

Third harmonic EC heating of ELMy H-mode in TCV

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ELMy H-mode is routinely obtained in TCV with ohmic heating only. Its operational range is well defined for a large set of plasma parameters. TCV is now equipped with up to 1.3MW of Electron Cyclotron Resonance (EC) heating at the third harmonic (118GHz). Unlike the existing X2 EC system, the X3 waves can access higher plasma densities before cut-off and can thus be used for heating H-modes. In fact, X3 requires higher T_e for efficient absorption than can be provided by ohmic L-mode plasmas and so one of the standard TCV ohmic type III ELMy H-mode is an ideal target. For the results presented here, this is an SNL diverted configuration with $I_p \sim 400\text{kA}$, $n_e \sim 5\text{-}6 \cdot 10^{19}\text{m}^{-3}$, $\kappa \sim 1.75$ and $\delta \sim 0.5$.

With an EC heating power below 1MW, the ELM frequency decreases, inducing a density rise which leads to a drop in the heating efficiency and sometimes a disruption. With the full power ($\sim 1.3\text{MW}$) coupled to the plasma, the type III ohmic ELMs cease for a short ELM free phase ($\sim 20\text{-}30\text{ms}$), then large ELMs appear, persisting for as long as the full power is applied. When the coupled power is reduced the plasma returns to the ohmic ELMy regime. During the large ELM phase, T_e rises from 1keV up to 2.5keV while T_i doubles from 600eV to 1.2keV. The energy released at each ELM reaches up 10%. Since the full available power is required to obtain the larger ELM regime, the question of the ELM type cannot be easily examined. Nevertheless this paper will describe this newly found ELM regime in TCV and

address the question of ELM type.

The figure shows an example of such a discharge with, from top to bottom, the D_α emission, the plasma current and the applied ECH power, the plasma density and the electronic temperature at the plasma centre.

