Quench dynamics in strongly correlated Bose-Hubbard chains

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We present a series of experiments in the context of 1D physics with ultracold atoms, combining optical lattice potentials with the capability to tune the strength of the onsite particle interaction U. For an array of tilted 1D chains with site-to-site tilt E and initial unity occupation we record the dynamics after a quench to the paramagnetic-to-anti-ferromagnetic phase transition point U≈E by monitoring the number of doublons created as a function of time after the quench. We observe characteristic oscillations that we analyze in the many-body context. For U/2≈E, U/3≈E etc. we observe coupling to next-nearest neighbors and beyond. In particular, we for U/3≈E find evidence of higher-order super-exchange interaction scaling as J^3/U^2, where J is the nearest-neighbor tunneling matrix element.