# Effect of internal magnetic islands on confined fast ions in ASDEX-Upgrade and Wendelstein 7-X

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In this work, we assess the impact of magnetic islands on confined fast ions in toroidal fusion plasmas, as measured by Fast-Ion D-$\alpha$ (FIDA) spectroscopy. We simulate the neutral beam injection and fast ion distribution function using the BEAMS3D Monte Carlo code [1] for tokamaks and stellarators. Synthetic FIDA spectra are then calculated using the FIDASIM code [2, 3], taking into account the relevant plasma parameters and detailed geometry.

In a reactor, the fusion-born fast alpha particles must heat the thermal plasma collisionally to reach self-heating conditions. Therefore, they need to be well confined within the magnetic field. In present experiments, neutral beams can be used to generate and study fast ions, which we focus on here. Tokamaks are largely axisymmetric, but suffer from dynamic magnetic perturbations, i.e. modes, which can break this property and lead to increased fast ion transport and losses [4, 5]. Stellarators are intrinsically three-dimensional but are generally less prone to transient perturbations. In tokamaks and stellarators, magnetic islands can arise from helical perturbations of the background magnetic field, either internally from the plasma or externally from magnetic coils. They shift fast ion orbits and can cause outward transport, degrading confinement.

BEAMS3D has recently been verified against NUBEAM as well as validated against experimental data at the ASDEX Upgrade tokamak using FIDA [6]. To elucidate the effect of internal magnetic islands in AUG and W7-X on confined fast ions, simulations with equilibrium configurations with and without islands are compared, isolating the magnetic and collisional effects. The simulations allow the interpretation of FIDA measurements in plasmas with (strong) islands and comparison to experimental data.

## References

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