Accelerator Mass Spectroscopy with the ATLAS Superconducting Linear Accelerator: An Ultrasensitive Forensic Tool: Track Material to Source by Unique Isotopic Ratio Measurement Identify reprocessing Activity

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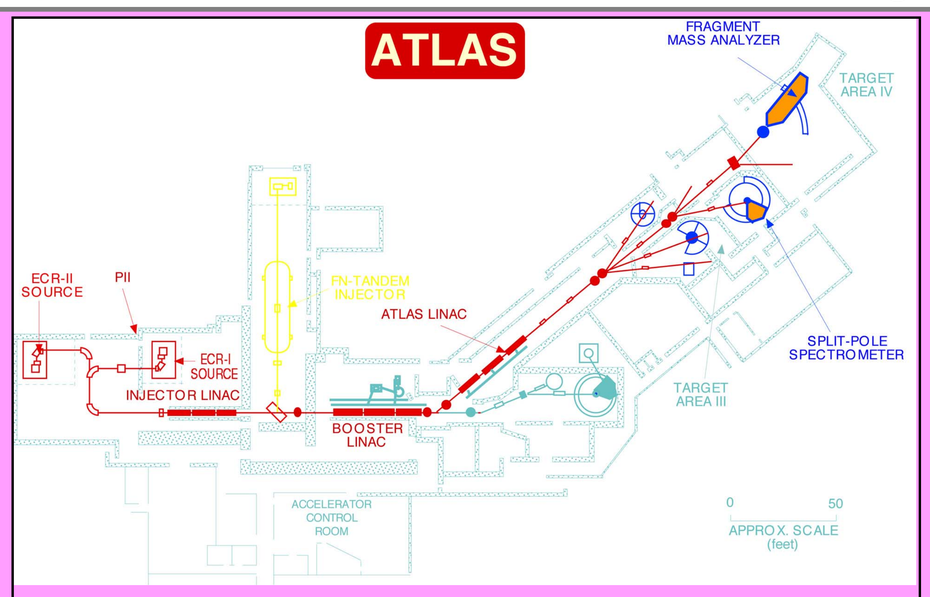
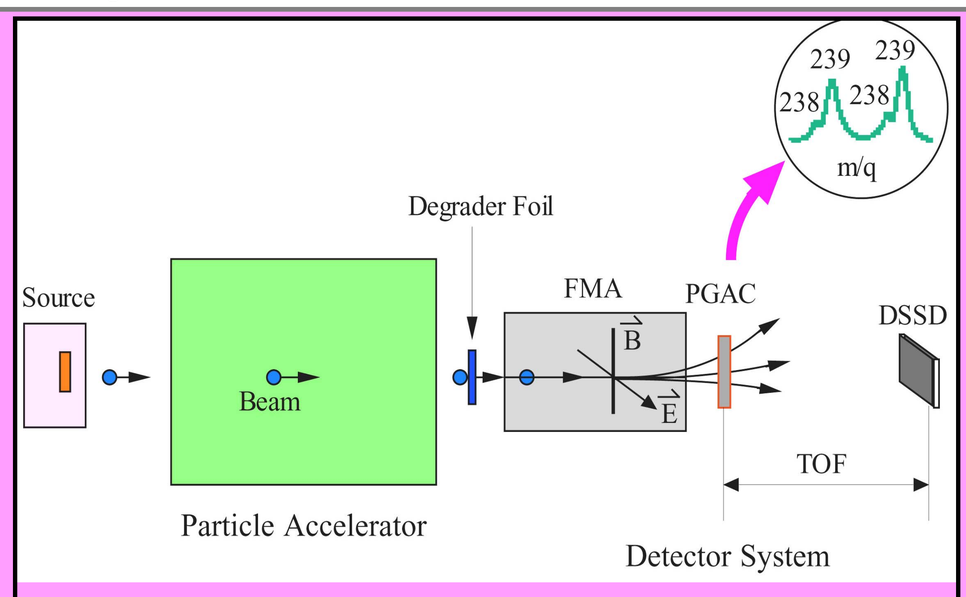


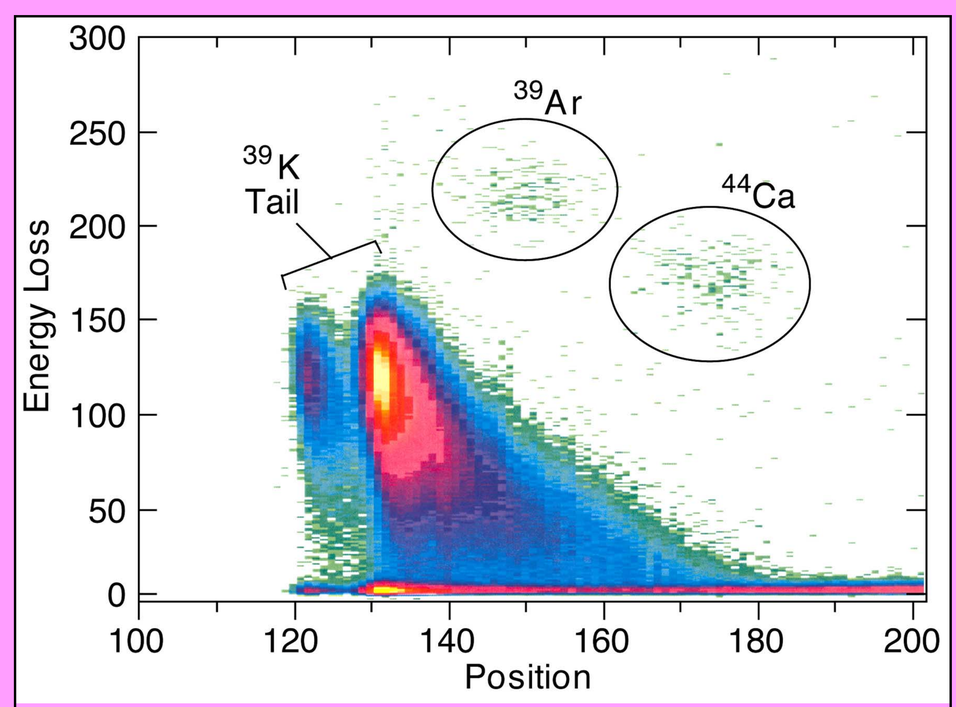
ATLAS Facility floor plan emphasizing the portions used in Accelerator Mass Spectroscopy Experiments



