Comparative Response Study Of 3mm and 5mm Thick Scintillators and Alignment Tolerance Study

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- PRad Collaboration meeting
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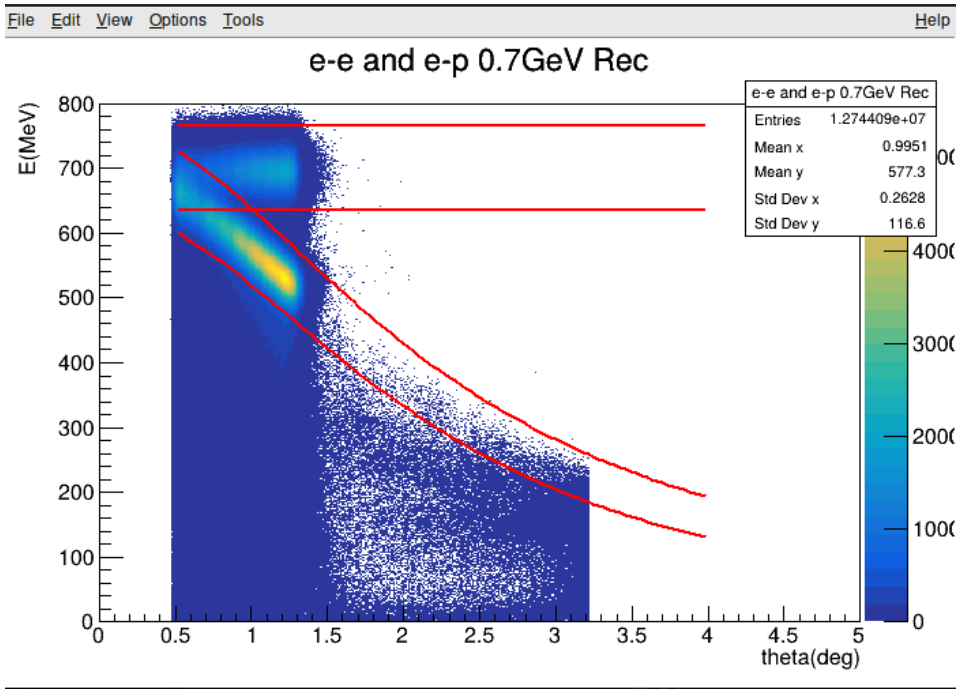
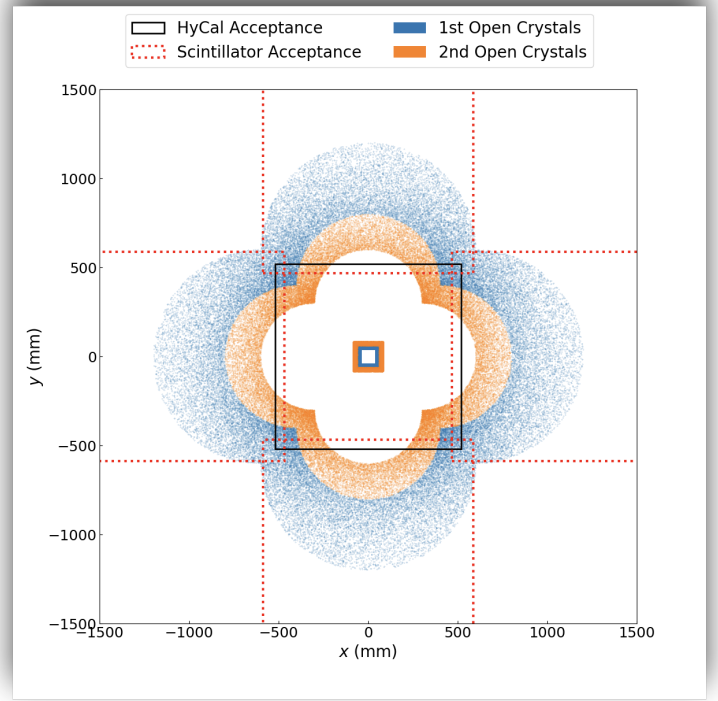
Outline

- Introduction
- Setup for the comparative Response Study of 3mm and 5mm Scintillators
- Alignment Tolerance Study Of Veto Scintillators
- Current Status
- Summary

Introduction: Why Veto Scintillators essential?

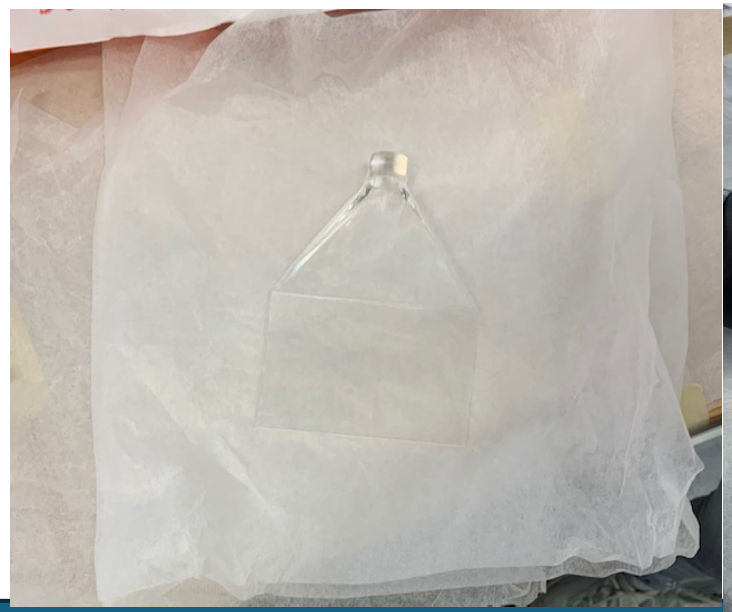
- PRad II aims to reach an unprecedented low Q^2 (~10^{-5} GeV^2)
- Lower Q^2 corresponds to lower scattering angles (~0.5°–0.8°).
- Hycal alone cannot reliably separate elastic ep events from Moller background.
- The Veto Scintillators enable clean separation of ee and ep events at low angles

