Influence of neoclassical tearing modes on confined fast ions
in ASDEX Upgrade

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Neoclassical tearing modes (NTMs) are caused by a 3D helical perturbation in the bootstrap current and are often triggered by a large sawtooth crash or another event that can seed a large enough magnetic island. NTMs degrade plasma confinement and particularly lead to substantial losses of fast ions [1, 2, 3]. Redistribution of confined fast ions due to NTMs was observed indirectly by changes in the fishbone activity after the onset of NTMs [4]. Recent experiments in the ASDEX Upgrade tokamak with fast ion D-alpha (FIDA) spectroscopic measurements in presence of NTMs suggest that confined fast ions experience redistribution and that fast ion density in the plasma centre drops. The effect is studied both numerically using an orbit following code and experimentally using multi-view FIDA and collective Thomson scattering diagnostic.

Numerical simulations show different response of trapped and passing energetic particles to the perturbed topology of the magnetic field due to different mechanisms of interaction with the perturbed magnetic field: orbit stochastisation for passing particles and resonant interaction at the turning points of banana orbits for trapped particles. The simulations are based on orbit following of fast ions with various energy and pitch in the presence of magnetic perturbations which model magnetic islands of various widths and rotation frequencies.

References:
4. H. Zohm et al., 2001 PoP, 8(5) 2009