Topological Valley Photonic Crystals for Coherent Communications, THz / 6G

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Abstract

The realization of integrated, low-loss, and efficient systems for data-intensive applications requires on-chip integrated photonic circuits, which have great potential for advanced information and communication technologies such as the future 6G. A promising platform for achieving this transition is Valley Photonic Crystals which enable the construction of topological interfaces, facilitating the propagation of light with minimal losses and backscattering through edge modes. Here, we introduce variations in topological protection by considering different interfacial designs and air-hole geometries for passive functional devices. To experimentally verify the scalability of topological protection, we demonstrate the performance of terahertz (THz) topological ring resonators designed for operation at 600 GHz. This work showcases how the scaling of topological protection can be achieved by utilizing a combination of air hole geometry and interfacial degrees of freedom, providing functional tuning of devices at the chip level (1). Additionally, a THz beamformer as an application example is also presented. It demonstrates the low losses and high integration potential of Valley Photonic devices for telecommunication transmission at 300 GHz (2).
(1) A. Subahan Mohammed et al, JLT, 42 (23), 8323 (2024),

(2) Wang, W. et al, Nature, 632(8025), 522-527 (2024).

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