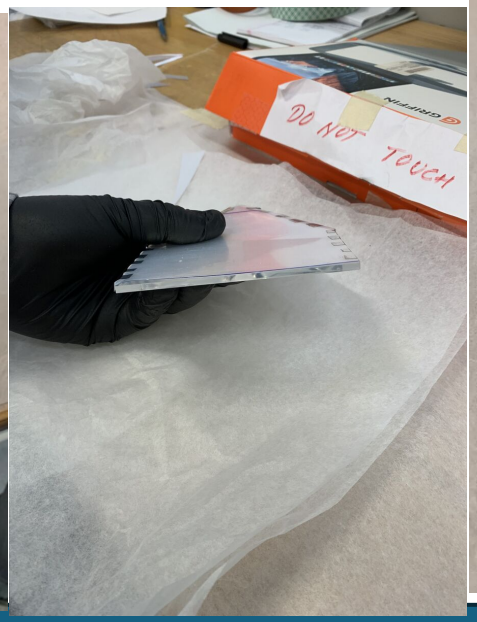




Hardware Setup for Comparative Response Study of 3mm and 5mm thick Scintillators (Work Done With Youri Sharabian)

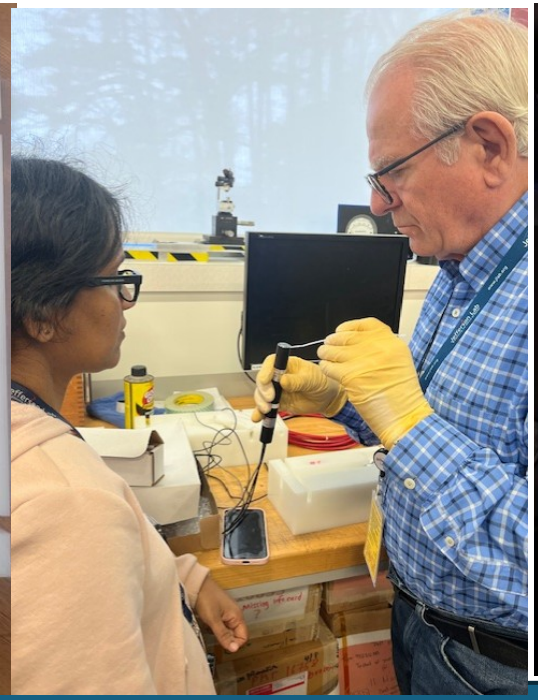
- Used 100mm × 65mm × 3mm and 100mm × 65mm × 5mm Scintillators
- Attached with matching light guides using uv-activated glue
- Wrapped the assembly with reflecting material

