A Possible Dual-Lateral Upgrade to the FAUST Detector Array

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In the last several years advances in silicon strip technology and continuous position-sensitive detectors have allowed for more precise measurements of the emission angle of fragments from heavy-ion reactions. By achieving a greater understanding of the emission pattern of fragments from heavy-ion collisions, it is possible that the different modes of disassembly of excited nuclei can be differentiated [1]. Because of the success of FAUST due to its reconstruction capabilities it is a prime candidate for a move towards greater position sensitivity to allow for a greater understanding of multifragmentation reactions.

Micron Semiconductor, the manufacturer of the current FAUST silicon detectors, was contacted to discuss the possibility of creating a position-sensitive detector for FAUST. In looking at current technology and the design constraints of FAUST, a dual-axis lateral position-sensitive detector has been chosen to allow for the desired position sensitivity without sacrificing isotopic resolution [3, 4]. Micron Semiconductor has manufactured and delivered several prototypes that fit within the mechanical constraints of FAUST, however they have not met design specifications as of yet. These detectors have an area of 20mm x 20mm. There are two conductive strip contacts along opposite edges on each side of the detector. The contacts on the front side are perpendicular to those on the back side. The front of the first side prototype detector has a resistivity of 6.8 kΩ while the back side has 22 kΩ. Optimal resistivity on each side has yet to be determined. The active area is surrounded by guard rings on both the front and back side. When an incident particle hits the detector the charge is split between the contacts on each resistive layer. This allows for the total energy to be determined by the summation of either the contacts on the front side or the back side of the detector. The position of each axis can be easily determined using a conventional formula such as $X \propto (Q_1 - Q_2)/(Q_1 + Q_2)$, where Q is the charge collected from one contact.

In the past several months, the first proto-types have been tested. In Figure 1 we see the position reconstructed using the method above. The position resolution is quite clear giving the shape of the mask in front of the detector, however, there are problems concerning the edges of the detector near the conductive strips. Clearly shown on three sides of the detector there is concave bowing. This concave bowing should be corrected by applying voltage to the guard rings. Unfortunately, the guard rings on the first proto-type have been unable to accept voltage. Additionally, to achieve position resolution as in figure 1 the depletion voltage must be reached but a reduction in the energy resolution given by the peaks of a ^{228}Th alpha source occurs as you approach this value. Inconsistent position linearity has also occurred and the determination of position has been a function of bias applied, even if saturation of the semiconductor has been reached. This we believe has been due to the extremely high leakage currents which are on the order of 1.5μA per detector and can fluctuate independently of applied conditions.

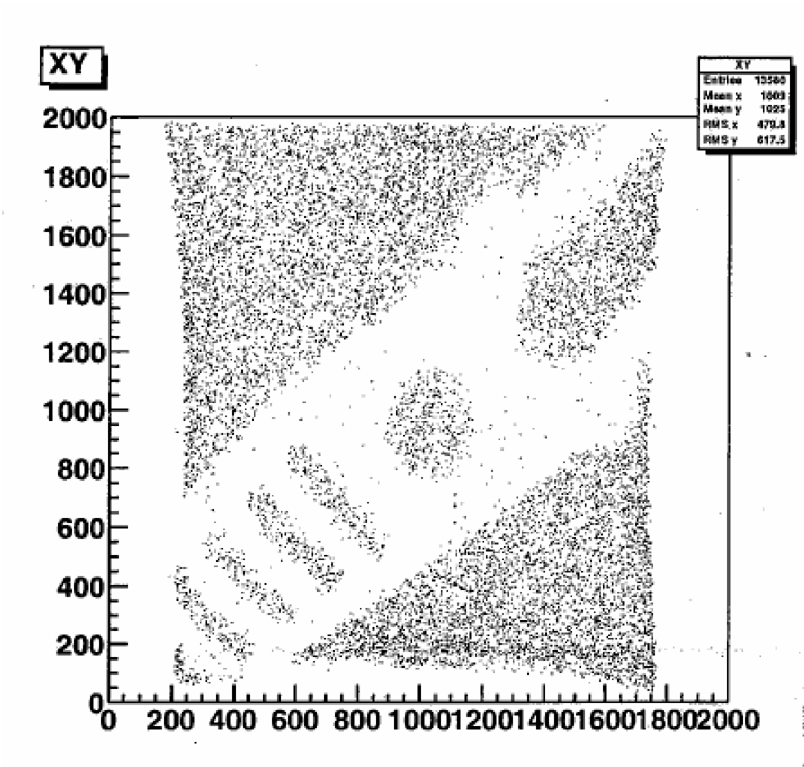

Figure 1. The x y position resolution of the first proto-type detector.

Micron semiconductor has pursued solutions to these problems and has delivered a second proto-type which has recently arrived. It is hopeful that this current proto-type meets our specifications and within the next year the series can be delivered in full.

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