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ASTERICS ion beam extraction : system optimization by simulation

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As part of the NEWGAIN project [1], the ECR ion source ASTERICS aiming at delivering a continuous beam of 10 pμA U34+ is under development [2]. This work reports the parametric simulation study of ASTERIC's ion extraction triode system using the IBSimu C++ library [3], focusing on an argon (Ar) beam.
The simulations assessed the impact of hot electron temperature escaping the plasma on the space charge compensation factor and its subsequent effect on beam emittance. A detailed exploration of the electrodes potential parameter space was carried out by varying the electrode gaps to optimize the Ar12+ beam quality. The optimal conditions minimizing the beam emittance were found for a 50 mm gap, with a source potential of 20 kV and the electron repeller electrode set to -4 kV.
Furthermore, parametric studies were performed to investigate the influence of geometric parameters, such as the plasma electrode angle, width and radius of curvature. These studies, detailed in this work, indicate that variations in geometry significantly affect beam focusing and emittance.

[1] M. Moscatello et al., "NEWGAIN project at GANIL SPIRAL2:design of the new heavy ion injector for the superconducting LINAC", in Proc. 14th Int. Part. Accel. Conf. (IPAC'23), Venice, Italy, pp. 1747–1749, 2023. doi:doi/jacoW-ipac2023-tupa193/index.html
[2] T. Thuillier et al, 2024 J. Phys.: Conf. Ser. 2743 012059. doi:10.1088/1742-6596/2743/1/012059
[3] T. Kalvas, et al., "IBSIMU: A three-dimensional simulation software for charged particle optics", Rev. Sci. Instrum. 81, 02B703, (2010). Doi:10.1063/1.3258608

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