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Probing one-dimensional strongly correlated systems with a Bosonic Quantum Gas Microscope PHILIPP M. PREISS, M. ERIC TAI, RUICHAO MA, KAZI RAJIUBL ISLAM, MARKUS GREINER, Harvard University — One-dimensional quantum systems often exhibit strongly correlated many-body physics. These strong correlations can be quantified by the entanglement entropy of a sub-system, which diverges logarithmically with system size in the gapless phase (such as the superfluid phase), violating the area law of entanglement generally followed in the ground state of the gapped phases. We study a one-dimensional system of Rb-87 in an optical lattice under a Quantum Gas Microscope to probe strong correlations with single-site resolution. While it is experimentally difficult to measure the entanglement entropy for a large system, the particle number fluctuations of a sub-system contain the signature of entanglement and are expected to show the same logarithmic divergence. With our Bosonic quantum simulator, it is also possible to study non-trivial emergent properties, such as the fractionalization of a fundamental excitation into multiple collective excitations in the system, analogous to the spin-charge separation in one-dimensional electronic systems.

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