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Novel Neutron Focusing Optics YELENA BAGDASAROVA, MIT — Neutron scattering methods are among the most important tools for studying the structure and dynamics of matter. However, a neutron analog of an optical microscope has not been built so far, mostly because weak interactions of neutrons with most materials preclude making effectiveneutron lenses. The purpose of my research is to investigate and demonstrate the effectiveness of a novel neutron optics that might make neutron microscopy practical. This optics is based on an existing x-ray optics design known as Wolter optics. Its design consists of two confocal mirrors (elliptical or parabolic mirror followed by a hyperbolic mirror) that reflect neutron beams at grazing incidence from one focus to the other. The advantage of Wolter optics is that its geometry satisfies the Abbe's sine condition almost exactly, resulting in near-perfect imaging of small, off-axis objects. Effectiveness of the mirrors is explored by simulating the mirror design in a standard neutron ray-tracing software package. The mirror simulation is used to conduct numerical experiments in order to evaluate performance as a function of the geometry and properties of the mirror and source. The simulated results are compared with tests of real Wolter-type neutron mirrors, conducted at the MIT Nuclear Reactor Laboratory.

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