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## Development of Helium Electron Cyclotron Wall Conditioning on TCV for the operation of JT-60SA

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Wall conditioning will be required in JT-60SA to control fuel and impurity recycling and to improve plasma performance and reproducibility. In addition to glow discharge cleaning, operable only in the absence of toroidal field, Electron Cyclotron Wall Conditioning (ECWC) plasmas created with its ECRF launchers are envisioned. ECWC has been successfully operated in Helium at the first harmonic in JT-60U, allowing recovering from disruptions. However, in JT-60SA ( $R = 2.96$  m,  $a = 1.18$  m,  $B_T = 2.25$  T), with gyrotrons frequencies  $f = 110$  or  $138$  GHz, ECWC discharges will have to be operated at the second harmonic of the EC wave.

This paper reports on Helium ECWC experiments on TCV in support of JT-60SA operation. About forty discharges have been produced in TCV, at a toroidal field  $B_T = 1.3$ - $1.54$  T, with gyrotrons at  $82.7$  GHz in X2 mode. Hence, the cold ECR layer lies in TCV at  $R = 0.78$ - $0.92$  m, mimicking operation in JT-60SA. Helium pressures ranged between  $0.5$  and  $2 \times 10^{-2}$  Pa and ECRH powers up to  $480$  kW, using different launchers. Horizontal and vertical poloidal fields with amplitudes typically  $0.1$  to  $2\%$  of  $B_T$  have been used, aiming at extending the discharge vertically and radially. Discharge homogeneity was estimated from the electron density radial profile measured with Far Infrared Interferometry (FIR) and from visible CCD images, while wall coverage was assessed from the ion saturation current measured by the TCV array of wall-mounted Langmuir probes located at the high and low field sides, and at the bottom of the device. Electron densities of  $5$ - $15 \times 10^{18}$   $m^{-3}$  and temperatures of  $20$ - $40$  eV have been measured with the TCV FIR and Thomson Scattering systems. Typical edge temperatures were found to be  $3$  eV at the probes.

The efficiency of ECWC was assessed from the amount of released  $D_2$  fuel, measured in the exhaust gas using optical Penning gauges connected to the vacuum vessel. About  $2 \times 10^{20}$   $D_2$  molecules could be removed with the forty He-ECWC discharges operated in TCV. Despite this, the initiation of a standard ohmic  $D_2$ -plasma could not be sustained after conditioning. Thus, demonstration of the ability of ECWC, operated in X2 mode, to recover to normal operation still remains to be done. For this, a larger operational domain will need to be investigated, e.g. higher pressures, different field patterns, and longer ECWC operation will be needed.

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