Improved Position Calibration of the FAUST Array

Layla Bakhtiari, SJY group
Dr. Sherry Yennello
Cyclotron Institute, Texas A&M University

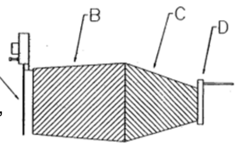
Purpose

To design a more effective electron shield for the array and a position calibrator for new Dual-Axis, Dual Lateral, (DADL) detectors. The current shielding design leaves the possibility for a particle to travel through multiple electron absorber foils, which may result in an inconsistent energy loss and possible particle misclassification.

What is FAUST?

MOTIVATION

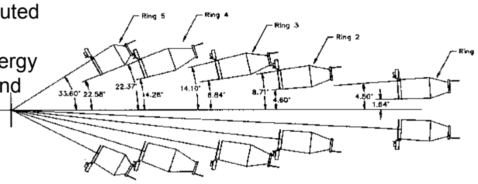
The Forward Array Using Silicon Technology, (FAUST), is a cluster of detectors used to detect charged particles originating from reactions of heavy nuclei. Study of such reactions constrains the Equation of State of nuclear matter, which in turn can give insight into the formation of atomic elements.



Schematic of an individual telescope: A) Silicon wafer, B) Cesium Iodide crystal C)Light Guide D)Photodiode

CONSTRUCTION

- 68 detector telescopes distributed amongst five rings
- Each telescope measures energy deposited in the Si detector and the CsI crystal
- 1.6̊ -33.6̊ effective detection range from Z axis

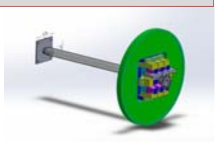


Gimero-Nogues *et al*., NIMA, 399, 1997

Electron Attenuation Tunnel

DESIGN

- 1.4 micron aluminized Mylar film tunnel along Z axis
- 2 part assembly: aluminum support cuffs to hold the tube form and an insertion rod to install the tube while the array is fully assembled.

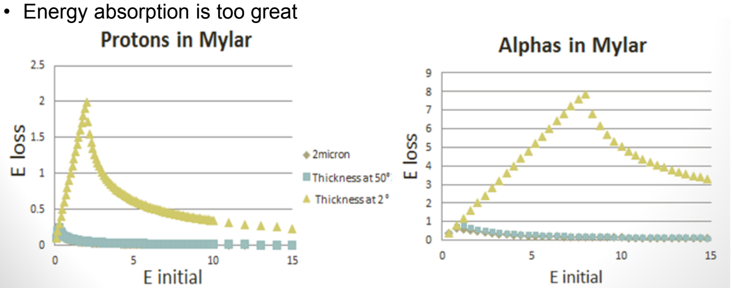


Effective Mylar thickness experienced by particles that hit a detector varies greatly for different trajectory angles

t=thickness e=effective thickness

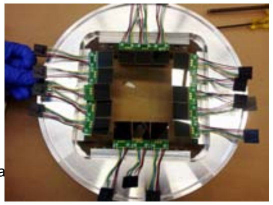
SRIM

- Calculates energy loss of particles through mediums
- Energy absorption is too great



Dual-Axis, Dual-Lateral (DADL)

One of the planned upgrades for FAUST is the replacement of the silicon wafers with Dual-Axis, Dual-Lateral resistive silicon detectors. These DADL detectors will provide better angular resolution and be used to study asymmetry energy through the correlation functions of particles produced in a reaction.



- Equipotential, Equiresistive surface
- 6 signals per detector: Left, Right, Top, Bottom, and 2 Guard rings
- allows observation of the precise position of an event on a detector

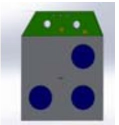
S. Soisson et al., NIMA, 613, 2010

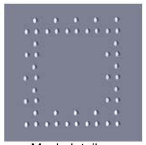
Position Calibration Mask

DESIGN

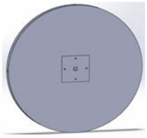
In the pattern design, two holes were placed equidistant from the corner of the detectors. A third hole was placed to break the symmetry, and thus indicate the presence of a rotation, if any.

