Measurement of $T_e$ and $n_e$ in the poloidal plane using line ratios from puffed and ambient He on TCV with the MANTIS diagnostic.

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The MANTIS diagnostic simultaneously measures 2D plasma brightnesses in 10 selected spectral regions from 380 nm to 950 nm. All 2D images are formed from the same toroidally tangent sightlines through TCV’s divertor region [1]. Its ability to measure absolute and relative spectral emissivities via tomographic inversion and spatially resolved spectral brightnesses provides a wealth of new information for understanding divertor physics. Emissivities ratios combined with collisional radiative modeling (CRM) allow 2D poloidal plane estimations of several plasma parameters such as $n_e$, $T_e$, ionization rates and recombination rates. This work focuses on estimations of $n_e$ and $T_e$ using neutral Helium line ratios. Emission from two He I singlet transitions, two He I triplet transitions, and a He II line (468 nm) were measured for several plasma configurations. The Helium emission model is adapted from that of contemporary work already reported for data from several machines [3] [2]. Reducing the uncertainties inherent to tomographic inversion and atomic modeling are of paramount importance in validating this diagnostic technique. Therefore, plasma equilibria for which the divertor Thomson scattering chords sampled the full divertor leg were examined, so that MANTIS measurements of $n_e$ and $T_e$ could be compared with Thomson scattering measurements. MANTIS measurements are also compared with measurements from the divertor spectrometers, reciprocating and wall mounted Langmuir probes and bolometry. Helium seeding was actuated both through a fueling valve on the divertor floor and a valve attached to the edge of the divertor baffle which puffs directly into the MANTIS’s field-of-view. By utilizing a local puffer directly in MANTIS’s field-of-view, $n_e$ and $T_e$ measurements can be made without tomographic inversion. Initial estimates of $n_e$ from the CRM shows good agreement with measurements from supporting diagnostics, while the initial estimates of $T_e$ are too high (> 30 eV). This is consistent with other reported results [2] [3]. The ranges of $n_e$ and $T_e$, as expected from traditional diagnostics, were $0.5 \times 10^{19}$ to $1 \times 10^{20}$ m$^{-3}$ and 1 to 30 eV.

References


$^1$See author list of S. Coda et al 2019 Nucl. Fusion 59 112023.