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Atom Counting with Accelerator Mass Spectrometry

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ABSTRACT

Accelerator mass spectrometry (AMS) was born in the late 1970s when it was realized at nuclear physics laboratories that the accelerator systems can be used as a sensitive mass spectrometer to measure ultra-low traces of long-lived radioisotopes. It soon became possible to measure radioisotope-to-stable isotope ratios in the range from 10^{-12} to 10^{-16} by counting the radioisotope ions "atom by atom" and comparing the count rate with ion currents of stable isotopes (1.6 μA = 1×10^{13} singly-charged ions/sec). It turned out that electrostatic tandem accelerators are best suited for this, and there are now world-wide about 160 AMS facilities based on this principle. The current review will present the history, technological developments and research areas of AMS through the 45 years since its discovery. Many different fields are touched by AMS measurements, including (alphabetically) archaeology, astrophysics, atmospheric science, biology, climatology, cosmic-ray physics, environmental physics, forensic science, glaciology, geophormology, hydrology, ice core research, meteoritics, nuclear physics, oceanography, particle physics - and more. Since it is virtually impossible to discuss all fields in detail in this review, only some specific fields with recent

advances will be highlighted in more detail. For the others, an effort has been made to provide relevant references for in-depth studies of the respective fields.

CONTENTS