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Representations of the Symmetric Group and Nonstandard Quantum Statistics

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In quantum mechanics, a particle in one of N possible states is typically described by a vector in an N-dimensional space X. One calculates the probability of a given event occurring by representing the event as an operator on this space and taking the trace of product of this operator with the projection onto the line defined by the particle. To define states consisting of n particles, the typical method is to begin with the nth-degree tensor product of X, and then restrict to certain subspaces determined by the physical properties of the particles in question. For example, when dealing with bosons we require that the distribution be symmetric with regard to switching any two particles, producing the symmetric tensor product space. As it turns out, the whole tensor product space can be completely decomposed into such smaller spaces, in correspondence with the irreducible representations of the symmetric group. Here, we investigate the probabilities a multi-particle system inherits from the single-particle distribution in each of these spaces.