Veto Scintillator status

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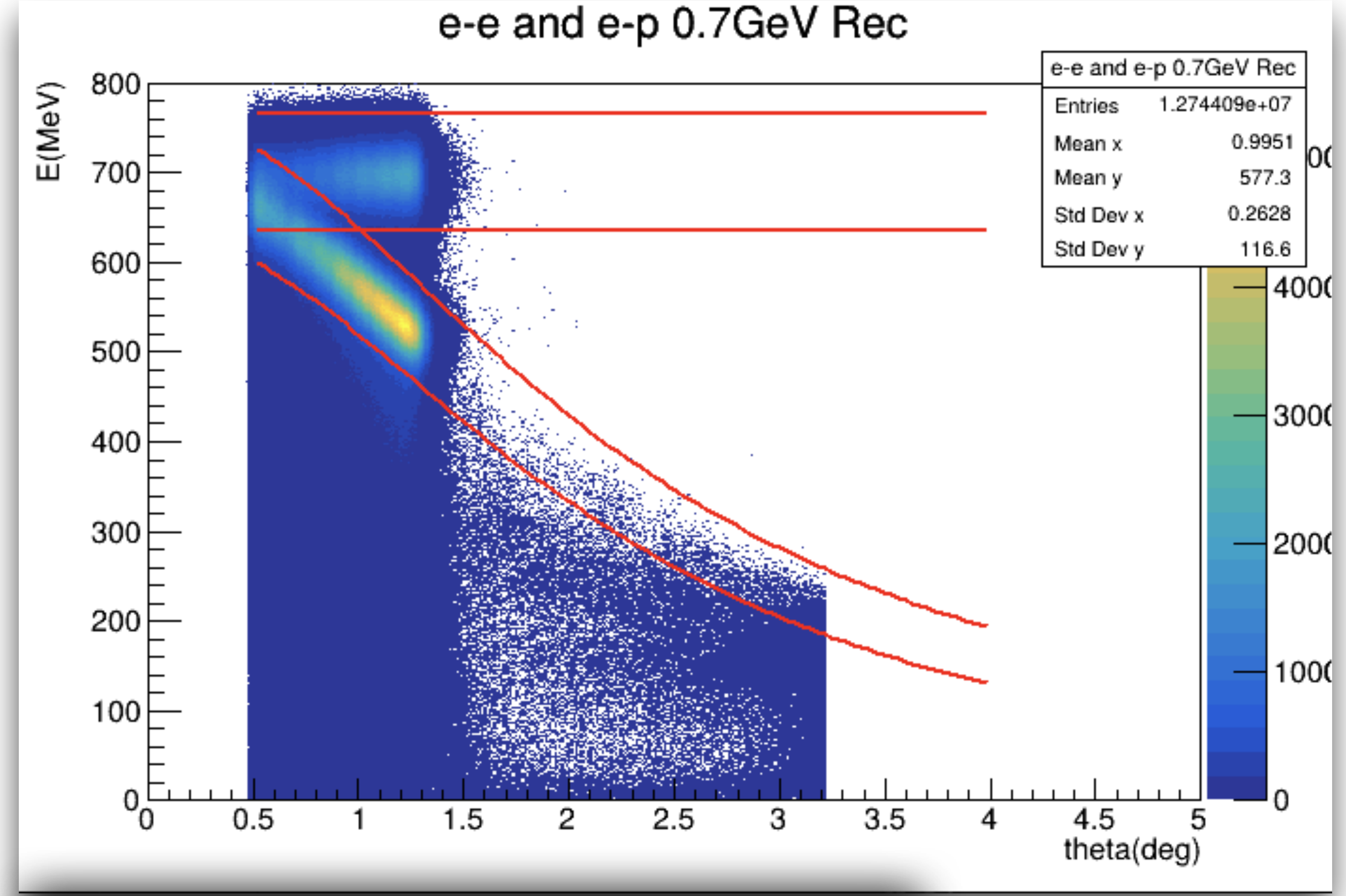
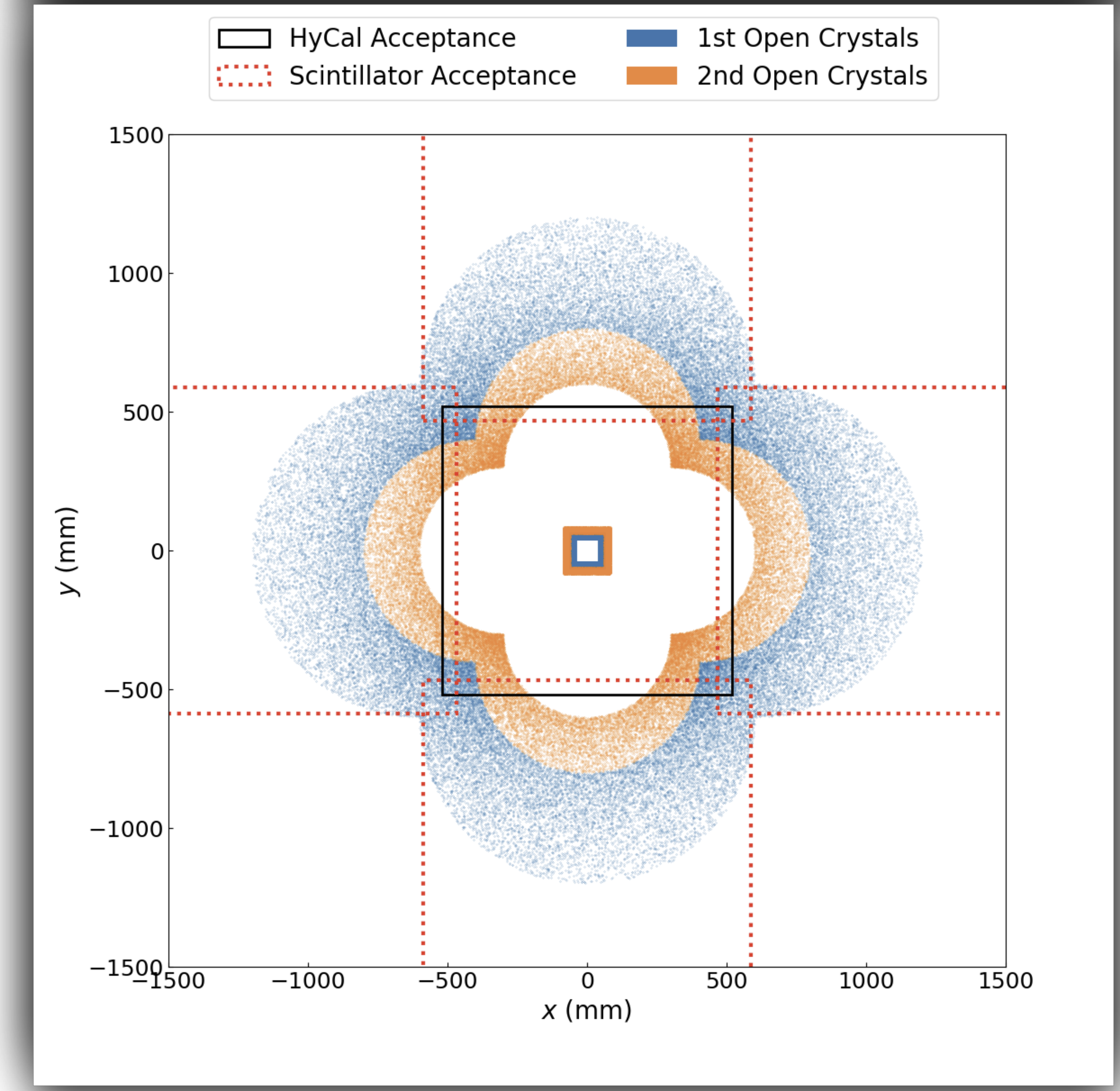
- Scintillator thickness selection
- Scintillator alignment study
- Current status

Introduction

Why we need scintillator tagger?

