

SM Spring 99A

A system offers noninteracting spinless bosons energy levels $E_n = n\epsilon$ for orbital wavefunctions $\phi_n(r)$, $n = 0, 1, 2, \dots$.

- (a) Two identical spinless bosons are introduced into the system. Write down explicit two-particle wavefunctions $\Psi(\mathbf{r}_1, \mathbf{r}_2)$ and the corresponding energies for the two lowest lying two-particle states. Pay particular attention to symmetry and the indistinguishability of the particles.
- (b) Now particles are added until the system contains 100 identical bosons. How many independent 100-particle states are there with energy 4ϵ ? Identify the orbitals ϕ_n contained in these different states, but you are not asked to write the explicit wavefunctions.
- (c) The system is placed in contact with a reservoir at temperature T and a source of bosons that maintains a chemical potential μ . T and μ are adjusted until the system in equilibrium maintain an average of 99 particles in the orbital with $E_0 = 0$, one particle in the orbital $E_1 = \epsilon$, and a negligible occupancy of higher levels. Use the Bose-Einstein distribution to calculate the values of μ and T in terms of ϵ .