Neutron Phase Imaging and Tomography using a Grating Interferometer

F. Pfeiffer[1], C. Grünzweig[1], O. Bunk[1], G. Frei[1], E. Lehmann[1], and C. David[1]

[1]Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

We report how a setup consisting of three gratings yields quantitative two- and three-dimensional images depicting the quantum-mechanical phase shifts of neutron de Broglie wave packets induced by the influence of macroscopic objects. Since our approach requires only a little spatial and chromatic coherence it provides a more than two orders of magnitude higher efficiency than existing techniques.

This dramatically reduces the required measurement time for computed phase tomography and opens up the way for three-dimensional investigations of previously inaccessible quantum-mechanical phase interactions of neutrons with matter.

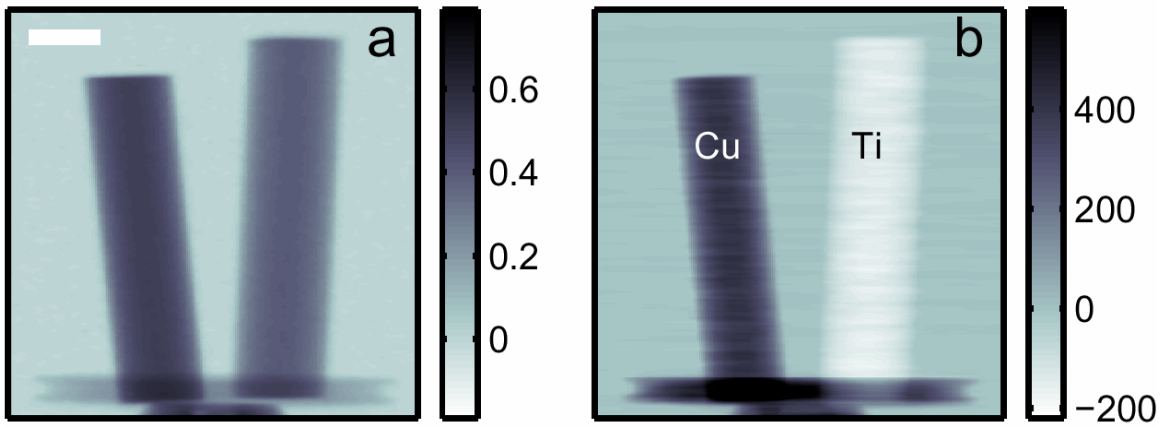

Figure: Conventional neutron attenuation image (a) and retrieved phase image (b) of two metal rods. It is interesting to note that Ti has a brighter color compared to the background, whereas Cu appears darker. This is due to the negative neutron scattering length density of Ti. Consequently, a negative phase shift is measured in the material. The scale bar corresponds to 5 mm.

[1] F. Pfeiffer, C. Grünzweig, O. Bunk, G. Frei, E. Lehmann, and C. David, *Neutron Phase Imaging and Tomography*, Phys. Rev. Lett. **96**, 215505 (2006).