ICFO

JOURNAL CLUB: Spectroscopy of edge and bulk collective modes in fractional Chern insulators

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Elements Room

The exploration of atomic fractional quantum Hall (FQH) states is now within reach in optical-lattice experiments. While ground-state signatures have been observed in a system realizing the Hofstadter-Bose-Hubbard model in a box [Leonard et al., Nature (London) **619**, 495 (2023)], how to access hallmark low-energy collective modes remains a central open question in this context. We introduce a spectroscopic scheme based on two interfering Laguerre-Gaussian beams, which transfer a controlled angular momentum and energy to the system. The edge and bulk responses to the probe are detected through local density measurements by tracking the transfer of atoms between the bulk and the edge of the FQH droplet. This detection scheme is shown to simultaneously reveal two specific signatures of FQH states: their chiral edge branch and their bulk magnetoroton mode. We numerically benchmark our method by considering few bosons in the ????=1/2 Laughlin ground state f the Hofstadter-Bose-Hubbard model, and demonstrate that these signatures are alrea y detectable in realistic systems of two bosons, provided that the box potential is sufficient y large compared to the droplet. Our paper paves the way for the detection of fraction l statistics in cold atoms through edge signatures.

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