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Vortices in multiply connected Bose–Einstein condensates

We study minimizers of the Gross–Pitaevskii energy, introduced to model Bose–Einstein condensates (BEC) which are subject to a uniform rotation. This energy is very closely related to the Ginzburg–Landau energy of superconductivity, and an essential feature of the model is the formation of quantized singularities (vortices) in an appropriate singular limit. Following some recent experiments in BEC, we consider condensates with annular (planar) or toroidal (3D) geometry and examine minimizers to determine the presence and location of vortices in the condensate as the rotational speed increases. These questions involve singularly perturbed elliptic systems, and we will use variational methods with sharp estimates on the energy together with some tools from geometric measure theory to study the 3D case.

These results have been obtained in collaboration with L. Bronsard, A. Aftalion and J. A. Montero.