Topological phase transition of non-abelian nodal lines in photonic crystals

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Topological photonics has recently expanded to include many fascinating areas of physics, for example, non-Hermitian systems such as topological lasers and PT symmetric topology, and non-Abelian topological charges. Topological charges of nodal lines in a multigap system are represented by non-Abelian numbers, and the Euler class, a topological invariant, can be used to explain their topological phase transitions, such as pair-annihilation of nodal lines [1,2]. In this work, we use photonic crystals to create nodal lines in the 3D momentum space [3]. We then deform the photonic crystal to make topological phase transitions of the nodal lines. Notably, the patch Euler class can be used to theoretically predict the nodal lines' stability based on the non-Abelian topological charge theory [4]. Specifically, by manipulating the separation between the two single diamond structures and the extent of structural distortion, we show the topological transition of nodal lines, e.g., from nodal lines to nodal rings.

[1] R.-J. Slager, et al., Nat. Comm. **15**, 1114 (2022).
[2] H. Park, et al., Phys. Rev. B **105**, 214108 (2022).
[3] H. Park, et al., ACS Photonics **8**, 2746 (2021).
[4] H. Park, et al., Nanophotonics **13**, 1079 (2024).

Short Bio:

Sang Soon Oh received his PhD degree in Physics from Korea Advanced Institute of Science and Technology, South Korea. After a post-doctoral fellowship at Electronics Telecommunications Research Institute (ETRI) in South Korea (2007-2010), he joined the Department of Physics at University of Surrey, UK as a postdoc (2010). In 2011, he joined the Condensed Matter Theory group in the Department of Physics and Optical Semiconductor Device group in the Department of Electrical and Electronics Engineering at Imperial College London. Since December 2017, he has been Sкr Cymru II

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