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Interplay of Topology and Geometry in Fractional Quantum Hall Liquids[1]

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Fractional Quantum Hall Liquids (FQHL) are the ultimate strongly correlated electron systems, and the birth place of topological phase of matter. Early theoretical work has emphasized the universal or topological aspects of quantum Hall physics. More recently it has become increasingly clear that there is very interesting bulk dynamics in FQHL, associated with an internal geometrical degree of freedom, or metric. The appropriate quantum theory of this internal dynamics is thus expected to take the form of a quantum gravity, whose elementary excitations are spin-2 gravitons. After briefly reviewing the topological aspect of FQHL, I will discuss in this talk how to couple and probe the presence of this internal geometrical degree of freedom experimentally in the static limit [1], and detect the graviton excitation in a spectroscopic measurement [2]. [1] Kun Yang, Geometry of compressible and incompressible quantum Hall States: Application to anisotropic composite-fermion liquids, Phys. Rev. B 88, 241105 (2013). [2] Kun Yang, Acoustic Wave Absorption as a Probe of Dynamical Gravitational Response of Fractional Quantum Hall Liquids, Phys. Rev. B 93, 161302 (2016).

[1]Work supported by DOE.