Negative ion characterization in a helicon plasma source for fusionneutral beams by cavity ring-down spectroscopy and Langmuir probelaser photodetachment

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Abstract:Negative ions are characterized in the helicon plasma source resonant antenna ion device (RAID) at the Swiss plasma center by means of cavity ring-down spectroscopy (CRDS) and Langmuir probe (LP)-assisted laser photo detachment. A high density and axially homogeneous plasma column is produced via a RF antenna able to sustain the propagation of helicon waves in a steady state regime. An electron density ne~=2.0×1018m−3 in H2plasma at 0.3 Pa and 3 kW of input power is measured in the center of the plasma column by LP and microwave interferometry. The electron temperature profile is peaked on axis reaching Te≈5eV and decreasing to 1.5 eV at r=0.05m. Thus, a hot core region forms where H2 molecules are rovibrationally excited (H2(v)), and a cold edge, where low energy electrons can attach to H2(v) and produce H− ions by dissociative attachment. In this work we use LP-assisted laser photo detachment and CRDS diagnostics to measure H− and D− radial density profiles and how they depend on source parameters. We show that negative ions are distributed on a shell of 0.06 m radius with a peak value of ~2.0×1016m−3 in H2 plasma. These results suggest that, although substantial technical development is needed, helicon plasmas could be considered as a possible candidate as sources of negative ions for future NBIs.