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Observation of beamlet displacement and parallelism in NIO1

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The compact radiofrequency negative ion source NIO1 (Negative Ion Optimization phase 1) has many available CF40 ports for side views of beamlet matrix. Two kinds of deflecting magnetic systems are present, namely the fringe field of the source filter Bs (mostly directed in vertical direction, x, where z is beam extraction direction) and the electron deflection filter Bd (due to magnets inserted in the extraction grid EG and the post-acceleration grid PA) mostly directed in the horizontal direction (y). Their effect can be separated by visible cameras looking from different directions, namely CAM1 (looking from –x axis) is sensitive to Bs while CAM2 (looking from –y axis) verifies Bd effect; both cameras are also sensitive to beam optics, dependent on extracted beamlet currents, their uniformity and applied voltage. Optional algorithms for noise rejection and pre-smoothing can improve automatic recognizing of beamlet peaks, while a good fraction of images can be simply fitted by Gaussian shapes. This analysis allows to estimate beamlet displacement and deflection. Furthermore, alignment and scaling of images is discussed also with reference to background objects, to validate the analysis performed. At the optimum of beam optics, the two dimensional analysis of the beam shape is carried out, to verify the Gaussian shape of the beamlets in both dimensions. The position of the beamlet peaks is studied along beam propagation direction when the beam optics is optimized, to estimate the residual vertical deflection as a function of the beamlet current and source parameters. Experimental data are exploited to perform systematic analysis of correlation between images, other source measurements and simple beam simulation is also attempted. Moreover, beamlet convergence was sometimes observed, and corresponding datasets were tagged for optics correction. Finally beam size information useful for Faraday cup design is obtained.

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