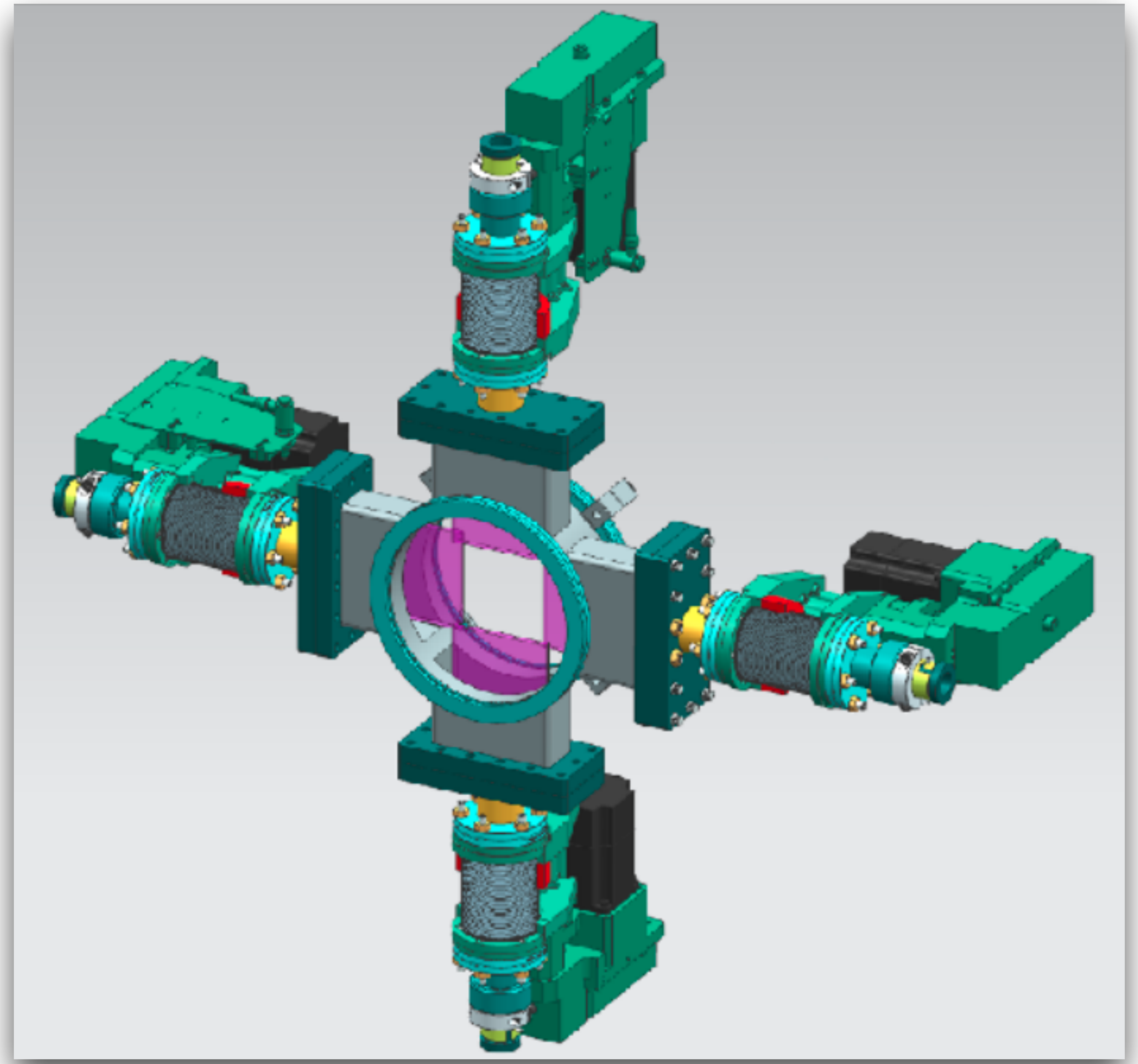
- PRad-II aims to reach an unprecedented low Q^2 (~10^{-5} GeV^2).
- Lower Q^2 corresponds to lower scattering angles (0.5 ~0.8)
- HyCal alone cannot reliably separate elastic e-p events from Moller background.
- The Veto scintillators enable clean separation of e-e and e-p events at low angles.

