UCGretina

GEANT4 GRETINA/GRETA Simulation

bitbucket.org/lriley/ucgretina

Third AGATA-GRETINA/GRETA tracking arrays collaboration meeting
ANL
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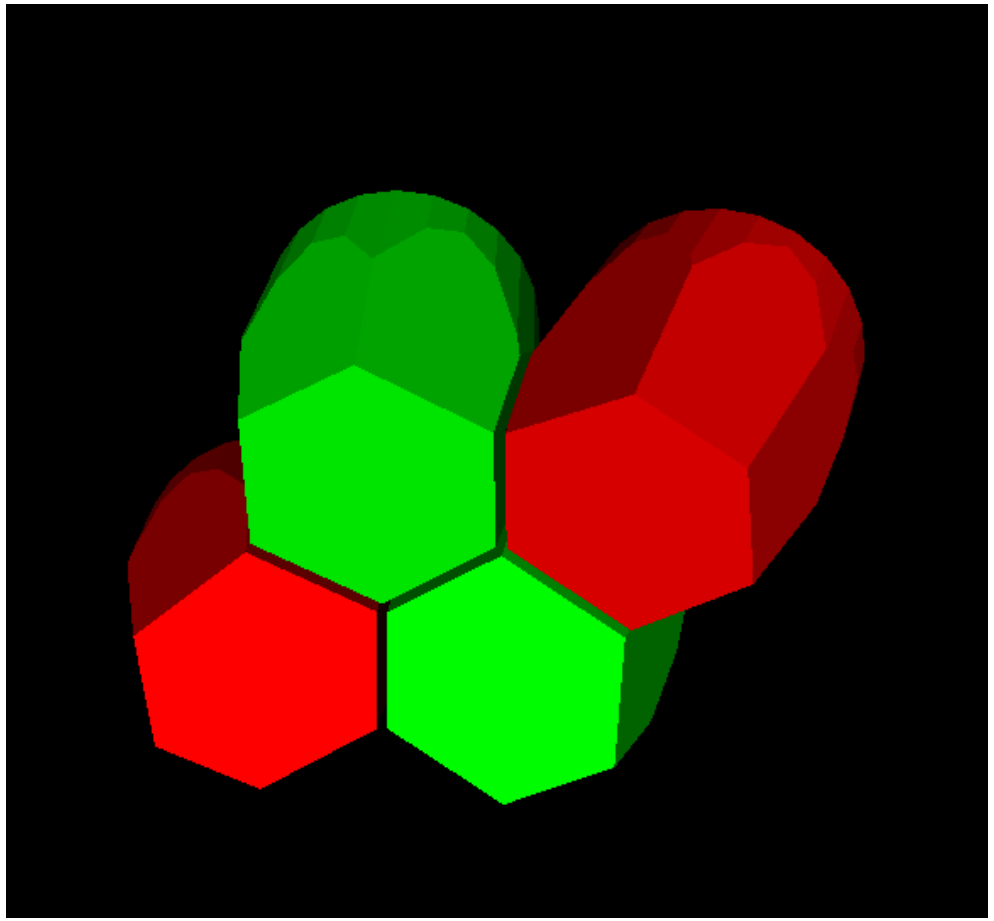
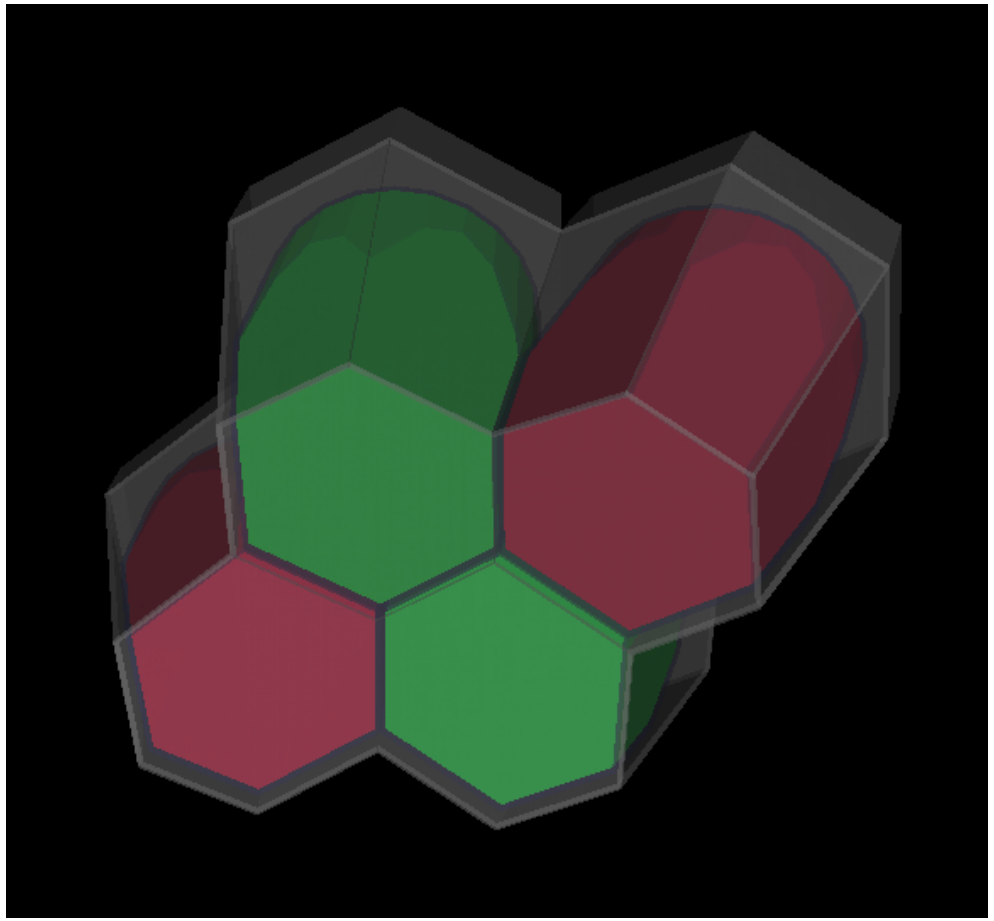
GRETINA/GRETA Geometry
adopted from the AGATA simulation code

