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DRiFT Stilbene Simulations for the NEUANCE Detector Array

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XCP: Computational Physics Division

XCP-3: Monte Carlo Methods, Codes, and Applications

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Maria Isabel Pinilla (XCP-3)

- Educational Background
 - B.S. Mechanical Engineering, KSU, 2014
 - M.S. Student
- XCP: Computational Physics Division
 - XCP-3: Monte Carlo Methods, Codes, and Applications
 - Mentor: Madison Andrews
 - Co-mentor: Mike Rising
- Research
 - Summer: Adding stilbene simulation capabilities to DRIFT
 - M.S.: Radiological source replacement for oil well logging applications

Research Overview and Motivation

- **Improve ability to simulate detector response functions through the use of MCNP associated tools**
 - MCNPTools
 - Detector Response Function Toolkit (DRiFT)
 - Currently under development
 - Uses MCNPTools to read PTRAC files
 - Generates detector response functions for scintillators
 - Previously validated with EJ-301 measurements
- **Stilbene research is gaining momentum in nonproliferation applications**
 - New crystal growth technique, larger crystals
 - Higher light output and better PSD performance than EJ-309
- **NEUANCE Detector Array at LANSCE**
 - Composed of 21 stilbene crystals
 - Measurements at NEUANCE can provide validation for correlated fission and detector cross-talk models

Research Approach

• MCNP

- Light output function (DE/DF tally treatment card) - neutrons
 - W. Hansen, NIM in Phys. Res., 2002
 - M.M. Bourne, University of Michigan dissertation, 2016
- Gaussian Energy Broadening (GEB tally treatment card) - neutrons & gammas
 - Iterative MC simulation with Compton kinematics-based GEB approach, C. Kim, NIM, 2015

Fig 1: Gaussian fit to experimental spectrum

Fig 2: Iterative GEB fit

• GEB constants:

- $a = -0.0572$
- $b = 0.2497$
- $c = -0.4321$

• DRiFT stilbene processing capabilities

- Light output function
- Light emission spectrum (a)
- Neutron and gamma pulse shapes (b)
- PMT quantum efficiency (c)

Fig 3: (a)

Fig 4: (b)

Fig 5: (c)

Summary of Results

- Gamma-rays

Fig 6: DRiFT Gamma-ray Results

Fig 7: MCNP v. DRiFT Low-Energy Comparison

Summary of Results

- Neutrons

Fig 6: MCNP and DRIFT Cf-252 Simulation Results

Summer Fun

Snowing in May in Los Alamos

IRRMA X, Chicago, IL