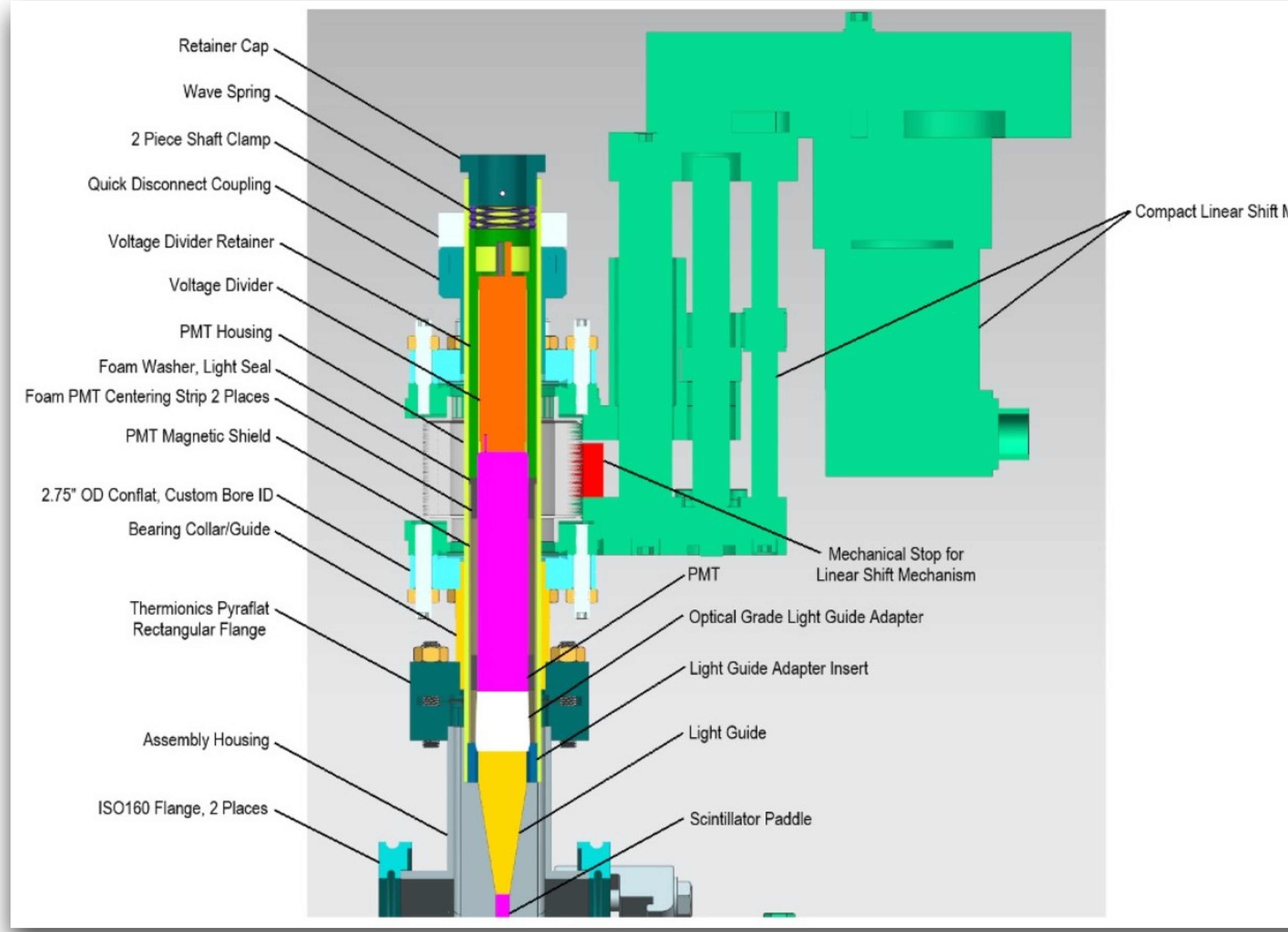




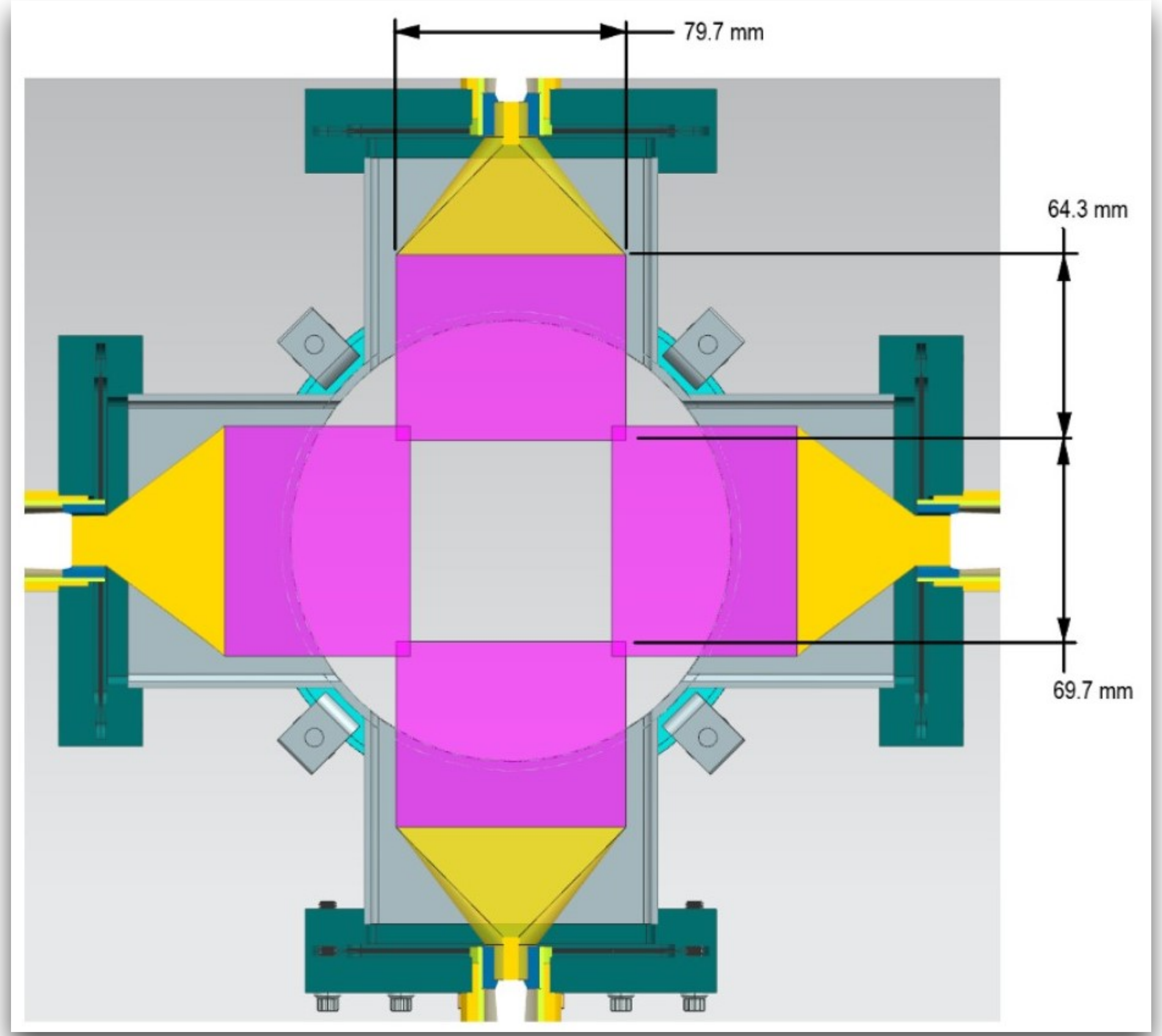
Veto Scintillator Design

- Based on Youri Sharabian's concept a scintillator tagger setup has been designed by Chris Guthrie.