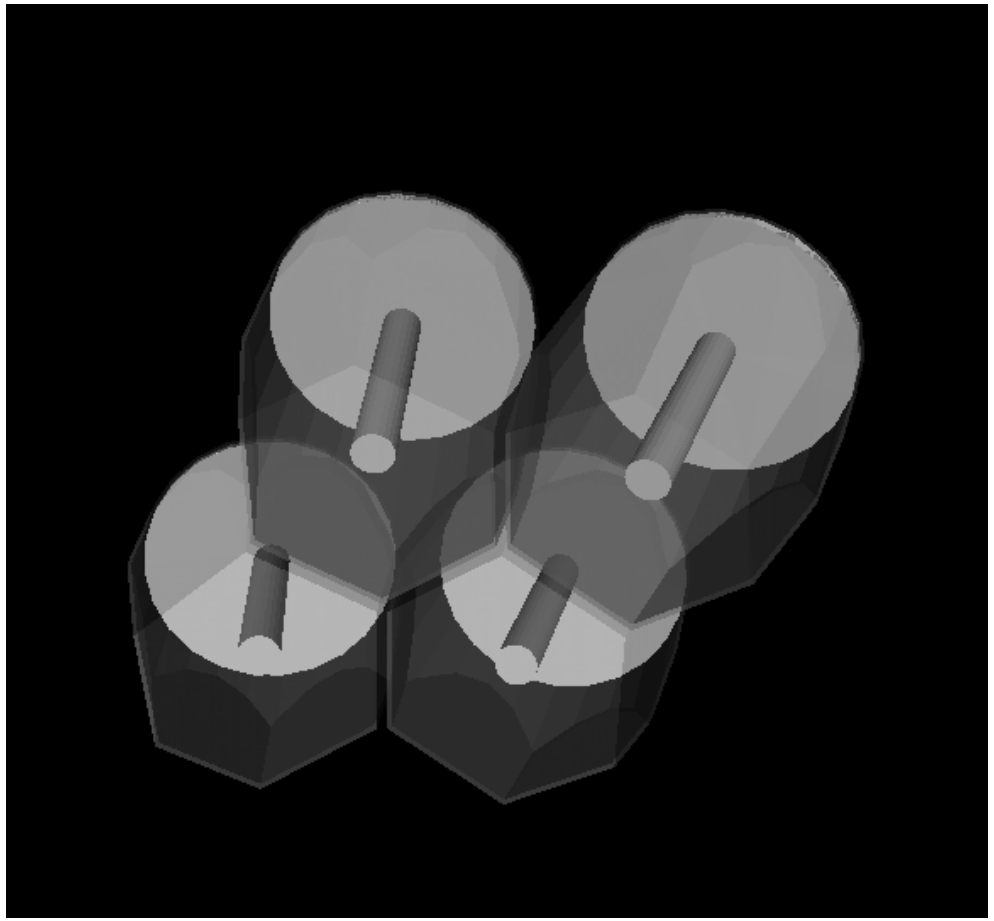


GRETINA/GRETA Geometry

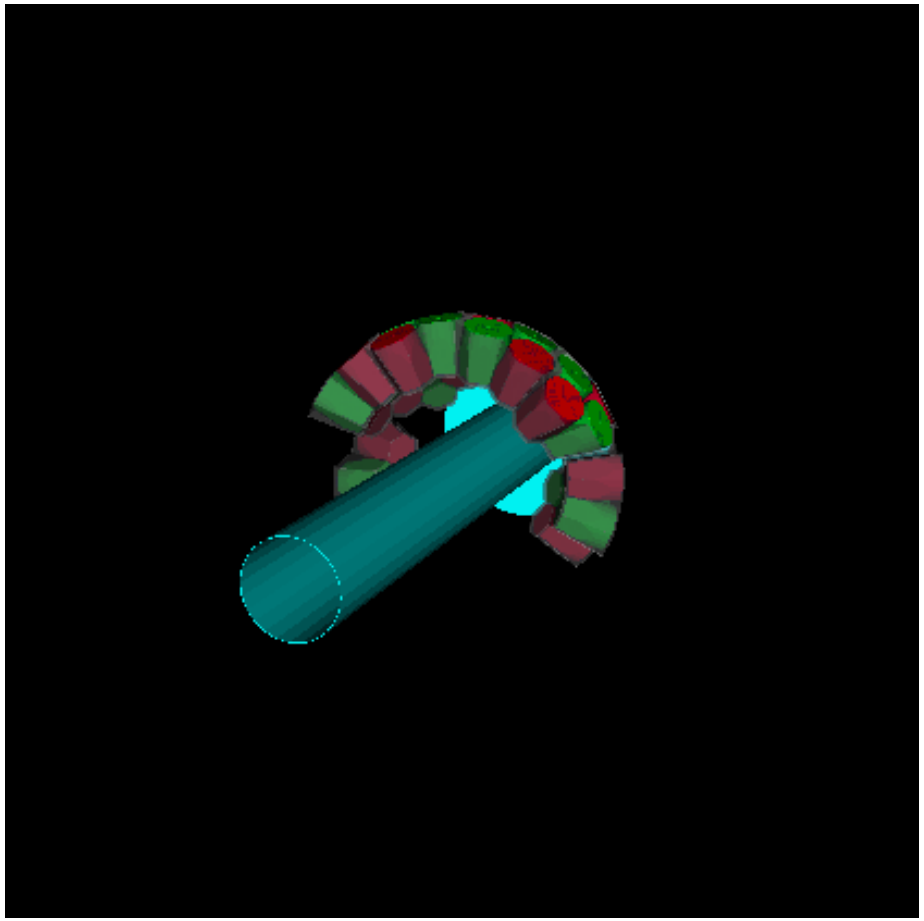
… with modified capsules and cryostat walls …



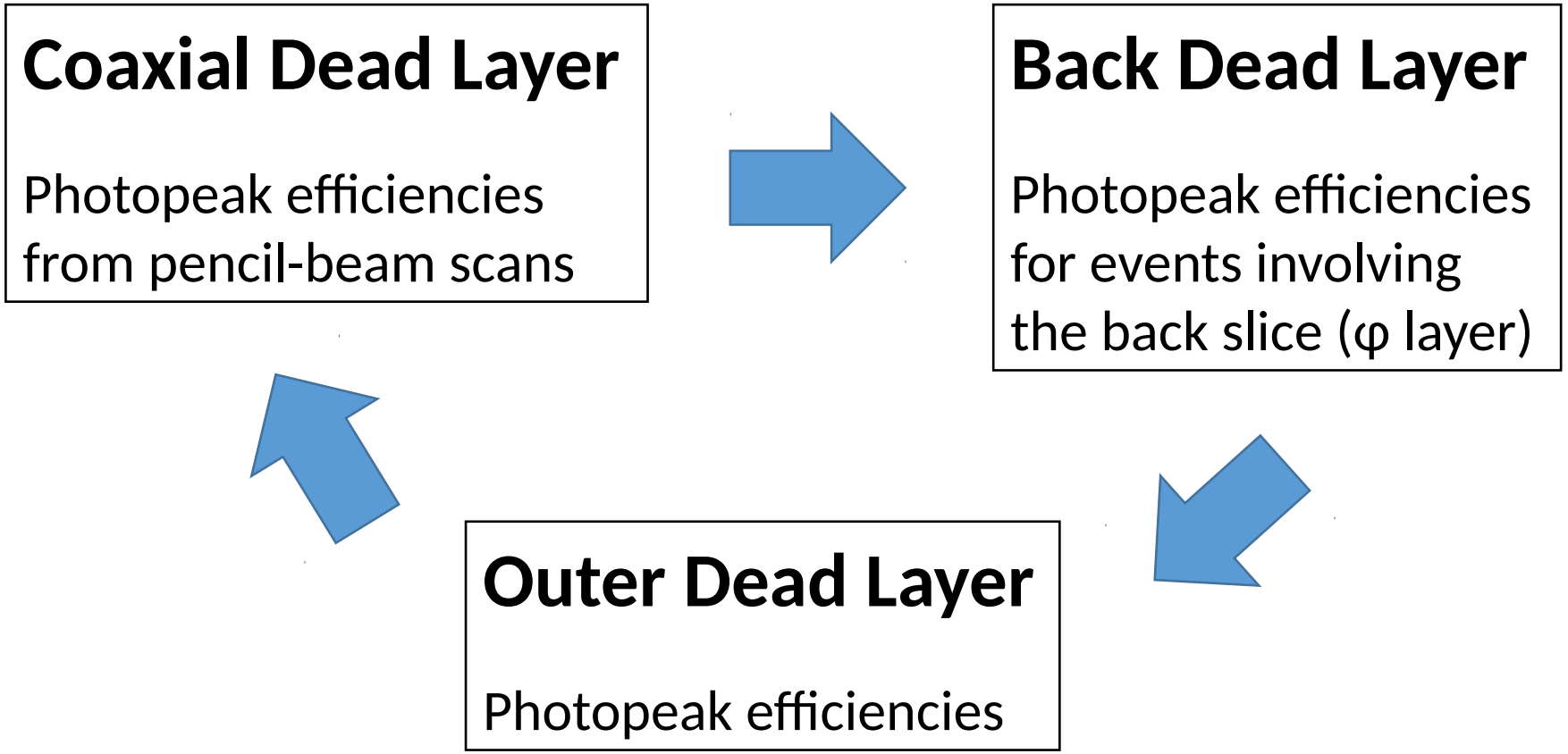
GRETINA/GRETA Geometry
… and back, coaxial, and outer dead layers …



