Chez Pierre

Presents ...

Monday, November 7, 2011
12:00pm
MIT Room 4-331

Jason W. Fleischer
Princeton University

"Superfluid dynamics of light"

Laser light is naturally coherent, which means that its propagation behavior must be the same as any other coherent wave dynamics in condensed matter physics. A common example is photonic crystals, in which periodic (or quasiperiodic, or random) structures guide light in the same way that electrons are transported in solid materials. When the propagation medium is nonlinear, different parts of a light beam can interact, allowing energy redistribution, instabilities, etc. Here, we establish an optical hydrodynamics by exploiting the mapping between the Gross-Pitaevskii treatment of coherent matter waves and the nonlinear Schrödinger description of paraxial beam propagation. Using laser light in a photorefractive crystal, we experimentally demonstrate superfluid shock waves, vortex flow, and hydrodynamic instabilities. We also consider the approach to the superfluid state by demonstrating classical wave versions of Bose-Einstein condensation and the Berezinskii-Kosterlitz-Thouless transition.