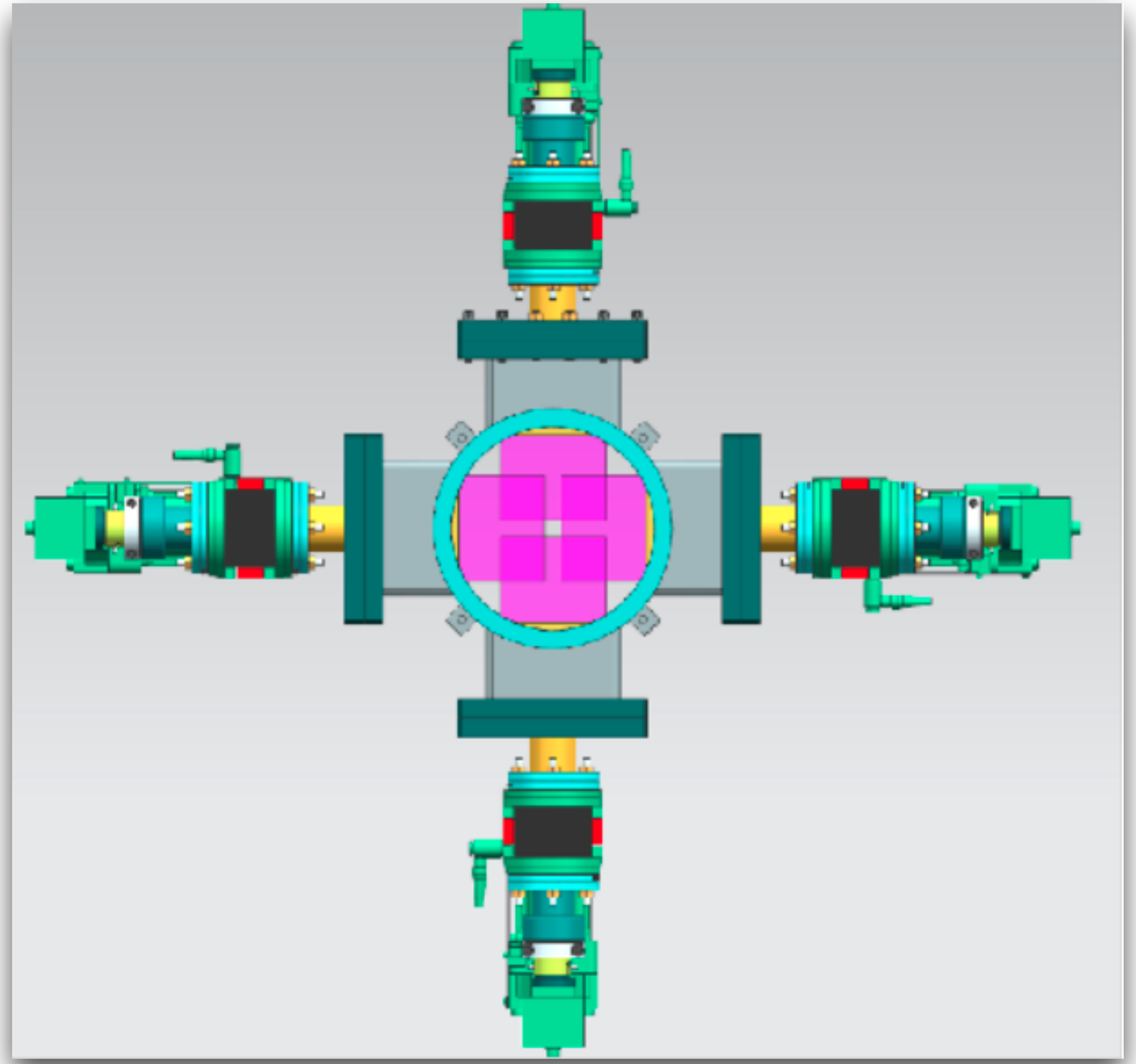




Scintillator tagger will be used in two positions



Production position



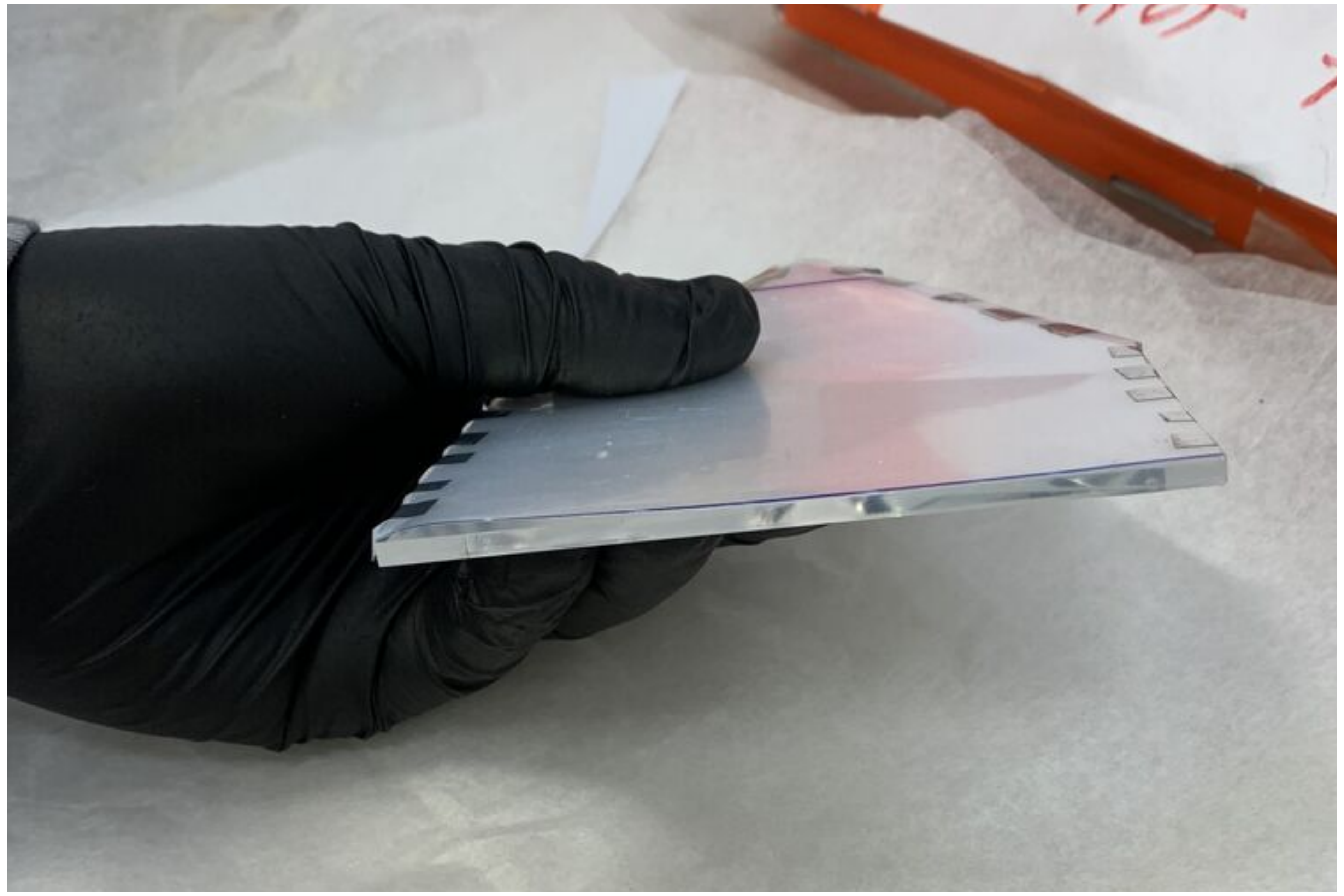
Calibration position

Scintillator thickness selection

- Goal: Select optimal scintillator thickness with minimal material.