GRETINA/GRETA Geometry
… and a beam pipe/flange

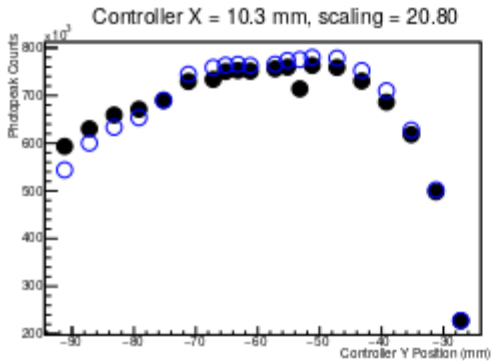


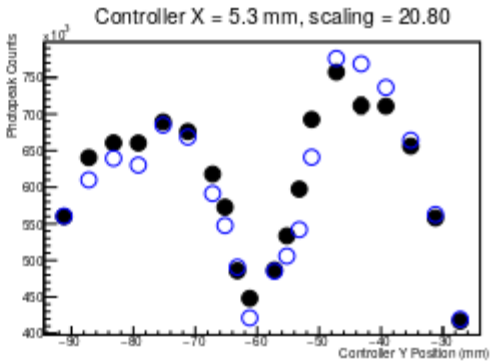
GRETINA/GRETA Geometry
constraining dead layers: Q4, Crystal 4

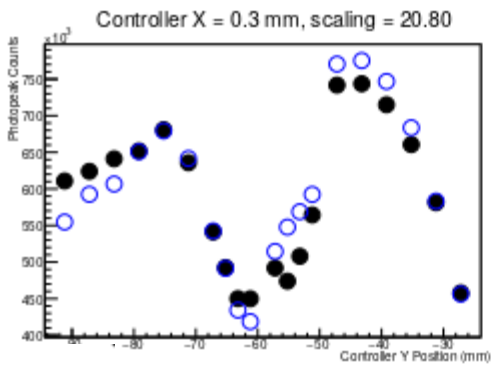


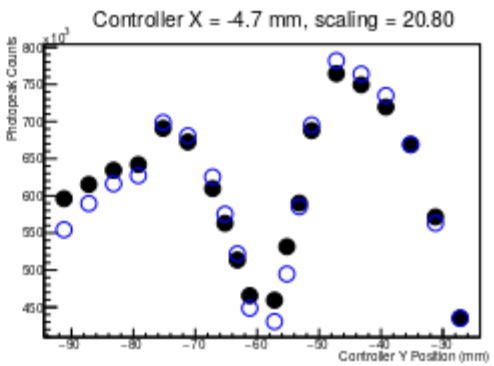
GRETINA/GRETA Geometry

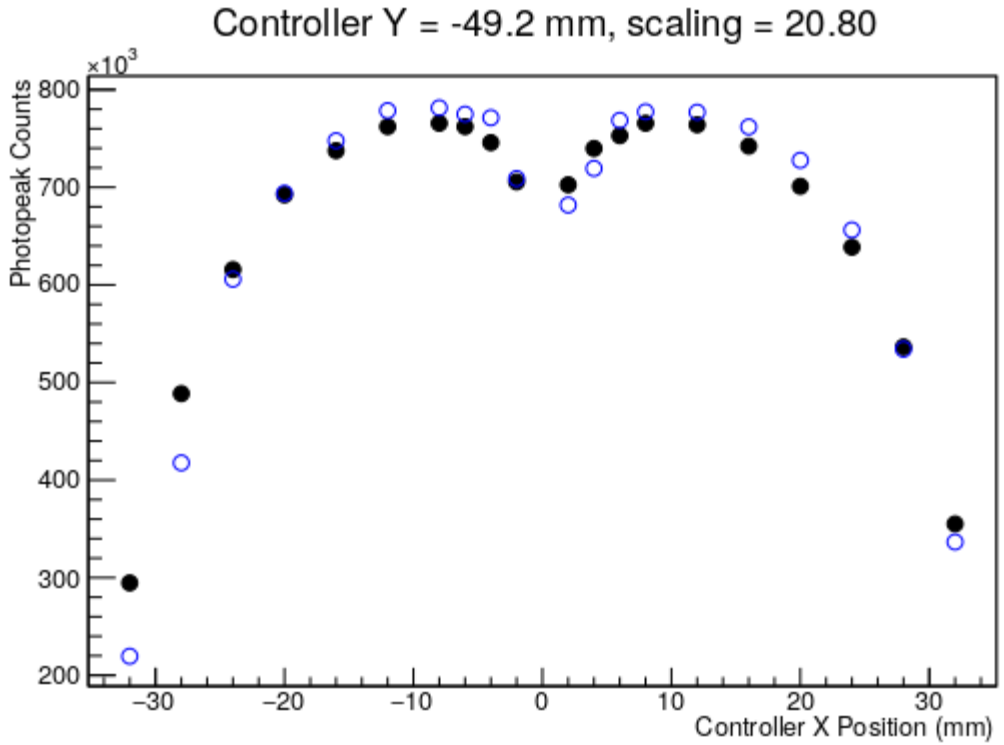
constraining dead layers: Pencil-beam scans Q4, Crystal 4







