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Formation and detection of a chiral orbital Bose liquid in an optical lattice[1] XIAOPENG LI, Univ of Maryland-College Park, ARUN PARAMEKANTI, University of Toronto, W. VINCENT LIU, University of Pittsburgh, ANDREAS HEMMERICH, Hamburg University — Recent experiments on p-orbital atomic bosons have suggested the emergence of a spectacular ultracold superfluid with staggered orbital currents in optical lattices. This raises fundamental questions like the effects of collective thermal fluctuations, and how to directly observe such chiral order. Here, we show via Monte Carlo simulations that thermal fluctuations destroy this superfluid in an unexpected two-step process, unveiling an intermediate normal phase with spontaneously broken time-reversal symmetry, dubbed "chiral Bose liquid." For integer fillings ($n \geq 2$) in the chiral Mott regime, thermal fluctuations are captured by an effective orbital Ising model, and Onsager's powerful exact solution is adopted to determine the transition from this intermediate liquid to the para-orbital normal phase at high temperature. A suitable lattice quench is designed to convert the staggered angular momentum, previously thought by experts difficult to directly probe, into coherent orbital oscillations, providing a smoking-gun signature of chiral order.

[1]JQI, CMTC, and JQI-NSF-PFC

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