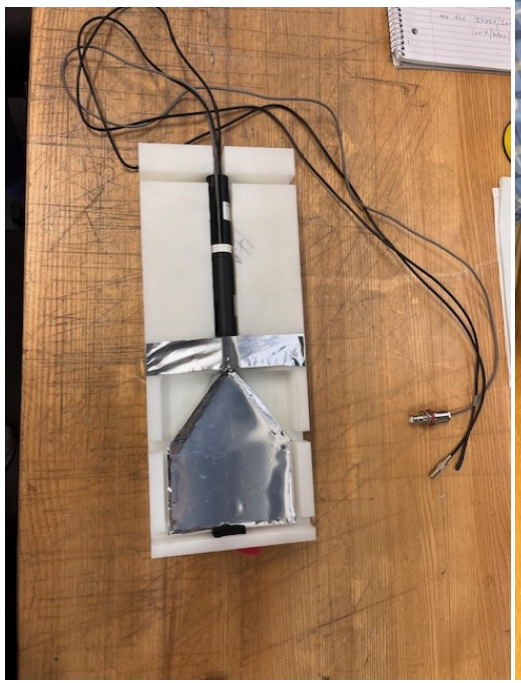




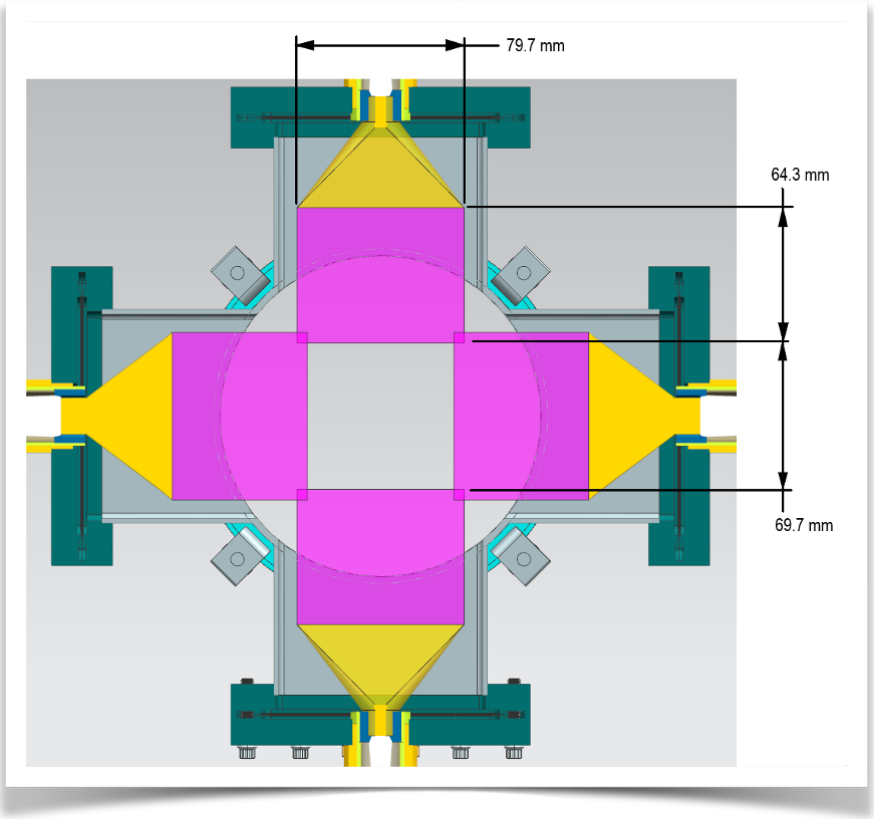
Final Setup For Cosmic Testing

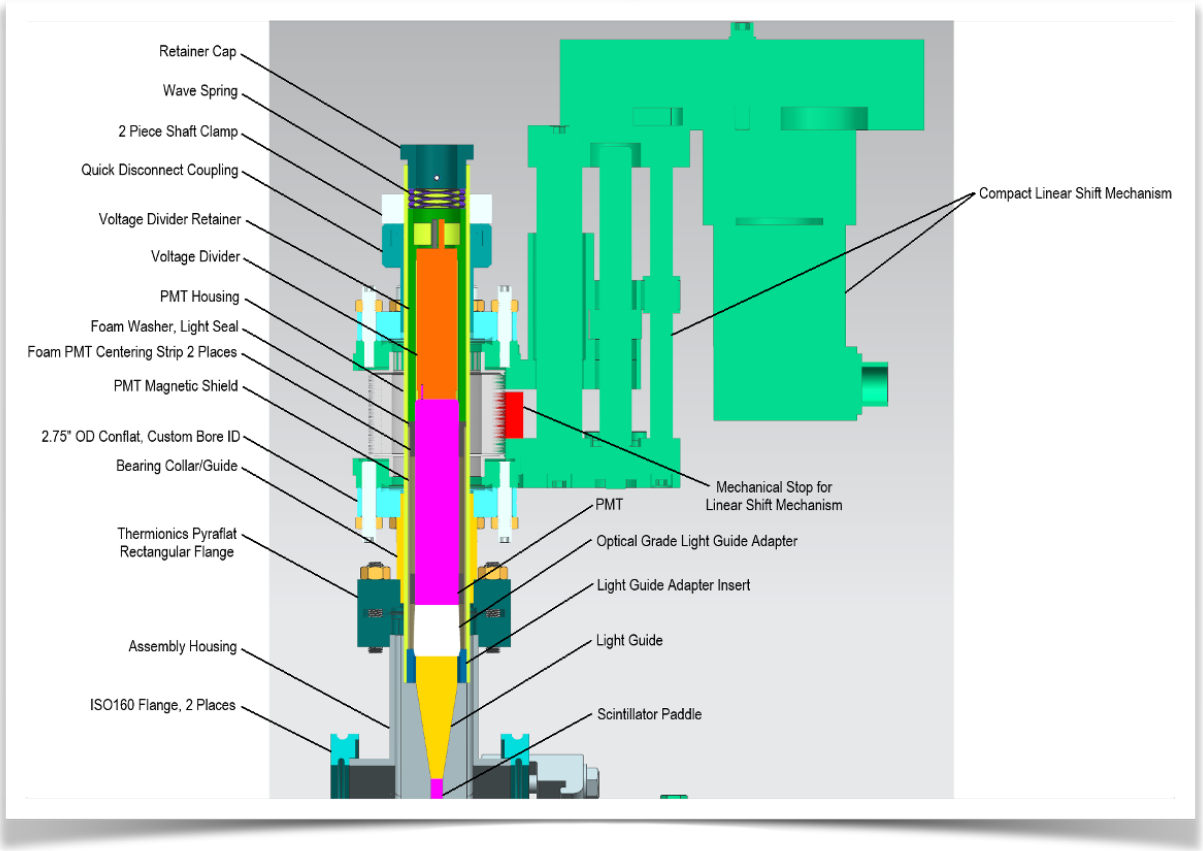
- Designed a Holder to fix the scintillator, light guide, PMT and divider
- Applied optical grease between light guide and PMT
- Placed both assemblies inside a black box
- DAQ System Setup is Currently in Progress





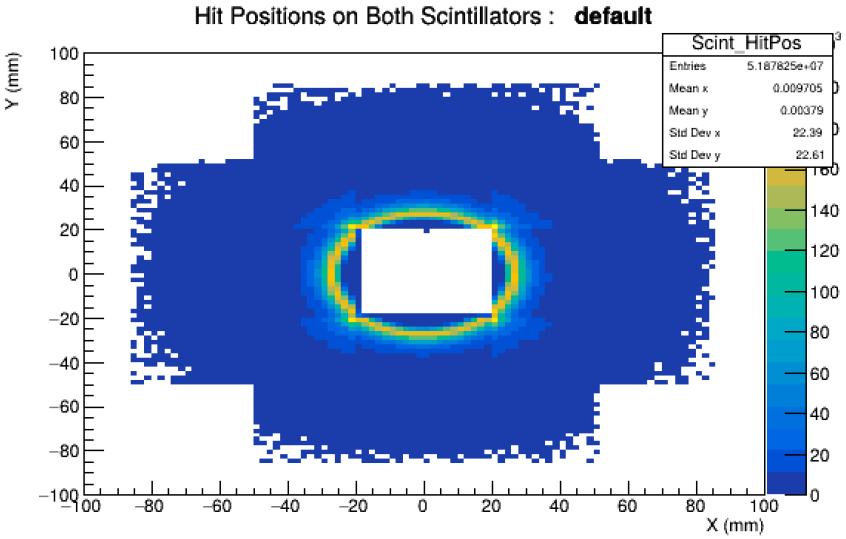
Based on Youri Sharabian's concept a Scintillator Tagger setup has been designed by Chris Guthrie

