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STOPPING EFFICIENCY SIMULATION OF CRYOGENIC GAS STOPPING CELL

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The mass is a fundamental property of an atom comprising all information on its constituents and their interactions. Thus, it carries information on the internal structure of the nucleus, reveal the quantum mechanical shell structure within complex nuclei and determine the energy available for nuclear transformations in radioactive decay processes. Mass measurements allow us to benchmark nuclear models and thus contribute to investigations of the nature of the strong interaction itself. With the aim of high-precision mass measurement (HPMM) of heavy and super heavy elements, a new experimental setup is being built in FLNR, Dubna. The setup consists of the following parts: target unit; gas-filled separator of complete fusion reaction products; cryogenic gas stopping cell (CGSC); a radio-frequency system for transporting and cooling a low-energy beam; and a multi-reflection time of flight mass spectrometer (MR-TOF MS). CGSC is responsible for the final slowing down and thermalizing the energy-bunched fragments produced and selected in the Gas Filled Separator. The thermalization is achieved in a volume filled with ultra-pure helium gas at cryogenic temperatures. After the thermalization, the fragments are extracted and transported with a radio frequency quadrupole (RFQ) to the MR-TOF MS. The stopping and thermalization of the incoming fusion-evaporation residuals (EVRs) is a key step in HPMM of the heaviest elements. Due to the typically low incoming ion rates and low particle integrals CGSC has to be as efficient as possible. The HPMM requires at least a few ions for a measurement any loss should be avoided. The kinetic energy of the incident EVR, the entrance window foil type and thickness as well as the buffer-gas type and density of the CGSC condition the stopping efficiency. Only the ions that are stopped within the active gas volume of the CGSC can be extracted. The stopping efficiencies for EVRs cannot be tested on-line and one have to rely on simulations. To use the CGSC on ion beam the optimal entrance window foil thickness for every reaction is necessary evaluate. The Geant4 and SRIM software packages was used in these simulations with different entrance window materials and beam and target combinations.

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