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The Středa Formula and its Remarkable Consequences: From Strongly Correlated to Topological Floquet Systems

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Identifying experimentally accessible probes that are able to reveal truly distinctive properties of topological phases of matter has remained as an ever-relevant mission. In this talk, I will present recent advances that were made possible thanks to a remarkable thermodynamic relation known as the Widom-Středa formula, which relates the quantized Hall conductivity of an insulator to its density response under an external probe magnetic field. I will discuss how this response can be interpreted as a genuine local topological marker and briefly show how we adapted this well-known formula to explore the emergence of quantized valley Hall signals in strained honeycomb lattices [1]. I will also explain how this non-perturbative relation allowed us to derive a fundamental connection between the failure of Luttinger's theorem and the classification of correlated quantum Hall phases with winding numbers built from single-particle Green's functions [2]. Finally, I will present our more recent findings on the generalization of the Středa formula to out-of-equilibrium Floquet systems, in which effective topological properties are generated by means of a time-periodic external field [3]. This approach enables us to derive the abstract winding numbers used to classify Floquet topological phases from physical principles and to connect them to tractable response functions.

- [1]. EMaxime Jamotte, Lucila Peralta Gavensky, Cristiane Morais Smith, Marco Di Liberto, and Nathan Goldman, "Quantized valley Hall response from local bulk density variations," *Communications Physics* 6, 264 (2023).
- [2]. Lucila Peralta Gavensky, Subir Sachdev, and Nathan Goldman, "Connecting the Many-Body Chern Number to Luttinger's Theorem through Středa's Formula," *Phys. Rev. Lett.* 131, 236601 (2023).
- [3]. Lucila Peralta Gavensky, Gonzalo Usaj, and Nathan Goldman, "The Středa Formula for Floquet Systems: Topological Invariants and Quantized Anomalies from Cesáro Summation," (2024), arXiv:2408.13576.