# Topological phases on fractal lattices

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Over the last decade, topological phases of matter have attracted an immense attention due to potential applications in the context of spintronics, topotronics and quantum computation. Existing theoretical classification schemes of non-interacting fermionic topological phases rely on the relation between bulk topological index and protected edge modes known as the bulk-boundary correspondence. However, the question how to classify the systems with a non-integer dimension remains unanswered.

In this work, we investigate topological properties of fractal lattices with different Hausdorff dimensions and ramification numbers exposed to uniform external magnetic field within tight-binding approximation. We present density of states (DOS) in the $E-\Phi$ plane and compare with the results for regular lattices. To consider obtained spectra and distinguish between them in a qualitatively manner, we perform multifractal analysis. Using edge-locality marker, we discuss the localization of chiral edge modes inside the fractal structures as a function of number of iterations. Non-local correlations are studied through entanglement measures for free-fermionic systems. Moreover, we compute level spacings statistics in the presence of on-site disorder in order to determine whether bulk states are extended or localized. Disorder-induced topological phase transitions are examined by calculating the Chern number from non-commutative geometry perspective.

[1] E. Prodan, T. L. Hughes, and B. A. Bernevig, *Phys. Rev. Lett.* **105**, 11501 (2010)