Applied Mathematics

McGill & CRM Applied Mathematics Seminar

2:35 pm Monday 15th March 2004
At McGill, Burnside Hall 1205

"Giant vortex and the breakdown of strong pinning in a rotating Bose–Einstein condensate"

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Coffee and refreshments will be served after the seminar

Abstract: We consider a two-dimensional Ginzburg–Landau model for a Bose–Einstein condensate (BEC) in an anharmonic trap which favors an annular shape for the support of the wave function u. We study minimizers in the Thomas–Fermi limit, as the characteristic length ε tends to 0, for two different regimes in the rotational speed Ω. When Ω is independent of ε we observe that the energy minimizers acquire vorticity for Ω sufficiently large, but the vortices are strongly pinned in the central hole where the potential is negative. In this regime, minimizers exhibit no vortices in the annular bulk of the condensate. There is a critical rotation speed of order $\Omega = O(|\ln \varepsilon|)$ for which this strong pinning effect breaks down and vortices begin to appear in the annular bulk. We derive an asymptotic formula for the critical Ω, and determine the location of nucleation of the vortices at the critical value. These results are related to certain experimental and numerical observations of BEC.