HOW UNDISTINGUISHED? SPIN, PERMUTATION SYMMETRY, AND SPECTRAL EXCLUSION IN COUPLED ROTOR SYSTEMS

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Fermi-Dirac anti-symmetry or Pauli exclusion effects are well known in atomic structure and in ortho-para spin statistical weight detrmination in molecular spectra. Less appreciated is how much more exclusive can be Bose-Einstein symmetry. In addition to the recent renaissance of Bose-Einsein-Condensation effects, there is an extraordinary ”wholesale exclusion” of rovibrational species in high symmetry rotors with zero-spin nuclei, notably, isotopically pure Buckyball 12C60 with 119 of its 120 symmetry species banned for life. The effects can be traced to having a collection of identical and indistinguishable wave-particles, or faceless entities devoid of ”tags” or markings. A discusion of where the banned species ”go” and how they might ”come back” begs the question of just how identical or indistinguished a quantum entity may be. (Might some be more identical than others?) External tagging, such as turning on a spin, is a quantum jump, and half-way or partial identity appears inconceivable. However, internal or spontaneous symmetry breaking is a different matter. Effects which gradually isolate or distinguish only certain identical entities are discussed along with their spectroscopic and dynamic implications.