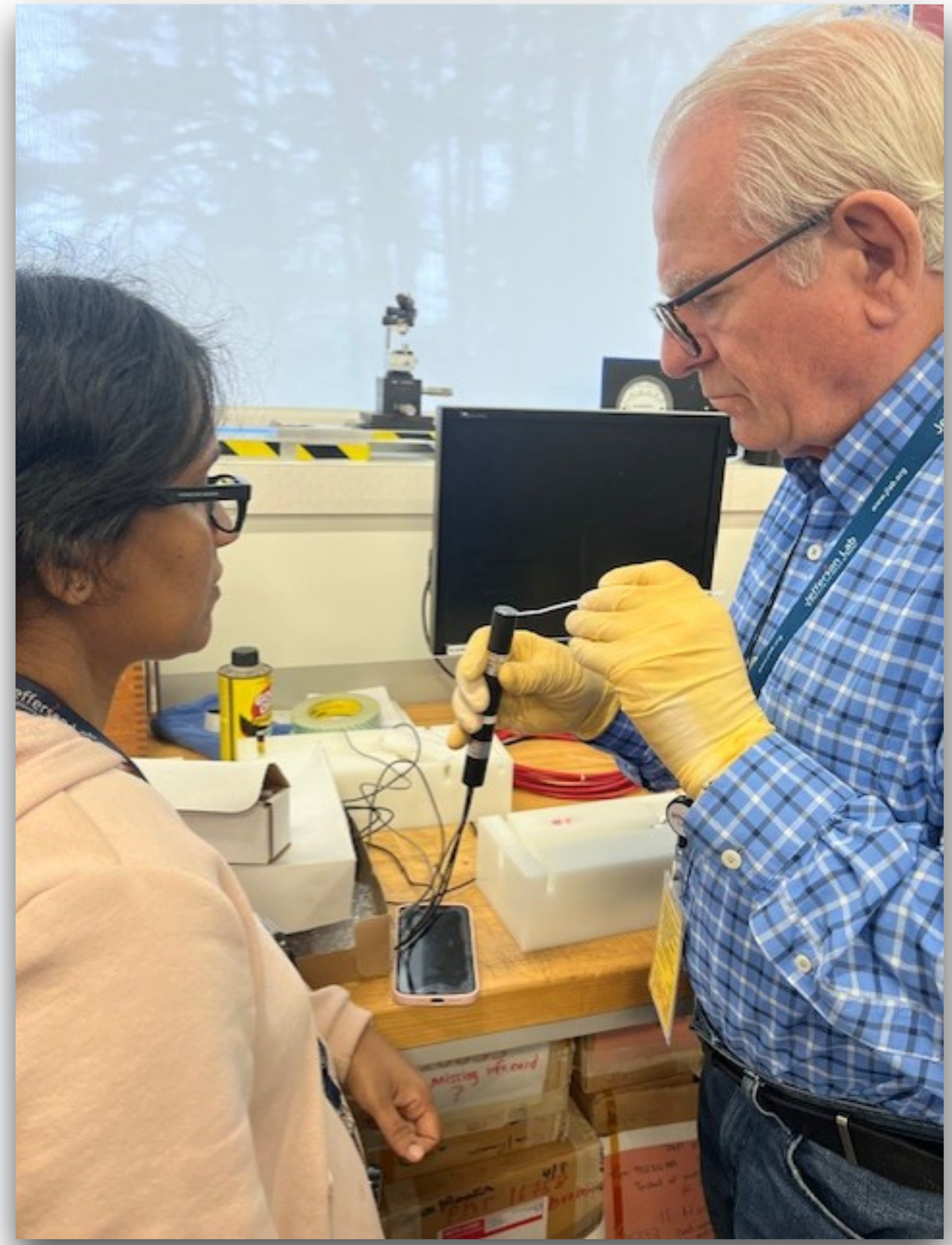
- Thicker scintillators produce stronger signals but introduce more background through added material.

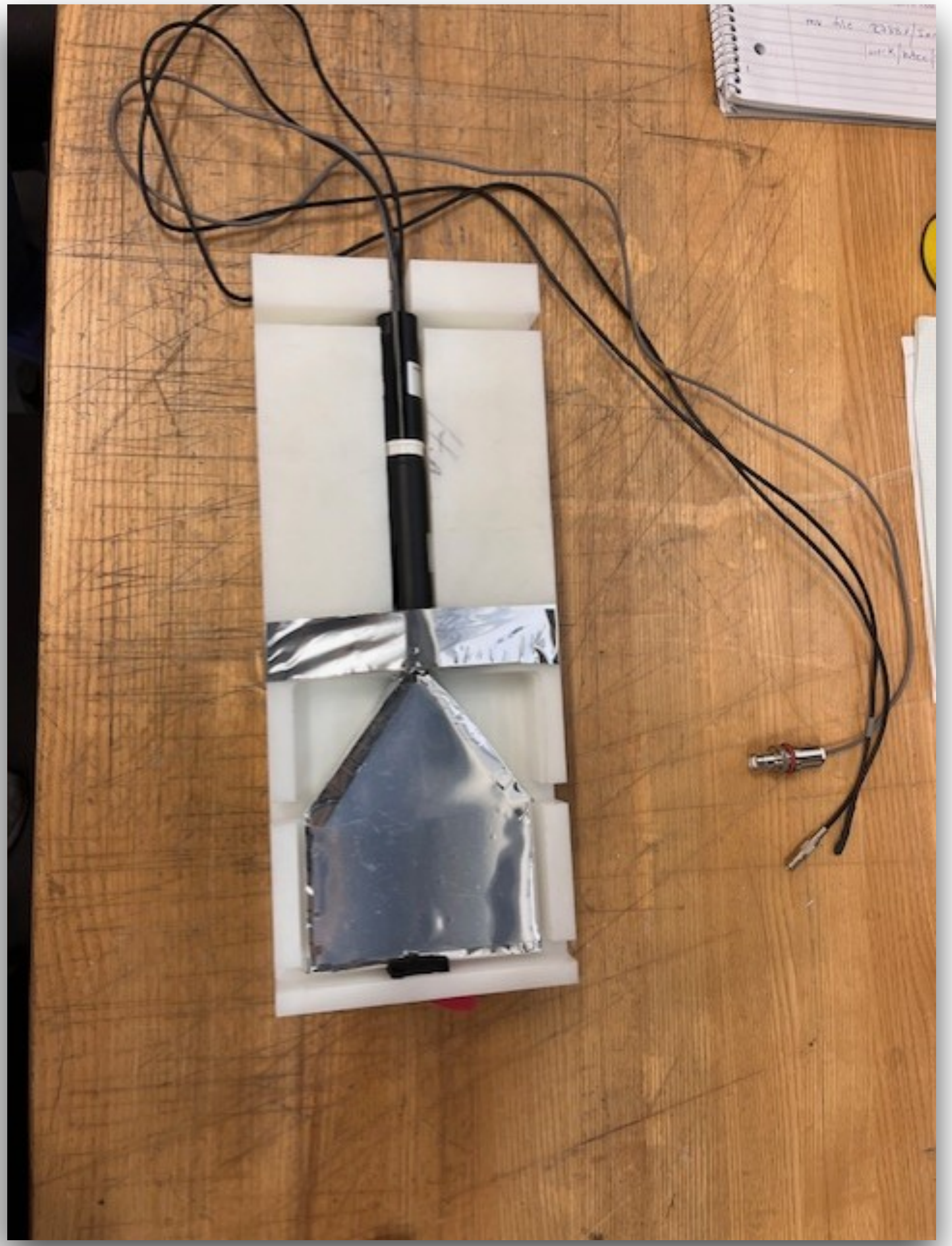
- 3 mm and 5mm scintillator paddles were proposed for the experimental comparison. (100 mm * 65 mm * 3 mm and 100 mm * 65 mm * 5 mm)



Scintillator paddle Assembly

- Scintillator paddles were attached to matching light guides using UV-activated glue.
- Wrapped the scintillator and light guide assembly with reflecting material to maximize the light collection.
- Appilied optical grease between light guide and PMT for better optical coupling.
- Place the full setup inside the light tight dark box for testing.





