Comparison of Langmuir Probe and Thomson Scattering Measurements in DIII-D*

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Langmuir probes are widely used to measure plasma properties but the theories used to interpret the data are subject to the validity of various assumptions. Plasma density, as measured by probes, is inferred through theory from the more fundamental measurements of electron temperature and particle flux. Electron temperature and the effective probe area also depend on assumptions that are often difficult to verify. Using the divertor Thomson scattering system (DTS) and the target plate single Langmuir probe array on DIII–D, the theoretical relationship among these parameters can be tested experimentally. The nearest laser and target plate probe measurement points are separated by 1.6 cm vertically which is approximately 1 meter along the field. The vertically scanning divertor reciprocating probe overlaps both of these measurements as well as more laser measurement points up to 25 cm above the target plates and employs both single and double Langmuir probes. We also compare upstream scrape-off layer measurements using a reciprocating Langmuir probe and the core Thomson scattering system. Flat, domed, and other probe geometries have also been employed which allow us to examine the effects of incidence angle on projected area. The domed/flat flux ratio is less than the geometric area ratio away from the strike point which suggests sheath expansion effects. Particle flux measured directly by the probes (I_{sat}/area) is proportional to neC_s calculated from DTS density and temperature measurements over a wide range for many types of plasmas. Different experimental conditions are systematically examined.

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