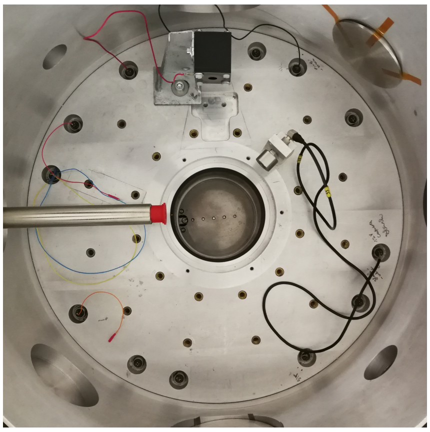
CologneAMS Newsletter

Projectile X-Ray AMS Tests for ^{90}Sr



Projectile X-ray AMS (PXAMS) is a useful method for isobar separation by the measurement of characteristic X-rays. We investigate the projectile X-ray production yield at energies of 2 MeV/amu for medium mass isotopes on heavy stopper materials, like Au or U. Accelerator mass spectrometry in combination with this separation technique can be an alternative detection method to liquid scintillator counting for isotopes like ^{90}Sr which are difficult to measure.

— Markus Schiffer

PXAMS tests for ^{90}Sr Measurement

Projectile X-ray AMS (PXAMS) is a well-known method for isobar separation by the measurement of characteristic X-rays. The discrimination of AMS nuclide and isobar suffers from low X-ray production yields and low geometric detection efficiencies, compared to the detection with particle detectors. New commercial Fast Silicon Drift Detectors (FSDD) with large active areas of 50 mm^2 and high energy resolution, ΔE=123 eV at 5.9 keV, allow nowadays a high detection efficiency.

We investigate the projectile X-ray production yield at energies of 2 MeV/amu for medium mass isotopes on heavy stopper materials, like Au or U. The discrimination of isobars is important for all accelerator mass spectrometry measurements and can be used for the determination of isotopic concentrations. This technique can be an alternative detection method to liquid scintillator counting for isotopes which are difficult to measure, like ^{90}Sr, which plays an important role for nuclear waste management.

In this kind of reaction we observed shifts in X-ray energies which are explained in the literature by molecular-like electron states for heavy ion collisions. This may become important for the understanding of background events generated by K_β, L_β and M_β lines.

The first tests have been performed with 100 MeV ion beam energies with different projectiles, ^{53}Cr, ^{55}Mn, ^{58}Fe and ^{58}Ni. The projectile rate was determined by rutherford scattering with a silicon detector at 45° degree with respect to the beam axis. The measurement were performed at the FN-Tandem Accelerator beamline "left 30°" with the modified Proton Induced X-ray Emission (PIXE) chamber [2].

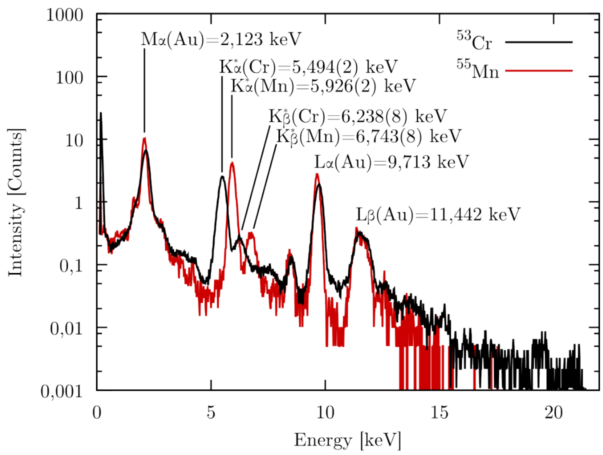


Figure 1: *First test of ^{53}Cr and ^{55}Mn projectile X-rays at 100 MeV ion energy, as example for the separation of the isobars ^{53}Cr and ^{53}Mn* [1].