Youri Sarabian completed the work with the help from MSState group and DAQ setup was performed by Sergey.

Test results for thickness comparison

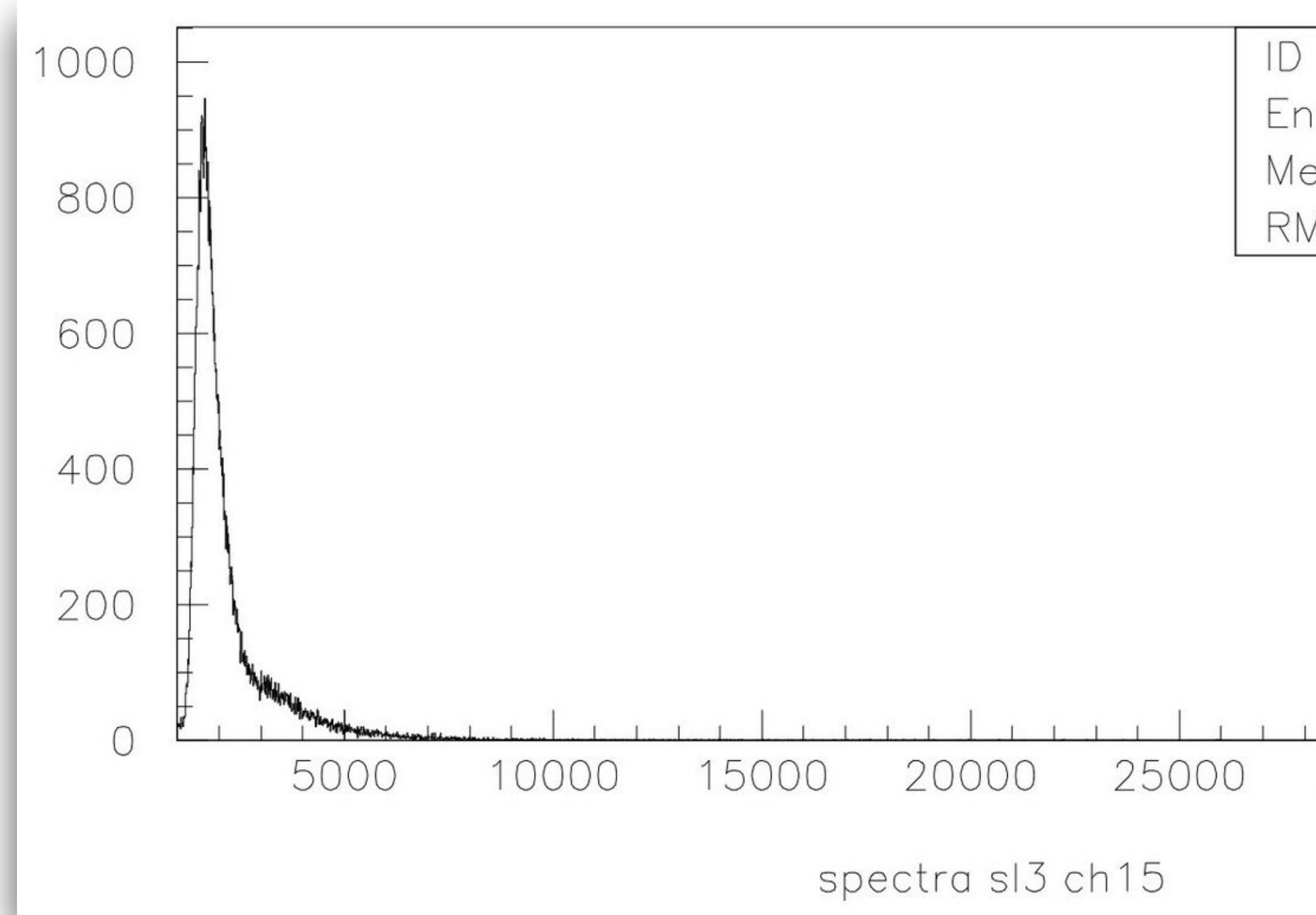
- 3 mm scintillator paddle has operated at 1300 V and 5 mm paddle has operated at 1250 V.

- Pedestal subtracted DAQ data confirmed,

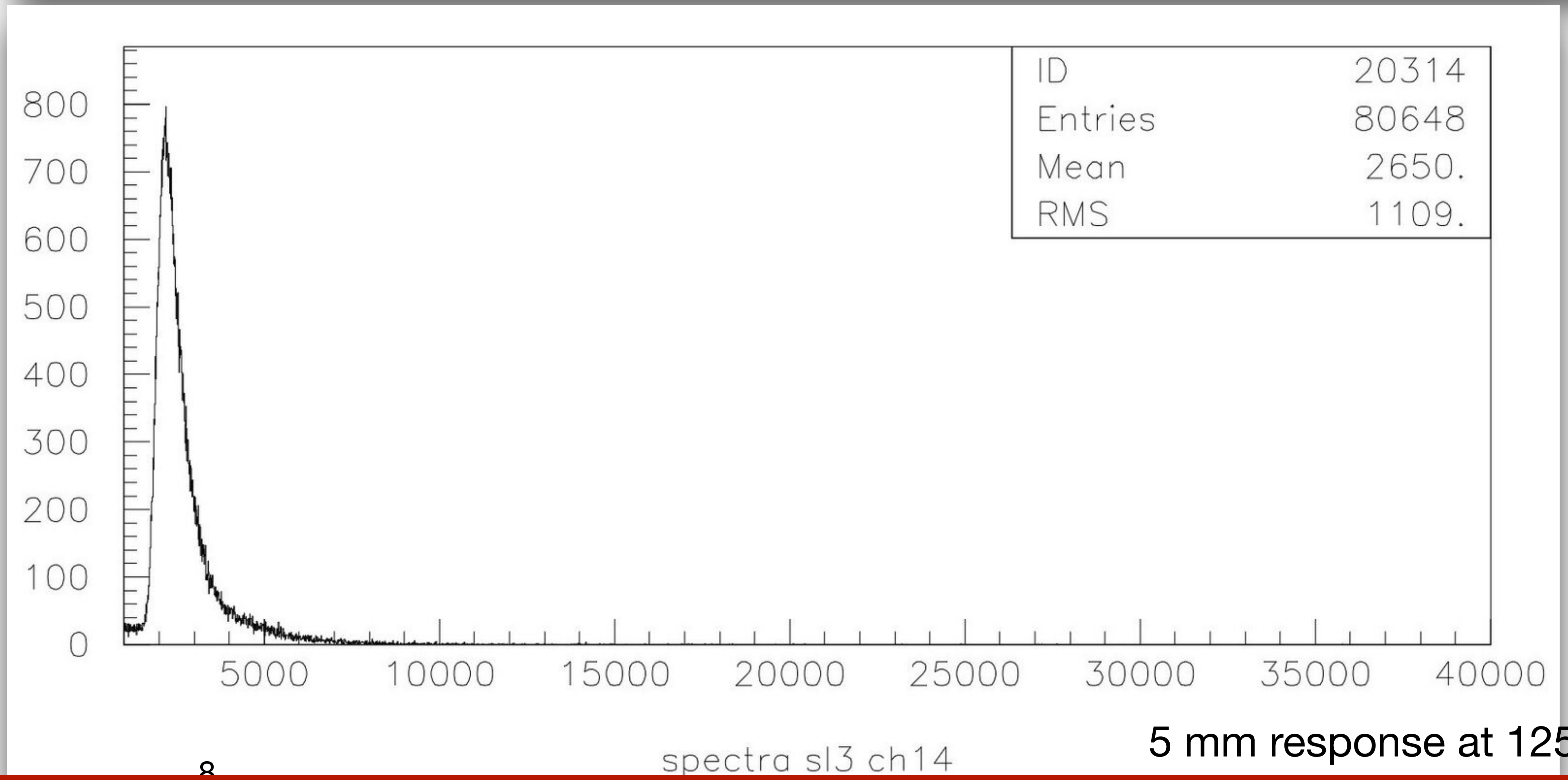
3 mm paddle provided adequate signal strength and 5 mm paddle produced slightly larger signals as expected.

