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Fragmented Many-body States of Spin-2 Bose Gas HSIANG-HUA JEN, Institute of Physics, Academia Sinica, Twaian, SUNGKIT YIP, Institute of Physics, Academia Sinica, Taiwan — For a spin-1 Bose gas with "antiferromagnetic interaction" in zero magnetic field, the exact ground state is fragmented, consisting two-particle spin-singlets for even number of particles. While its mean-field (MF) state is polar, it is claimed that the exact ground state can be viewed as an angular average over its MF polar state, as a direct analogy to, e.g., the generation of Fock states by averaging over the relative phase of the coherent state in the case of a double well. This picture has become the common belief in the community. In this work, we demonstrate how angular-averaged MF polar states are unable to construct the exact many-body ground states in the spin-2 case. That the angular averaged MF states is the exact ground state is simply a coincidence in the spin-1 system. We address the inapplicability of the angular-averaging process, and further investigate the limitations on obtaining the exact many-body state from angular averaging of the MF cyclic state. We also show how the angular-averaged MF state deviates from the exact eigenstate by studying the two-particle density matrices. Our results overturn the common belief that the exact ground states are equivalent to angular-averaged MF states, and give a broader perspective on fragmented many-body bosonic ground states.

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