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Space-charge Effects in a Cryogenic Stopping Cell

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At the Low-Energy-Branch (LEB) of the Super-FRS at FAIR, projectile and fission fragments will be produced at relativistic energies, separated in-flight, range-bunched, slowed-down and thermalized in a cryogenic stopping cell filled with ultra-pure helium gas, featuring enhanced cleanliness and high extraction efficiencies. Thermalised ions are extracted out of the stopping cell using a combination of DC and RF electric fields and gas flow. A prototype CSC for the LEB has been successfully commissioned at the FRS Ion Catcher at GSI.

Ionization of He buffer gas atoms during thermalization of energetic ions creates a region of high space charge in the stopping cells. Space charge creation has an adverse effect on extraction efficiency and extraction time of stopping cells as the high amount of charge distorts the applied DC electric drag fields. Thus understanding of space charge effects is of greatest importance to make full use of the high yields at the future rare ion beam facilities like FAIR. For this purpose a detailed study of space charge effects in the CSC was performed using the ion optical simulation software SIMION. Experimental parameters such as ion beam Intensities, electric fields, buffer gas density, buffer gas temperature and spill structures used during the online experiments are used for this simulations and results shows excellent agreement with the experimental results. Comparison between simulated results and online data and its implication for the final CSC for the Low Energy Branch at FAIR will be presented.

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