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P-orbital chiral Bose liquid and dynamical signature of chiral order ARUN PARAMEKANTI, University of Toronto, XIAOPENG LI, University of Maryland, ANDREAS HEMMERICH, Institute fur Laser-Physik, Universitat Hamburg, W. VINCENT LIU, University of Pittsburgh — Recent experiments on p-orbital atomic bosons have suggested the emergence of a spectacular ultracold superfluid with an antiferromagnetic orbital current pattern in optical lattices. This raises fundamental questions concerning the effects of thermal fluctuations as well as possible ways of directly observing such angular momentum 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 in the chiral Mott regime, thermal fluctuations are captured by an effective orbital Ising model, allowing us to determine transition from this intermediate liquid to the para-orbital normal phase at high temperature. A lattice quench is designed to convert the staggered angular momentum into coherent orbital oscillations, providing a direct time-resolved dynamical signature of chiral order. Such quenches may also be used to simulate spin dynamics using orbital degrees of freedom.

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