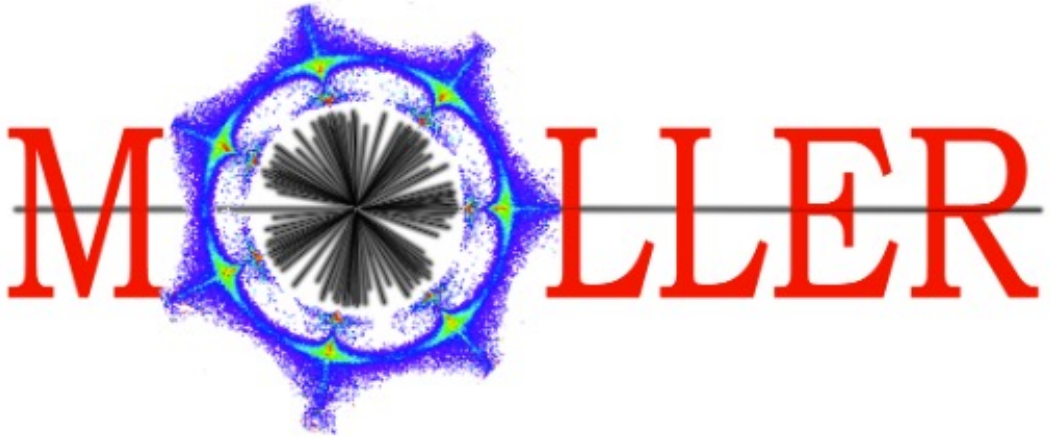


Scattered Beam Monitors and Scanning Detectors

Daniel Valmassei

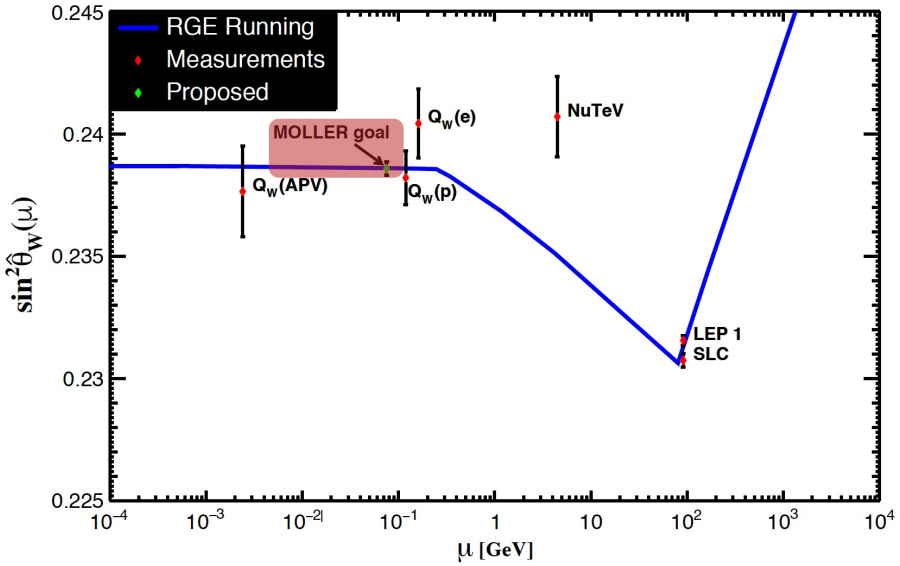
with Mark Pitt, Devi L. Adhikari, and Andrew Gunsch

Overview

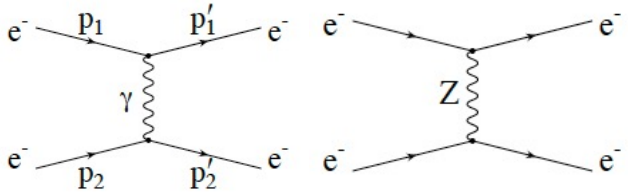
- Moller Scattering and the MOLLER Experiment
- Fundamental Considerations
- Detector Design
  - SAM
  - LAM
  - Downstream Scanner
  - Upstream Scanner