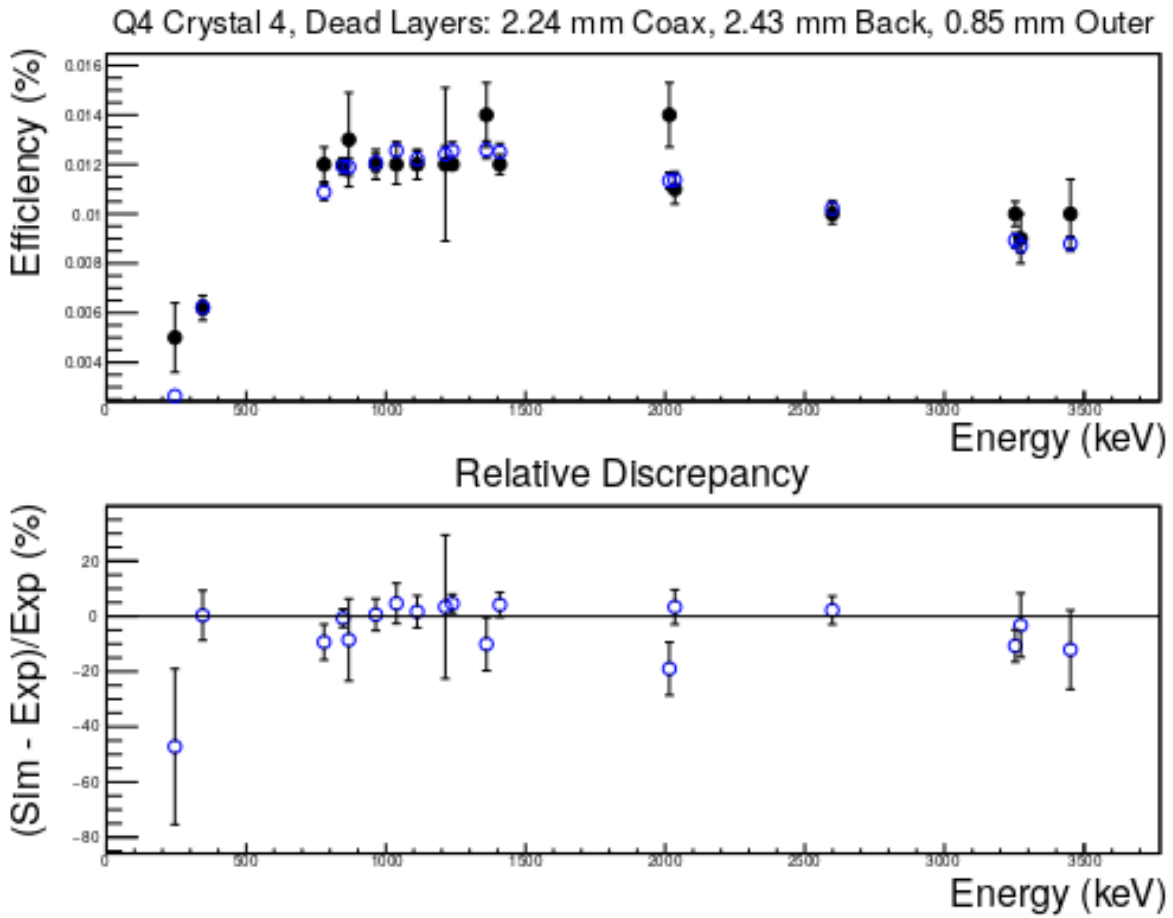




BERKELEY LAB
Lawrence Berkeley National Laboratory

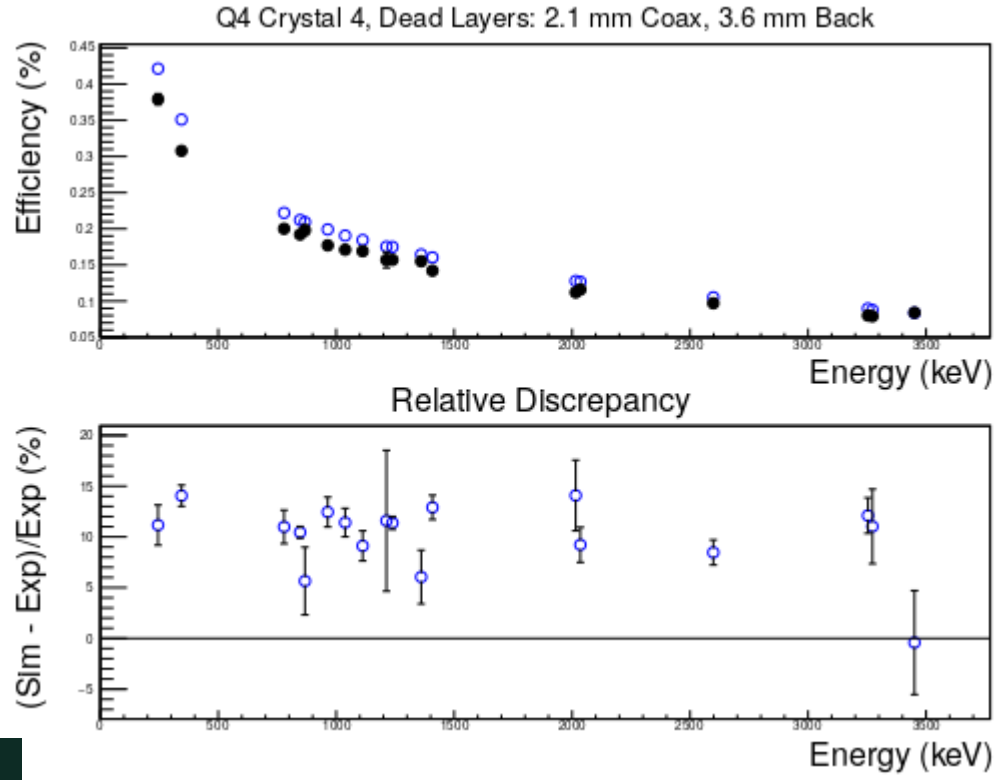
Best-fit coaxial dead-layer thickness = 2.24(6) mm

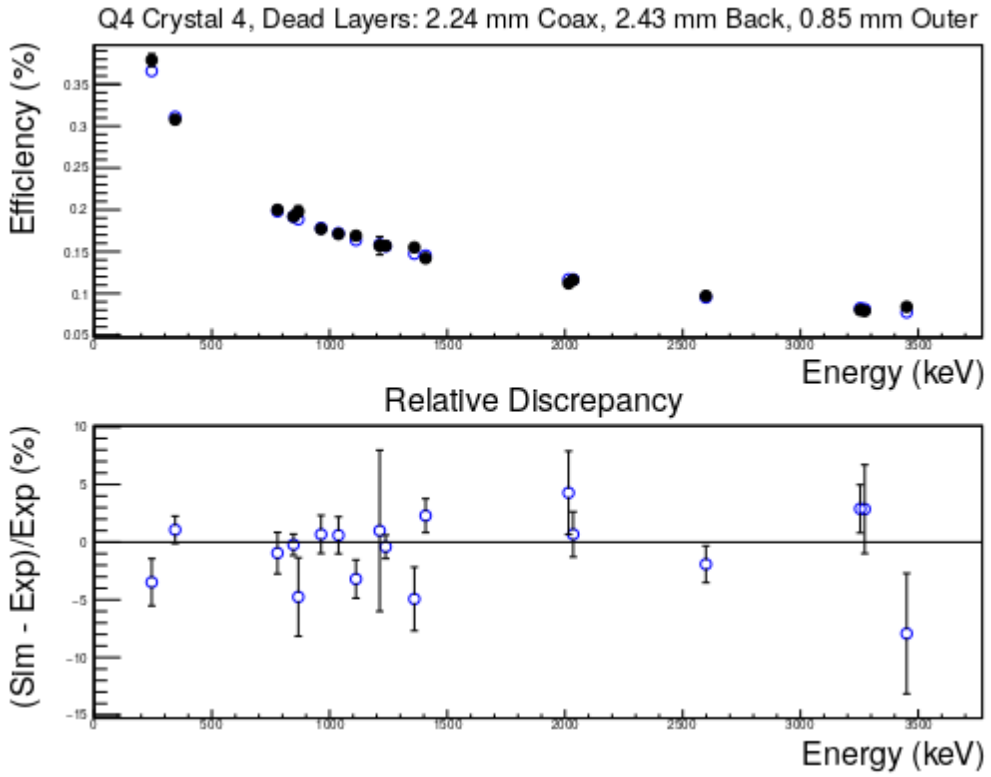
GRETINA/GRETA Geometry
constraining dead layers: back slice Q4, Crystal 4



Best-fit coaxial dead-layer thickness = 2.43(12) mm

GRETINA/GRETA Geometry
constraining dead layers: Q4, xtal4 photopeak efficiencies



