Fragment tracking with Si microstrip detectors*

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The performance of a new set-up of double-sided silicon micro-strip detectors (DSSD) developed for the R3B project [1] has been investigated in a production run aimed at measuring two-proton fragmentation of ^{20}Mg and ^{17}Ne [2].

To record simultaneously protons and the residual nuclei in micro-strip detectors requires both low-noise and wide-range integrated-circuit amplifiers. The present front-end electronics [3] uses VA64_hdr9 chips from IDE AS, Norway. The serialized differential linear output signals are fed into newly developed NIM modules (SIDEREM [4]) that digitize the signals, perform pedestal and common-noise subtraction and send the data via the GSI serial data bus (GTB) to a universal VME interface (SAM5) for integration into the standard GSI data-acquisition system, MBS.

Our experimental results show that both protons and heavy ions can be identified with good signal-to-noise ratio and high resolution. In Fig. 1 we show the energy-deposition spectra of ions ranging from protons to Mg corrected for variations in the gain of the individual channels and in the charge-collection efficiency dependent on the inter-strip hit position. The correction is different for the junction (S) side and the ohmic (K) side.

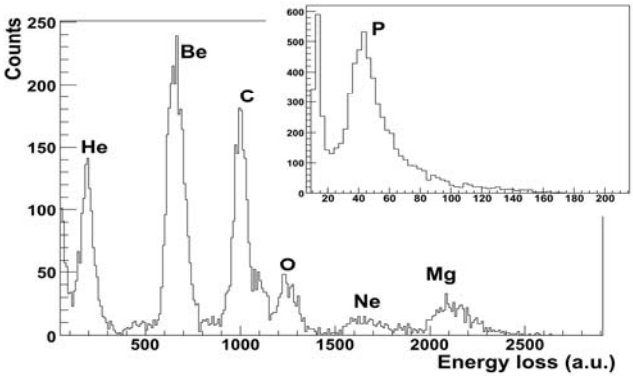

Figure 1: DSSD energy-loss spectrum, S-side. In the insert we show the proton spectrum detected in coincidence with ^{17}Ne fragments obtained from ^{20}Mg break-up.

Due to capacitive coupling between neighbouring strips the width of a hit cluster (defined as the number of adjacent strips showing a charge collection above 2σ of the noise level) depends on the total energy deposited in a cluster, i.e., on the atomic number *Z* of the ion. In Fig. 2 we plot the observed cluster widths as a function of *Z*. It is obvious that protons (which mostly fire a single strip) can be detected together with heavy ions only if they are well separated from the heavy-ion-peak centroid. The energy window for which the detectors show linear energy response is from minimum ionising particles up to 16 MeV for the K-side and 23 MeV for the S-side.

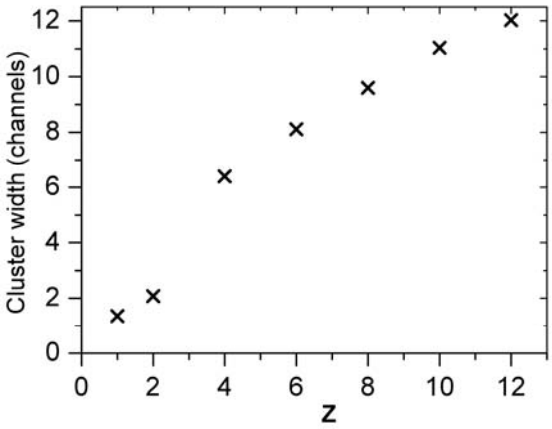

Figure 2: Cluster width as a function of Z.

The DSSD setup will be used in 2007 for astrophysical experiments (Coulomb breakup on Pb targets as time-reversed p-capture) and for quasi-free-scattering experiments on CH_2 targets. In the latter case, four detectors form a box around the beam axis covering an angular range of 15 to 75 degrees to detect protons from both target and projectile in (p,2p) reactions. This detection system serves as a prototype for the R3B recoil detector, which will be composed of a two-layer Si-strip tracker enabling the use of extended, thick liquid-H targets for quasi-free-scattering experiments with low-intensity radioactive beams.

References

[1] O.A. Kiselev *et al.*, GSI Scientific Report 2005, FAIR-NUSTAR-R3B-01.
[2] I. Mukha *et al.*, contribution to this report.
[3] http://dpnc.unige.ch/ams/GSItracker/www.
[4] J.Hoffmann *et al.*, contribution to this report.

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