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P5.1008 Toroidal field ripple-induced NBI energetic particle losses in JT-60SA

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JT-60SA is large device (R_0/a=3.0/1.1) which will use neutral beam (NB) injection as the main actuator to reach the desired plasma temperature and performance[1]. In total, the NBI system provides 34MW of power, of which 10 (24) MW is injected at the energy of 500 (85) keV. The geometry features both parallel and perpendicular injection. The toroidal field (TF) system has 18 coils, producing a field B_tor =2.28 T at the magnetic axis. At the plasma edge, the finite number of TF coils results in a 3D feature known as the TF ripple.This distortion of the magnetic field impacts on fast ion confinement and this effect has already been investigated for ITER because it can lead to loss of power delivered to the plasma and excessive heat fluxes to the wall [2, 3]. The same issue is relevant also for DEMO because of the potential occurrence of unwanted heat fluxes to the wall and loss of power deliver to the plasma. It is therefore mandatory to increase our confidence and prepare the validation of existing models against relevant experiments. For the JT-60SA case, the Biot-Savart law integrator BioSaw [4] has been used to calculate the TF ripple (Δ = (Bmax-Bmin)/(Bmax+Bmin)) - from the geometry of the TF coil. This value has been found to be <1 % inside the plasma separatrix. The 3D non-axisymmetric magnetic field is then applied to JT-60 SA reference scenarios to study the impact of this deformation of the magnetic field on NBI-injected particles orbit using the ASCOT Monte Carlo code. This work builds upon previous axisymmetric ASCOT simulations of JT-60 SA NBI injection [5]. In the inductive case here presented, an increase of the losses (both the prompt losses and the pitch-scattering losses) is documented: the axisymmetric case shows almost no losses during the slowing-down, while ripple can increase fast particle losses and then the power reaching different regions of the first wall. The orbit can be perturbed and the drifts sum up instead of cancel out (e.g. the super bananas get lost because the grad(B) drift). Lost particles where those which were ionized at rho>0.8, which is the area where the magnetic field is mostly perturbed. The region where these particles hit the wall is just below the midplane, around θ=-20 degrees. In the case of low-energy (85 keV), particles get lost also to the lower divertor region. The quantification of the power linked to 3D energetic particle losses will help the tuning of the experimental scenarios.

[1] H. Shirai et al., Nucl. Fusion 57 (2017) 102002
[2] K. Shinohara. et al, Fusion Eng. Des. 84, 24 (2009)
[3] Kurki-Suonio T. et al., NF 49 (2009)
[4] Akaslompolo S. et al., FED 98 (2015)
[5] Vallar M. et al., 44th EPS conference, P1.149 (2017)

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