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Two Topological Devices

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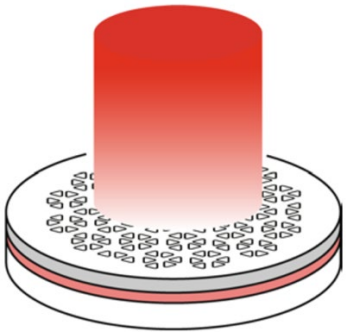
Despite three Nobel prizes, topological physics has yet to find its device applications. I will discuss our endeavors to invent two topological photonic devices that each significantly outperform their commercial counterparts.

First, we designed and experimentally validated a topological microwave isolator [1] 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 --- ubiquitous technology developed since World War II.

Second, 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 [2], we create the topological-cavity surface-emitting lasers (TCSELs) [3]. We further demonstrate the monopole modes in 3D [4], completing the kink-vortex-monopole trilogy of topological defect modes.



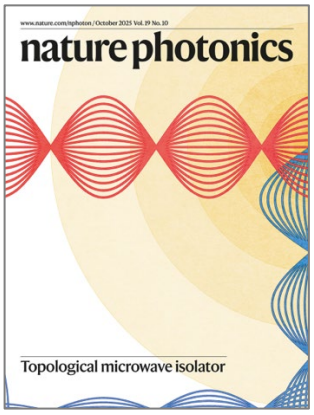


Figure 1. Illustration of the two topological devices.

References:
[1] Gang Wang, Ling Lu, Nature Photonics 19, 1064 (2025)
[2] Lechen Yang, Guangrui Li, Xiaomei Gao, Ling Lu, Nature Photonics 16, 279 (2022)
[3] Gao, Yang, Lin, Zhang, Li, Bo, Wang, Lu, Nature Nanotechnology 15, 1012-1018 (2020)
[4] Cheng, Yang, Wang, Lu, Nature Communications 15, 7327 (2024)