MEASUREMENTS OF ELECTRON TEMPERATURE AND DENSITY WITH DTS IN RADIATIVE DIVERTOR DISCHARGES ON DIII–D*

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We have obtained measurements of n_e and T_e in the divertor with an eight-point Divertor Thomson Scattering (DTS) system. Two-dimensional distributions have been obtained by sweeping the X–point. Several Radiative Divertor operating modes have been studied, particularly ELMing H–mode with gas puffing of D_2 and impurities (N and Ne). With D_2 puffing, the DTS profiles indicate that T_e in a large part of divertor region below the X–point is dramatically reduced (from ~30–40 eV without puffing to 1–5 ev), resulting in a fairly uniform low-T_e divertor. Electron densities rise to $>4\times10^{20}$ m^{-3} The density away from the separatrix near the divertor plate often increases relative to that at the separatrix.

We have used these results to compute the electron pressure distribution in the divertor. If we assume $T_e=T_i$, then the total pressure at the plate can be compared with measured upstream (midplane) pressure $n_e\{T_e + T_i\}$. The midplane plasma quantities are obtained from Thomson Scattering (n_e, T_e) and CER (T_i). With D_2 injection, we typically observe a reduction from the midplane to the divertor plate near the separatrix of ~10–20. As n_e often increases (T_e~constant) radially away from the separatrix, the calculated pressure increases, resulting in Partially Detached Divertor (PDD) operation. With impurity injection, we also see a decrease in the divertor T_e, along with pressure drops a factor 2–5.

We have also compared the spatial distributions of T_e and pressure with the radiation distributions measured by a crossed bolometer array. In the PDD case, the radiation distribution is distributed along the outer leg of the divertor, roughly coincident with the zone of decreased T_e. With Ne puffing, the radiation is divided between a localized zone near the X–point and a mantle in the plasma core. Detailed comparisons of the spatial profiles of n_e, T_e, pressure, and radiation for the PDD and impurity puffing will be presented. In addition, these data are compared with calculations of total pressure (including the ρv^2 term) from the UEDGE code.

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