Dynamics of interacting quantum vortices in a paraxial fluid of light

Myrann Baker Rasooli*[1], Tangui Aladjidi , Alberto Bramati , and Quentin Glorieux

[1]Laboratoire Kastler Brossel – Sorbonne Universités, UPMC, CNRS – France

Abstract

The dynamics of quantum vortices and solitons on a smooth inhomogeneous dark background is inversigated by using a paraxial fluid of light made of a near-resonant laser beam propagating through hot rubidium vapor.
We use a spatial light modulator to excite a vortex-antivortex dipole in a superfluid and observe its transition into a solitary-wave solution and backward, in agreement with the seminal predictions of Jones and Roberts.
By employing an analogy with ray optics, we are able to predict the trajectory of the interacting vortices, deriving an effective refractive index from the smoothly inhomogeneous fluid density.
Finally, we examine the compressible and incompressible kinetic energy spectra, alongside the velocity two-point correlation functions, for both the vortex-antivortex dipole and the vortex-free soliton and find scaling laws that offer a direct characterization of the vortices dynamics.

*Speaker