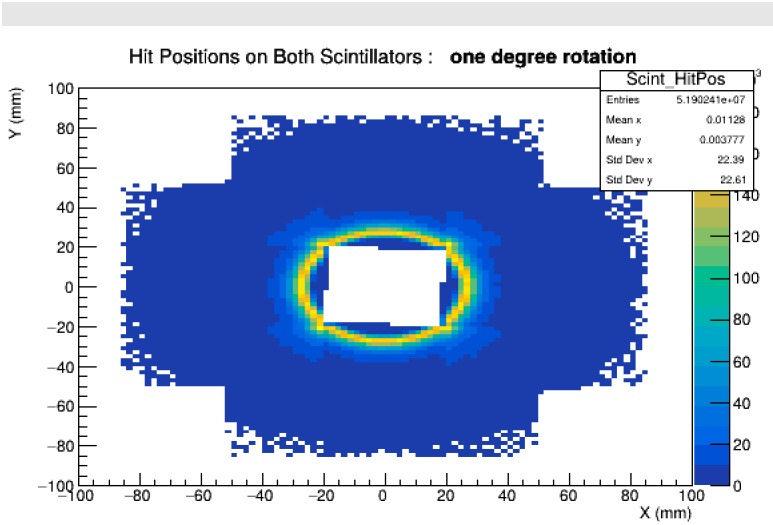


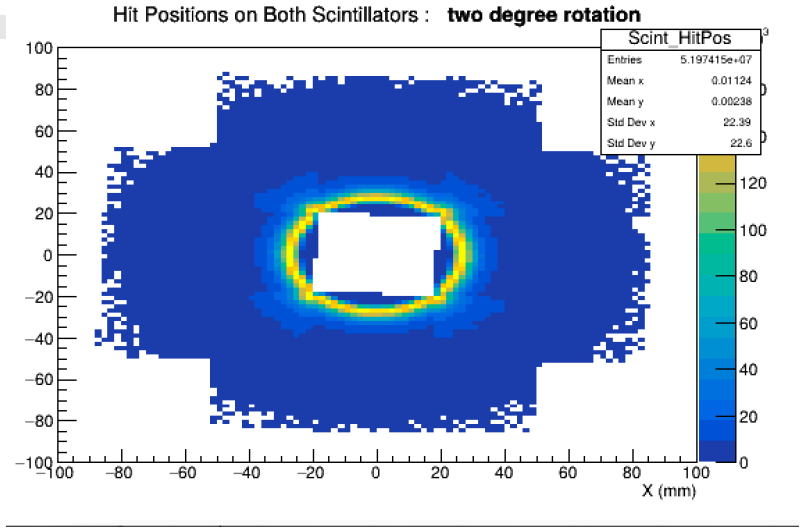


Veto scintillators Alignment Tolerance Study

- Rotated all 4 scintillators through 1 degree and 2 degree about the Z axis.
- Plotted Hit Positions On the Scintillators for Default, 1 degree and 2 degree rotation

