Ion Laser Interaction AMS: Why poor gas gives pure beams

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Isobars, i.e. atomic or molecular ions of almost the same mass as the ion of interest, are *the* challenge in (Accelerator) Mass Spectrometry. Exploiting electronic properties of the isobaric anions at sub-eV kinetic energies is becoming a breakthrough for isobar suppression. Key of a new method implemented at the Vienna Environmental Research Accelerator (VERA) is the photo-detachment of the unwanted isobars in a linear, gas-filled radio-frequency quadrupole (gf-RFQ) by a suitable laser. Isobar suppression by more than ten orders of magnitude has been reached, e.g. for Cl-36 over S-36. The fundamental prerequisite is: the negative ions of interest must remain unaffected by the interaction. For laser light this is the case if their electron affinity is greater than the photon energy. The use of pure Helium as the stopping medium - another prerequisite for slow anions to pass the gf-RFQ unaffected - turned out not to be fundamentally important. In fact, we see in several cases that ion-molecule reactions with small "impurities" (a few percent) of Hydrogen or Oxygen in Helium gas can reduce unwanted isobaric molecules by orders of magnitude with little effect on the molecules of interest. This "reaction cell chemistry" is highly welcome, but needs to be better understood. So far, we get sufficient and reliable isobar suppression only in combination with laser-photodetachment.