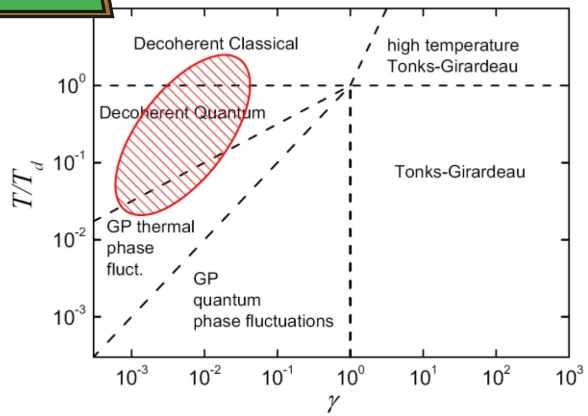
Atom Chips Amsterdam

Yang-Yang thermodynamics (Theory)



Reducing the dimensionality of a quantum system can have dramatic consequences. For example the one-dimensional (1D) Bose-gas exhibits a surprisingly rich variety of physical regimes that is not present in 2D or 3D. Further interest in this system stems from the availability of exact solutions for the many-body states and the resulting thermodynamics via the Yang-Yang formalism.

Recent experiments with ultracold Bose gases in the 1D regime are now providing previously unattainable opportunities to test the Yang-Yang thermodynamics.

$$\epsilon(k) = -\mu + \frac{\hbar^2 k^2}{2m} - \frac{k_B T g_1}{2\pi} \int_{-\infty}^{\infty} \frac{dq}{(g_1 m/\hbar^2)^2 + (k-q)^2} \ln\left\{1 + \exp\left[-\epsilon(q)/k_B T\right]\right\}$$

We require numerical solutions to the Yang-Yang equations describing the finite-temperature 1D Bose-gas recently studied on an atom chip. This project involves the programming of algorithms to solve the Yang-Yang equations and obtaining associated derivatives. The results can be compared to existing experimental data and used to interpret future results.

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