CO.CO.MAT

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Controlling many-body tunneling dynamics in a strongly correlated quantum gas

Atomic gases at ultralow temperatures prepared in optical lattice potentials provide an exquisite platform to study many-body quantum systems out of equilibrium. I will focus on a series of experiments in the context of the Bose-Hubbard model for which we independently control the tunneling rate J and the on-site interaction energy U. For 1D chains of bosons prepared in a Mott insulator and subject to a tilt E, we study correlated tunneling dynamics between neighboring lattice sites (and beyond), and identify the role of bond-charge interactions in modifying the overall tunneling rate [1,2,3]. In the superfluid regime, we observe quantum phase revivals of the Bloch oscillating matter-wave field when J˜U¡¡E. For J˜U˜E we find evidence for the transition to the quantum chaotic regime [4]. In the second part, I will present experiments in the context of driven quantum manybody systems. Specifically, we demonstrate Floquet engineering of a Hubbard model featuring occupation-dependent tunneling via periodically modulated interactions [5]. References [1] F. Meinert et al., Phys. Rev. Lett. 111, 053003 (2013). [2] O. Jürgensen et al., Phys. Rev. Lett. 113, 193003 (2014). [3] F. Meinert et al., Science 344, 1259-1262 (2014). [4] F. Meinert et al., Phys. Rev. Lett. 112, 193003 (2014). [5] F. Meinert et al., arXiv:1602.02657 (2016).

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