The MOLLER Experiment

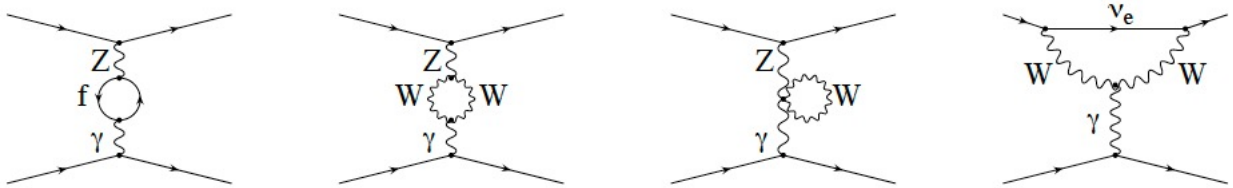
- $e^-e^- \rightarrow e^-e^-$ with 11 GeV longitudinally polarized electron beam incident on unpolarized hydrogen target
- $A_{PV} \propto Q_W^e = 1 - 4\sin^2 \Theta_W$
  - $\sin^2 \Theta_W$ becomes energy dependent at one-loop level
- Predicted $A_{PV} \approx 33 \pm 0.8$ ppb → 2.4% measure of Q_W^e
  - Current theoretical prediction error w/ $m_{Higgs} = 126$ GeV: ± 0.2 ppb (theory)



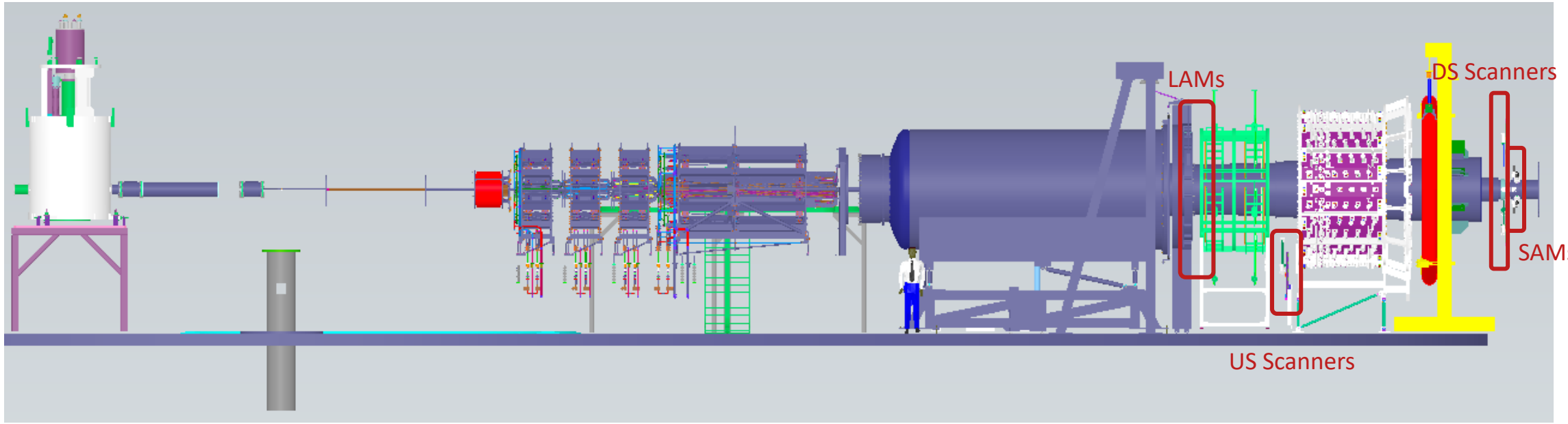
Tree level:



One-loop corrections:



The MOLLER Apparatus



Scattered Beam Monitors

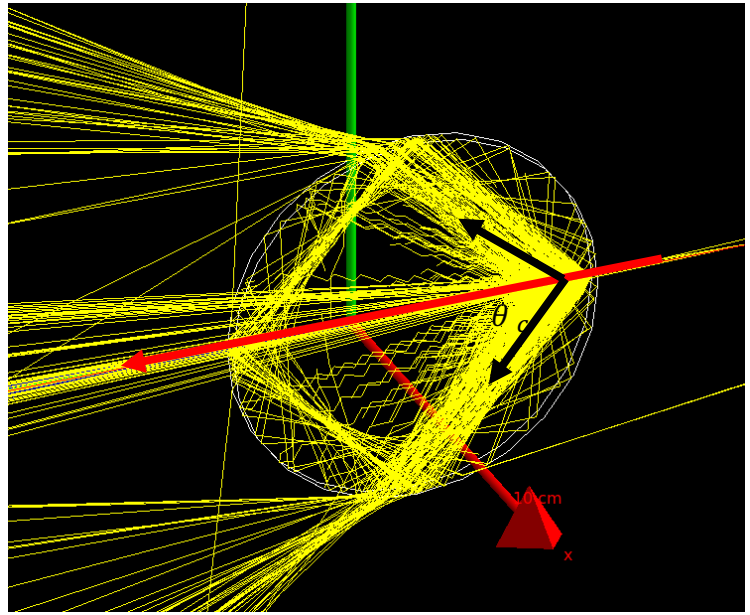
- Large Angle Monitors (x7)
- Small Angle Monitors (x8)
- Diffuse Beam Monitors (x14)
  - Integrating Cerenkov detectors
  - Sensitive to potential false asymmetries
  - DBM's not included in this talk

