

Phase retrieval from non-periodic images in the presence of vortices

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Vortices in the phase of non-periodic wave fields are common in classical and quantum mechanics. Examples are vortices in electromagnetic fields, superconductors, superfluids, Bose-Einstein condensates and in imperfect crystals. Some key features of vortex cores are explained and examples of the behaviour of vortex trajectories are given.

We discuss retrieval of the phase of classical and quantal wave fields in the presence of vortices.¹ Methods based on conservation of flux (the transport of intensity equation) assume that the phase is continuous and therefore fail when discontinuities are present in the phase. We demonstrate a practical method of phase retrieval for non-periodic objects that works reliably in the presence of singularities.² This iterative approach uses a series of through focal images. It is numerically stable, robust in the presence of noise and applicable to many areas of physics, including those mentioned above.

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¹ ALLEN, L.J., FAULKNER, H.L.M, OXLEY, M.P. and PAGANIN, D. - Phase retrieval and aberration correction in the presence of vortices in high-resolution transmission electron microscopy, *Ultramicroscopy* 88 : pp. 85-97 (2001)

² ALLEN, L.J., FAULKNER, H.L.M, NUGENT, K.A., OXLEY, M.P. and PAGANIN, D. - Phase retrieval from images in the presence of first-order vortices, *Phys. Rev. E* 63 : 037602 (4 pages) (2001) .