UNIVERSITÄT LEIPZIG

BuildMoNa

SCIENTIFIC AND METHOD MODULES

Module name	Quantum Coherent Structures: Non–Hermitian Systems
Number	2020-A3
Aims	The concept of a "closed" system is an idealization. Every real system is open, i.e. at least some degree of coupling to the environment exists. The theoretical description thus requires non-Hermitian Hamiltonians or Liouvillians which have their intricacies, among them the occurrence of exceptional points (EPs). The module delivers an introduction to theoretical concepts and experimental realizations of exceptional points which possibly have applications in beyond-classical sensor sensitivities.
Basics	General knowledge of classical electrodynamics and quantum mechanics Mathematically, an exceptional point (EP) is the degeneracy point of the eigenvalues of a complex matrix, the simplest case being for a 2x2 matrix. The special fact is that the normally two orthogonal eigenvectors of a 2x2 eigenvalue problem degenerate at the EP and only *a single* eigenvector exists. Corresponding to this mathematical consideration, EPs can be realized in real physical systems such as anisotropic optical materials or electronic circuits. A sign of the degenerate eigenvector at the EP is, for example, a circular polarized light mode.
Contents	The module will contain introductory and more specialized lectures on exceptional points and non-Hermitian systems in general from theoretical and practical perspectives. The module is equally directed to theoretically and experimentally working students.
Methods	Seminars
Type	Online Course
Date (month/year)	30 September 2020
Time	See page 2
Work load	5 hours presence (online course)/55 hours self-study (paper+exam)
Examination	Written examination
Credit points	2
Responsible scientists	M. Grundmann, B. Rosenow
Industrial partners	-
Recommendations for literature, e-learning	S. Richter et al., *Voigt Exceptional Points in an Anisotropic ZnO-based Planar Microcavity: Square-Root Topology, Polarization Vortices, and Circularity*, Phys. Rev. Lett. **123**(22), 227401:1-7 (2019)

Graduate School BuildMoNa
Universität Leipzig
Linnéstr. 5
04103 Leipzig
Germany

Phone: +49 341 97-36015
Fax: +49 341 97-36017

buildmona@uni-leipzig.de
www.buildmona.de

SCHEDULE for Module 2020-A3

Time	Lecturer	Program	Location
Wednesdey, 30 September 2020			
10:00-10:45	Dr. Chris Sturm	Exceptional points in anisotropic optical bulk materials	online
10:45-11:00		*Break (coffee, bathroom, ...)*	
11:00-11:45	Dr. Chris Sturm	Exceptional points in anisotropic optical artificial materials	online
	Lunch break		
13:00-13:45	Dr. Parveen Kumar	Quantum measurement as a paradigm for dissipative dynamics: from Lindbladian to non-Hermitian Hamiltonian	online
13:45-14:00		*Break*	
14:00-14:45	Dr. Parveen Kumar	Quantum measurement as a paradigm for dissipative dynamics: from Lindbladian to non-Hermitian Hamiltonian	online
		Break	
15:00-15:45	Dr. Holger von Wenckstern	Exceptional points in coupled electronic circuits	online

Didactic elements:
All lectures will be presented online. The link to the video conference will be shared with the registered participants via email.

Exam:
For the exam a written summary accompanied by a critical analysis (total of 2-3 pages) of a recent paper in the literature on exceptional points will be graded.