Scanner Detectors

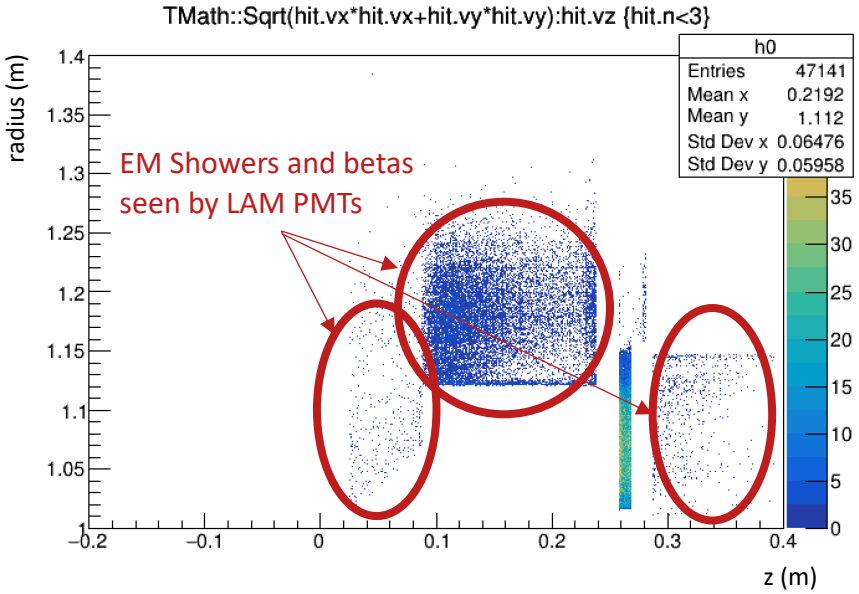
- Upstream Scanner (x1)
  - 2D scanning in both integrating and counting modes
- Downstream Scanner (x4)
  - 1D radial scanning in integrating mode

Light Transport in Beam Monitors

