Detecting different correlation regimes in a 1D Bose gas using in-situ absorption imaging

FRANCISCO SALCES-CARCOBA, SEIJI SUGAWA, YUCHEN YUE, ANDIKA PUTRA, IAN SPIELMAN, NIST - Joint Quantum Institute - Univ of Maryland-College Park — We present the realization of a single 1D Bose gas (1DBG) using a tightly focused Laguerre-Gauss beam as a waveguide for a $^{87}\text{Rb}$ cloud. Axial confinement is provided by a weak trap that also sets the final density profile. A homogeneous 1DBG at $T = 0$ can be fully described by the dimensionless interaction parameter $\gamma \propto 1/n$, where $n$ is the linear density; at sufficiently low densities the system becomes strongly interacting. An inhomogeneous (trapped) system can enter this description within the local density approximation (LDA) where the interaction parameter becomes position dependent $\gamma(x) \propto 1/n(x)$. The system then displays different correlation regimes over its extension which can be detected by measuring its equation of state (EoS) or the density-density correlations in real space using in-situ absorption imaging.