Karlsruher Institut für Technologie

KIT-Fakultät für Physik

1. Juli 2022

Einladung zum Physikalischen Kolloquium

08.07.2022 **Verónica Ahufinger Breto, Universitat Autònoma de Barcelona**
»Supersymmetry transformations in coupled optical waveguides«
Einführung: C. Rockstuhl

Abstract: In the last few decades, the mathematical concept of supersymmetry (SUSY) has been extended from Particle Physics to other fields and applied for instance to Optics [1] and to discrete waveguide lattices [2]. In this talk, we will review some recent results on the use of SUSY (i) to design integrated photonic devices with new functionalities and enhanced performances with respect to the standard ones and (ii) to engineer the topology of photonic structures.
For multimode optical waveguides, continuous SUSY transformations allow obtaining a superpartner refractive index profile whose guided modes share propagation constants with the original waveguide, but where the fundamental mode is removed from the spectrum. In conjunction with adiabatic transfer techniques like Spatial adiabatic passage (SAP) or Stark-Chirped Rapid-Adiabatic-Passage (SCRAP), we design [3,4] efficient and robust mode-division (de)multiplexing devices.
On the other hand, we also explore discrete SUSY (DSUSY) transformations to perform topological state engineering in arrays of coupled optical waveguides. Specifically, we examine the potential of DSUSY transformations to systematically address, alter and reconfigure the topological properties of a system. To this aim, we theoretically and experimentally study [5] the changes that topologically protected states in photonic lattices undergo as DSUSY transformations are applied to their host system. In particular, we consider the simplest system with non-trivial topological properties, the Su-Schieffer-Heeger (SSH) model and demonstrate how SUSY-induced phase transitions can selectively suspend and re-establish topological protection of specific states. In addition, making use of the isospectrality of SUSY transformations, we propose a general and high-fidelity method to prepare gapped topological modes in discrete systems from a single-site excitation [6]. The method consists of adiabatically connecting two superpartner structures, deforming the input state into the desired mode. We demonstrate the method by pumping topological states of the SHH model in an optical waveguide array.

[1] S. M. Chumakov and K. B. Wolf, Phys. Lett. A **193**, 51 (1994).
[2] S. Longhi, Phys. Rev. B **81**, 195118 (2010).
[3] G. Queraltó, V. Ahufinger, J. Mompart, Opt. Express **25**, 27396 (2017).
[4] D. Viedma, V. Ahufinger, J. Mompart, Opt. Express **29**, 39200 (2021).
[5] G. Queraltó *et al*., Communications Physics **3**, 49 (2020).
[6] D. Viedma *et al.*, Opt. Express **30**, 23531 (2022).

Der Vortrag findet um **15:45 Uhr im Otto-Lehmann-Hörsaal**, Physik-Flachbau (Geb. 30.22), statt.

Zusätzlich wird der Vortrag im Livestream angeboten:

https://kit-lecture.zoom.us/j/65700657432
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Passcode: 953877

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