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Exact many-body ground states of a spin-1 Bose gas in Tonks-Girardeau limit[1] HSIANG-HUA JEN, Institute of Physics, Academia Sinica, Taipei, Taiwan, SUNGKIT YIP, Institute of Physics and Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei, Taiwan — We investigate the many-body ground states of a one-dimensional spin-1 Bose gas in Tonks-Girardeau (TG) limit. It is known that in TG gas limit of scalar bosons, the system becomes fermionized that bosons do not penetrate each other, and their wavefunctions take the form of noninteracting fermions. For a spin-1 Bose gas with an infinite atom-atom interaction in a harmonic trap, we construct the many-body ground states from the ones of a noninteracting Fermi gas along with the spin degrees of freedom. With zero magnetic field in the sector of $S_z = 0$ and in the regime of spin-incoherent Luttinger liquid where we assume negligible $|a_2 - a_0|$, the interaction energy becomes spin-independent, and the many-body wavefunctions of a spin-1 Bose gas is also SU(3) invariant. The many-body wavefunction can be derived by calculating the weightings of spin functions using the conjugacy class G of S_N symmetric group for the number of atoms N. We then study the first-order correlation function of the density matrix, from which we extract its momentum distribution. Finite-temperature calculation of the wavefunction by including orbital excitations is also investigated to compare with the case of spinless bosons.

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Hsiang-Hua Jen
Institute of Physics, Academia Sinica

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