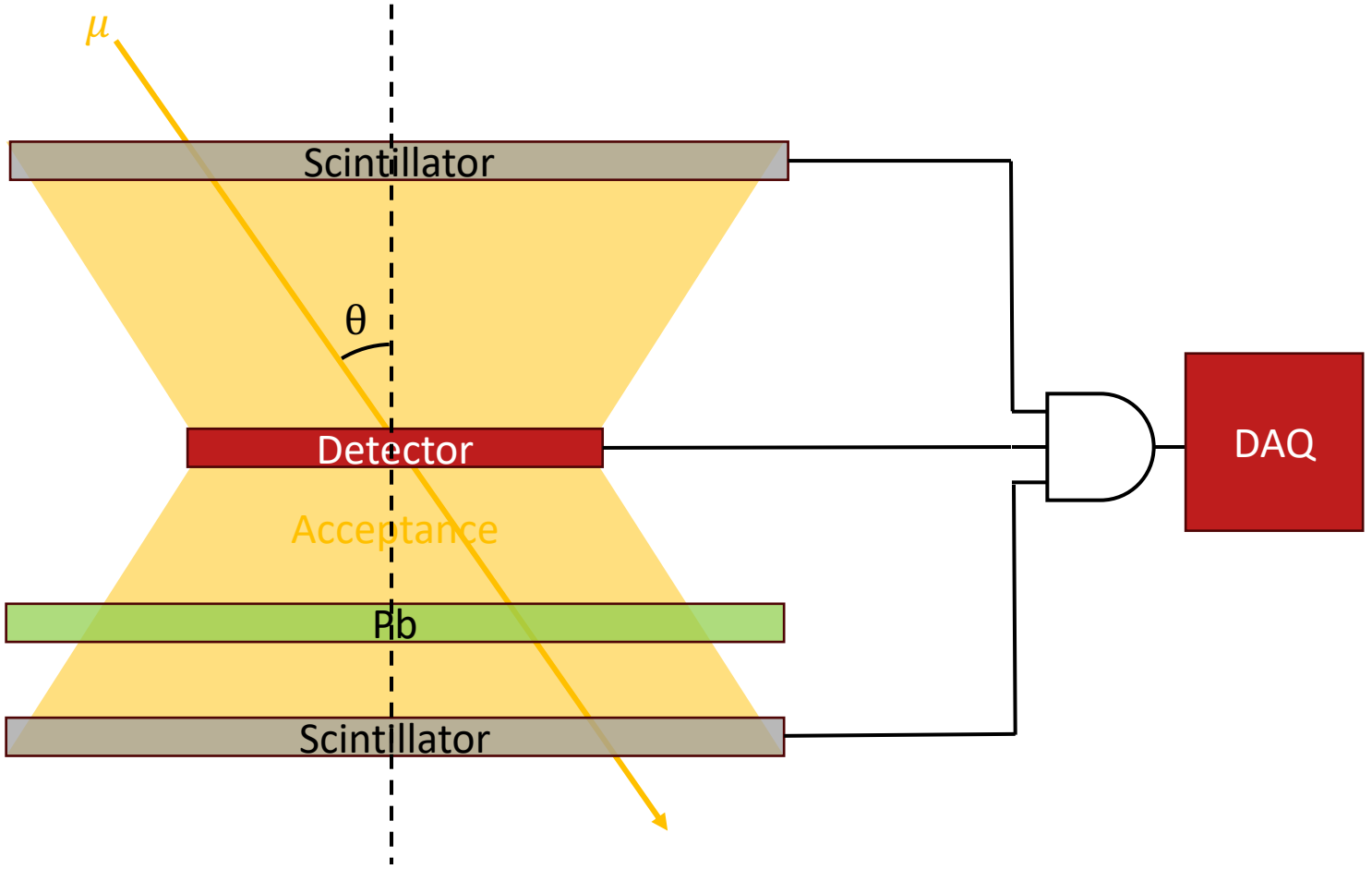
- Goal: Detect $\beta \approx 1$ electrons in high-rate (GHz) regions
  - Currently simulating for cosmic tests
- Tools: Cerenkov radiation, total internal reflection
- Difficulties: Attenuation, EM Scattering



