Università degli Studi di Trento – Dipartimento di Fisica

Computational Physics 1

Recitation class, May 26, 2021

The Gross–Pitaevskii equation

1 Bose–Einstein condensate in a harmonic trap

Reproduce Fig. 9 of the review of BEC by Dalfovo *et al.*, that is

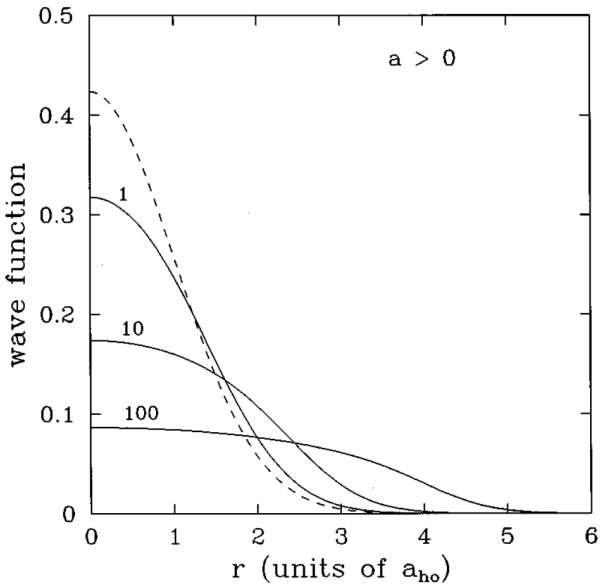

FIG. 9. Same as in Fig. 8, but for repulsive interaction (a >0) and $Na/a_{\rm ho}$=1,10,100.

Figure 1: The shape of the condensate wavefunction for a repulsive potential [from F. Dalfovo *et al.*, *Rev. Mod. Phys.* **71**, 463 (1999).]

where N is the number of atoms, a is the s-wave scattering length and $a_{\rm ho}$ is the lengthscale of the trapping harmonic potential.*

1.1 Energies

Compute the three components of the BEC energy functional – that is the kinetic energy, the energy of interaction with the external potential, and the potential energy – as a function of $Na/a_{\rm ho}$ in the range $[1; 100]$.

*The quantity $a_{\rm ho}$ in the paper is the same as λ_H in the handout.