The tests have shown good results and further measurements are scheduled to produce a stable Sr ion beam to investigate the X-Ray production yield for ^{90}Sr.

by MARKUS SCHIFFER

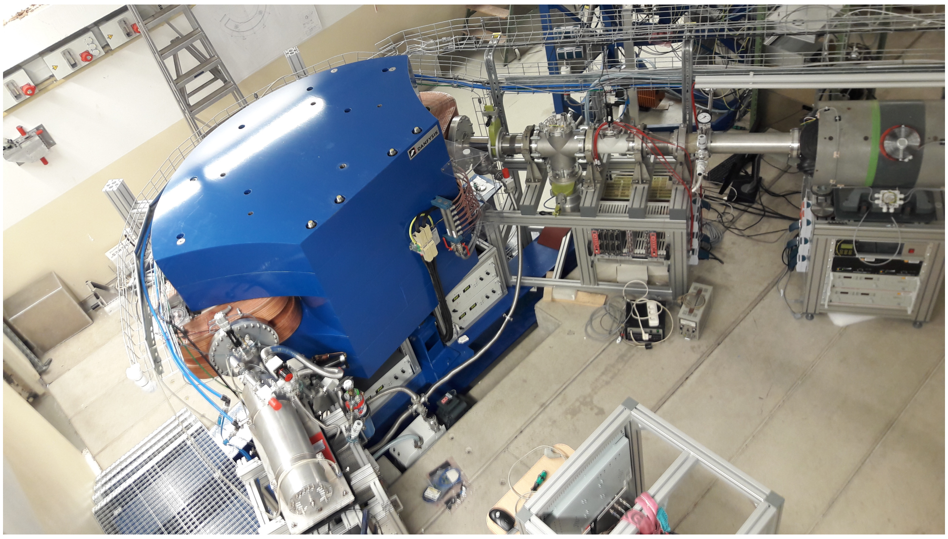


Figure 2: The new 135° gas-filled magnet at the Cologne FN-Tandem Accelerator.

First tests of the new 135° gas-filled magnet at the Cologne 10 MV AMS-System

The AMS-setup at the Cologne 10 MV FN-Tandem Accelerator is dedicated to measure isotopic ratios of medium mass nuclei [3]. After the first measurements of ^{53}Mn, measurements of ^{60}Fe and ^{63}Ni are possible with the new 135° gas-filled magnet. The isotope ^{60}Fe is of great importance for nuclear astrophysics and ^{63}Ni for nuclear waste management.

> “*We want to establish AMS as a new technique in the field of nuclear waste management.*”
>
> – Prof. Dr. Alfred Dewald

Test measurements of the new gas-filled magnet were performed with stable Fe and Ni beams to determine the transmission and the isobar separation. In order to avoid high energy loss in the entrance window of the magnet, the mylar-foil, which was used for the first tests, was replaced by a Si_3N_4 window.

In addition a new 5-anode gas-detector was positioned after the magnet [4]. A large 2 cm x 2 cm Si_3N_4 foil is used at the entrance and x-slits allow to reduce scattered particles.

Two different stable ion beams with 100 MeV, $^{58}Fe^{10+}$ and $^{58}Ni^{10+}$, were produced and measured downstream of the gas-filled magnet in the focal plane with a positionable silicon detector. The spacial separation of the isobars is sufficient to reach high suppression factors.

The future measurements will show important key roles for the measurement of rare nuclides:

1. isobar suppression
2. transmission
3. sensitivity
4. stability

These values are important for future AMS-measurements of ^{60}Fe where a huge amount of ^{60}Ni has to be suppressed and the system has to be stable for days of measurement time.

by Richard Spanier and Susan Herb

Next Newsletter

Neutron flux determination by ^{40}Ca(n,γ)^{41}Ca reaction in heavy concrete material.

References

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[3] M. Schiffer, R. Altenkirch, C. Müller-Gatermann, S. Herb, C. Feuerstein, G. Hackenberg, M. Marock, S. Heinze, A. Stolz, A. Dewald, *The first (^{53}Mn/^{55}Mn) isotopic ratio measurements at the Cologne FN-Tandem Accelerator*, Nucl. Instr. and Meth. B 437 (2018) 87-92.

[4] R. Altenkirch, C. Feuerstein, M. Schiffer, G. Hackenberg, C. Müller-Gatermann, A. Dewald, *Operating the 120° Dipol-Magnet at the CologneAMS in a gas-filled mode*, Nucl. Instr. and Meth. B 438 (2019) 184-188.