Topology between one and two dimensions

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Abstract

We know how topological insulators behave in 1,2,3 dimensions, but what happens in between? In this talk, I will first present theoretical and experimental results on the behavior of ultranarrow germanene nanoribbons. We found that a phase transition from 1D topological edge states to 0D end states occurs as the width of the nanoribbons is reduced below 2 nm [1], see Fig. 1. Then, I will discuss the topological properties of electrons in self-formed single-layer bismuth fractals with dimension d = 1.58 [2], see Fig. 2. Finally, I will present theoretical results on the Hubbard model in a fractal geometry [3] and discuss ongoing studies on a fractal made of Rydberg atoms with long-range interactions (in preparation).

Figures

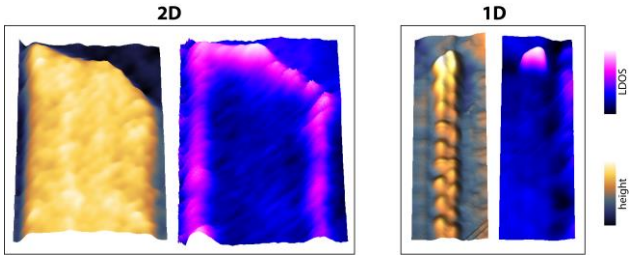

Figure 1: Topographic view (left) and local density of states (LDOS right) for broad (2D) and ultranarrow (1D) germanene nanoribbons. The topological states are visible in pink (high LDOS).

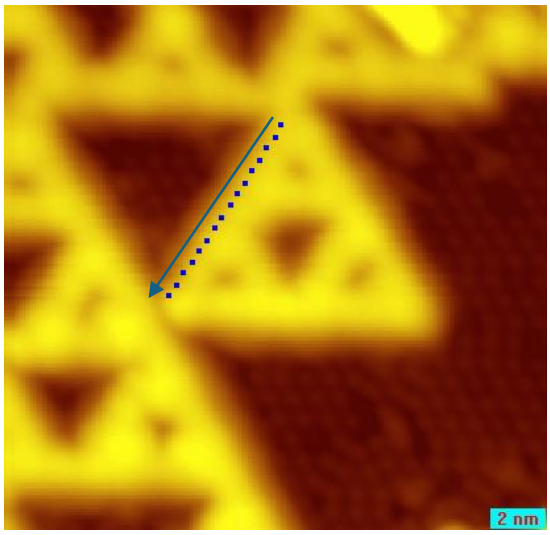

Figure 2: Topographic image of the single-layer bismuth Sierpinski fractals spontaneously formed in InSb substrates. The fractals have a Hausdorff dimension d = 1.58 and exhibit both, 1D edge states and 0D corner states.

References

[1] D. J. Klaassen, L. Eek et al., Nature Communications **16** (2025) 2059.

[2] R. Canyellas , C. Liu et al., Nature Physics **20** (2024) 1421.

[3] M. Conte, V. Zampronio, M. Rontgen, and C. Morais Smith, Quantum **8** (2024) 1469.