Topological light-matter interfaces with large topological invariants

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Topological light-matter interfaces, that are, systems where quantum emitters interact with topologically non-trivial photonic modes is one of the frontiers of topological photonics. The interplay between topology and strong interactions from the non-linear emitter level structure can lead to qualitatively different quantum optical phenomena [1, 2], and open new avenues for engineering robust quantum gates between emitters or photons that can be harnessed for different quantum technologies. These exciting perspectives have lead to the first implementations based on coupling quantum dots to topological photonic crystals [3] or superconducting qubits to coupled microwave resonators [4], among others. In this presentation, we will discuss about the physics emerging when the topological photonic systems display large winding phases in 1D [5] or large Chern numbers in 2D [6] topological insulators. In particular, we will show how in the 1D scenario the topological phases lead to qualitatively different shapes for the emitter-emitter interactions induced in topological band-gaps, among other effects. In 2D systems, we discuss the emergence of a topological multi-mode waveguide in their edges, and show how it leads to time-bin-like entangled emission patterns or exotic collective decays.

References

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Figures

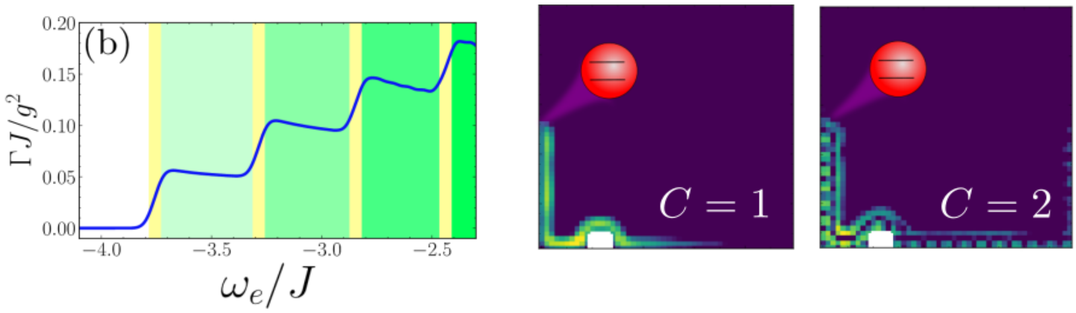

Figure 1: Quantized and robust photon emission with large Chern numbers.