The ion-funnel-to-IVAC system for chemistry experiments with radionuclides having half-lives in the sub-second regime

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The chemical characterization of superheavy elements (SHEs, $Z \geq 104$) is limited by low production rates of aimed at nuclear reaction products (NRPs) and the low half-lives of the produced radioisotopes of said elements. A state-of-the-art approach, used for such studies, is gas adsorption (thermo)chromatography, which reaches its limit with radionuclides featuring half-lives of [1]. Thus, radioisotopes of SHEs with half-lives in the sub-second regime cannot be addressed with the currently available technique. A promising alternative is the transfer of the NRPs into an evacuated environment (molecular flow regime), which may allow for the characterization of more short-lived radionuclides well below one second ($t_{1/2} \leq 1$ s) [2]. However, the transfer of NRPs requires a suitable interface between the physical pre-separation and, e.g., an isothermal vacuum adsorption chromatography (IVAC) experiment.

Here, we present the development of a buffer gas cell (BGC), comprising a DC cage, an ion-funnel as well as a radio-frequency quadrupole, for the stopping and transfer of NRPs behind a gas-filled separator into vacuum. Preliminary results of chemical experiments with very short-lived radioisotopes of homologs of SHEs on fused silica surfaces are targeted as a benchmark for the suitability of IVAC for addressing even shortest lived SHEs beyond flerovium.

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[2] P. Steinegger et al., *J. Phys. Chem. C,* **2016,** 120, 7122-7132.