世纪物理情·系列讲座

Chiral graviton modes in fractional quantum Hall liquids

【报告人】
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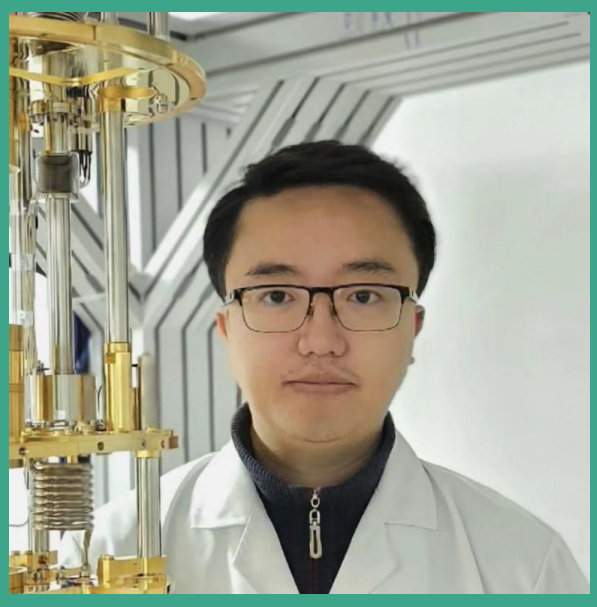
【摘要】

Recently, Haldane proposed a new geometric description for the fractional quantum Hall (FQH) effect, suggesting the existence of a previously overlooked quantum metric. Novel collective excitations called chiral graviton modes (CGMs) are proposed as quanta of the metric fluctuations. Such modes are condensed-matter analogues of gravitons that are hypothetical spin-2 bosons, and could be described by the corresponding Fierz-Pauli field equations in FQH liquids. CGMs are characterized by polarized states with chirality of +2 or -2, and energy gaps coinciding with fundamental neutral collective excitations (i.e., magnetorotons) in the long-wavelength limit. However, CGMs remain experimentally inaccessible. Here, we observe chiral graviton modes in FQH liquids using inelastic scattering of circularly-polarized light. The experiments are performed in a GaAs quantum well. At filling factor v = 1/3, the long-wavelength magnetoroton emerges under a specific polarization scheme corresponding to angular momentum -2. Remarkably, the mode chirality remains -2 at v = 2/5 but becomes the opposite at v = 2/3 and 3/5. The observations capture the essentials of the graviton modes and support the new FQH geometrical description. Our work offers access to quantum gravity physics in bench-top experiments.

【报告人简介】



Lingjie Du is a professor in school of physics at Nanjing University. Lingjie received his Bachelor’s degree in physics from Nanjing University in 2008, and his Ph.D. in physics from Rice University in 2016. Then he worked as a postdoctoral scientist at Columbia University before joining the faculty at Nanjing University at 2019. Lingjie’s research focuses on experimental studies of topological correlated states (such as fractional quantum Hall states and excitonic insulator) using techniques of low-temperature quantum transport and advanced optical spectroscopy.

主办单位:清华大学高等研究院