- .025 cm thick Tantalum construction
- very dense, yet reasonably machinable; blocks particles at very thin thicknesses

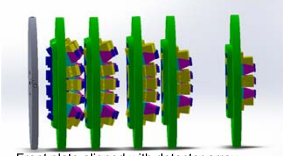




Mask detail



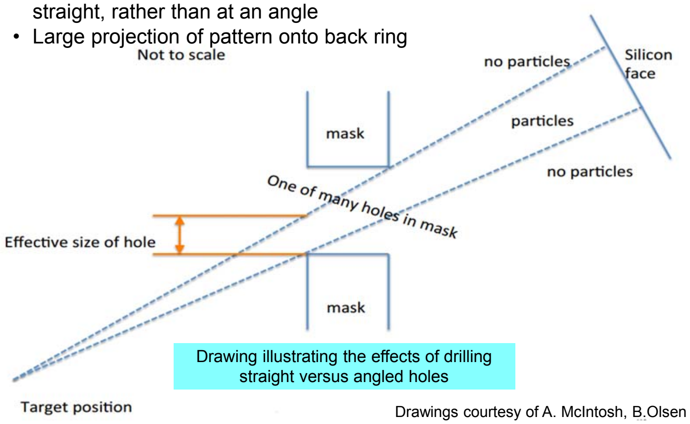
Mask mounted to front plate



Front plate aligned with detector array

CHALLENGES

- Machining capabilities: very small (#80 drill bit) on dense metal constrains holes to be drilled straight, rather than at an angle
- Large projection of pattern onto back ring

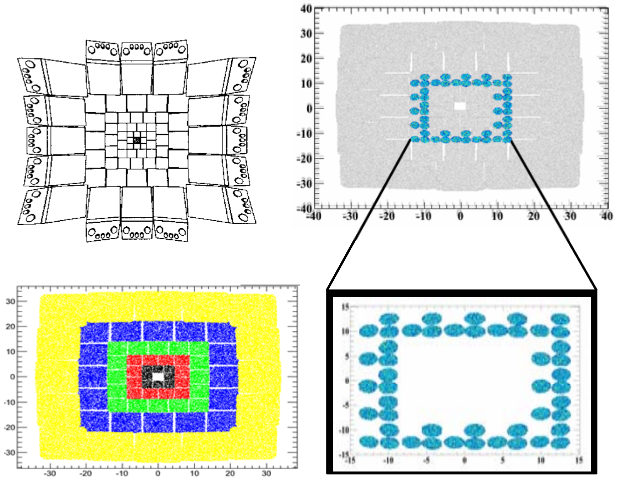


Drawing illustrating the effects of drilling straight versus angled holes

Drawings courtesy of A. McIntosh, B.Olsen

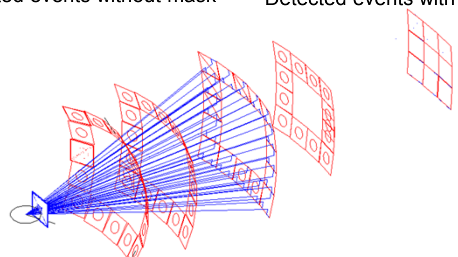
Simulation

A Monte Carlo simulation was written to predict events registered in the detectors with and without the mask in place. This run predicts that the mask should be effective for rings C-E, and questionable for rings A, and B. The elliptical distortion of the hole projections is due to the 2 dimensional nature of the simulation, which neglects the detectors' tilt in the Z axis.



Detected events without mask

Detected events with Mask



Monte Carlo pictures courtesy of A. McIntosh, P. Cammarata, M. Youngs

Future Work

- In beam Test Sept. 2 to assess viability of method
- Create mask encompassing all detectors in the array

Acknowledgements

Special thanks to Dr. Sherry Yennello and the SJY group members for their continued support, as well as Bob Olsen for his assistance with AutoCAD and the original Faust drawings.

This work is supported by grants from: the US Department Of Energy (Grant DEFG03-93ER-40773) and by the National Science Foundation (REU Grant No. PHY 1004780)