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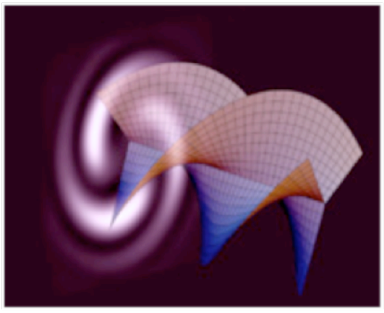

Miles Padgett

Lecture I, II: Optical vortices: Light in a Twist.

A feature of wave superposition is that one plus one does not necessarily equal two. The interference of two equivalent waves can result in a zero intensity – e.g. Young's double slits. However, the waves fill 3D space not just a 2D screen and Young's dark fringes map out planes. But two waves are a special case. In general, when three or more waves interfere, complete destructive interference occurs on lines (phase singularities) around which the phase advances or retards by 2pi. This azimuthal phase gradient means that the Poynting vector, and associated energy flow, circulates too – hence the lines are also called "optical vortices". Despite their appearance in all natural light fields, it was not until the early 1990's that it was recognized that the light surrounding a single line phase singularity carried an angular momentum, completely independent of the photon spin.

This orbital angular momentum can be created using simple lens systems, or holograms - made from 35mm film or encoded onto liquid crystal displays. Both whole beams, and single photons can carry this information, or transfer it to particles to create an optical spanner.

In this talk I hope to introduce the underlying physical properties and discuss a number of manifestations of orbital angular momentum, which highlight how optics still contains surprises and opportunities for both the classical and quantum worlds.