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### **Exact Solutions of the Time-Independent Schrödinger and Gross-Pitaevskii Equations**

MARK NOVOTNY, BHAVIKA BHALGAMIYA, Mississippi State University

A prescription is given to obtain some exact results for certain external potentials  $V(\vec{r})$  of the time-independent Schrödinger equation and Gross-Pitaevskii (non-linear Schrödinger) equation. The study is motivated by the ability to program  $V(\vec{r})$  experimentally in Bose-Einstein condensates (BEC). The company ColdQuanta has developed the first generation of such a machine, and a BEC has been made and measured on the International Space Station. The BEC ground state is, under certain assumptions, modeled using the Gross-Pitaevskii equation. We present several examples of these two equations in 1D (one dimension) including the Gaussian, Lorentzian, Gumbel, logistic, Rayleigh, chi, and beta pdfs (probability distribution functions). The Gaussian pdf is obtained from the groundstate wavefunction that is the solution of the Schrödinger equation in a simple harmonic oscillator potential. Examples in 2D and 3D are also presented, including for the hydrogen atom in momentum space.