Measurements of electron and ion properties using Thomson scattering during plasma-wall interaction experiments in a linear plasma device

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Linear plasma devices are essential for studying plasma-wall interaction issues under conditions relevant to next-step fusion devices. Knowledge of the plasma parameters in front of the exposed material is required to understand plasma-induced material modifications and allow for the development of appropriate models. Thomson scattering (TS) is an attractive technique for this purpose as it is nonintrusive and does not suffer from the difficult interpretation associated with probes in strong magnetic field. Two TS diagnostics have been developed at DIFFER for the determination of electron and ion properties in the linear plasma generators Pilot-PSI and Magnum-PSI, uniquely capable of creating divertor-relevant plasma conditions. An advanced TS system measures n_e, n_0 and T_e profiles (spatial resolution <2 mm) along a laser chord of 100 mm. Very low n_e (9×10^{18} m^{-3}) can be measured within seconds with accuracies as good as 3%. The minimum measurable electron density and temperature are $n_e \sim 1\times10^{17}$ m^{-3} and $T_e \sim 0.07$ eV, respectively. By virtue of the high system sensitivity, single pulse TS can be performed on high density pulsed plasmas (used for replicating ELMs). To measure the ion temperature and flow velocity of the plasma a Collective TS system (CTS) is being built: the small Debye length of the Magnum-PSI plasma enables application of this method at relatively short laser wavelength. In a feasibility study it was shown that forward CTS with a seeded Nd:YAG laser operating at 1064 nm, can be applied at Magnum-PSI to measure T_i and v_{plasma} with an accuracy of <8% and <15%, respectively. The detection system is based on a Echelle grating spectrometer that will enable spatial profile measurements at very high spectral resolution (<0.005 nm). The design, status and experimental demonstrations of the performance of the different TS systems will be reported.