

FERMIONS AND BOSONS: COUNTING STATES

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References: Griffiths, David J. (2005), Introduction to Quantum Mechanics, 2nd Edition; Pearson Education - Problem 5.33.

A simple example of counting available states. We have three available single-particle states, and three particles to fit into these states.

For distinguishable particles, each particle can be in any of the three states, so there are a total of $3^3 = 27$ possible combinations.

For identical bosons, the total state must be symmetric. We can have all three particles in the same state (3 ways, one for each state), or all three in different states (1 way, since the combination must be symmetric), or two in one state and one in another (3 choices for the first state and 2 for the other state, so a total of 6 possible combinations). The total is thus $3 + 1 + 6 = 10$ possibilities.

For identical fermions, there is only one possible state, that being the totally antisymmetric combination of the 3 states.