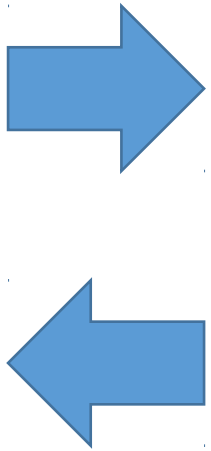


Best-fit outer dead-layer thickness = 0.85(2) mm

GRETINA/GRETA Geometry
constraining dead layers: 8 Quads

Coaxial & Outer Dead Layers

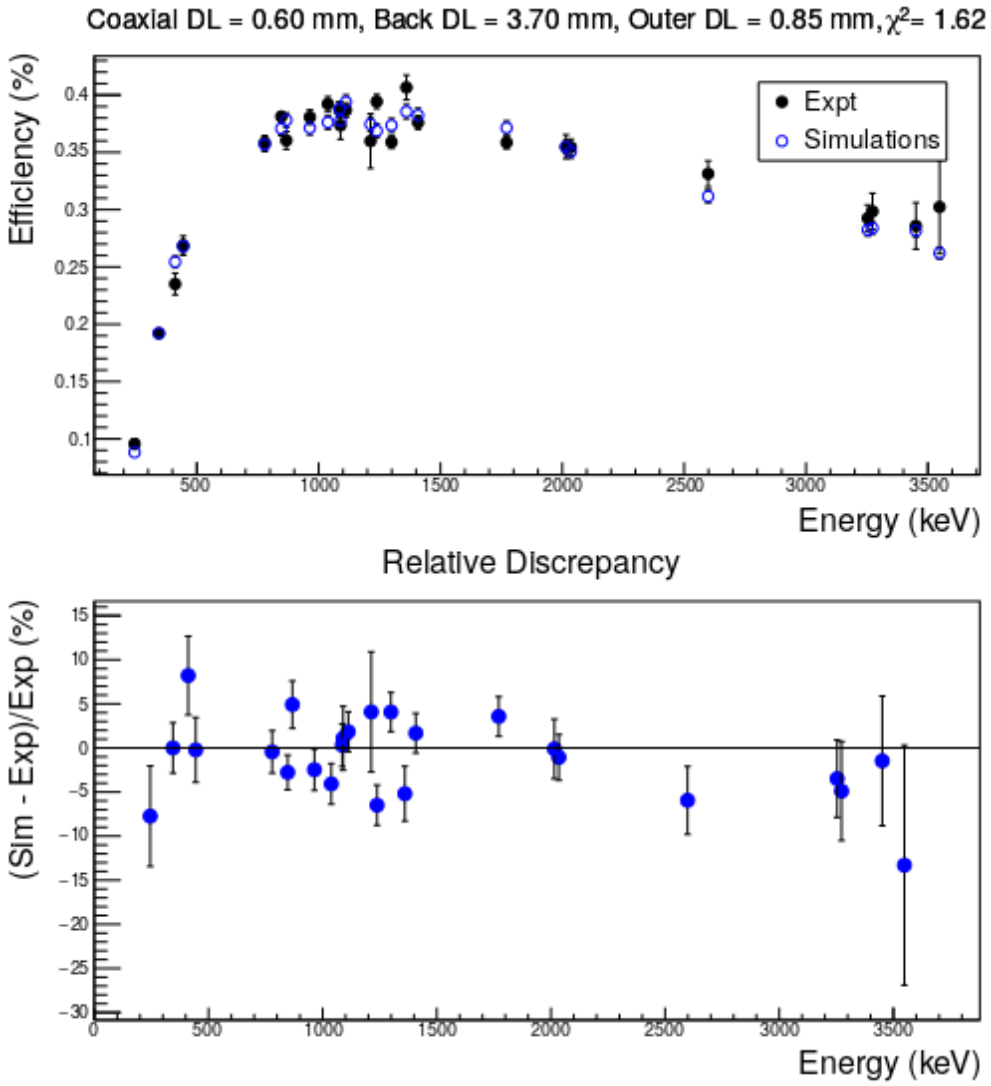
Photopeak efficiencies
(no pencil beam scans)



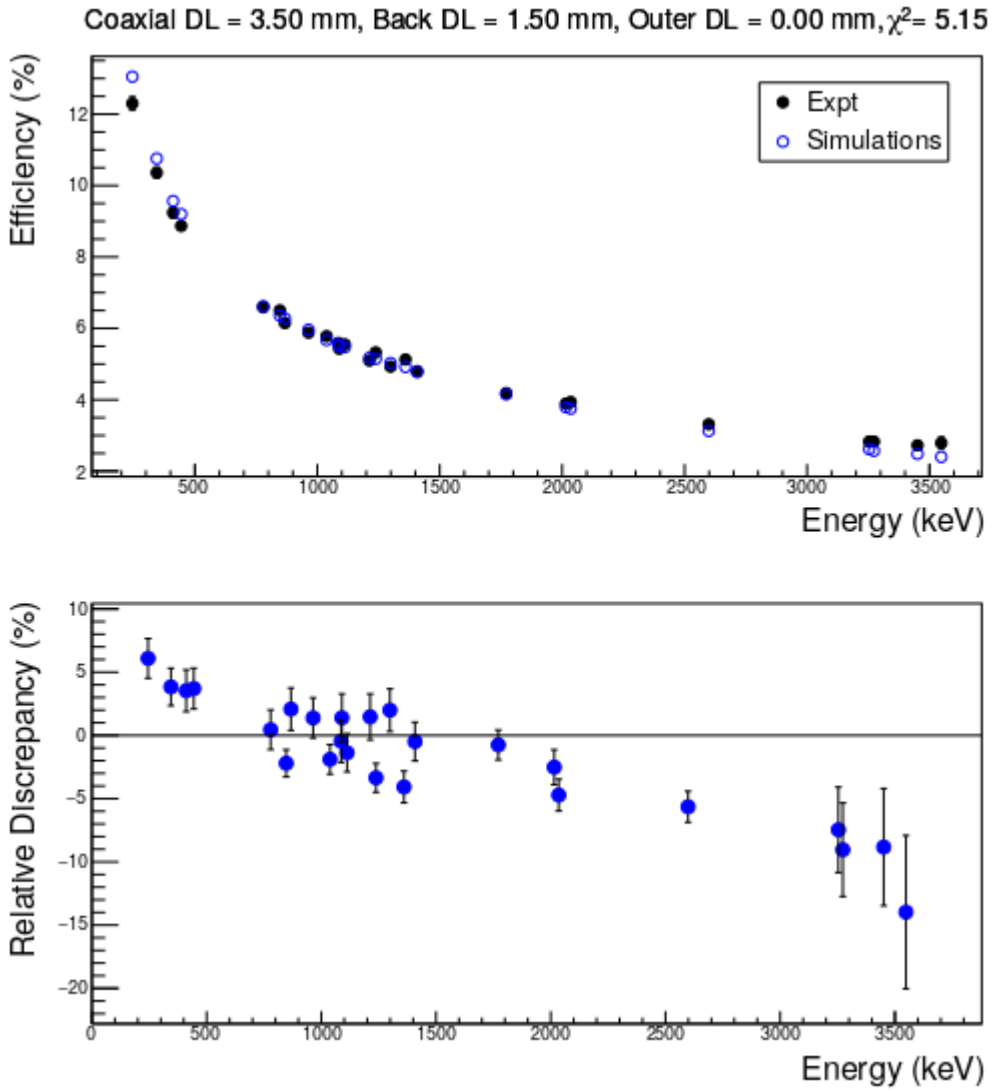
Back Dead Layer

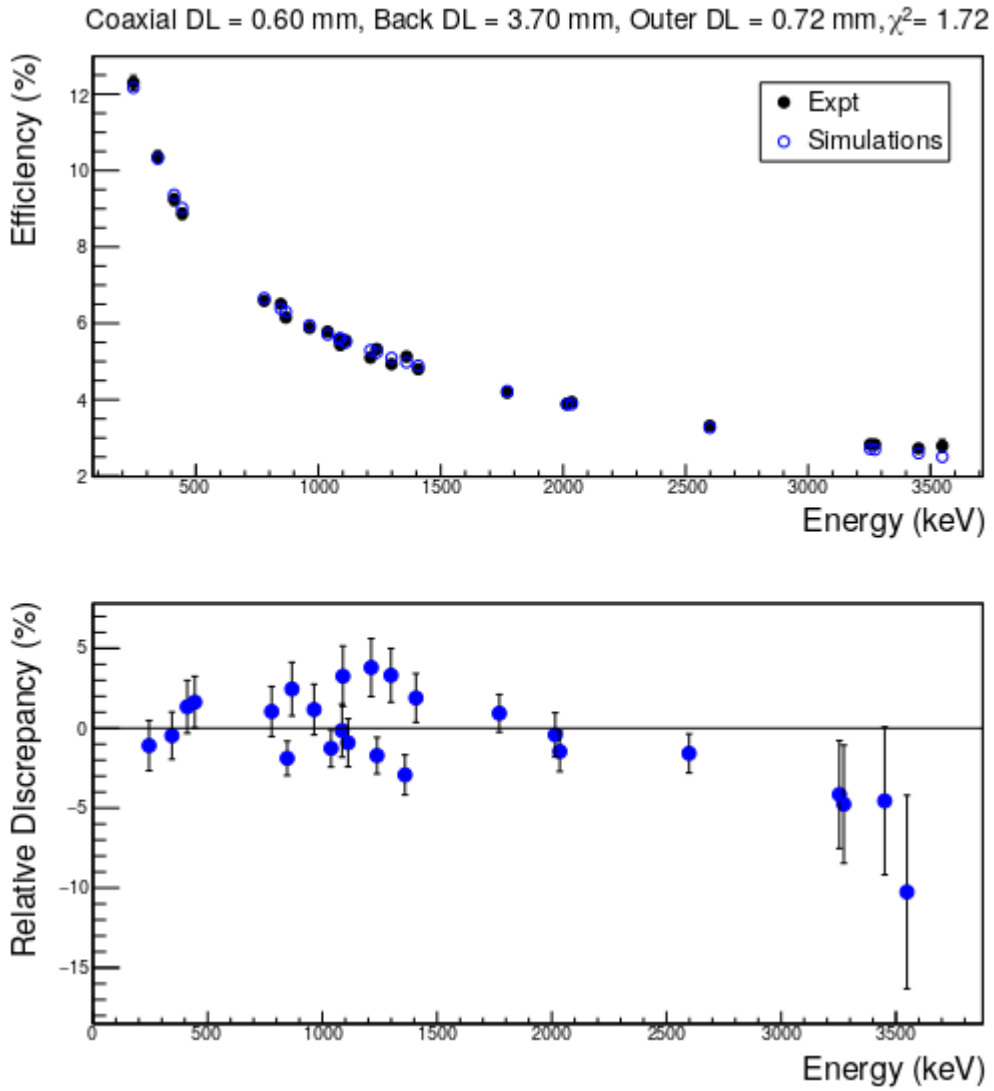
Photopeak efficiencies for events involving the back slice (φ layer)

