Module title	Abbreviation
Topological Order	11-TOPO-161-m01

Module coordinator		Module offered by	
Managing Director of the Institute of Applied Physics		Faculty of Physics and Astronomy	

ECTS	Method of grading	Only after succ. compl. of module(s)	
6	numerical grade	--	

Duration	Module level	Other prerequisites	
1 semester	graduate	--	

Contents

Topologically ordered phases possess no order in the conventional sense (i.e., no broken symmetry and no local order parameter). The order is instead characterized by topological quantum numbers. In the course, the general concepts will be illustrated with the study of specific examples of systems with topological order.
The topics discussed may include:
1. Fractional charge and statistics in quantized Hall fluids
2. Spin charge separation in spin chains and chiral spin liquids
3. Non-Abelian statistics of fractionalized excitations
4. Majorana zero modes in p-wave superconductors
5. Topological degeneracies on higher genus surfaces (e.g., torus geometry)
6. Spinons and visons in spin liquids including Kitaev models.

Intended learning outcomes

The students acquire in-depth knowledge of topological order in quantum condensates.

Courses (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.
Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: German and/or English

Allocation of places

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Additional information

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Referred to in LPO I (examination regulations for teaching-degree programmes)

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Module appears in

Master's degree (1 major) Mathematics (2016)
Master's degree (1 major) Physics (2016)
Master's degree (1 major) Mathematical Physics (2016)
Master's degree (1 major) Computational Mathematics (2016)
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2016)

Master's degree (1 major) Computational Mathematics (2019)
Master's degree (1 major) Mathematics (2019)