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Visible Camera-Based Diagnostic to Study Negative Ion Beam Profiles in ROBIN Ion Source

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The ion beam divergence & uniformity/homogeneity apart from beam energy are two crucial parameters of a large-size ion source-based NBI (Neutral Beam Injector) for the physical interpretations of beam dynamics & control of its extraction system. Characterization of H^- ion beam in ROBIN (Rf Operated Beam source in India for Negative ion) source using two orthogonally placed cameras installed at the top & a side port of the beamline, at an axial distance ~ 1.42m & ~ 1.90m from the grounded grid (GG) respectively are presented in this report. As the beam particles travel through the background gas, it emits photons in the visible range due to the production of excited species. The cameras characterize the beam profile based on the photon intensity level that is proportional to the beam current density. The ROBIN ion source with masked large area grid (LAG) extraction system, having only 146 open beamlet apertures dispersed equally on two grid segments for beam extraction. The grid segments are inclined by 0.873° from the vertical plane towards the forward direction. The exposed area of the grid segments focuses the beam vertically at a distance of $\sim$ 3m. The initial observations through lateral camera at 1.9m shows: individual beamlet identities are lost & each segment forms a Gaussian-type beam profile which eventually merges into a super-beam with a nearly flat-top profile with Gaussian wings at the edges. The shape of the super-beam depends on the mechanical beam focussing & the space-charge blowing-up effect. The estimation of beam uniformity/homogeneity & divergence is complex & so a beam modeling activity is initiated. The total beam profile is obtained by integrating all the beamlet profiles over the whole extraction area. The correlation between the measurements & simulation of the beam is highlighted in the report. Tomographic analysis using camera data & analytical models is the future scope of action.

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