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| **Student project at European Spallation Source Data Management and Software Centre** |  |

**Improving variance reduction in McStas Union components**

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| Supervisor | ? | Code difficulty | ★★★★☆ |
| Co supervisor | Mads Bertelsen | Physics difficulty | ★★★★☆ |

DESCRIPTION

Neutron scattering is an investigative technique that examines matter at the atomic scale, particularly the distances between atoms in crystals. This process involves placing a sample in a neutron beam. By analysing the scattering patterns of these neutrons, researchers can infer the sample's properties. Instruments used in these experiments are highly specialized for various types of samples and scattering methods.

The European Spallation Source, nearing completion in Lund, Sweden, houses 15 such instruments. These instruments have all leveraged Monte-Carlo ray-tracing for their design, a method that predicts performance in terms of neutron intensity on the sample and the resolution of detected signals. McStas is a popular software tool for this purpose and mainly developed in Denmark, and recent developments have allowed users to make detailed simulations of sample environments using Union components. These allow multiple scattering between all geometries, sampling a great number of possible neutron paths.

This project focuses on improving the variance reduction in the Union components, which at present only allows setting the scattering probability and a distribution between scattering processes. Allowing for example to have separate probabilities for the first and subsequent scattering would be an improvement. The project will also include a comparison of data with and without the improved statistics, investigating if the method introduces any bias.

REQUIREMENTS

Experience with the programming language C (Python is a benefit as well)

Some experience with condensed matter physics