- Solution: create a signal in the region of interest which outweighs the signal from the background region

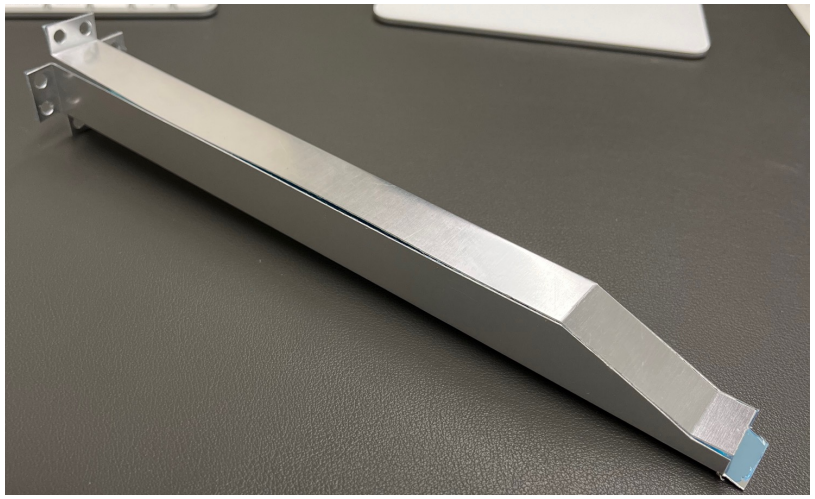


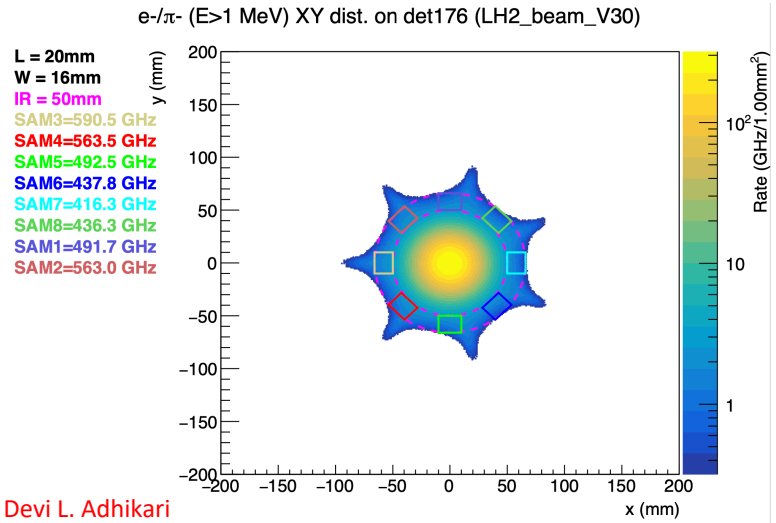
Cosmic Testing

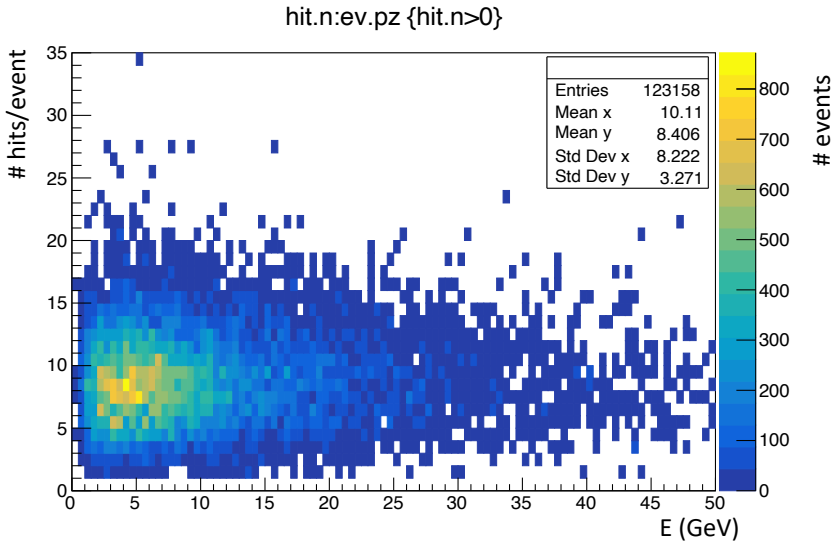


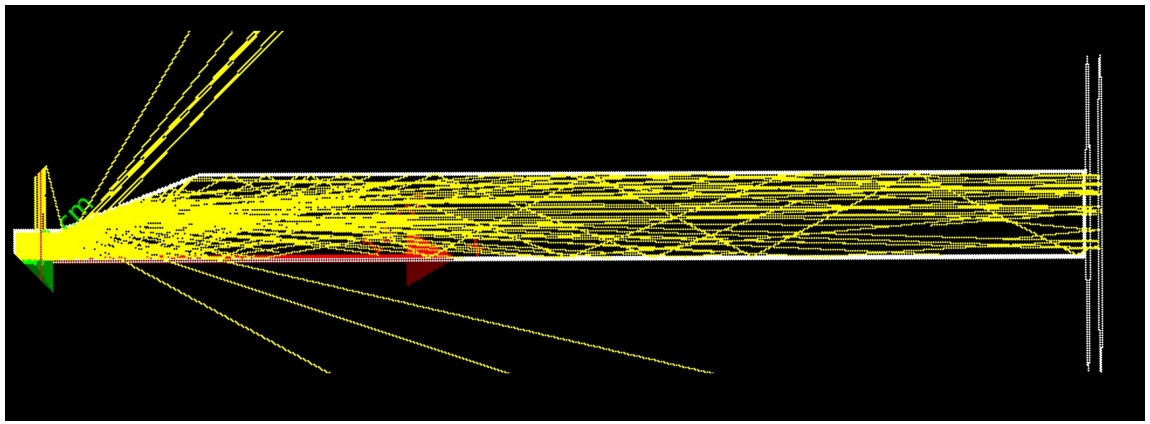
*Simplified Circuit

Small Angle Monitors (SAMs)



