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Permutation-symmetry related selection rules in spinor quantum gases VLADIMIR YUROVSKY, School of Chemistry, Tel Aviv University — Selection rules constraining possible transitions between states of quantum systems can be derived from the system symmetry. Invariance over permutations of indistinguishable particles, contained in each physical system, is one of the basic symmetries. Consider a many-body system with separable spin and spatial degrees of freedom of particles with arbitrary spins s. Eigenfunctions of such systems can be expressed as a sum of products of spin and spatial functions, which form irreducible representations (irreps) of the symmetric group. The quantum numbers are the Young diagrams $\lambda = [\lambda_1, \ldots, \lambda_{2s+1}]$. The selection rules for a general k-body interactions allow transitions between the states λ and λ' only if $\sum_{m=1}^{2s+1} |\lambda_m - \lambda'_m| \leq 2k$. For $s = 1/2$, the Young diagrams are unambiguously related to the total spin, and if $k = 1$, we get the conventional selection rule for dipole transitions. However, if $s > 1/2$, the rules cannot be expressed in terms of spins. The selection rules provide a way of control over the formation of many-body entangled states, belonging to multidimensional, non-Abelian irreps of the symmetric group. The effects can be observed with spinor atoms in an optical lattice in the Mott-insulator regime.

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