# Projection Optimization Method for Open-Dissipative Quantum Fluids and its Application to a Single Vortex in a Photon Bose-Einstein Condensate

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Open dissipative systems of quantum fluids have been well studied numerically. In view of a complementary analytical description we extend here the variational optimization method for Bose-Einstein condensates of closed systems to open-dissipative condensates. The resulting projection optimization method is applied to a complex Gross-Pitaevski equation, which models phenomenologically a photon Bose-Einstein condensate. Together with known methods from hydrodynamics we obtain an approximate vortex solution, which depends on the respective open system parameters and has the same properties as obtained numerically in the literature. Of particular interest is the manifestation of a radial component in the phase of the condensate wavefunction, which causes a spiral shape, which can be seen in Figure 1.

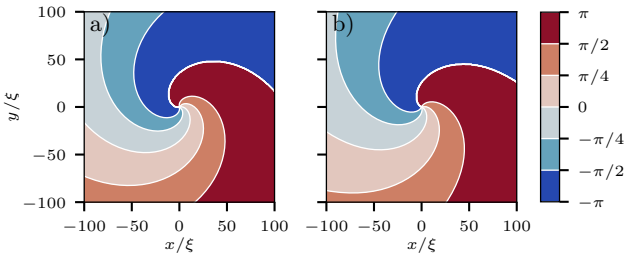


Figure 1: Contour map of the phase around the vortex. The contour lines, shown in white, demonstrate the spiral nature of the vortex. Here a) follows from the projection optimization method, while b) is obtained from the numerical solution