Non-interferometric determination of the Aharonov-Bohm phase shift and its application to imaging the magnetic structure of technological materials

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We show how certain new approaches to the phase problem for non-periodic objects are able to yield quantitative measurements of the famous Aharonov-Bohm phase shift without the need for an interferometer. A practical application of this method is to the quantitative imaging of magnetic vortex structures in high-temperature superconductors by electron microscopy. In this context, note that the use of Lorentz electron microscopy for the study of vortices in superconductors has been the subject of much recent work (see e.g. Nature **397** 308 (1999)). The analysis procedures for the data so produced falls short of a general methodology for extraction of all information (i.e. amplitude and phase) contained in the wavefield. By extending our previously-published techniques (Phys.Rev.Lett. **80** 2586 (1998) & Ultramicroscopy **83** 67 (2000)), we can remedy this and hence make a contribution towards the goal of achieving room-temperature superconductivity.