CSU PHYSICS COLLOQUIUM

"Vortices in a propagating laser beam simulate quantum fluid vortex dynamics "

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Monday, April 3rd at 4:00 PM

120 Engineering (Hammond Auditorium)

Abstract

Vortices are fundamental in a variety of fields, from turbulent superfluid helium and atomic Bose-Einstein Condensates (BEC), and even in the sun's swirling atmosphere and dark matter filaments connecting galaxies. We study vortex dynamics in a propagating laser beam, an established formal analogy to quantum fluid dynamics. Optical vortex experiments have a number of advantages, including deterministic programming of the initial position, topology, and shape of each vortex in arbitrary arrangements, direct readout of the evolved complex field, low system cost, and room temperature operation.

In this talk, I will present our recent experimental measurements of the physics of one, two, and many vortices in a propagating laser beam. I will show the following:

1. hydrodynamics explains vortex interaction physics (as it does in quantum fluids),

2. evolving vortices accumulate a programmable and measurable geometric phase,

3. trapped vortex dynamics can be observed in hybrid Bessel modes, and

4. propagation of a high-power laser in a medium allows us to simulate vortex dynamics in a nonlinear quantum fluid.

Biography

Dr. Mark Siemens is a Professor in the Department of Physics and Astronomy at the University of Denver (DU). His research group controls the spatial and temporal shape of lasers to probe and control basic excitations and transport in nanostructures. He is the faculty advisor for DU's Society of Physics Students, which is widely recognized for their physics outreach