FY15 Research Milestone - draft proposal 01/29/2013

Assess the effects of on NB injection parameters on fast ion distribution function and neutral beam driven current profile.

Fast ion behavior in MHD-quiescent plasmas is expected to be reliably predictable through numerical codes based on classical processes, such as the TRANSP code. However, improved understanding of fast ion confinement and transport processes is required to enable predictive capabilities for future devices such as ITER, FNSF and future ST-based devices, in which the fast ion distribution F_{nb} can be considerably altered by instabilities, rf injection or non-axisymmetric (3D) perturbations.

With the addition of three neutral beam (NB) sources, NSTX-U is well equipped to explore and characterize a broad parameter space of fast ion distribution properties, with significant overlap with conventional aspect ratio tokamaks.

In this research, the fast ion distribution will be characterized through the upgraded set of NSTX-U fast ion diagnostics as a function of NB injection parameters (tangency radius, beam voltage) and magnetic field. Well controlled, single-source scenarios at low NB power will be initially used to compare fast ion behavior with classical models in the absence of fast ion driven instabilities. NB-driven current profile will be documented for the NB parameter space attainable with the 6 NB sources.

As operational experience builds up during the first year of NSTX-U experiments, additions to the initial F_{nb} assessment will be considered for scenarios where deviations of F_{nb} from classical predictions can be expected.

The latter may include scenarios with fast ion driven instabilities, externally imposed 3D fields and additional Fast Wave (FW) heating. Achievement of this milestone will also directly contribute to other avenues of research, for example to study fast ion stabilization of low frequency, global MHD modes for varying radial and velocity fast ion distributions (cf. Research Milestone FY-R??).