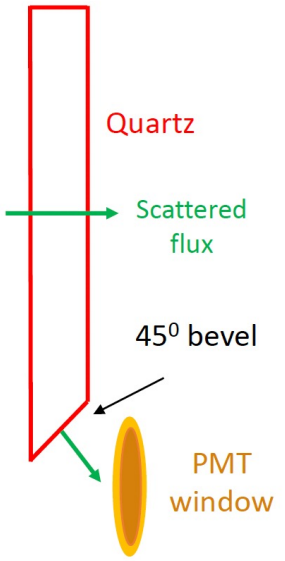


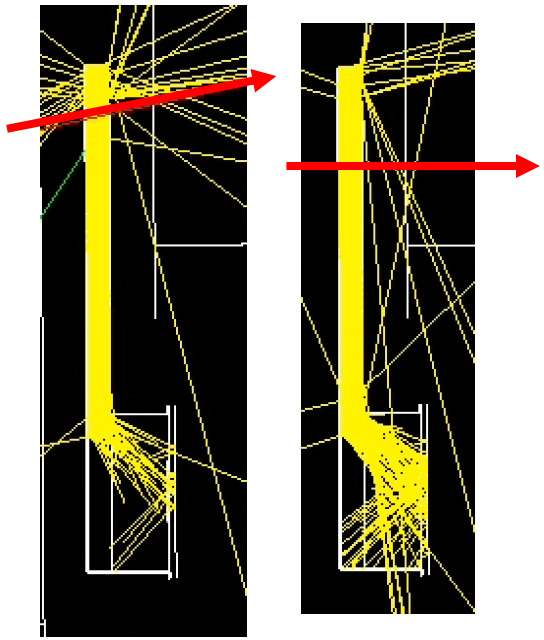


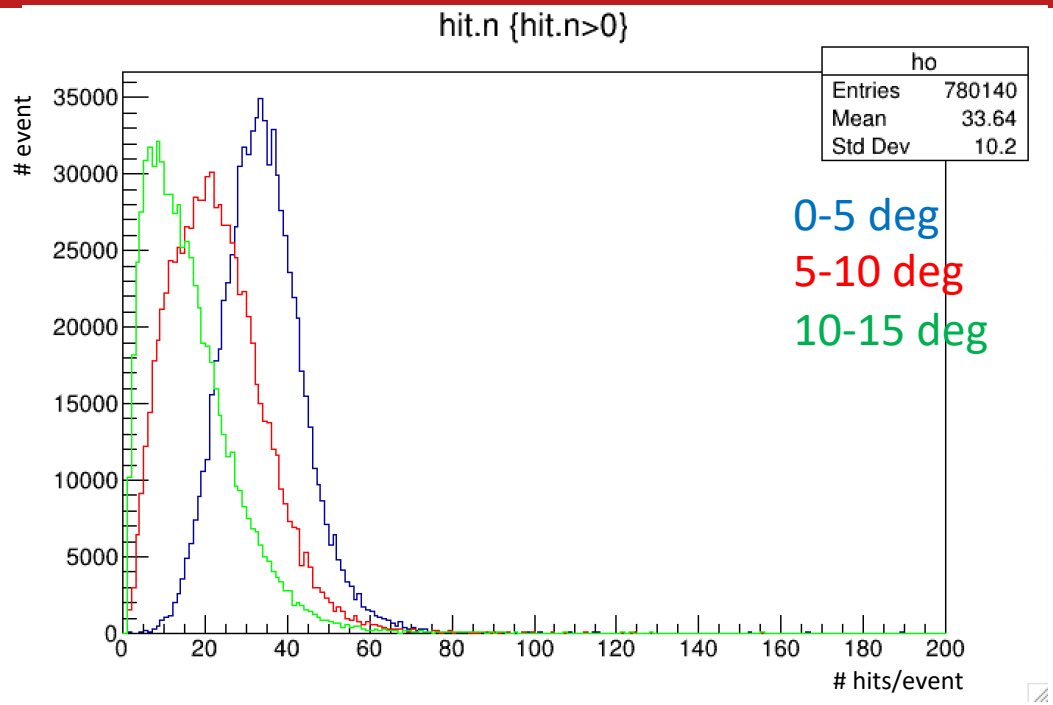


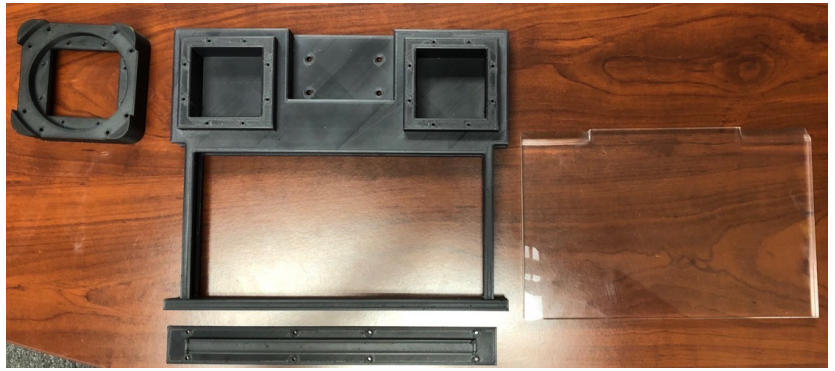
Large Angle Monitors (LAMs)

- Rate dominated by e-p elastic tail (~2/3 e-p elastic, ~1/3 Moller, ~0.3% e-p inelastic)
  - Small asymmetry (~7 ppb)
- Monitor for potential false asymmetry

