Development of a Thin Large-Area Fiber Detector for Radioactive-Beam Experiments*

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The R^3B setup at FAIR will allow kinematically complete measurements in order to study various astrophysical and nuclear structure questions. For the identification of beamlike particles their mass number A is determined from the deflection of the beam in a magnetic field B which follows the relation $B\rho \propto A/Z$. To calculate the radius ρ of the trajectories in the magnetic field the position of the particles need to be measured at various positions. To achieve an adequate mass resolution a new fiber detector for tracking of heavy fragments has been designed and tested during several experiments.

The detector is built of 1024 scintillating optical fibers, each with a width of 250 μm plus 30 μm optical cladding. All individual fibers are read out separately. The needed 1024 electronic channels are realized by using four 16×16 multianode position sensitive photomultiplier tubes [1] and NXYTER (neutron-X-Y-time-energy read-out) chips [2]. The NXYTER is a self-triggered ASIC with 128 independent channels which buffer charge and time information for each hit in each fiber. It is included in the triggered R^3B-LAND setup by using Gemex front-end boards [3]. Two variants of Gemex were in use: original boards with a switched power supply and modified versions with linear regulators.
The noise level and baseline position of the NXYTER signals are highly temperature dependent. So, special attention to the cooling is required, especially if the detector is used in vacuum.

In the s415 experiment (Pb at 500 AMeV) one unmodified Gemex and a modified one were used in parallel. Example energy spectra of the signals produced by the beam are shown in Fig. 1. It can be seen that the modified variant provides under the given experimental conditions a much better energy resolution. Both versions can be used for tracking since the signals can be distinguished from the intrinsic noise of the detector. (Note: The ADC produces inverse spectra, i. e. the noise is supposed to be between channel 2000 and 2500, but in these cases it was cut via NXYTER slow control.)

During the s412 experiment (Sn at 300 to 600 AMeV) the detector was used with unmodified Gemex boards. Fig. 2 shows the position correlation between the new fiber detector and an old one being located around 2.7 m and 12 m after the center of the magnetic field, respectively. A clear correlation is visible. The gaps stem from a not working connector at one PMT.

For the future work the missing channels have to be recovered in order to get a complete spatial coverage. All Gemex boards will be modified to linear regulated power supply.

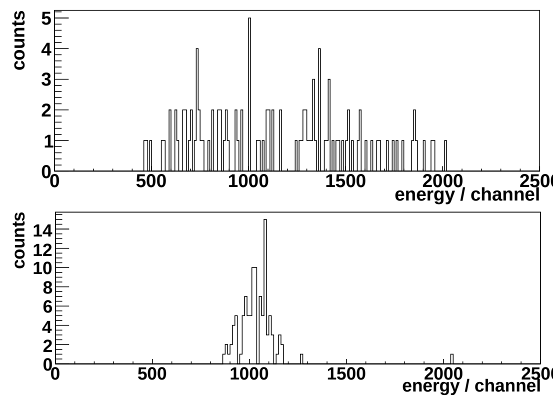

Figure 1: Shown are two examples of energy spectra. The upper and lower panel show one NXYTER channel from an unmodified and a modified Gemex board, respectively. Both spectra were recorded at the same time and stem from the same beam.

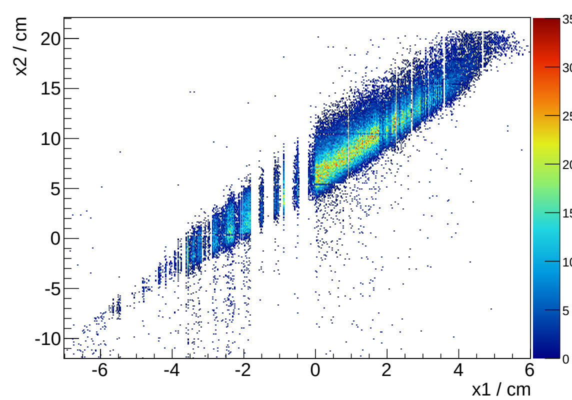

Figure 2: Position correlation of the new fiber detector (x1) and an other tracking detector (x2).

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References

[1] http://sales.hamamatsu.com/assets/pdf/parts_H/H9500.pdf
[2] A.S. Brogna et al., NIMA 568 (2006) 301
[3] B. Voss et al., GSI Scientific report 2011, p. 247