Schematic of AMS System as Used for Actinide Detection with Fragment Mass Analyzer

Features of Accelerator Mass Spectroscopy (AMS)

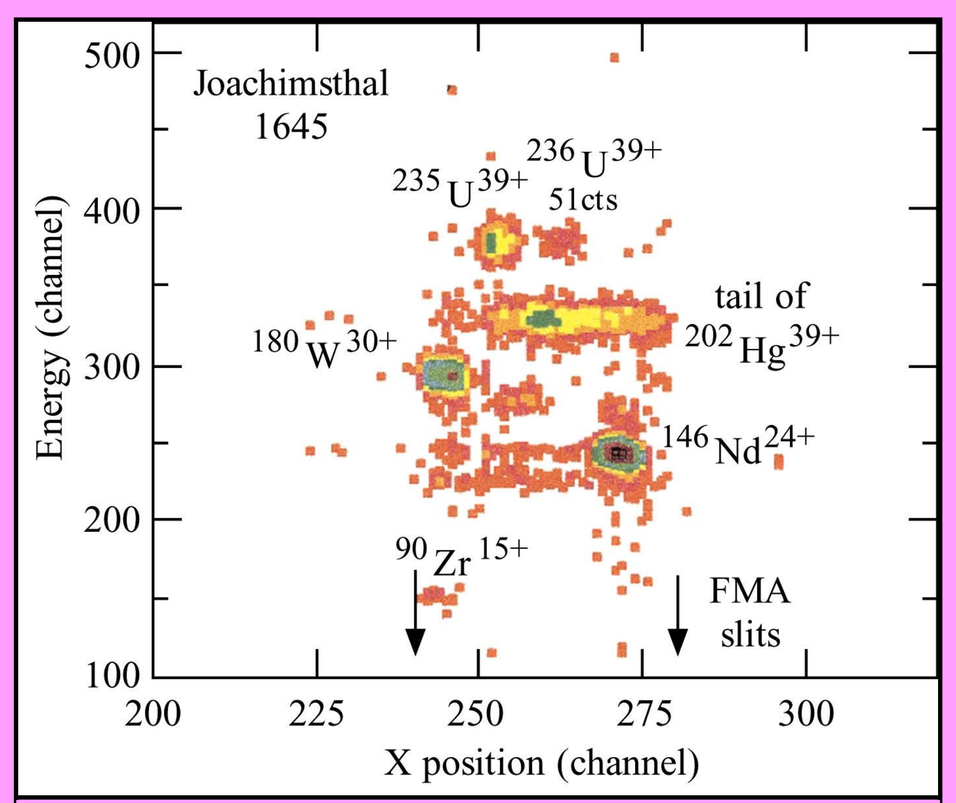
- Measure isotopic concentrations in small samples
  - Sample size: 1 to 10 mg
- Excellent isotopic and isobaric discrimination
  - Ultrahigh material sensitivity
  - Detectable concentrations as low as $5X10^{-17}$
- At ATLAS, AMS has been developed for the isotopes ^{3}He, ^{39}Ar, ^{41}Ca, ^{59}Ni, ^{60}Fe, ^{236}U and ^{244}Pu.
- Development of ^{85}Kr AMS is planned for the near future. ^{85}Kr AMS may be used to identify nuclear reprocessing activity.
- The technique is also suitable for detection of ultra-small quantities of actinide elements, that are by-products of nuclear weapons production and power industries.
- Actinide AMS may help identify the source of confiscated materials by comparing isotopic ratios in samples.



Position vs Energy Loss Spectrum in gas-filled magnettic spectrometer detector showing unique identification of ^{39}Ar from dominant ^{39}K stable background.

Radioisotopes for which AMS has been developed or is being developed at ATLAS

Isotope	$t_{1/2}$ (yr)	Isotopic Abundance Detection Limit
^{39}Ar	2.68×10^{2}	5×10^{-17}
^{41}Ca	1.04×10^{5}	1.0×10^{-15}
^{59}Ni	9.2×10^{4}	1.0×10^{-13}
^{60}Fe	1.50×10^{6}	1.0×10^{-13}
^{85}Kr	10.8×10^{1}	Under Development
^{236}U	2.3×10^{7}	1.0×10^{-12}
^{244}Pu	8.1×10^{7}	10^{8} total atoms



Identification of ^{236}U in focal plane detector of the ATLAS Fragment Mass Analyzer. Spectrum of Position (M/Q) vs Energy in Focal Plane Detector.