Simulation of a Power Neutral Beam Injection in RFX-Mod


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The 1 MW Neutral Beam Injector originally designed for the TPE–RX RFP experiment in Tsukuba will be installed on RFX-mod in the framework of a research agreement between Consorzio RFX and National Institute of AIST. With recent significant progress in both confinement and physics understanding in the RFP, studies of additional forms of heating and current drive are timely. The possibility to decouple heating and configuration sustainment (current), add poloidal current drive to help quench magnetic turbulence, heat and fuel directly the volume occupied by the quasi single helicity or finally inject momentum are all means that are expected to further comprehend RFP physics and assess the viability of an RFP reactor. The use of a power beam on RFX-mod represents therefore a good opportunity to make an important step forward. Topological constraints imply that the only acceptable injection geometry in RFX-mod is radial and on the equatorial plane. Such geometry restricts the number of possible experiments to study fast ion behavior in a RFP. Besides the widespread interest in the fusion community, fast ion confinement physics is particularly attractive in RFPs since it was shown that fast ions feature confinement times (G. Fiksel et al., Phys Rev Lett 95, 125001 (2005)) much longer than thermal ions. This has been ascribed to the phase space populated by toroidally drifting fast ions having an outward-shifted set of resonances (rational surfaces) seen by thermal ions, leaving a region near the plasma core free of resonant perturbations to the particle orbits. Fast ion confinement should even improve in an RFP that has reached a helical equilibrium (M. Gobbin et al., Nucl. Fusion 48, 075002 (2008)). The injection of the AIST beam into RFX-mod has been simulated by means of the TRANSP code for a variety of RFX-mod experimental situations. Results confirm that the applied torque is negligible, that electron and ion heating is marginal but that the fast ion population will be significant. This paper describes briefly the injector and the main issues regarding its installation on RFX-mod and then shows the results of the TRANSP simulations.