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Controling solid state phases through vacuum field

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While the effect of vacuum fields on atomic system (such as through the Lamb shift) is well known, there is a recent interest in controlling the many-body phases of solid-state systems using vacuum fluctuations strongly coupled to such a system inside a microcavity. In such a system, the strength of the electric field caused by the vacuum fluctuations, to which the strength of the light-matter coupling depends, scales inversely with the square root of the cavity volume. One very interesting feature of the circuit-based resonators is the fact that this volume can be scaled down to deep subwavelength values in all three dimension of space[1]. We have used transport to probe the ultra-strong light-matter coupling[2] and shown that the latter can induce a breakdown of the integer quantum Hall effect[3]. We have also explored the effect of a cavity on the fractional quantum Hall effect using a hovering cavity experiments[4].
In similar experiments performed in slot-antenna cavities, we have also observed that the cavity is able to dramatically suppress the longitudinal conductance between two successive plateau for some relatively high filling factors corresponding to magnetic fields 1-3T. These magneto-transport experiments are interpreted as a transport anisotropy that arises from ordering of the stripe phase through the vacuum fluctuations of the resonator[5].

1. Scalari, G. et al. Ultrastrong Coupling of the Cyclotron Transition of a 2D Electron Gas to a THz Metamaterial. Science 335, 1323–1326 (2012).
2. Paravicini-Bagliani, G. L. et al. Magneto-Transport Controlled by Landau Polariton States. Nat. Phys. 15, 186–190 (2019).
3. Appugliese, F. et al. Breakdown of topological protection by cavity vacuum fields in the integer quantum Hall effect. Science 375, 1030–1034 (2022).
4. Enkner, J. et al. Tunable vacuum-field control of fractional and integer quantum Hall phases. Nature 1–6 (2025) doi:10.1038/s41586-025-08894-3.
5. Graziotto, L. et al. Cavity QED Control of Quantum Hall Stripes. arXiv.org https://arxiv.org/abs/2502.15490v1 (2025).

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