Physics 4410
Quantum Mechanics 2

Lecture 10

Many-body wave functions

September 16, 2020

Activity 1: Complexity of many-body systems.

Consider N spin-$\frac{1}{2}$ (two level) particles. Ignoring particle indistinguishability, describe the possible configurations of spins. How many states are there in Hilbert space? Could you find the ground state of an arbitrary $N = 20$ problem on your computer?

1. What are the requirements on N-body boson/fermion wave functions?

2. Describe bosonic/fermionic ground states.

3. Slater determinants can be used to build fermionic ground states.

Activity 2: 3 non-interacting indistinguishable particles are in a one dimensional harmonic oscillator in an eigenstate with energy $E = \frac{9}{2}\hbar\omega$. What are all possible states if the particles are bosons? What if fermions (assume all in the same spin state)?

Activity 3: Deuteron

A deuteron is a nucleus consisting of a proton and a neutron. The proton and neutron are each a spin-$\frac{1}{2}$ fermion. Is the deuteron a boson or a fermion? Why?