1D Bose gases

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I will describe a series of experiments with 1D Bose gases. Several equilibrium properties of these gases have been measured across coupling limits, including the strongly coupled or Tonks-Girardeau limit. These include energies, cloud lengths and pair correlations. There is good agreement with the well-known, exact Lieb-Liniger solutions for a δ-function interacting Bose gas. These gases are integrable many-body systems, so they have the unique property that they do not come to conventional thermodynamic equilibrium. This has also been demonstrated in the lab. How thermalization begins when integrability starts to be lifted is an open question in quantum mechanics. We are trying to address this question experimentally. I will describe that work and discuss a theoretical model of a particular thermalization mechanism.

I will also give an update on our progress toward building a neutral atom quantum computer in a site-addressable 3D optical lattice.

Work performed in collaboration with Jean-Felix Riou, Toshiya Kinoshita and Trevor Wenger at Penn State and Vladimir Yurovsky from the Chemistry Department of Tel Aviv University.