

# Modelling of scenarios for scientific exploitation of the COMPASS

## Upgrade tokamak

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The COMPASS Upgrade tokamak [1] will be a tokamak of major radius  $R_0 = 0.894\text{m}$  with the possibility to reach high field ( $B_t \sim 5\text{ T}$ ) and high current ( $I_p \sim 2\text{ MA}$ ). The machine should see its first plasma in 2023. The main auxiliary heating system used to access H-mode will be 4MW of Neutral Beam Injection (NBI) power. The NBI will have a nominal injection energy of 80 keV at a maximum injection radius  $R_{\text{tan}} = 0.55\text{m}$ .

Detailed integrated modelling with the METIS code [2] yields the pressure and current profiles for various sets of achievable engineering parameters. The parameter range should allow the achievement of two types of H-mode observed on C-Mod [3]: the usual ELMy H-mode at lower densities and the stationary, ELM-suppressed Enhanced  $D\alpha$  (EDA) regime, seen at high densities and high values of  $q_{95}$ . Furthermore, at higher toroidal field, the window of operation of the improved, low-fluctuations, L-mode like density, confinement mode (I-mode) [4] will be significant, especially at reversed field or Upper Single Null operation. These 3 distinct confinement regimes thus occur at significantly different values of the pedestal top density and collisionality.

The FIESTA code [5] calculates the equilibrium for the three distinct confinement regimes mentioned above, for magnetic fields ranging from 2.5T to 5T. Using our orbit-following code EBdyna [6], we can then evolve the NBI ions during the complete thermalization process and we calculate the amount of NBI ions loss in the edge region due to the edge losses, ripple losses and neutralizations. This allows commenting on the accessibility and stability of the various confinement regimes.

[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] E.A. Tolman et al. 2018 Nucl. Fusion 58 046004

[4] Pedestal Structure and Stability in High-Performance Plasmas on Alcator C-Mod by John Reel Walk, Jr. MIT PhD thesis in Nuclear Science and Engineering (2010)

[5] G. Cunningham, Fusion Engineering and Design 88 (12) 2013, p. 3238-3247

[6] F. Jaulmes et al. 2021 Nucl. Fusion 61 046012