

Design and development of an Allison type emittance scanner for the SPIDER ion source

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Rev. Sci. Instrum. **91**, 013328 (2020); <https://doi.org/10.1063/1.5129650> Abstract: Low divergence negative ion beams are crucial for the development of ITER-like fusion reactors. SPIDER is the prototype beam source of the ITER heating neutral beam injector, and it recently started beam acceleration, up to a voltage of 30 kV. The main diagnostics used to measure beamlet divergence are a movable diagnostic calorimeter (STRIKE), which gives the thermal footprint of the beamlets; beam emission spectroscopy; and visible imaging. These systems do not allow a direct measurement of single beamlet phase-space distribution, which is useful for comparison with numerical simulations and to estimate accelerator performances. To this purpose, a movable Allison type emittance scanner for the SPIDER negative ion beam was developed and proposed for the installation on the STRIKE supporting structure. This paper describes the numerical analyses performed to dimension the mechanical and electrical components, such as the Faraday cup and the slits. An analytical approach based on the integration of an arbitrary phase-space distribution was adopted in order to simulate the device performances. The constraints due to the operation in a high heat load environment are discussed.