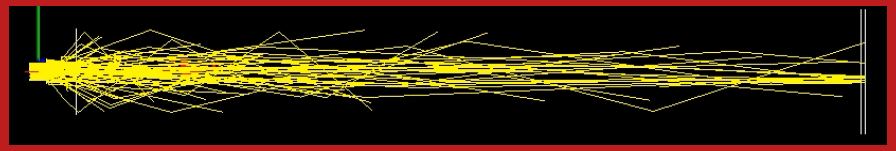




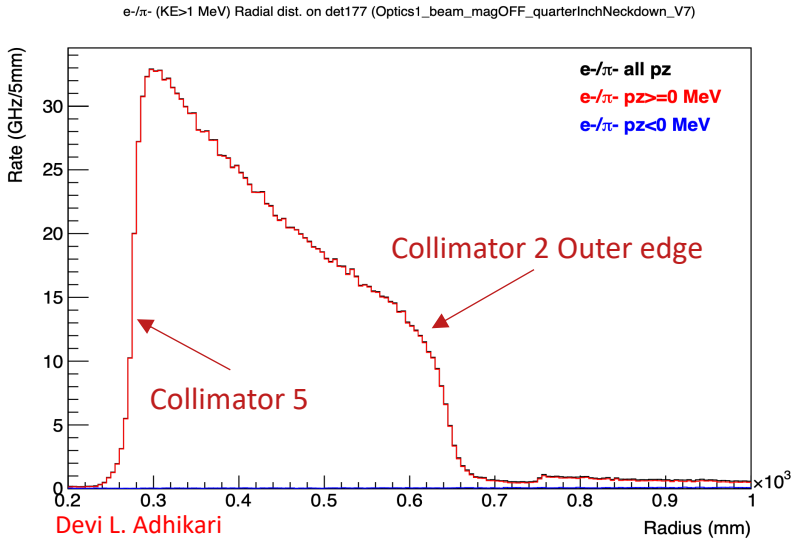


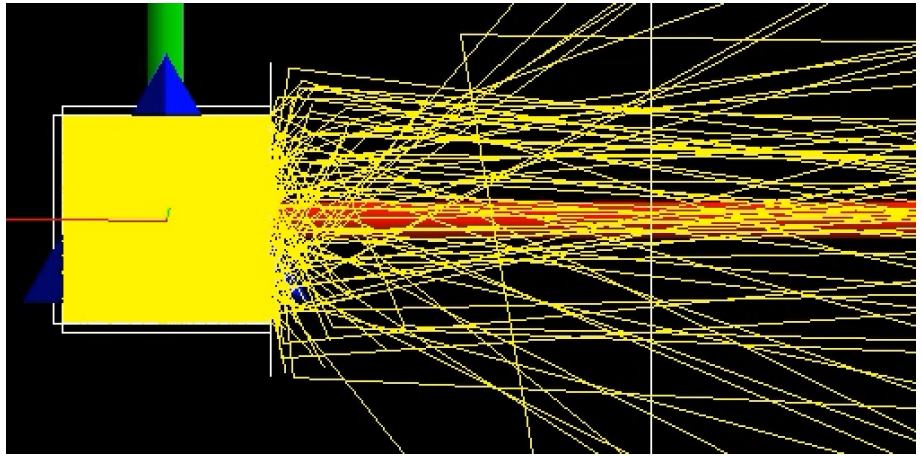


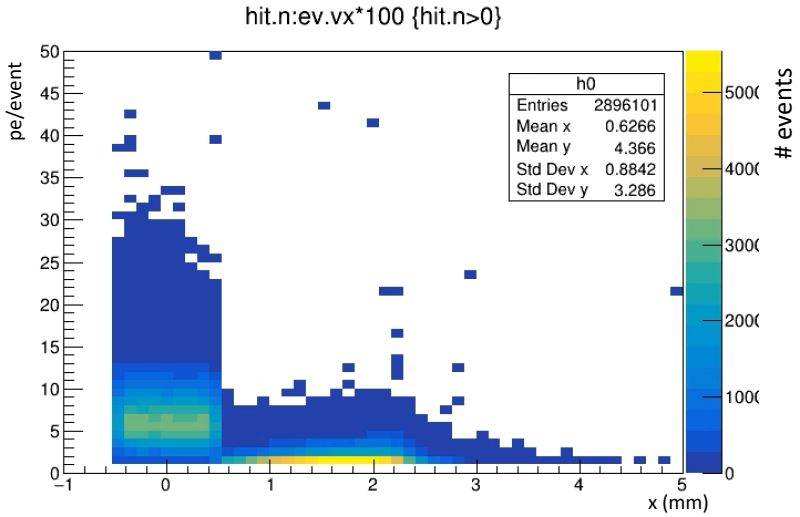
Downstream Monitors



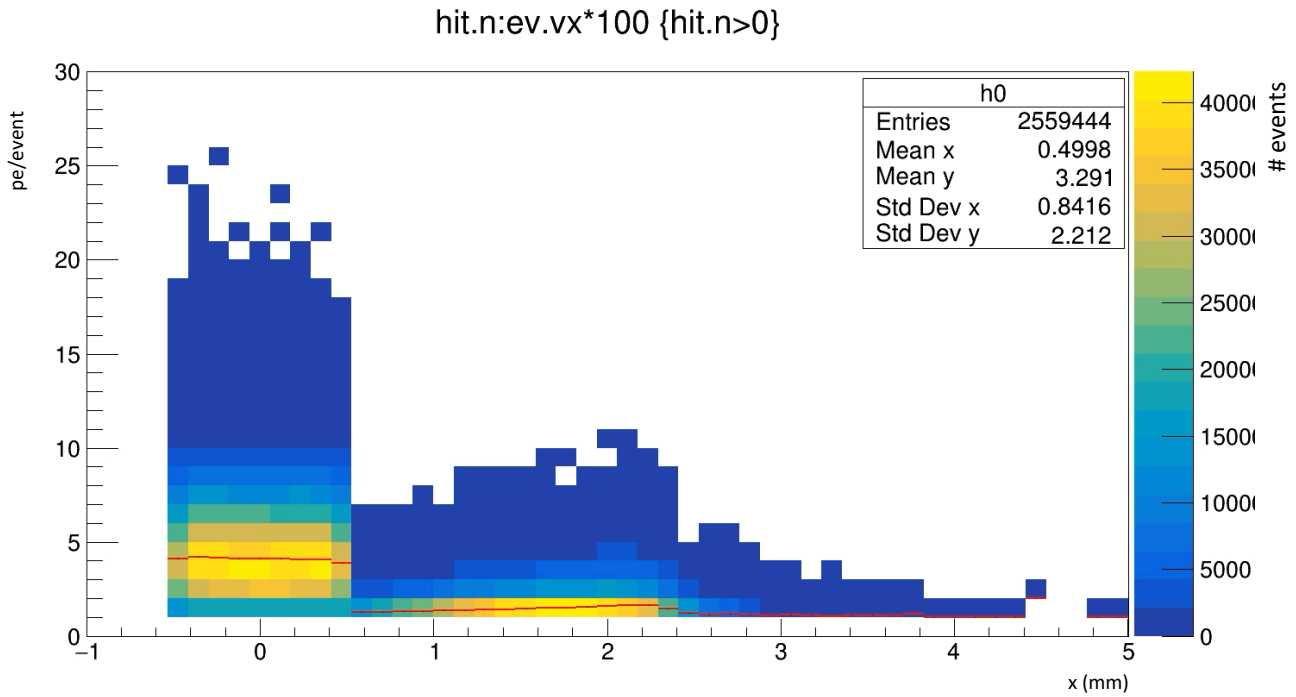
- Goal: measure outer edge of Collimator 2 and Collimator 5
- Concern: background at Collimator 5 edge will be high due to high rate through lightguide

