Challenges in the development of compact AMS facilities

M. Suter,[1] H.-A. Synal,[1] M. Christl,[1] J. Lachner,[1] S. Maxeiner,[1]
A.M. Müller,[1] M. Seiler,[1] C. Vockenhuber,[1] and L. Wacker[1]

[1]*Laboratory of Ion Beam Physics, ETH Zürich, 8093 Zürich, Switzerland*

Looking at small AMS facilities, one might get the impression that these instruments are simply based on a reduction in size. But the physics is changing significantly when the energy is reduced from the MeV region to the 100 keV range. Therefore the lower energies require a careful optimization of the design of the various components. In particular, it is essential to consider all of the processes taking place in the stripper canal such as energy loss, energy and angular straggling and charge state yield as well as the destruction of molecules. In this context, a good understanding of the gas density distribution, as well as good pumping, is essential for minimizing the background. In the ion optics, the effects of energy and angular straggling have to be considered.

For isotopes that require particle identification due to the presence of isobaric background or m/q ambiguities, the detection systems must be individually optimized for the specific application. To this end, systematic studies are being performed at ETH to obtain reliable information on the limitations of various detection schemes, such as gas detectors, the absorber method and the degrader foil technique for finding the best solutions to provide performance that is competitive with larger instruments.

Based on examples, the physics will be discussed and procedures described for optimizing the lay–out of small AMS systems. Especially the potential of stripping with He gas will be discussed. Recent results from ETH developments directed towards radiocarbon instruments operating with final energies around 50 kV are shown. Also the potential of multi–isotope AMS facilities (^{10}Be, ^{26}Al, ^{41}Ca ^{129}I and Actinides) operated with accelerator voltages in the few hundred kV range will be discussed.