

Shaking a Quantum Hall Liquid to Reveal Its Hidden Geometry

Scientific Achievement

A linearly polarized ultrafast laser pulse can excite chiral-graviton-like quadrupole modes in a fractional quantum Hall system when inter-Landau-level scattering is included.

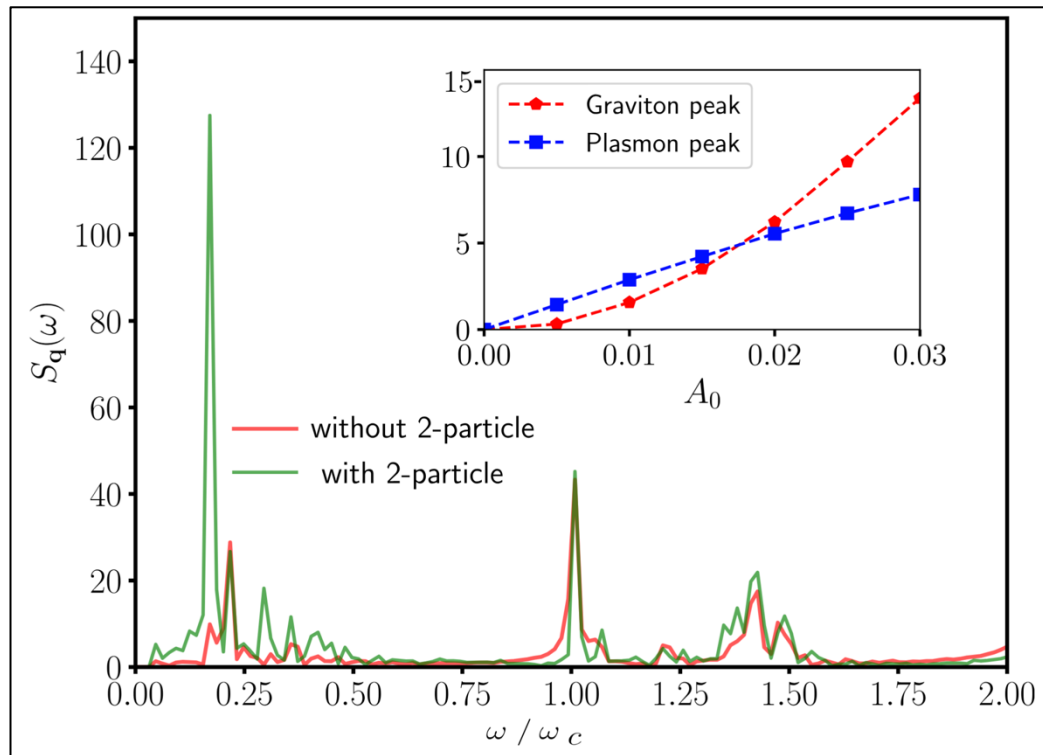


Figure: Structure factor of the FQH state after pump pulse, with and without 2-particle inter-Landau level interaction. Inset: quadratic dependence of graviton response.

Significance and Impact

A CINT User Team identified a possible optical route to access neutral geometric excitations of fractional quantum Hall fluids, complementing recent light-scattering experiments.

Research Details

- Derived a two-Landau-level model including Coulomb interaction that scatter electrons between Landau levels.
- Simulated laser-driven dynamics using exact time evolution.
- Identified magnetoplasmon and chiral-graviton-like modes via currents, structure factors, and quadrupole overlaps.

Kirmani, A.; Fauseweh, B.; Zhu, J.-X. Laser-Driven Ultrafast Dynamics of a Fractional Quantum Hall System. *Physical Review B*. 2026.

Work was performed, in part, at the Center for Integrated Nanotechnologies.