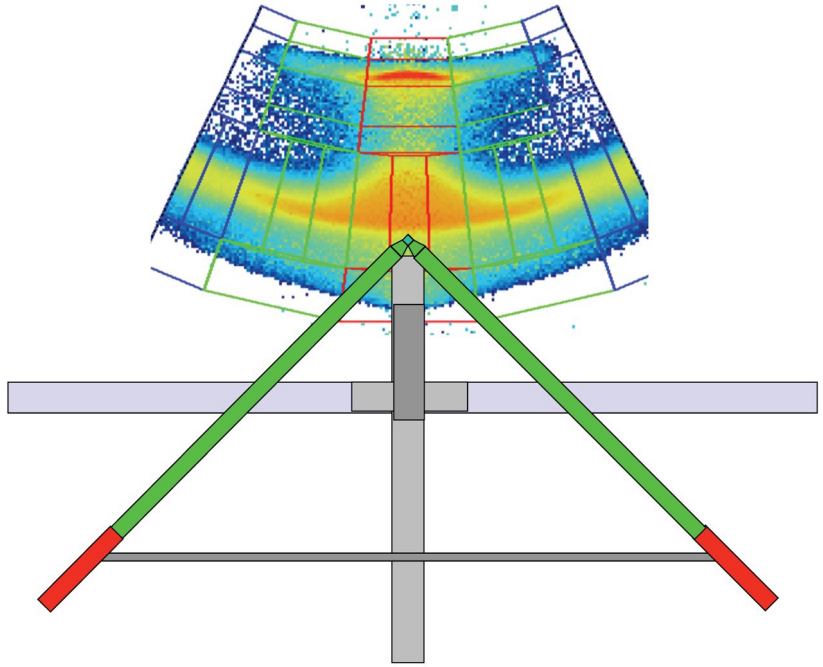






Upstream Monitors





These simulations are the worst-case scenario for US/DS Scanners. The light guides will be evacuated for experiment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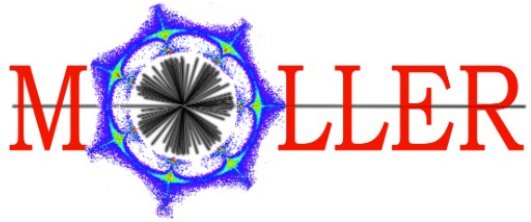
MOLLER

Thank you!


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