NEW DETECTOR CONCEPTS FOR AMS

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We propose two new detector concepts that may be particularly well suited for AMS measurements with small accelerators: 1) a fully solid state ΔE-E detector for light ions utilizing ion-induced electron emission from foils, and 2) a time-of-flight (TOF) system based on a two-dimensional electronic chopper.

The Foil Detector

When a fast ion passes through a thin self-supporting foil, the yield of ion-induced electrons is a function of nuclear charge and velocity of the projectile, and is roughly proportional to the electronic stopping power dE/dx. Thus, particle identification is possible by measuring the number of electrons emitted with a multichannel plate and the projectile energy with a surface barrier detector. The use of a large number of foils (typically 10) greatly increases the detector efficiency and the resolving power.

The Electronic-Chopper TOF System

In a typical TOF measurement in AMS, the start detector is a multichannel plate measuring ion-induced electron emission from a thin foil. In the present system, a two-dimensional electronic chopper is used. This avoids limitations due to energy straggling and charge-state changes in a foil. However, one has to find other means to generate the start signal in a well-defined relation to the ion's position. By applying harmonic voltages $V_0 \sin \omega t$ and $V_0 \cos \omega t$ to x- and y-deflection plates, respectively, a monoenergetic ion beam describes a circle on the detector located at some distance from the deflection plates. Let the TOF measurement be started at $t = 0$, and let an ion enter the deflection plates at an arbitrary time $t = t_1$. It then hits the detector after its TOF at some point with polar coordinates (r, j) on the circle, where it generates the stop signal. The radius r depends on the ion energy, the angular position j depends on t_1, $j = \omega t_1$. To obtain the ion's TOF, t_1 has to be subtracted from the measured time difference and hence, j has to be known. The experimental design can be greatly simplified, if the j-position is detected by a delay-line that is matched to the chopper period $t = 1/\omega$ (delay time $td = 0$ for $j = 0$, $td = t$ for $j = 2p$). Thus, the measured time difference gives the ion's TOF without further correction. The particular advantages of this new spectrometer are very high duty cycle due to the continuous operation, and relatively low power requirements due to the harmonic excitation.

THE NEW HVEE MULTI-ELEMENT AMS-SYSTEM

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During the last two decades, AMS has become an important tool in mass spectrometry for long-lived radioisotope measurements. Besides ^{14}C, other elements such as ^{129}I are of growing interest for research fields where the higher sensitivity of the AMS method is used instead of conventional counting techniques. Nowadays isotopes like ^{10}Be, ^{14}C, ^{26}Al and ^{129}I can be measured with "small"