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Modelling of toroidal ripple field and fast ions in the COMPASS Upgrade tokamak

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The COMPASS Upgrade tokamak [1] will be a tokamak of major radius R0˜0.894 m with high-field (Bt˜5 T) and high-current (Ip˜2 MA). The machine should be completed by 2022. It will be located in Prague, Czech Republic and is currently in design phase. The main auxiliary heating system used to access H-mode will be 4 MW of Neutral Beam Injection (NBI) power with an injection energy of 80 keV. This will create a population of well-confined energetic D ions. In this contribution, the modelling studies the effects of the toroidal ripple induced by the 16 TF coils: a Biot-Savart solver is used to calculate the intensity of the perturbation (BTFR/Bt˜10ˆ-3 at outermost mid-plane positions).

Detailed integrated modelling with the METIS code [2] yields the pressure and current profiles in various planned scenarios (Bt from 2.5 T to 5 T and Ip from 0.8 to 2 MA). These profiles are an input to the FIESTA code [3] that derives a complete mapping of the poloidal flux using realistic positions of the various shaping coils. These maps are then used to follow during a few ms the fast particles in the 3D field using the EBdyna_go orbit solver [4] with a precision of order 10ˆ-4 on the value of pφ (radial position) of each trajectory. We quantify the amount of NBI ions in the edge region, in the Scrape Off Layer and in the divertor. Initial distributions of ions are either uniform or obtained from BBNBI code [5]. Results for various engineering parameters indicate the losses on the Plasma Facing Components for co- and counter- injection.

[1] R. Panek et al. Fusion Engineering and Design 123 (2017) 11–16
[2] J.F. Artaud et al 2018 Nucl. Fusion 58 105001
[3] G. Cunningham, Fusion Engineering and Design 88 (12) 2013, p. 3238-3247
[4] F. Jaulmes et al 2014 Nucl. Fusion 54 104013
[5] O. Asunta et al. Computer Physics Communications 188 (2015) 33–46

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