth crash amplitude or period.

Collective Thomson Scattering (CTS) is well suited for studies of the mechanisms underlying fast-ion redistribution by sawteeth, given its flexible measurement geometry which allows measurements in specific regions of fast-ion phase space. Recently, at ASDEX Upgrade, the installation of a dedicated CTS receiver for background monitoring has helped to significantly improve the acquisition and analysis of CTS data, with CTS measurements of thermal and energetic ions in MHD-quiescent discharges showing good agreement with results from other diagnostics and with neo-classical theory.

Building on this, we present the first CTS measurements of sawtooth-induced redistribution of fast ions at ASDEX Upgrade and compare the results with those predicted with the Kadomtsev sawtooth model implemented in TRANSP. We also discuss the results in light of those obtained using other fast-ion diagnostics such as fast-ion D-alpha spectroscopy (FIDA), neutral particle analysers (NPA) and fast-ion loss detectors (FILD) and consider what can be gained from a combined analysis of these measurements using tomographic reconstruction.

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