

The Gross-Pitaevskii equation for quantized vortices: application to superfluid helium and to ultracold dilute atomic gases

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In 1961, I was a graduate student at Harvard when Gross and Pitaevskii published their time-dependent non-linear Schroedinger equation. The GP equation describes quantized vortices with a core determined by quantum mechanics. My Ph D thesis “Vortices in an imperfect Bose gas” explored various implications of the GP equation, although it gives only a crude description of superfluid helium. Later, in 1995, the experimental creation of BECs in cold atomic gases changed the situation dramatically because the GP equation describes these systems accurately. In particular, ingenious experiments with cold-atom BECs can directly visualize the dynamics of quantized vortices in real time, in good agreement with predictions based on the GP equation.

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