



PhD Program between the Freie Universität Berlin (FUB) and the China Scholarship Council (CSC)

**Open PhD Position at Freie Universität Berlin,
offered only to Chinese CSC scholarship candidates 2024**

Department/Institute: | Physics |

Subject area: | Quantum Information/ Nanoscience / 2D materials |

Name of Supervisor: | Prof. Dr. Kirill Bolotin |

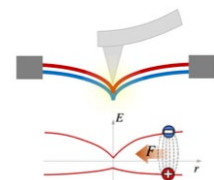
Number of open PhD positions: | 1 |

Type of the PhD Study: | 2 - sandwich |

Project title: | Tunable quantum emitters created in a 2D material
nanomechanical platform |

PhD Project description:

Single photon emitters is a critical technology needed for the realization of secure quantum encryption as well as for some quantum computing approaches. Currently, available emitters only emit at an energy defined at the fabrication stage. This makes it difficult to create two (or more) distinct emitters at the same energy, which is the requirement for some quantum encryption protocols.



The goal of this project is to realize widely energy-tunable quantum emitters in 2D materials. We use mechanical strain as a tool both to generate single photon emitters and to control their energies. To accomplish this, we will develop nanomechanical platform to induce tunable nonuniform strain in suspended 2D materials. Optically generated excitons will be trapped in effective potential wells with tunable depth. Such localized excitons can be considered tunable quantum emitters. At the end of the project, we will move towards large-scale arrays of such emitters. We will apply such devices to realize quantum encryption and potentially carry out quantum simulations.

The project involves working with two-dimensional materials (e.g. graphene, TMDs, hBN, and others), state-of-art nanofabrication, optical setups, as well as frontier fundamental science. You will be making nanodevices, carrying out (quantum) optical measurements, and developing computational and theoretical approaches to understand these systems. You will work in an active international team that is part of a big research cluster devoted to the study of hybrid molecular material. The project combines the techniques from nanofabrication, optics, electrical transport and nanoscience. We look forward to working with you!

Language requirements:

- IELTS: 6,5 or TOEFL: 95 ibt
- OR
- Test Daf 16 bzw. DSH 2

Academic requirements:

Masters in Physics, Applied Physics, Material Science, or Nanoscience. Coursework in Quantum Mechanics and Electrodynamics is necessary. Programming experience is a plus. Experience with electronics, 2D materials, nanofabrication or optics is a plus. Enthusiasm about both experimental and theoretical science is a big plus!

Information of the professor or research group leader (website, awards etc.):

The Bolotin lab (bolotingroup.com) specializes in quantum electronics and optoelectronics of two-dimensional materials. Prof. Kirill Bolotin holds the chair of electrical transport in 2D materials in Free University Berlin. The key experimental techniques are electrical transport, strain engineering, photocurrent spectroscopy, and state-of-art nanofabrication. His work, among which are the discoveries of the fractional quantum effect in graphene, the demonstration of strain-engineering of 2D MoS₂, first measurements of the exciton binding energy in 2D MoS₂, and the discovery of the renormalization of the elastic constants of the 2D materials was cited more than 12,000 times. