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(G*) Accelerator Mass Spectrometry measurements of chlorine-36 using the Isobar Separator for Anions

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Accelerator Mass Spectrometry (AMS) provides high sensitivity measurements (typically at or below 1 part in 10^{12}) for rare, long-lived radioisotopes. These high sensitivities are achieved when isobars, elements with the same atomic weight as the isotope of interest, are eliminated. AMS laboratories use established techniques to suppress interfering isobars of some light isotopes. However, smaller, low energy (≤ 3 MV) AMS systems are unable to separate abundant isobars of many isotopes. Larger accelerators are still unable to separate the interfering isobars of some heavier isotopes.

The Isobar Separator for Anions (ISA) is a radiofrequency quadrupole (RFQ) reaction cell that provides selective isobar suppression in the low energy system of the accelerator beamline. The ISA accepts a 20-35 keV mass analyzed beam from the ion source and reduces the energy to a level that the reaction cell can accept, using a DC deceleration cone. The reaction cell is filled with an inert cooling gas, to further lower the ion energy, and a reaction gas to preferentially react with the interfering isobar. RFQ segments along the length of the cell create a potential well which confines the traversing ions. DC offset voltages on these segments maintain a controlled ion velocity through the cell. The beam is then reaccelerated before exiting the ISA chamber. The ISA has been integrated into a second injection line of the 3 MV tandem accelerator at the A. E. Lalonde AMS Laboratory, University of Ottawa.

The ISA-AMS system has facilitated the measurement of chlorine-36, which is typically not achievable by smaller accelerators due to the interference of its abundant isobar, sulfur-36. The cooling gas has been experimentally selected based on chlorine beam transmission through the ISA. Using nitrogen dioxide as the reaction gas, seven orders of magnitude reduction of sulfur to chlorine has been observed. A chlorine-36/chlorine abundance sensitivity of ~$1x10^{-14}$ was achieved by combining the sulfur suppression from the ISA and the degree of dE/dx separation in the detector offered by the 3MV-AMS system. The linearity and stability of the system have been tested over a range of chlorine-36/chlorine ratios using a diluted NIST chlorine-36 standard.

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