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UNIVERSITÄT
TÜBINGEN



CSC-Tübingen PhD Scholarship Program

2026/2027 application round: prospective PhD positions at the University of Tübingen

Faculty: Faculty of Science

Institute: Institute for Theoretical Physics

Supervising Professor: Igor Lesanovsky

About the Supervisor: The supervisor's research group was established in 2019 and investigates the physics of synthetic many-body systems that are controlled by external fields. The group's research goal is to uncover emergent complex behavior such as phase transitions. An overview of the group's research can be found on www.open-quantum-systems.com.

Project title: Interacting polaritons as a nonlinear photonic computing medium

Topic: In a cold atomic gas coupled to highly excited Rydberg levels, light travels as polaritons that interact strongly over distances far exceeding their own width. Because the interaction is long-ranged, light beams that never overlap still influence each other. This is because the medium behaves as a densely connected nonlinear network with no wiring. This project asks whether such a network can carry out computational tasks on data encoded directly in the light beams that traverse it. Information is written into spatial modes or pulse trains, and propagation through the correlated, driven-dissipative medium acts as a nonlinear map, with collisions between solitons — pulses that keep their shape as they propagate — providing elementary operations. The aim is to relate the network's computational capacity — its expressivity, memory and noise tolerance — to physical parameters such as interaction range, loss and the build-up of correlations, and to use machine-learning methods both to design the medium and to benchmark its computational capabilities.

Intended Degree: PhD in Physics

Type of the PhD Study: Full-time (complete doctoral studies at the University of Tübingen)

Required Degrees and Qualifications: MSc in Physics

Language Requirements: Certified high standard of English (e.g. through TOEFL or IELTS).

Notes: The applicant must have a high level of independence, the ability to work in a team and excellent knowledge of analytical methods of theoretical physics. Programming skills (e.g., Python or Matlab) are also advantageous.