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Spectroscopic analysis of wall conditioning and ECR-heated pre-ionization phases in MT-I spherical tokamak

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The optical actinometric technique is used to investigate the addition of impurities in the argon and helium microwave discharges during the wall conditioning process of the MT-I spherical tokamak. This technique normalizes the change occurring in the electron energy distribution function with changing plasma conditions through the emission intensity of the selected Ar/He lines. Any change in relative spectral intensities correlates with the group of electrons involved in the electron impact excitation and the concentration of the plasma species involved in the optical emission. The study investigates the impurity level and the change that occurred in the electron temperature and electron density by using relative intensities, Boltzmann plots, and stark broadening of the selected Ar/He lines. Optimization of the pre-ionization phase is also necessary to step forward to the main tokamak operation. The spectroscopic characterization is performed in terms of plasma parameters, with the sequential imaging of the electron cyclotron resonance (ECR)- heated plasma zones displaying their growth and progression. At lower fill pressure, plasma imaging illustrates the two distinct ECR-heated plasma zones corresponding to the first and second harmonics. The studies provide insights into the physics of preferential plasma heating in space and time-varying magnetic fields producing ECRH zones.

Keywords: MT-I Spherical Tokamak, Microwave resonance heating, Optical actinometry, Impurity level, ECR-heated plasma zones, Sequential plasma imaging

Primary author: QAYYUM, Abdul (Pakistan Tokamak Plasma Research Institute)

Co-author: Dr DEEBA, FARAH (Pakistan Tokamak Plasma Research Institute)

Presenter: QAYYUM, Abdul (Pakistan Tokamak Plasma Research Institute)

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