bem: Modeling for Neutron Bragg-Edge Imaging

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1 Summary

Due to its zero net charge, neutron is a unique probe of materials. Low neutron absorption and scattering cross sections by most nuclei make it suitable for studying bulk samples. Unlike X-ray scattering, neutron form factors are not monotonically dependent of atomic numbers; the fact that the neutron scattering cross section of hydrogen is large makes neutron a useful tool in biology. In the past half century, Neutron imaging has seen growing applications in various scientific fields including physics, engineering sciences, biology, and even archaology [1].

With energy-resolved neutron imaging techniques, Neutron Bragg-edge imaging has recently found applications for materials science in phase mapping, stress/strain mapping, and texture analysis [2, 3]. To model Bragg-edge neutron imaging data, it is necessary to calculate the total neutron cross section of a sample. This open-source python package provides easy-to-use functions to calculate coherent elastic (diffraction), incoherent elastic, coherent inelastic, and incoherent inelastic scattering cross sections, as well as absorption cross sections based on approximations and formulas in [4]. Also implemented are algorithms that take into account the March-Dollase texture model, and the Jorgensen peak profile [4].

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