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Constraints of ECRH for high-field and high-density tokamak COMPASS-U

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COMPASS Upgrade, a medium-sized tokamak is under design at the Institute of Plasma Physics in Prague [1]. Due to wide range of operation scenarios with toriodal magnetic field up to 5 T and expected high density during H-mode ($I_\mathrm{p} = 2\,\mathrm{MA},\ n_\mathrm{GW} = 8.7 \cdot 10^{20}\ \mathrm{m}^{-3}$), the design of suitable solution is a challenging task. \\

The ECRH system will be designed to inject the 2 MW of RF power in the initial stage. The main concerns are the cutoff condition on the density and regime of heating (frequency and mode). It is impossible to propose the system which provides the central heating for all the relevant scenarios. The concessions has to be made.

Feasibility studies have been conducted by running numerical simulations with the beam-tracing code TORBEAM [2] and by using scenario predictions from the fast integrate tool METIS [3]. It has shown the possibility to use 140/105 GHz dual tunable frequency system. In scenarios with intermediate magnetic field, the torodial injection angle has to be utilized to shift the resonance layer from high-field side towards the center of the plasma. For the experiments with the lowest magnetic field (≈ 1.25 T) the X3 mode heating is not sufficient due to the low absorption, thus the large shinethrough.

The natural H-mode density was estimated based on scalings from Alcator C-mod [4] and other machines. Given high densities should be avoided for the safety of operation, so plasma current must be reduced. To increase the cutoff density the system will be designed in such a way that it can be upgraded towards 200+ GHz gyrotrons.

Overview of the TORBEAM results for the current drive, NTM suppression and further studies will be provided.

Primary authors: FARNIK, Michal (Institute of Plasma Physics of the CAS); BOGAR, Ondrej (Institute of Plasma Physics of the CAS, Za Slovankou 1782/3, 182 00 Prague 8, Czech Republic); Mr CASOLARI, Andrea; Mrs MACUSOVA, Eva; JAULMES, Fabien (IPP CAS (CZ)); Dr KOMM, Michael (IPP CAS); HAVLICEK, Josef; Mr HRON, Martin

Presenter: FARNIK, Michal (Institute of Plasma Physics of the CAS)

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