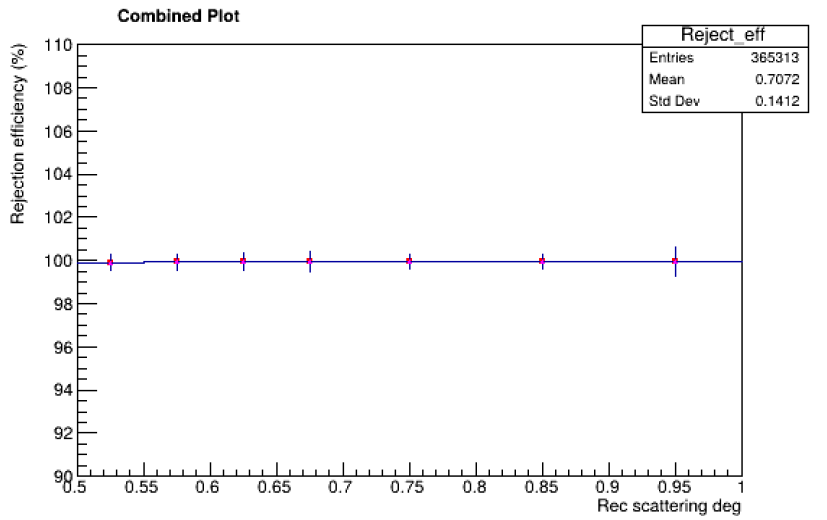


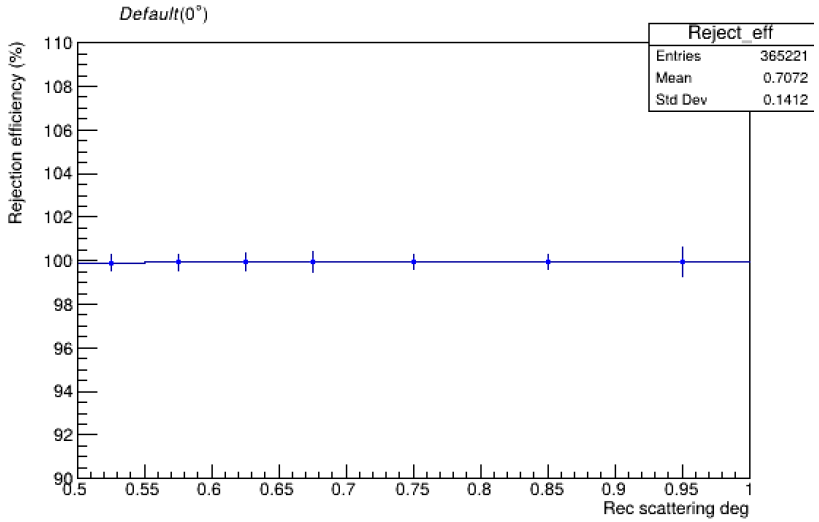


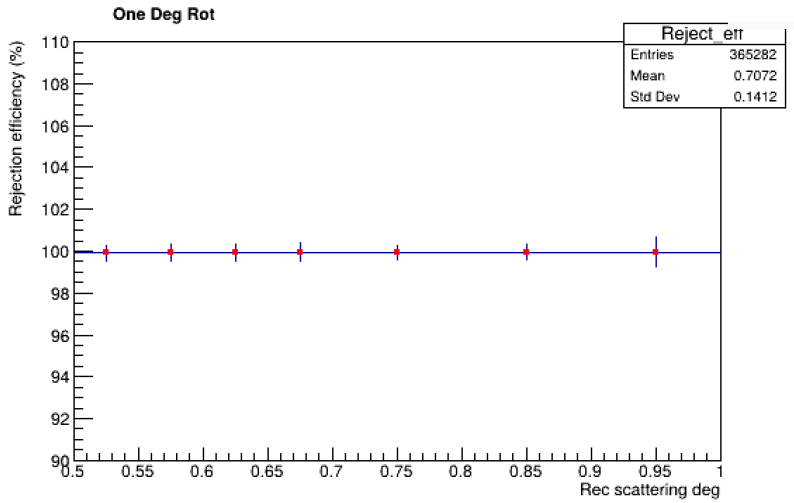


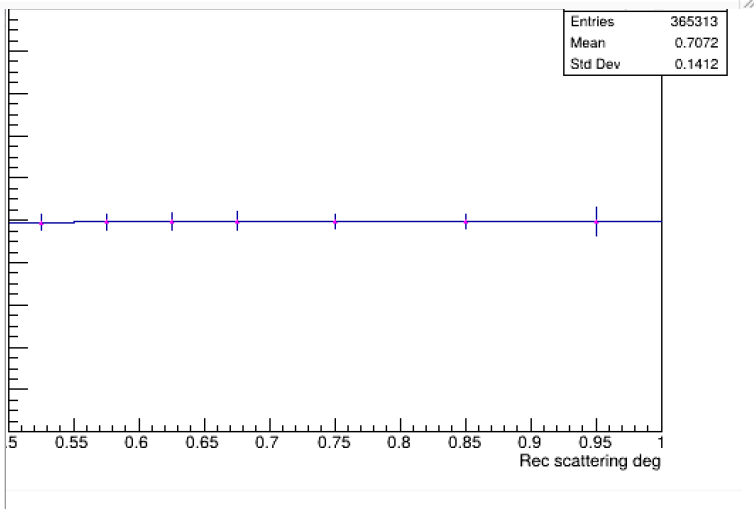
Rejection efficiency Comparison for three different configurations of the scintillators

$$\text{Rejection Efficiency} = \left(1 - \frac{\left(\frac{ee}{ep}\right)_{\text{after veto}}}{\left(\frac{ee}{ep}\right)_{\text{before veto}}}\right) \times 100$$

