Freezing instability of the Laughlin state in ideal Chern bands

We demonstrate that the Laughlin wave-function in ideal Chern bands relevant to moiré materials does not always realize the well-known fractionalized phase of matter but also a variety of other complex states. By exploiting its exact mapping to a classical Coulomb gas, we will demonstrate that the Laughlin state undergoes a Berezinskii-Kosterlitz-Thouless phase transition from its usual plasma state into a dielectric with correlations that decay as power-laws with continuously varying exponents and gaplessness that appears to be beyond the Goldstone mode paradigm. We will discuss some of our speculations on the relevance of this finding to moiré materials and its possible connections to critical states in other settings.

[1] Saranyo Moitra, Inti Sodemann Villadiego, arXiv:2509.18265 (2025).

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