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Bose–Einstein condensation in the Luttinger–Sy model with contact interaction

We study bosons on the real line in a Poisson random potential (Luttinger–Sy model) with contact interaction in the thermodynamic limit at absolute zero temperature. We prove that generalized Bose–Einstein condensation (BEC) occurs almost surely if the intensity ν_N of the Poisson potential satisfies $[\ln(N)]^4/N^{1-2\eta} \ll \nu_N \lesssim 1$ for arbitrary $0 < \eta \le 1/3$. We also show that the contact interaction alters the type of condensation, going from a type-I BEC to a type-III BEC as the strength of this interaction is increased. Furthermore, for sufficiently strong contact interactions and $0 < \eta < 1/6$ we prove that the mean particle density in the largest interval is almost surely bounded asymptotically by $\nu_N N^{3/5+\delta}$ for $\delta > 0$.