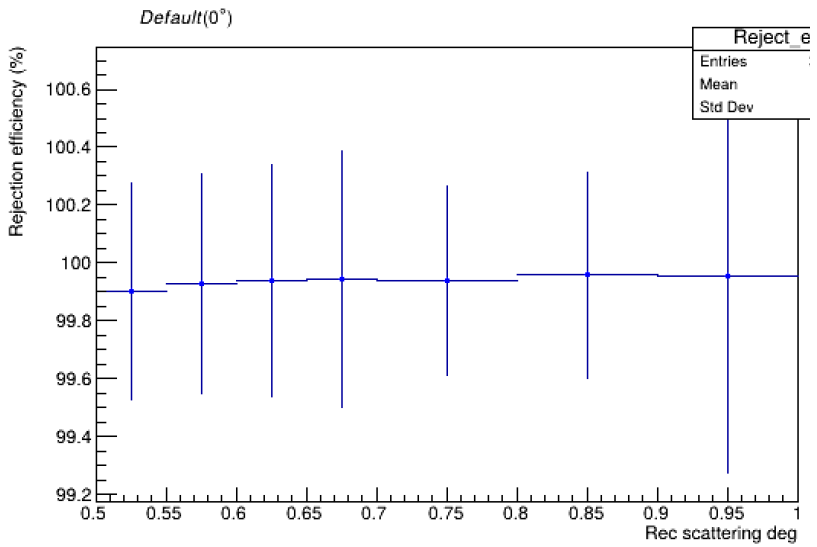


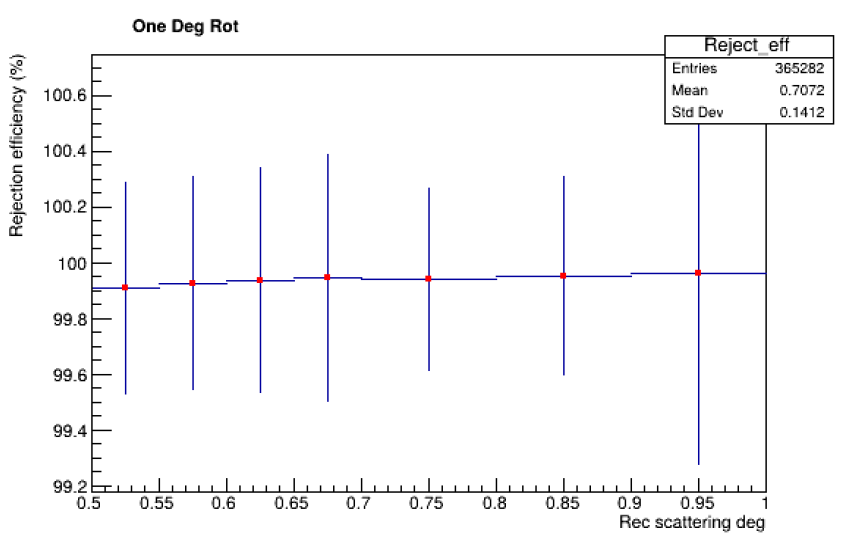


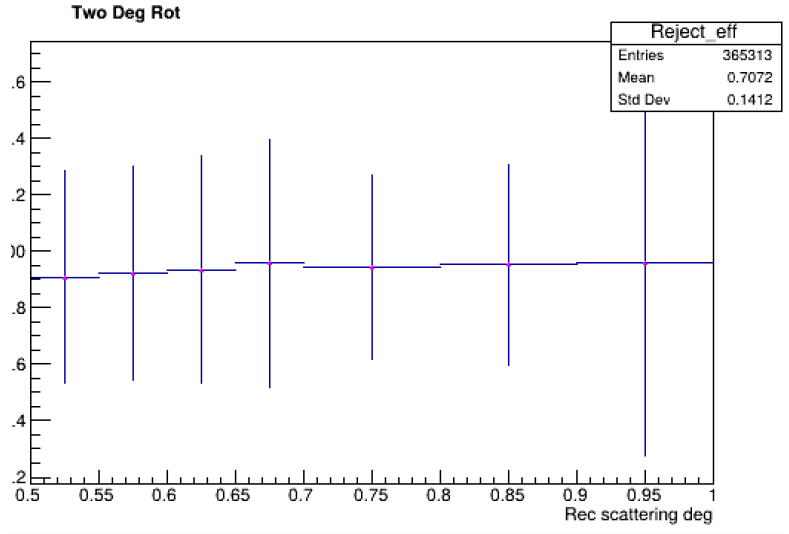


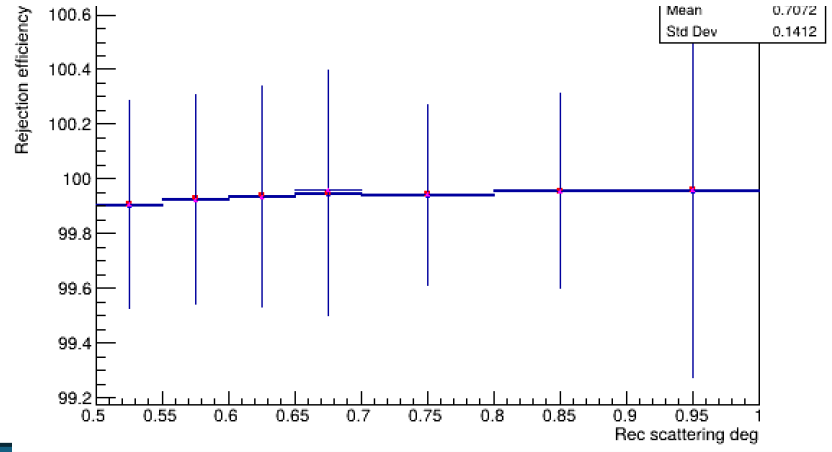


Zoomed-in view

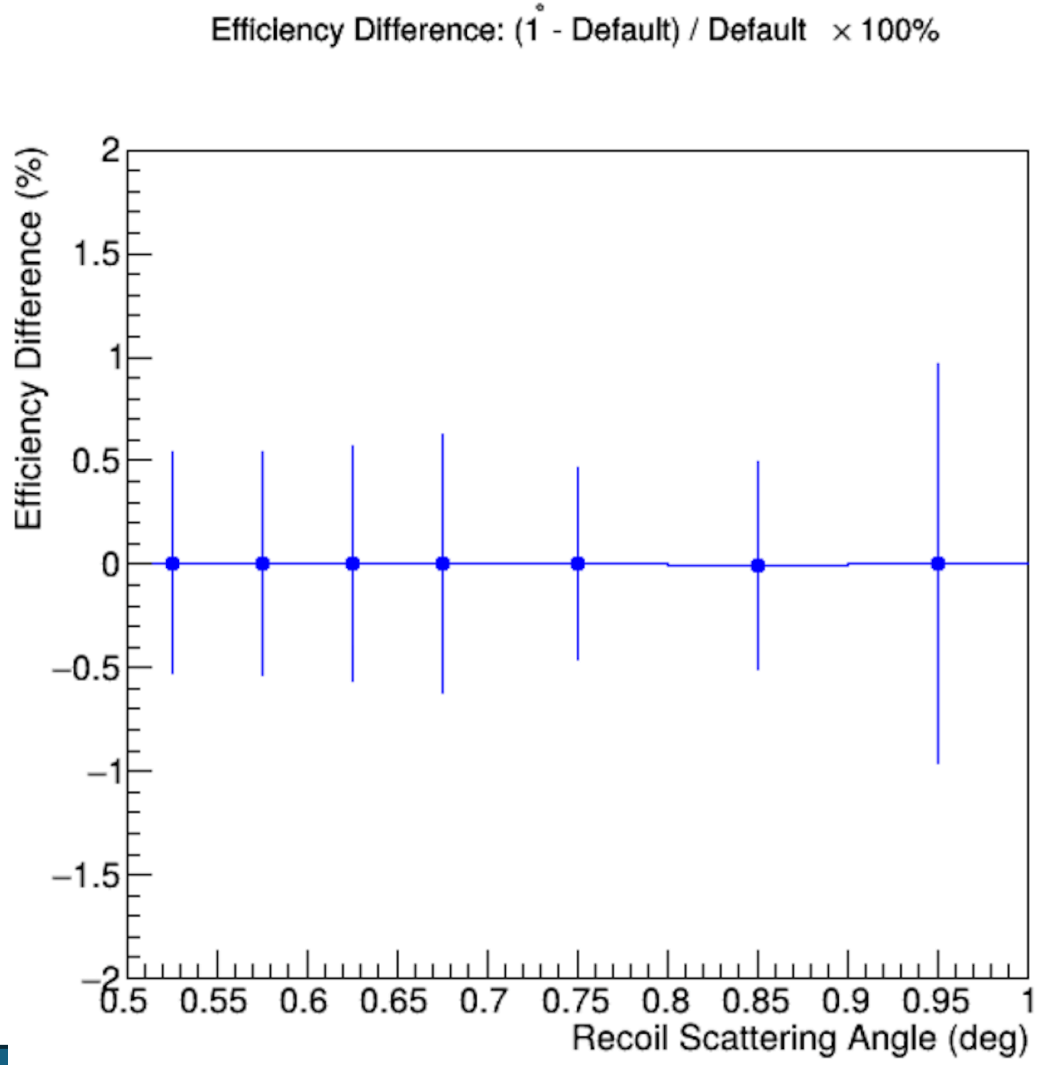


