Isobars in AMS: how to stop them cold

R. Golser,[1] O. Forstner,[1] P. Andersson,[1] M. Martschini,[1] A. Priller,[1] and P. Steier[1]

[1] *University of Vienna, Faculty of Physics,*
Vienna Environmental Research Accelerator (VERA), Austria

Accelerator Mass Spectrometry (AMS) is the most sensitive method to measure long-lived isotopic species. Abundance sensitivities of a radioisotope relative to the stable isotope can routinely be measured as low as 10^{-15} if no stable isobar interferes. C–14 is a prominent example, where the stable isobar N–14 is suppressed in the ion source due to its atomic properties (carbon does form negative ions, nitrogen does not). Cl–36 is an example, where the stable isobar S–36 is usually separated in a gas–ionization detector due to the different energy loss in matter, i.e. due to the difference in nuclear charge. This method requires high energies of the order of 0.5 MeV per nucleon. However, chlorine and sulfur differ also in their negative–ion properties: the electron affinities (EAs) are 3.6 eV and 2.1 eV, respectively. A suitable laser can neutralize sulfur anions by electron detachment but leave chlorine anions unaffected, so they can then be accelerated. Because of the low cross section for photo–detachment of the order of 10^{-17} cm^2, an interaction time in the millisecond range is necessary for a continuous wave laser of a few watts. This can be realized by buffer–gas–cooling the negative ions to thermal energies with helium gas in a linear RF quadrupole guide (see e.g. [1]).

Our aim is to utilize laser photodetachment for AMS with VERA. We want to suppress interfering isobars almost fully from interesting radioisotopes already at the low energy side. This opens up the possibility of using molecular ions, where we expect that the EAs of a large number of radioisotopes change to values higher than the EA of the respective isobaric interference. For example, the negative molecular ions FeH^- and HfF_5^- would allow VERA to measure Fe–60 and Hf–182 by suppressing the interference from Ni–60 and W–182, respectively. So far, selective neutralization of buffer–gas–cooled molecular anions, whose vibrational and rotational degrees of freedom smear out the onset of photodetachment, is a promising idea. We are just at the edge of putting this idea into practice for AMS.

[1] Y. Liu *et al.*, Appl. Phys. Lett. **87** 113504 (2005).