University of Crete
Department of Physics

Physics Colloquium

Thursday, 23 October 2025 | 17:00 – 18:00, Seminar Room 3rd Floor

Photonic application of topological physics

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ABSTRACT

Topological physics has earned three Nobel Prizes in physics without any commercial applications. In this colloquium, I will discuss our endeavors to invent two topological photonic devices that each significantly outperform their commercial counterparts.

First, we show that the textbook design of everyday semiconductor lasers, used in internet communications and cellphones, aligns with standard topological models in 1D. By advancing to the 2D vortex zero mode, we create the topological-cavity surface-emitting lasers (TCSELs). Furthermore, we demonstrate the monopole modes in 3D, as proposed half a century ago, thus completing the kink-vortex-monopole trilogy of topological defect modes.

Second, we designed and experimentally validated a topological microwave isolator by leveraging topological one-way edge states, achieving ultra-high isolation >100 dB. Its performance could surpass five plus commercial junction isolators connected in series –technology developed since World War II.

References

- *Nature Nanotechnology* **15**, 1012 (2020)
- *Nature Photonics* **16**, 279 (2022)
- *Nature Communications* **15**, 7327 (2024)
- *Nature Photonics* **19**, 1064 (2025)