A Large Area Tilted Electrode Gas Ionisation Chamber (TEGIC) *

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The upcoming radioactive beam facilities with their significantly increased beam intensities require new concepts for faster detectors to identify secondary beams. We have developed a prototype Tilted Electrode Gas Ionisation-chamber (TEGIC) for heavy ions and tested it in beam at the Munich Tandem accelerator.

Precice energy loss measurement is still the most common method to identify the different elements in secondary beams produced by fragmentation reactions at high kinetic energies. Due to a significant radiation damage in solid state detectors by the heavy projectiles, gas detectors provide a robust alternative. Typically used so called MUlti Sampling Ioization Chambers (MUSIC) are limited in rate capability by the long drift path and shaping times needed. A promising concept to increase the counting rate capabilities of ionisation chambers is the tilted-electrode-gas-ionisation-chamber (TEGIC) [1]. A series of plane electrodes like in a Parallel Plate Counter (PPC) shortens the drift distance for electrons and ions to several millimeters. Theses electrodes are in addition tilted by 60° with respect to the beam axis to enhance this effect and disentangle the two drifting species in space.

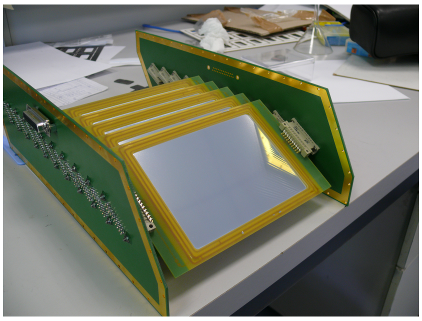

Figure 1: TEGIC foils mounted on the PCB frame.

Figure 1 shows a typical structure for a TEGIC - Detector. Thin (2 μm) Mylar foils stretched on standard PCB frames are mounted inside a gas tight housing. These foils are aluminized on both sides with a conductive layer of only 250 nm. These foils are connected alternating either to ground or high voltage to provide the drift field between anodes and cathodes. Every anode is read out individually by one channel of a charge sensitive preamplifier MPR16 (Mesytec) to measure the energy loss per segment, similar to the concept of a MUSIC. The prototype consists of 5 cathode/anode/cathode pairs. Figure 2 shows the detector operational at the beam line II/-10°. 2 μm thin beam entrance and exit windows limit the detector gas pressure to a 10 hPa range around atmospheric pressure.

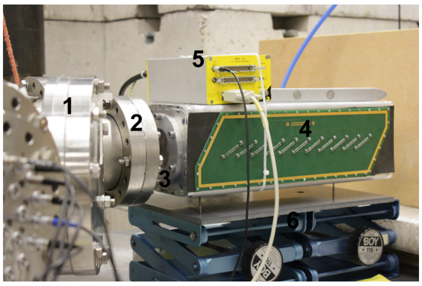

Figure 2: Setup: 1) vacuum chamber, 2) window flange with 50 μm Kapton window, 3) air gap (3 cm), 4) TEGIC detector, 5) pre-amplifier, 6) adjustable tables (from [2]).

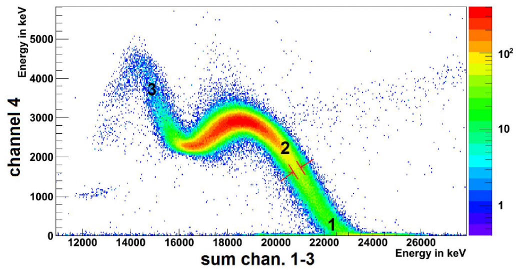

Figure 3: Energy measured in channel 4 where particles are stopped vs. the sum energy of channels 1-3 (from [2]).

A beam test was performed at the MLL Tandem-accelerator in Garching using a 40 MeV ^{7}Li and a 20 MeV proton beam (see fig. 2). A systematic study of the energy loss in different segments of the detector showed the typical Bragg curve for stopped particles. Although the particle energy was smeared by the 50 μm thick Kapton window at the beam exit we could deduce an upper limit for the average relative energy resolution per segment of about 3% from a detailed correlation analysis of subsequent channels (see fig. 3). Even at particle rates around 130 kHz the detector showed only a minor degradation in energy resolution which was still limited by the beam properties and not by the detector. After this successful test we will build a full size detector with an active area of 10 cm x 25 cm to be used at the Super Fragment Separator (SFRS) of the upcoming FAIR facility at Darmstadt.

REFERENCES

[1] K. Kimura et al., NIM **A 538** (2005), 608-614

[2] S. Maurus, Development of a TEGIC-Detector for Heavy Ions, BSc thesis, Technische Universität München (2012).

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