Accelerator mass spectrometry - from DNA to astrophysics

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Direct atom counting with Accelerator Mass Spectrometry (AMS) revolutionized the utilization of long-lived radionuclides, which previously had to be detected through their feeble radioactive decay. This brought about a reduction in sample size by factors of thousand to a million (g to mg to μg), opening up many new applications.

With AMS one usually measures ratios of the rare radionuclide to a stable nuclide in the range from 10^{-12} to 10^{-16} with mass spectrometric techniques including an accelerator. It turned out that tandem accelerators have many advantages for such measurements, and consequently almost all AMS facilities around the world ($\sim$100) are based on this type of accelerator. Although ^{14}C comprise about 90% of all AMS measurements, nearly 50 different radionuclides across the nuclear chart - both natural and man-made – are by now being utilized by AMS. This led to a wide variety of AMS applications in almost every domain of our environment at large.

In this presentation, an overview of AMS application will be attempted touching briefly on the many fields of research where AMS has made an impact. These include (in alphabetical order) anthropology, archaeology, astrophysics, atmospheric science, biomedicine, cosmic ray physics, environmental science, geophysics, glaciology, hydrology, nuclear physics, oceanography, paleoclimatology. A few non-standard applications of AMS such as the dating of DNA with the ^{14}C bomb peak to determine the birth of cells in humans, and the search for superheavy nuclides in nature will also be discussed.