Illinois Wesleyan University
Digital Commons @ IWU

John Wesley Powell Student Research Conference

2012, 23rd Annual JWP Conference

Apr 14th, 9:00 AM - 10:00 AM

Monte Carlo Simulations of Electron Scattering Experiments

Alan Russian
Illinois Wesleyan University

Bruno deHarak, Faculty Advisor
Illinois Wesleyan University

Mark Liffiton, Faculty Advisor
Illinois Wesleyan University

Follow this and additional works at: http://digitalcommons.iwu.edu/jwprc

Part of the Computer Sciences Commons

Alan Russian; Bruno deHarak, Faculty Advisor; and Mark Liffiton, Faculty Advisor, "Monte Carlo Simulations of Electron Scattering Experiments" (April 14, 2012). *John Wesley Powell Student Research Conference.* Paper 16.
http://digitalcommons.iwu.edu/jwprc/2012/posters/16

This Event is brought to you for free and open access by The Ames Library, the Andrew W. Mellon Center for Curricular and Faculty Development, the Office of the Provost and the Office of the President. It has been accepted for inclusion in Digital Commons @ IWU by the faculty at Illinois Wesleyan University. For more information, please contact digitalcommons@iwu.edu.
©Copyright is owned by the author of this document.

Monte Carlo Simulations of Electron Scattering Experiments

Alan Russian, Dr. deHarak, and Dr. Liffiton

Computer Science and Physics, Illinois Wesleyan University

Research Question

- Is it necessary to account for the following details when modeling electron scattering experiments?
  - True Interaction Volume When Using a Moveable Gas Mount
  - Gaussian Laser Distribution
  - Cosine-Squared Gas Distribution
- Experiments typically have a 10% error. Are these approximation errors greater than 10%?

Methodology

- Used a Monte Carlo Simulation: Performed operations on random points that represented electrons
- Written in Python
  - Used SciPy for Graphing
  - Used PyQt for GUI
  - Over 600 Lines of Code

Program Screenshots

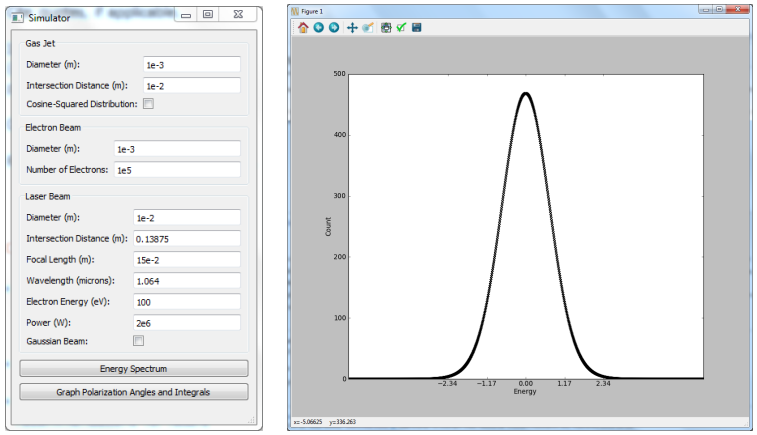

Figure 1. Parameter Window and Energy Spectrum

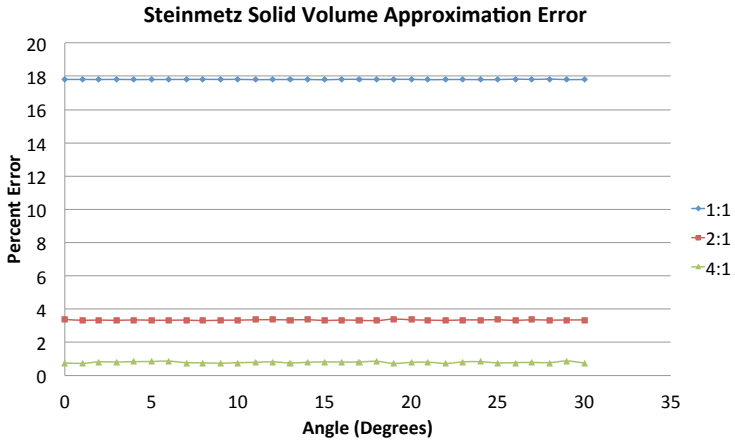

Figure 2. Approximation error of Steinmetz solid volume using a line/cylinder approximation

Results and Data Analysis

- Percent error of two cylinder interaction volumes when using line/cylinder approximation is displayed in *Figure 2*.
- Adding a Gaussian distribution to the laser alone does not make a difference of over 10%.
- Adding a cosine-squared distribution to the gas jet as well as the Gaussian distribution laser makes over a 10% difference when looking at 2 photons and above.

Conclusion

- A line/cylinder approximation for intersection volume cannot be used when the ratio of cylinders is approximately 1:1.
- One needs to take into account the cosine-squared gas distribution and the Gaussian distribution laser when looking at the absorption of two or more photons.