HOW UNDISTINGUISHED? SPIN, PERMUTATION SYMMETRY, AND SPECTRAL EXCLUSION IN COUPLED Rotor Systems

WILLIAM G. HARTER and HORACE T. CROGMAN, Department of Physics, University Of Arkansas, Fayetteville, AR 72701.

Fermi-Dirac anti-symmetry or Pauli exclusion effects are well known in atomic structure and in ortho-para spin statistical weight determination in molecular spectra. Less appreciated is how much more exclusive can be Bose-Einstein symmetry. In addition to the recent renaissance of Bose-Einstein-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 discussion of where the banned species "go" and how they might "come back" begs the question of just how identical or indistinguishable 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.