Developments towards ion cooler assisted AMS measurements of ^{90}Sr at CologneAMS

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Strontium-90 ($T_{1/2}$ = 28.90 a) is among the most prominent fission products produced with high yield in the nuclear fuel cycle and nuclear weapons tests. It is very mobile in the environment and due to its chemical similarities to calcium it easily accumulates in bones and teeth following ingestion or inhalation. However, ^{90}Sr is not only of environmental interest for its radiotoxicity, but also as a potential tracer.

Decay counting is the state-of-the-art method for ^{90}Sr. However, as ^{90}Sr is a pure low-energy β^--emitter, it is typically measured through the detection of its daughter nuclide ^{90}Y in secular equilibrium, which is time-consuming as well as requiring thorough chemical separation. The main challenge for the detection by mass spectrometry is the interference of isobars, i.e., ^{90}Zr and ^{90}Y. Hence, the practical detection limit (LoD) of mass spectrometric methods, e.g., ICP-MS, RIMS, conventional AMS, is either above or close to the radiometric LoD of 3 mBq [1].

The Ion-Laser InterAction Mass Spectrometry (ILIAMS) system at the Vienna Environmental Research Accelerator (VERA) is capable of near complete isobar suppression via element-selective laser photodetachment in a gas-filled radiofrequency (RFQ) ion cooler [2]. The technique exploits differences in detachment energies between the isotope of interest and isobars, thus, neutralizing the isobars while leaving the isotope of interest unaffected. Chemical reactions with a buffer gas can cause additional suppression. In the case of ^{90}Sr, a suppression of ZrF_3^- vs. SrF_3^- of $>10^5$ can be achieved by admixing 3% of O_2 to the He buffer gas. With the ILIAMS system a LoD of <0.1 mBq for ^{90}Sr has been achieved by AMS [2].

In a collaboration between the University of Cologne and the University of Vienna, a new advanced ion cooler has been developed and built [3]. Performance tests of the new ion cooler have been conducted at a dedicated test bench in Vienna. Currently, around 30% of transmission through the ion cooler has been achieved. Ion residence time measurements have been performed to show that the new hybrid guiding electrode structure of the ion cooler is working as intended. Finally, a fast and simple chemical preparation for large sample sizes is under investigation. This new ion cooler will be part of the Anion Laser Isobar Separator (ALIS), a new low-energy isobar suppression system at the 6 MV accelerator of CologneAMS. Its suitability for high sample throughput for ^{90}Sr will be tested and optimized.

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