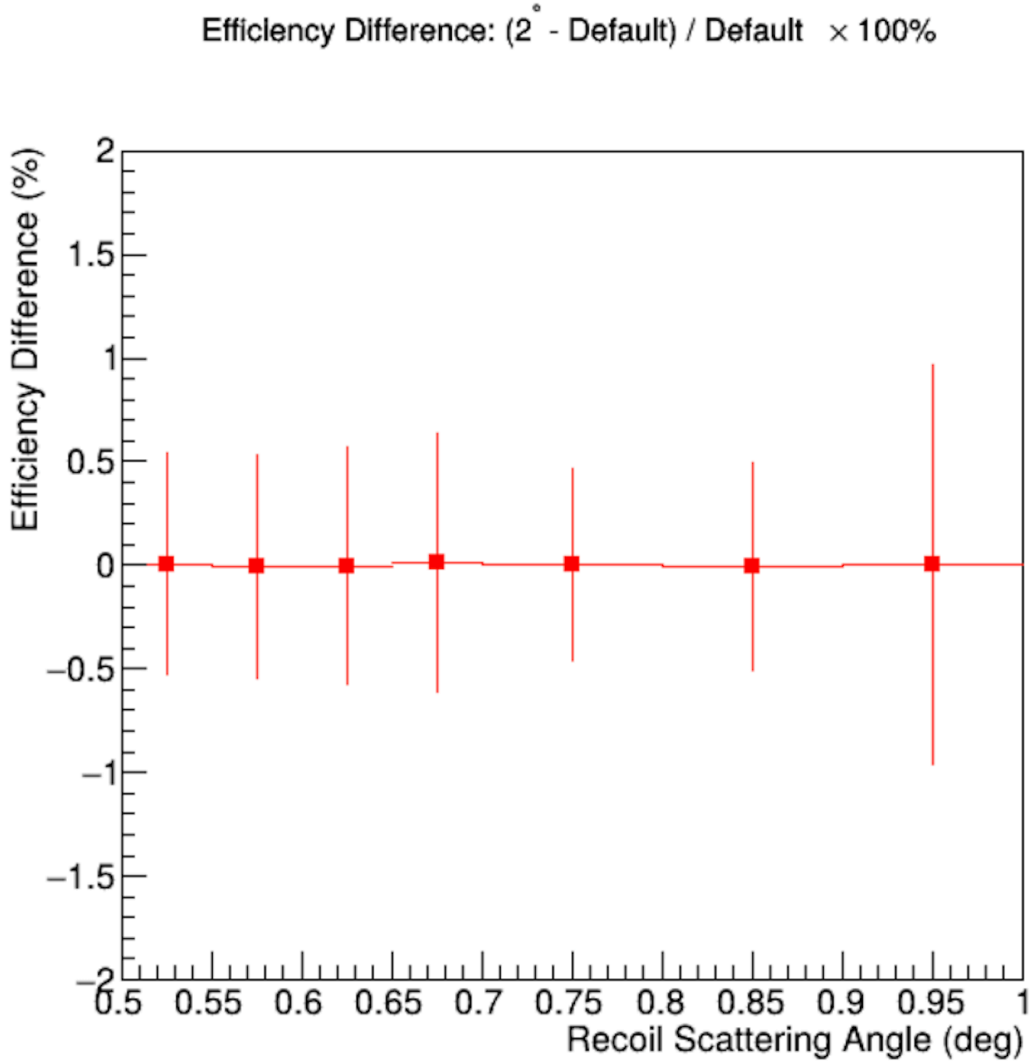






Percentage change in rejection efficiency





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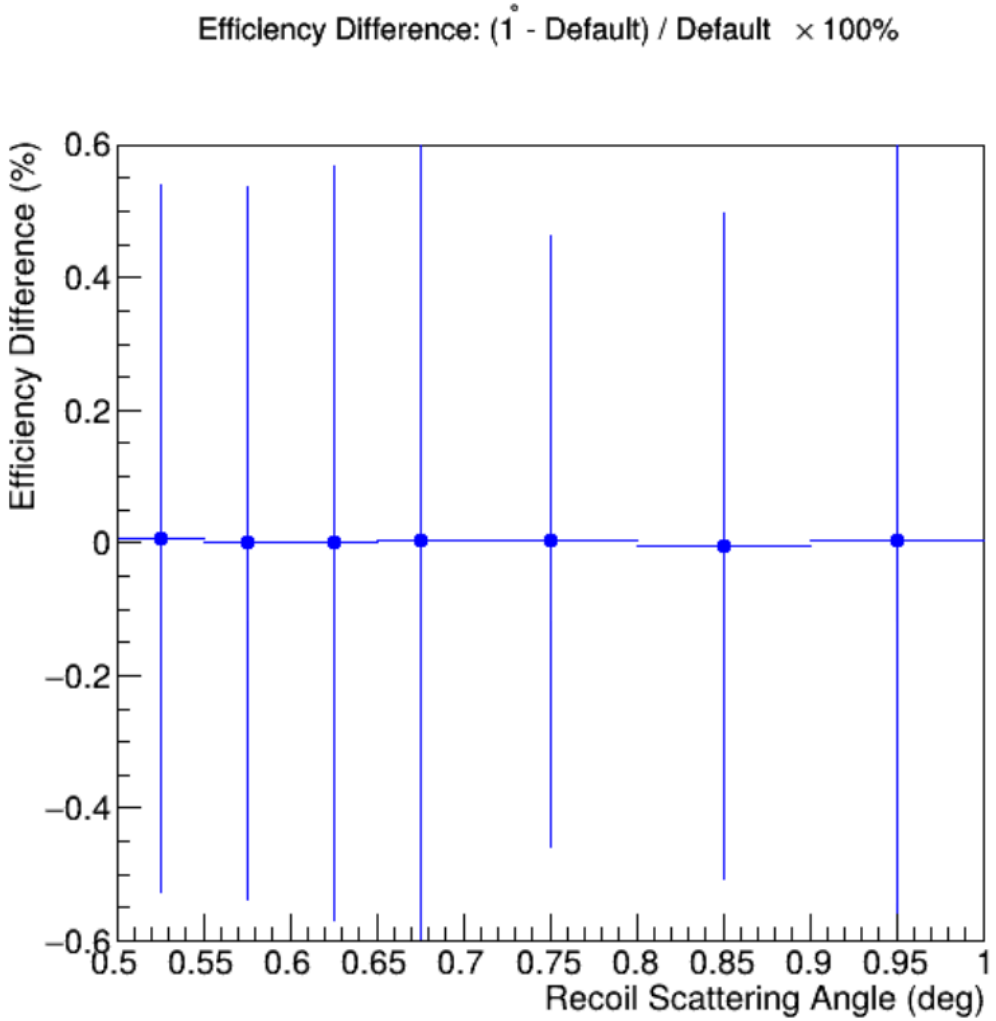

