Onion-Skin Method (OSM) Analysis of DIII–D Edge Measurements*

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Onion-skin method (OSM) analysis provides a complimentary method to standard 2-D fluid codes, such as UEDGE, for modeling edge plasmas. In standard 2-D codes, “point” boundary conditions, density and power input, are set at the “upstream end”; the values of the cross-field transport coefficients, $D_\perp$, $\chi_\perp$, must also be specified. In OSM analysis a larger amount of experimental information is input, “band” boundary conditions spanning across the SOL — typically target Langmuir probe measurements of T_e and I^+_{sat} as a function of distance across the targets, which is necessary and sufficient to constrain OSM solutions. The values of $D_\perp$, $\chi_\perp$, rather than being an input, are extracted as part of the OSM analysis. OSM analysis can be carried out at various levels of sophistication. In the most basic form, the standard divertor Two-Point Model is applied to each SOL flux tube of the computational grid, thus giving the plasma parameters at each point upstream of the target, i.e. a 2-D solution is generated. OSM solutions are inherently 2-D since cross-field transport is necessarily included, although since virtually all of the computational effort is focused on solving the variations of plasma quantities along the field lines, a common misunderstanding is that it is 1-D. In the DIVIMP-OSM used here, the same parallel and atomic physics is used as that in the standard 2-D fluid edge codes. The usual conservation equations are solved iteratively with a Monte Carlo neutral code, here EIRENE. The spatial distribution of the cross-field fluxes, the only free element, can be made proportional to d^2n/dr^2, etc., for diffusive transport, but the solutions are usually insensitive to the spatial distributions.

Results will be reported for a DIVIMP-EIRENE OSM analysis carried out for different operating conditions in DIII–D. Target Langmuir probe and Thomson scattering measurements in the divertor provided the boundary conditions. Code output is compared with upstream profiles of n_e and T_e (core Thomson scattering), T_i (charge exchange recombination spectroscopy), toroidal and poloidal distributions of hydrogenic and impurity radiation, bolometry, pressure gauge measurements, target heat loading and reciprocating probe data.

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