Efficiencies Involving φ Layer, 8 Quads: ^{152}Eu, ^{56}Co



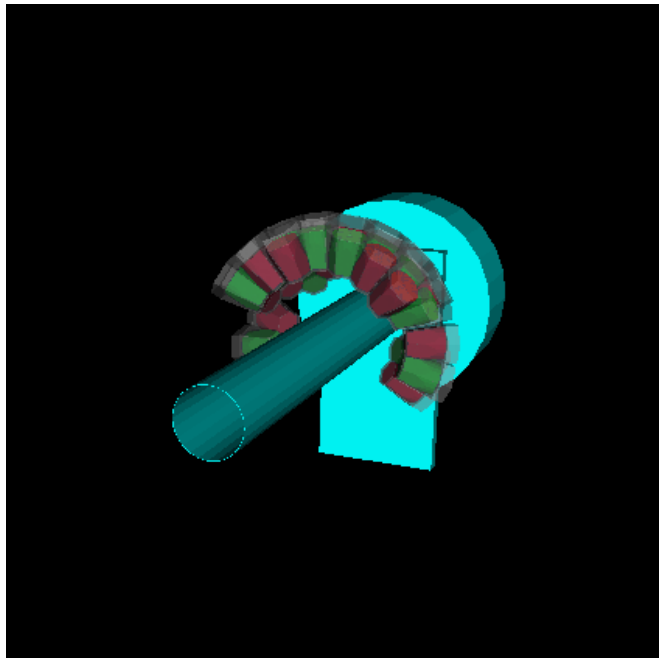
Photopeak Efficiencies, 8 Quads: ^{152}Eu, ^{56}Co

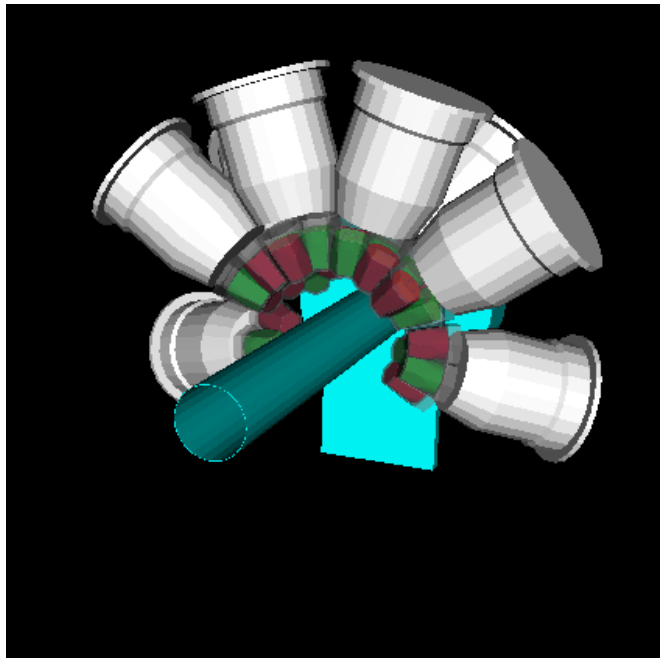


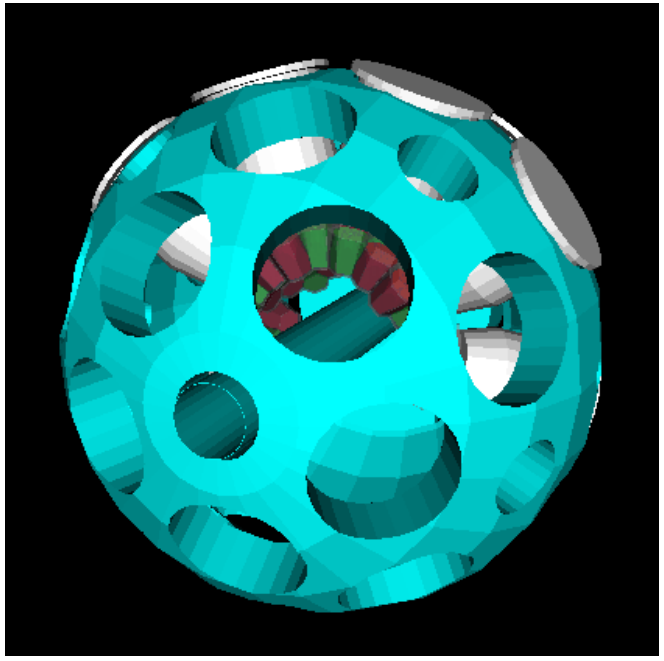


NSCL

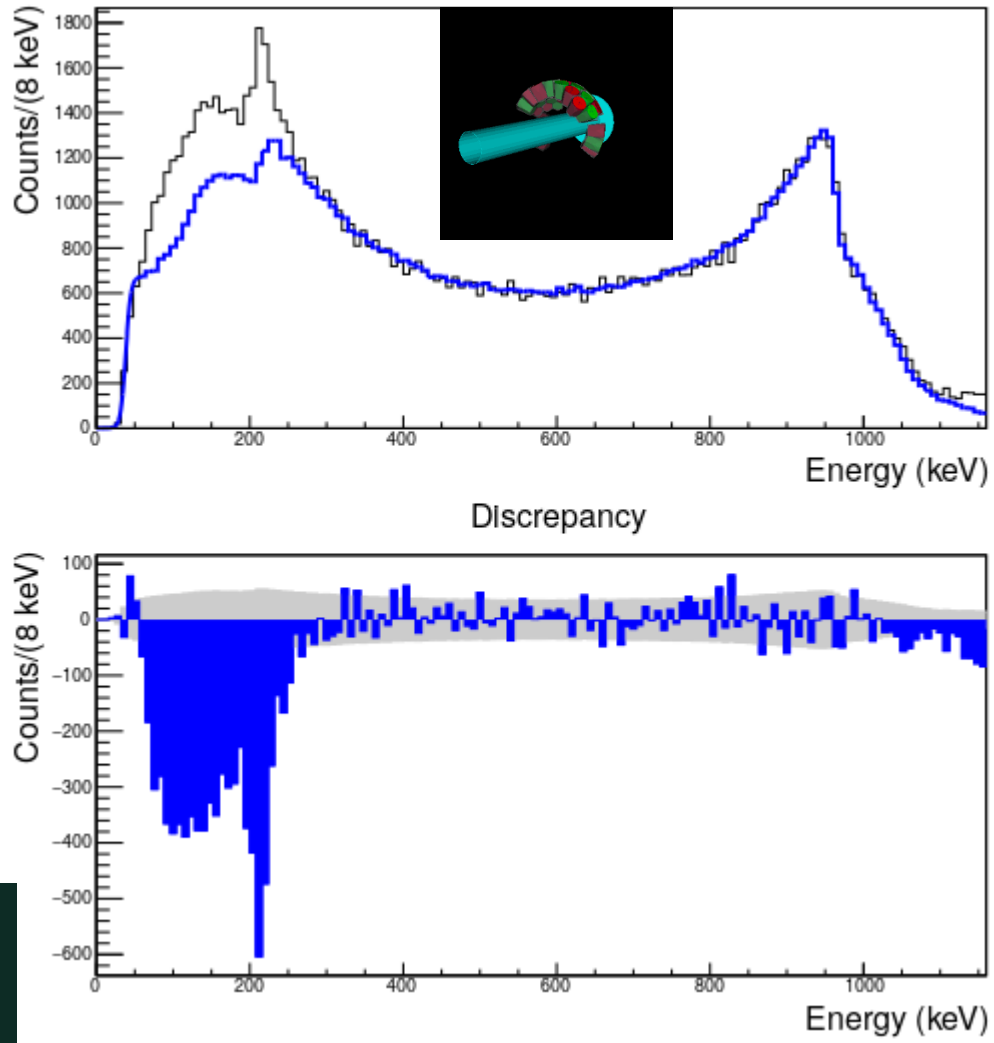
GRETINA/GRETA Geometry
… and additional dead material