•Hardware tests agreed with prior GEANT4 simulation predictions by Yuan Li.

•3 mm paddle selected for final PRad II veto detector



3 mm response at 1300 V



5 mm response at 1250 V

Veto scintillator alignment study

- Veto scintillators should maintain high rejection efficiency for background events at very low scattering angles.
- Misalignment between veto scintillators could reduce the discrimination of Moller events from the elastic e-p events.

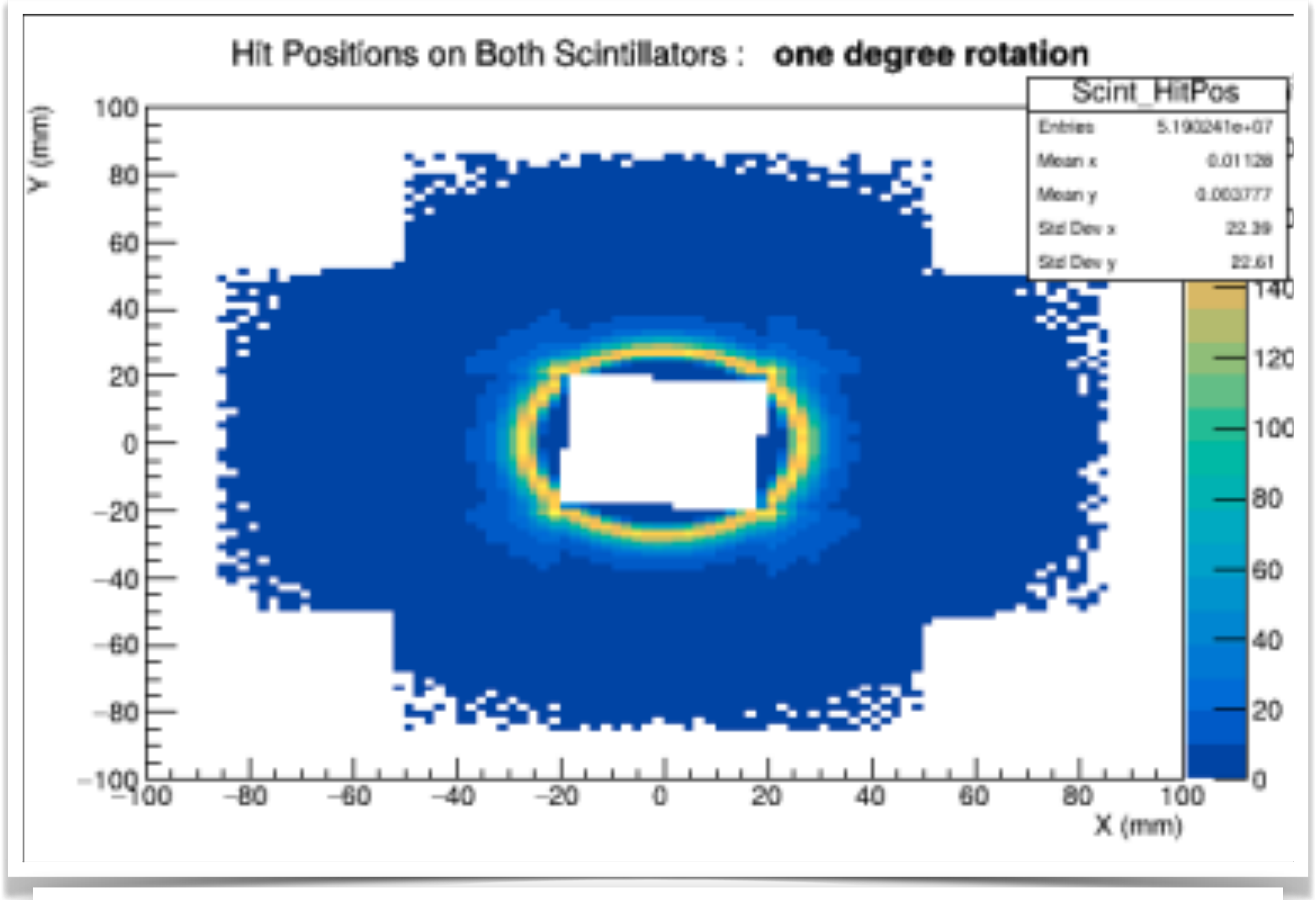
Geant4 simulation has performed for:

