Cesium delivery system for Negative Ion Source at IPR


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The technique of surface production of negative ions using Cs has been efficiently exploited over the years for producing negative ion beams with increased current densities from negative ion sources used on neutral beam lines. Deposition of Cs on the source walls and the plasma grid lowers the work function and therefore enables a higher yield of H\(^-\), when hydrogen particles (H and/or H\(_2^+\)) strike these surfaces.

A RF based negative ion source test bed, ROBIN, has been set up at IPR. A 1 MHz RF generator launches 100 kW RF power into a single driver on the plasma source to produce a plasma of density \(\sim 5 \times 10^{12}\) cm\(^{-3}\). Use of Cs, enables delivery of a 10 A negative ion beam with a current density of \(\sim 30\) mA/cm\(^2\). The present set up shall allow for acceleration of beams to 35 kV. The ROBIN ion source is similar to a RF based negative ion source, BATMAN, presently operating at IPP.

The optimization of the Cs oven design to be used on this facility as well as multi-driver sources is underway. The oven shall be mounted on the backplate of the ion source and heated to 150 – 250 \(^\circ\)C using flexible heating elements controlled by PID temperature controllers. A Cs inventory of 10 g in the Cs oven is considered to avoid frequent Cs refilling. A remotely controlled all metallic valve is incorporated in between the Cs container and delivery tube of the Cs oven to avoid the contamination of the Cs in case of fault conditions or venting of the source.

In the meanwhile, characterization experiments of such a Cs delivery system with a 1 gm Cs inventory are in progress. In the present set up, the remotely operated valve has not been installed to avoid the complications. The Cs container is kept at a temperature of 150 – 180\(^\circ\)C. All other parts of the oven are kept at a temperature \(\sim 50\)\(^\circ\)C higher than the container to avoid any cold spot in the oven. Four PID temperature controllers are used to control the temperatures of the various oven parts. A surface ionization detector, SID, has been installed in the vacuum chamber to measure the Cs ion current. A hot filament of SID ionizes the Cs atoms striking on it whereas other filament collects the Cs ions and thereby Cs ion current is measured. By measuring the Cs ion current, the Cs flux output at a particular Cs container temperature is measured. Also, the SID is attached to a linear motion feedthrough which allows moving the SID without breaking the vacuum. By moving the SID, the angular distribution of the Cs flux output can be measured.

The paper will discuss the design of the Cs delivery system, experiment methodology and experimental results.