

| Module title  |                   | Abbreviation                         |
|---|-------------------|--------------------------------------|
| Topological Effects in Solid State Physics  |                   | 11-TEFK-201-m01                      |
| Module coordinator  |                   | Module offered by                    |
| Managing Director of the Institute of Theoretical Physics and Astrophysics  |                   | Faculty of Physics and Astronomy     |
| ECTS  | Method of grading | Only after succ. compl. of module(s) |
| 8   | numerical grade   | --                                   |
| Duration  | Module level      | Other prerequisites                  |
| 1 semester  | graduate          | --                                   |
| Contents  |                   |                                      |
| 1. Geometric phase in quantum systems<br>2. Mathematical basics of topology<br>3. Time-reversal symmetry<br>4. Hall conductance and Chern numbers<br>5. Bulk-boundary correspondence<br>6. Graphene (as a topological insulator)<br>7. Quantum Spin Hall insulators<br>8. $\mathbb{Z}_2$ invariants<br>9. Topological superconductors   |                   |                                      |
| Intended learning outcomes  |                   |                                      |
| In-depth theoretical understanding of the topological concepts in quantum physics related to solid state systems. Ability to connect their knowledge with different research activities at the Department of Physics and Astronomy at Würzburg University.  |                   |                                      |
| Courses (type, number of weekly contact hours, language — if other than German)   |                   |                                      |
| V (4) + R (1)<br>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. 90-120 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).<br>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.<br>Language of assessment: German and/or English<br>Assessment offered: In the semester in which the course is offered and in the subsequent semester |                   |                                      |
| Allocation of places  |                   |                                      |
| --  |                   |                                      |
| Additional information  |                   |                                      |
| --  |                   |                                      |
| Workload  |                   |                                      |
| 240 h   |                   |                                      |
| Teaching cycle  |                   |                                      |
| --  |                   |                                      |
| Referred to in LPO I (examination regulations for teaching-degree programmes)   |                   |                                      |
| --  |                   |                                      |

**Module appears in**

Master's degree (1 major) Nanostructure Technology (2020)  
Master's degree (1 major) Physics (2020)  
Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  
Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)  
Master's degree (1 major) Mathematical Physics (2020)  
Master's degree (1 major) Quantum Technology (2021)  
Master's degree (1 major) Computational Mathematics (2022)  
Master's degree (1 major) Mathematics (2022)  
Master's degree (1 major) Mathematical Physics (2022)  
exchange program Physics (2023)