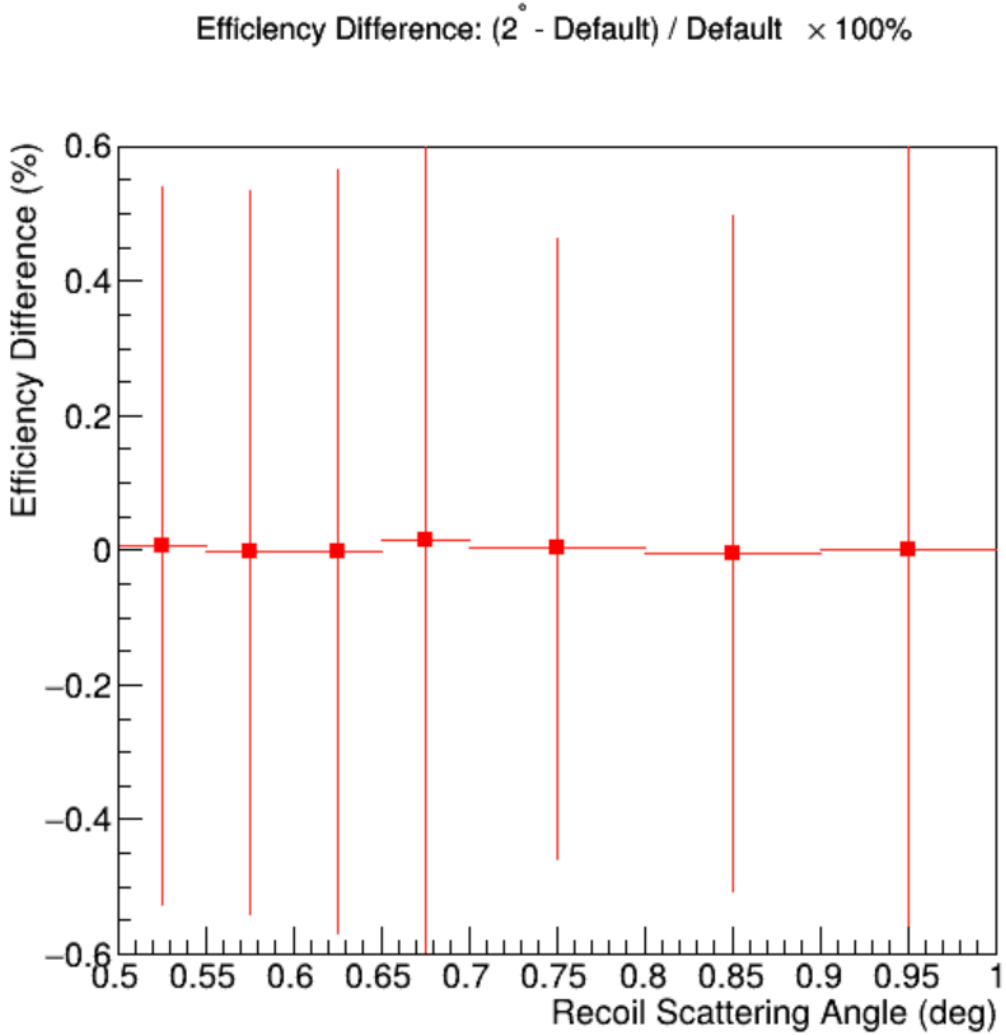

Summary

- Alignment tolerance study results indicate that 1 degree(corresponding to a 0.87mm displacement at the edges of the scintillators) and 2 degree rotations do not significantly impact veto scintillators rejection efficiency.
- Hardware setup for testing the response of 3mm and 5mm scintillators is ready.
- DAQ System Setup is in progress.
- Geant4 simulations by Yuan Li have shown that the 3mm thickness should be adequate for the needs of PRad II, but a real hardware test is needed for final confirmation.
- We plan to conduct cosmic ray test and analyze the signal responses of both the scintillators.

Acknowledgements

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- My Advisor : Dr.Dipangkar Dutta, Mississippi State University
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- Yuan Li, Shandong University[Helped with simulation work]
- Armen Stepanyan, JLab (Fast Electronics Group) [terminated the PMT dividers to the HV and LEMO connections]
- Current and future Prad collaborators

PRoton Radius

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Questions ?