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

**Numerical optimization of Monte-Carlo ray-tracing simulation of neutron scattering instrumentation using McStas and McStasScript Python API**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | |  | |
| Supervisor | ? | Code difficulty | | ★★★★☆ |
| Co supervisor | Mads.Bertelsen@ess.eu | 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 analyzing 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.

This project aims to enhance McStas by integrating numerical optimization capabilities into its Python API, McStasScript. This improvement involves two key aspects: firstly, embedding this functionality into McStasScript, and secondly, applying this enhanced capability in practical scenarios. Potential applications include designing a neutron filter to eliminate high-energy neutrons from the beam, optimizing a detector system, or improving sample environment conditions.

REQUIREMENTS

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

Some experience with condensed matter physics