Exact Analysis of a One-Dimensional Weakly Repulsive Bose-Fermi Mixture

Toshiaki Kaminaka[a], Jun Sato[b], and Tetsuro Nikuni[a]

[a]Department of Physics, Faculty of Science, Tokyo University of Science, Japan
[b]Department of Physics, Graduate School of Humanities and Sciences, Ochanomizu University, Japan

We study one-dimensional system of Bose-Fermi mixture with repulsive δ-function interactions using the nested Bethe ansatz method [1,2]. This system is integrable when the masses of bonsons and fermions are equal and the interactions between Bose-Bose and Bose-Fermi particles are equal. By use of the power series expansion method [3], the Surtherland integral equation [4] describing the ground state properties is solved analytically in the weak coupling regime. Physical quantities such as the ground state energy, sound velocity, and the chemical potential are explicitly expressed in terms of a dimensionless parameter $\gamma = c/D$ and boson fraction $\alpha = N_b/N$, where c is the interaction strength, D is the number density, N_b is the number of bosons, and N is the total number of particles.

1. H. A. Bethe, Z. Phys. **71**, 205 (1931).
2. C. N. Yang, Phys. Rev. Lett.**19**,1312 (1967).
3. M. Wadati, J. Phys. Soc. Jpn. **71** 2657 (2002).
4. B. Sutherland, Phys. Rev. B **12**, 3795-3805 (1975)

Section: LD - Low dimensional and confined systems

Keywords: One-dimensional integrable system, Quantum gas, Bose-Fermi mixture, Bethe ansatz method