Re-construction of Detached Divertor Plasma Conditions in DIII-D Using Only Spectroscopic and Probe Data *

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DIII-D's divertor Thomson scattering (DTS) system provides a unique opportunity to directly measure n_e and T_e in a divertor plasma, with precision and accuracy, even for strongly detached plasma conditions. On most tokamaks DTS is not available. On DIII-D, DTS access to the (generally detached) inner leg is restricted. A method is therefore needed for empirically "re-constructing" detached divertor plasmas when DTS is not available. Langmuir probe (measuring I_{sat}) and spectroscopic measurements are, in contrast with DTS, usually available. On DIII-D this comprises probes built into the divertor targets and measurements of poloidal spectroscopic distributions using filterscopes and high-resolution Multichord Divertor Spectroscopy (MDS), as well as toroidally- and poloidally-viewing cameras. It is shown that detached divertor plasmas in the DIII-D *outer* leg can be re-constructed, i.e. indirectly inferred, using non-DTS data alone — as then confirmed by comparison with the directly measured DTS data. The undertaking thus amounts to using DTS to develop means for proceeding without DTS.

Simple-as-Possible Plasma (SAPP) L-mode conditions were used with where the outer divertor leg was (just) detached. The absolutely calibrated poloidal distributions of $D_\alpha, D_\beta, D_\gamma$ were measured across the outer target. It was known — from DTS — that T_e at the location closest to the target was 0.8 ± 0.2 eV, approximately constant across the outer divertor I_{sat}-footprint. The OEDGE edge interpretive code was used to simulate the signals, to compare with the measured ones. The code took the I_{sat} profile as input and varied the assumed T_e profile across the target. When the value of T_e used in the code was set at 1.6 eV the simulated signals were much lower than the measured ones, by factors of ~2X, ~3X and ~4X ($D_\alpha, D_\beta, D_\gamma$), while if T_e was set to 0.4 eV, the difference with experiment was more than an order of magnitude, thus indicating the potential capability of these spectroscopic signals to closely identify the value of T_e at the target.

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