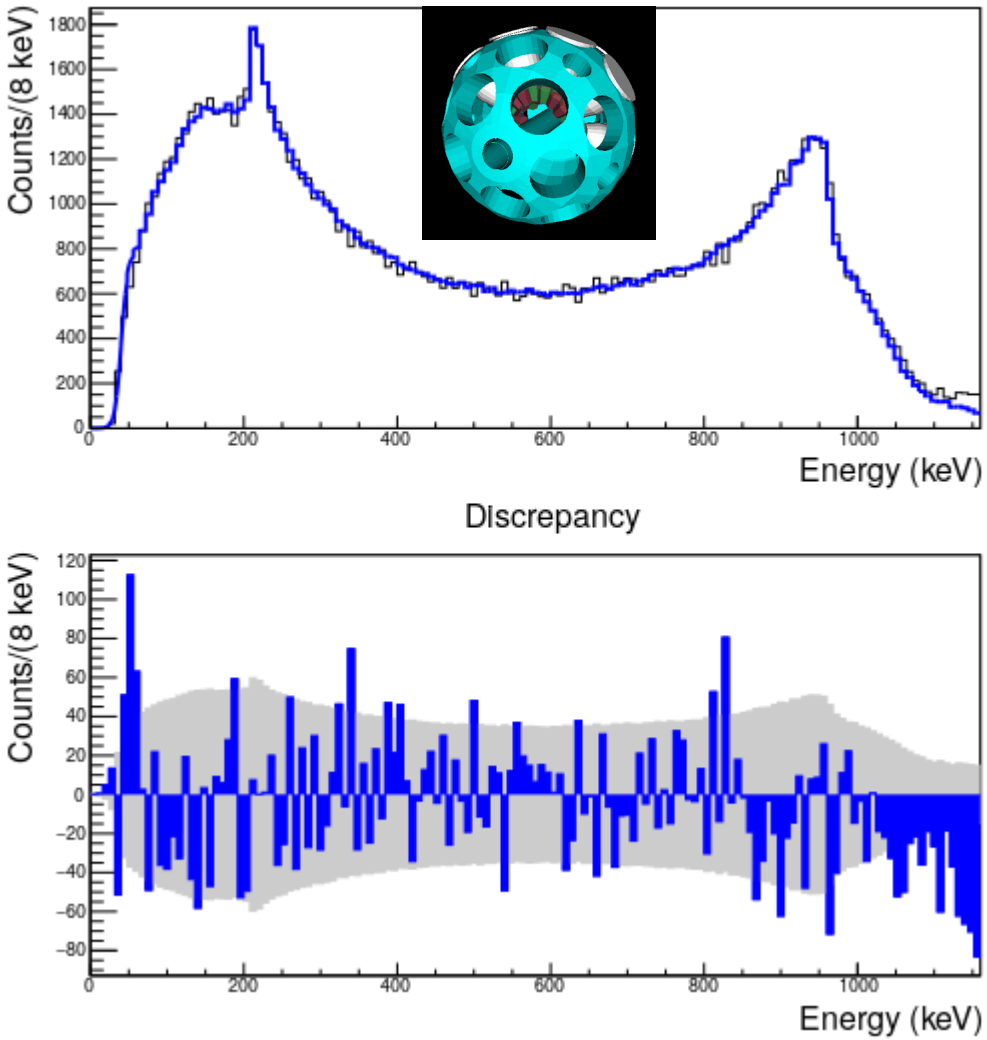






LaBr-Gated ^{60}Co: Compton Continuum





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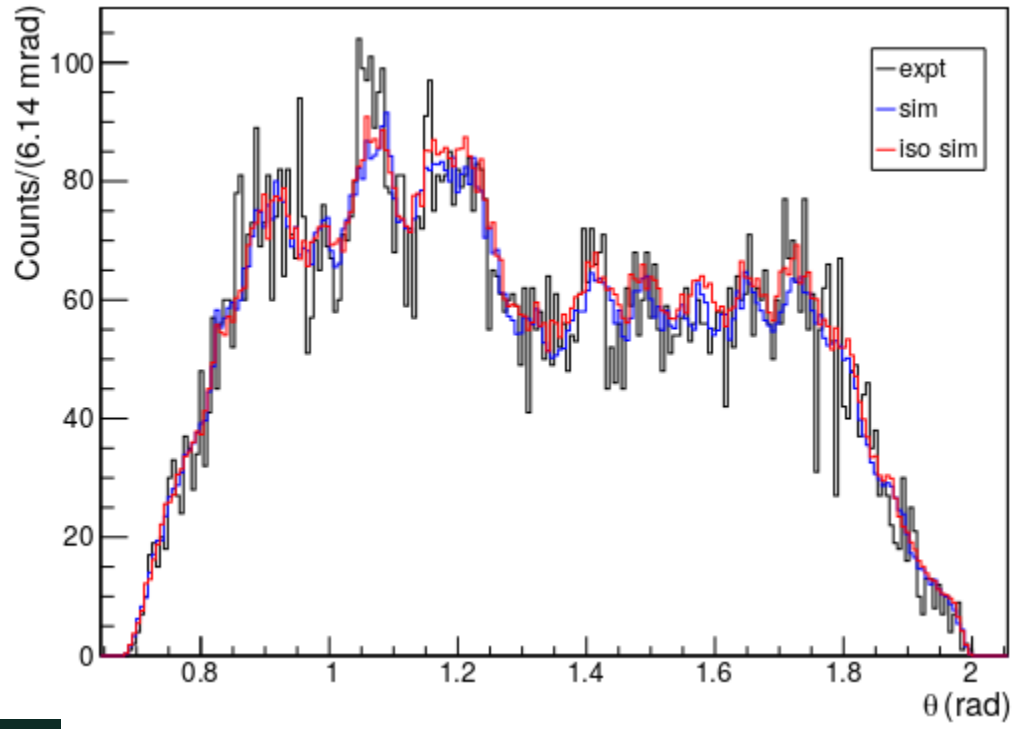
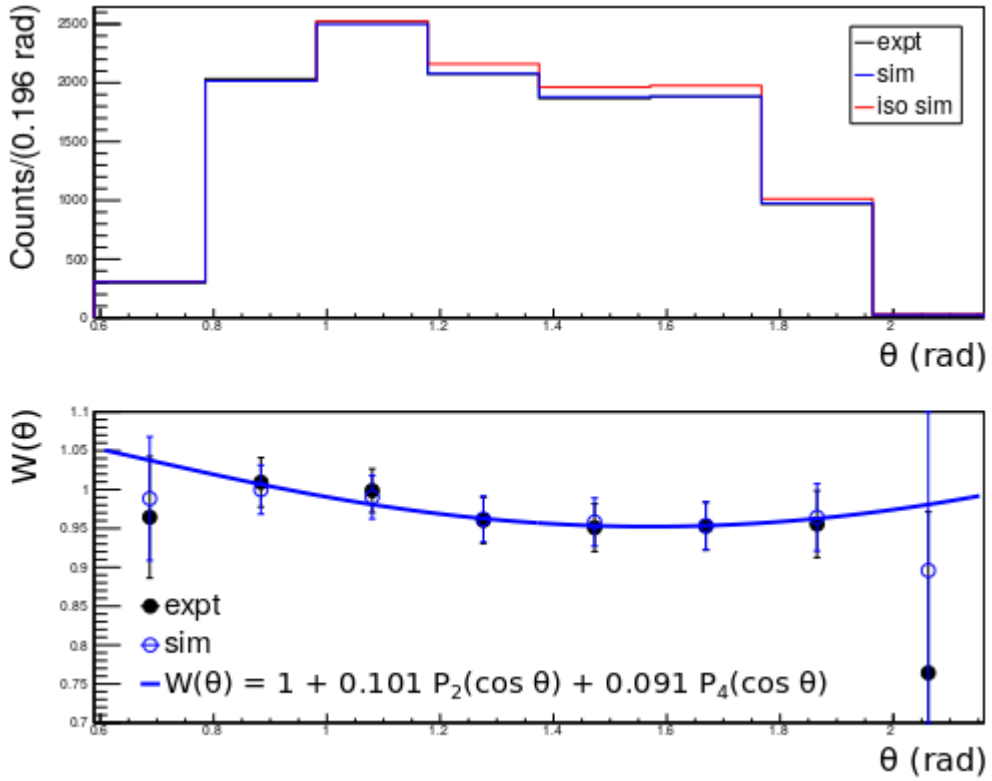
LaBr-Gated ^{60}Co: Angular Correlations





