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Even-odd spatial nonequivalence for atomic quantum gases with isotropic spin-orbit couplings G.S. SINGH, REENA GUPTA, Physics Department, Indian Institute of Technology Roorkee, Roorkee 247 667, India — A general expression for the density of states (DOS) of power-law trapped d-dimensional ideal quantum gases with isotropic spin-orbit couplings (SOCs) is derived and is found to bifurcate into even-$d$and odd-d classes. The expressions for the grand potential and hence for several thermodynamic quantities are then shown to be amenable to exact analytical forms provided d is an odd integer. Also, a condition $\gamma < 2d$ is obtained in case of odd-d for appearance of the Bose-Einstein condensation with γ as the power-law exponent. It is thus established that isotropic SOCs render even and odd dimensional spaces nonequivalent for uniform as well as trapped gases, and that the DOS of one-dimensional (1D) ideal gases, uniform or trapped, remains unaffected by the SOC. Furthermore, the analytical study of the transition temperature and the condensate fraction in a 3D Bose gas under combined presence of the harmonic trapping and the Weyl coupling shows that the condensation is favored by the former but disfavored by the latter. This countering behavior is discussed to be in conformity with the exchange-symmetry-induced statistical interactions resulting from these two entities as enunciated recently [Phys. Rev. A **88**, 053607 (2013)].

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