Contribution ID: **71** Type: **Poster**

The impact of neutral beam parameters on current drive and neutron yield in DEMO-FNS

Thursday 6 October 2022 09:10 (5 minutes)

DEMO-FNS facility (R = 3.2m, a = 1m, k = 2, B = 5T) will be a hybrid reactor designed to combine fusion and fission technologies. In a hybrid reactor the power is mainly produced by a fission blanket which is exposed to the neutron flux coming from confined plasma, or a fusion neutron source (FNS). Plasma parameters required for FNS steady-state operation are essentially lower as compared against "pure"fusion reactors, and FNS dimensions can be small. DEMO-FNS fusion power will be 40 MW.
DEMO-FNS neutral beam injectors (NBI) are designed to provide a steady state plasma heating, rotation, fueling, current drive and neutron generation. Four injector units will deliver 30MW power in deuterium, E = 500 keV, in a steady-state scenario. NBI concept and main components are almost copied from ITER HNBI, implementing acceleration of negative ions and their neutralization on gas. The high density of injected power in DEMO-FNS implies a particular operation scenario with high fraction of fast particles, when the main part of neutron flux will result from fusion between hot ions and relatively cold background.
The current drive and neutron yield produced by the tangentially injected beam in a steady-state operation is to be tightly coupled with plasma magnetic geometry and kinetic profiles. The fast ions deposition and performance are limited by the losses associated with the neutral beam shape and aiming. The main channels of incident ("direct") beam losses include shine-through neutral power, fast ion drop-out and capture to banana orbits (orbital losses). The detailed evaluation of NB direct losses is a necessary step for NB energy, shaping and steering selection during the reactor design.
BTR (Beam TRansmission) conventional beam model is extended to a detailed analysis of beam losses and performance in plasma. The beam current drive and neutral yield can be efficiently enhanced for any beam-plasma configuration. The beam tracing workflow is implemented in BTOR (Beam in TORoid) suite, designed as a Python pipeline. The examples of BTOR comparison against "traditional"beam tracing suites, performed for other beam-driven tokamaks (T-15MD and EAST), justify the "light"beam model application to fast beam-plasma tuning. The results obtained for DEMO-FNS are compared with NBI performance in ITER, as both tokamaks are beam-driven and their NBI systems are quite similar.

Author: DLOUGACH, Eugenia (NRC «Kurchatov Institute», Moscow, Russia)

Co-author: VELTRI, Pierluigi (ITER Organization)

Presenter: VELTRI, Pierluigi (ITER Organization)

Session Classification: Poster Session 2

Track Classification: 12. Numerical simulations of sources or beams