Testing of a pulsed He supersonic beam for plasma edge diagnostic in the TJ-IU torsatron

Abstract: A new, compact atomic beam source based on the supersonic expansion of E-fe has been developed for application as a plasma edge diagnostic. The beam is produced from a pulsed valve with a duration between 0.2 to 2 ms and a nominal repetition rate < 500 Hz. A terminal speed ratio > 10 and a divergence of +/- 1 degrees have been achieved at stagnation pressures below 2 bar. The diagnostic has been tested in ECRH plasmas on the TJ-IU torsatron, representing the first application of a supersonic beam to plasma characterization, to our knowledge. Operational conditions which minimized the total amount of He injected into the plasma were chosen. Non-perturbative injection conditions in the low density plasmas could be obtained at local He densities of similar or equal to 1 x 10(11) cm(-3) and a beam diameter < 1 cm. Due to the relatively low electron density of the ECRH plasmas, and to the good penetration characteristics of the supersonic He beam, the diagnostic could be used up to fairly low values of the normalized plasma minor radius, r/a (a = 12 cm). Details of the optimization of the atomic beam diagnostics and typical results for steady state conditions in the TJ-IU plasmas are presented.