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Negative Ion Production and Beam Extraction Processes in a Large Ion Source

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Recent research results of a large (700 mm long, 350 mm wide and 230 mm deep) negative ion source at the National Institute of Fusion Science are described. An electrostatic probe with four-independent electrodes measures flow of charged particles in plasma. One of the probe electrodes is utilized as a single Langmuir probe for photodetachment negative ion density measurement. Line integrated negative ion density obtained by cavity-ring down photodetachment measurement provides data to calibrate the local density of negative hydrogen (H-) ions measured by means of photodetachment method. This method is available to obtain negative-ion density even in the plasmas including quite low electron densities. The probe *I-V* characteristics have shown flat plasma potentials profile as the source is operated without Cs, while the profile shows a slope when Cs is introduced into the discharge. Higher electron density shields penetration of bias potential into the plasma with smaller distance. Electrons and negative ions respond against the change in extraction electric field in different manner in the magnetized region produced by the filter field and electron extraction suppression field. Temperatures of negative ions are measured with saturation cavity ring-down method, and that of hydrogen atoms are observed with high-resolution spectroscopy and Hα absorption spectroscopy. Data obtained from a laser Cs absorption spectroscopy, Cs flux monitor and a local work function measurement system characterize Cs recycling in the source and its correlation to the extracted H- ion current density from the source.