Comparison of ion beam diagnostics with laser induced fluorescence (LIF) and retarding field energy analyser (RFEA) in a low-temperature RF-plasma.

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An RFEA in a plasma will be surrounded by a sheath so the velocities measured by the RFEA will be the velocities of the ions after they have been accelerated by the sheath and any potential drops inside the probe. Due to distorting effects in an RFEA and the uncertainty of the correct plasma potential, deriving a correct velocity distribution for the plasma from RFEA-measurements is difficult. LIF on the other hand will measure a velocity distribution that is close to the velocity distribution function in the plasma. In order to compare RFEA with LIF measurements, we suggest to convert the LIF-measurements to RFEA-equivalent data assuming an ideal RFEA-probe and a one dimensional sheath behaving as a simple potential drop.

We use this method to present a comparison of LIF and RFEA measurements from the inductively coupled helicon device Njord at the University of Tromsø where an expanding magnetic field configuration gives rise to an ion beam. We find that while the RFEA-measurements give a much wider background distribution than LIF, the beam measurements are more similar. Measurements at different pressures show that equivalent beam energies are obtained from both techniques.

Other studies [1] have shown that RFEAs can be more sensitive to ion beams than LIF-measurements. With our comparison we show that RFEAs are a good diagnostics tool for ion beams, although it does not give a fully realistic measurement of the background distribution.

We also find, as expected, that the beam intensity in the RFEA measurements falls off like an exponential function with distance to the source and that a background distribution grows up as the beam intensity decrease.

References