In Beam: Ion Tracking, Reactions, and γ Decay

- **Beam/Beam-Like Reaction Product** (GenericIon Class)
  - Tracked through the target and to the S800 quadrupole
  - Incoming kinetic energy
    - Option 1: Mean KE and dp/p
    - Option 2: User-supplied incoming KE distribtution
  - Relativistic 2-body reaction kinematics
- **γ decay in flight**
  - Option 1: Single transition
  - Option 2: User-supplied partial level scheme
    - Level lifetimes
    - Angular correlations

γ Tracking

- **Raw data:** "hits" depositing energy in active detector volumes
  - Primary particles (emitted γ rays)
  - Secondary particles (scattered electrons, scattered γ rays, pairs)

- **First pass:** consolidate secondary electrons with each Compton-scattering interaction

- **Second pass:** Consolidate multiple interaction points within each segment
  - User-specified "packing resolution" (6 mm?)
  - IP positions: barycenters of consolidated hits

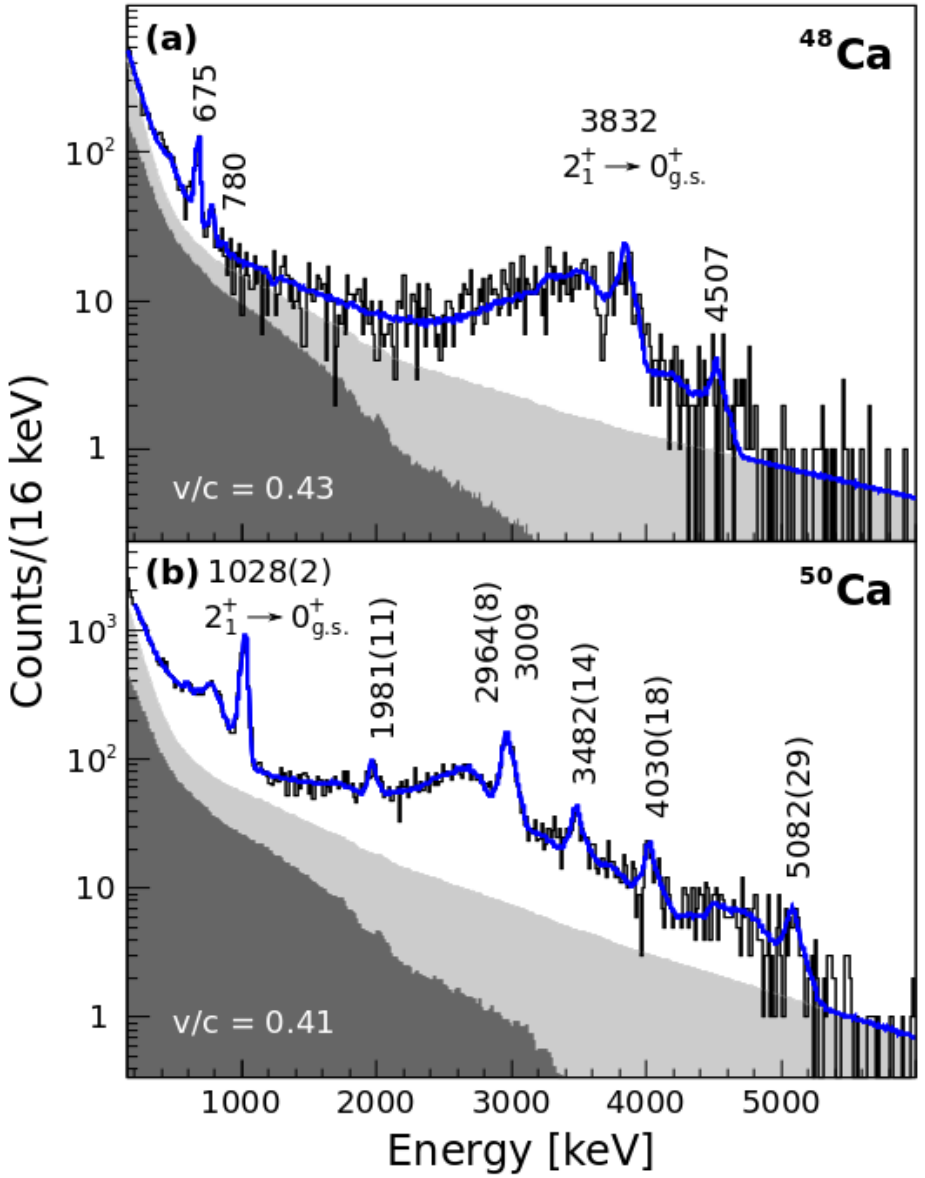
In-beam

Inverse-kinematics (p,p')

GRETINA @ NSCL

30 mm LH Target
≈50 pps

L. RIley et al., PRC**90**, 011305(R) (2014)



Output

- **Decomposed γ-ray packets** (Mode 2 data, Type 1)
- **S800 physics data packets** (Type 9)
- **Emitted γ-ray packets** (Type 11)
  - Number of emitted γ rays
  - Full-energy flag (multiplicity 1, full energy in one crystal)
  - For each emitted γ:
    - Energy
    - Emission position (x, y, z)
    - Emission direction (theta, phi)
    - Source beta
- User sorting code must fold in thresholds, energy & position resolution

Ongoing / Future Work

- Geometry/Efficiencies
  - Update efficiencies and the dead-layer model for the full 11 (or 12) quads
  - Understand variations in dead layers – pencil-beam scans of a sample of crystals
  - Implement realistic segmentation
- Continued work on angular distributions/correlations
- Response to neutrons
- Investigate Geant4 modeling of polarization
- Evaluate Addback and Tracking
  - Determine packing resolution empirically (hit multiplicity?)
  - How to handle background?
  - Test cases?
- Additional reaction kinematics (fragmentation, knockout, pickup, e.g.)

Thank You!

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Thank You!

Heather Crawford

Dirk Weisshaar, Remco Zegers, Charlie Hultquist

Samantha Wildonger (UC `12), Michael Agiourgousis (UC `13), Ben Roberts (UC `13), Bryan Sadler (`14), Ethan Haldeman (UC `18), Chase Stine (UC `18), Jonathan Kustina (UC `16), Sean Gregory (UC `17) Esther Lawson-John (UC `20)

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