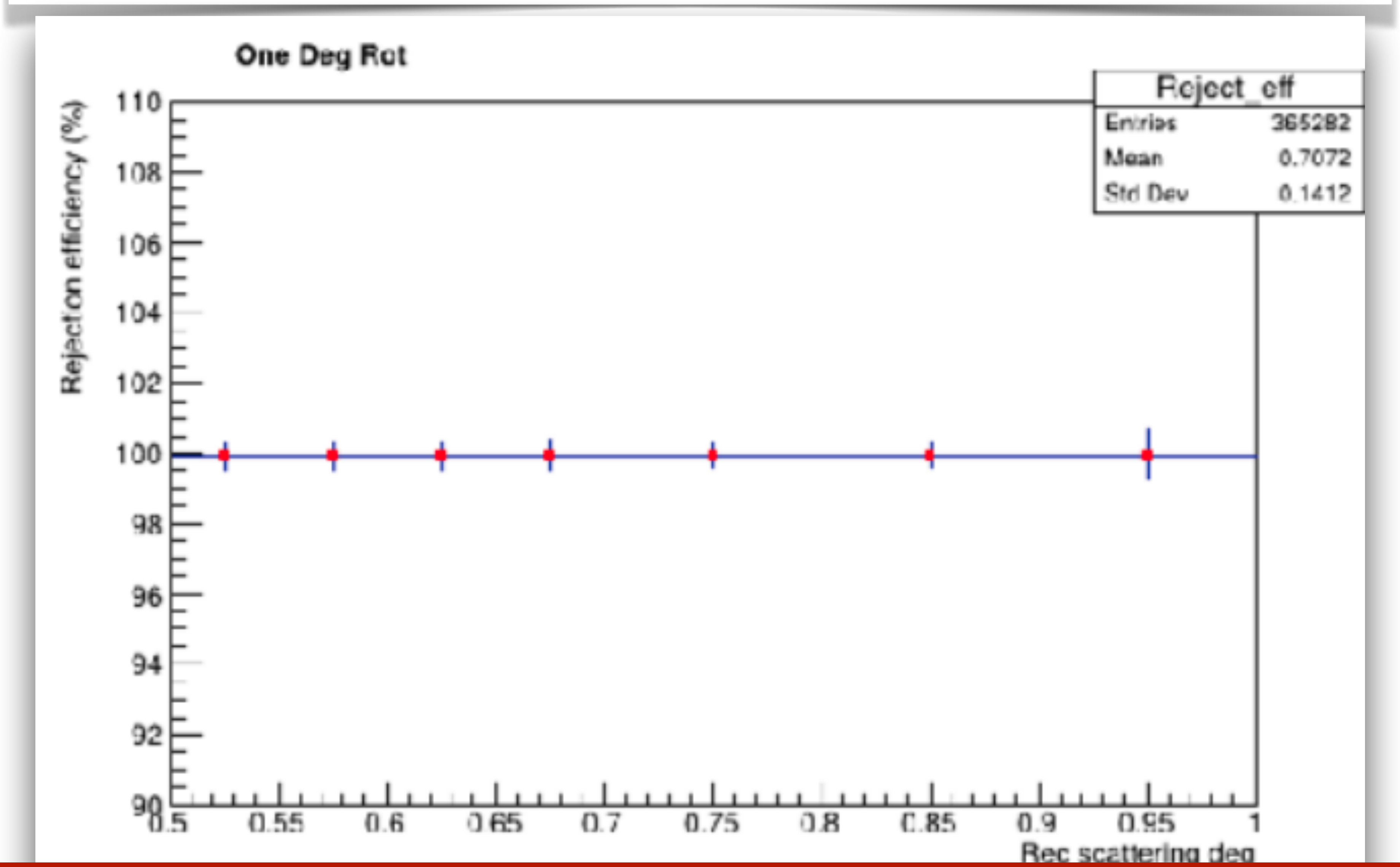
Perfect alignment and 1 deg and 2 deg rotation.

From the simulation confirms that 2deg rotation have negligible impact on efficiency performance.

We expect scintillators to be surveyed with a precision of 0.5 mm

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





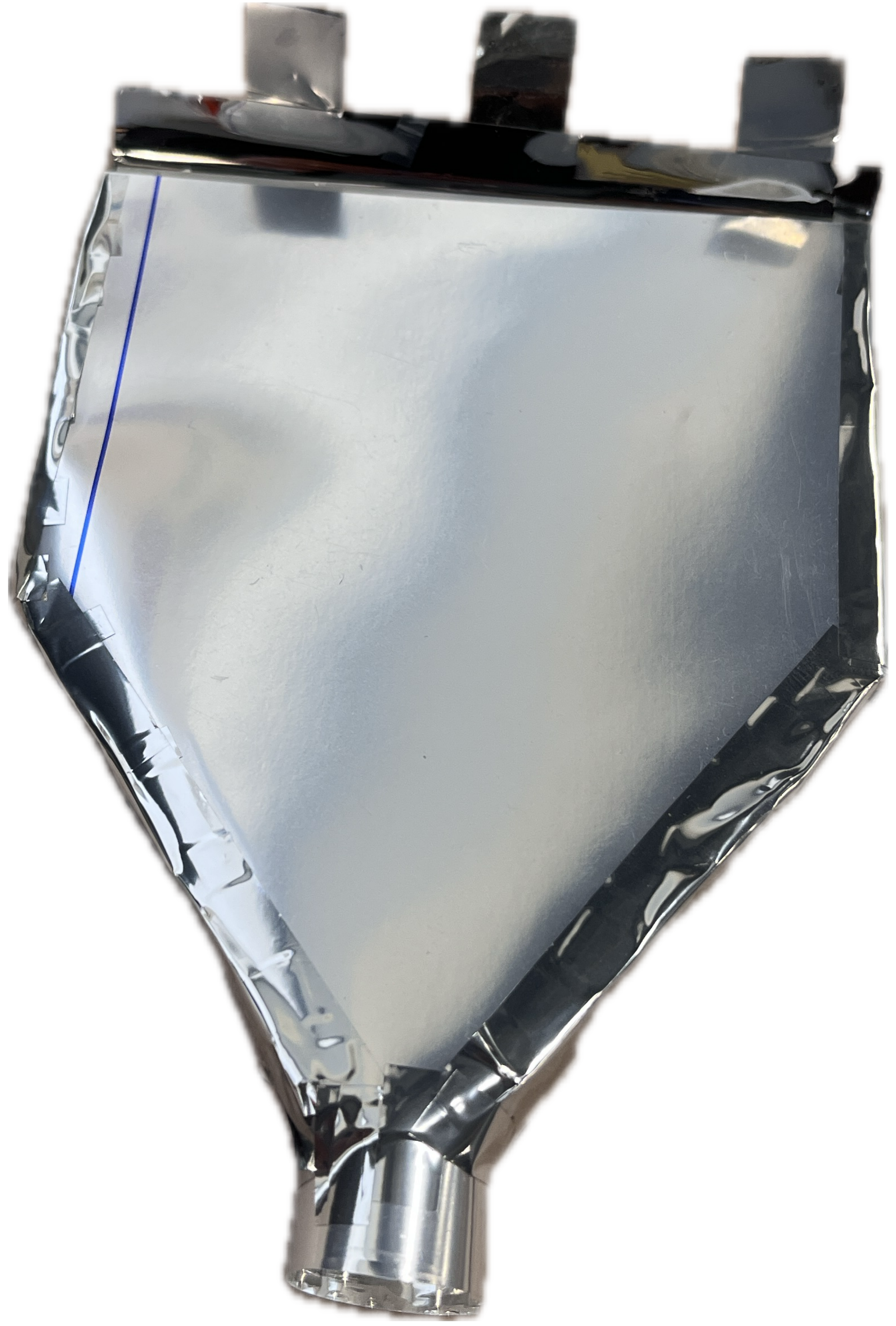
Current status

- All Scintillators, light guides were glued and wrapped. The Scintillators were wrapped with the small flap on the bottom that can open for alignment and close it later.

- PMTs, transition cylindrical scintillator parts are at Jlab.

- All parts were ordered and will receive all parts by October 10th.

- All components ready to install in the Hall by end of October.



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- Sergey Boyarinov, JLab.
- Yuan Li, Shandong University.
- Current and Future PRad Collaborators.

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QUESTIONS?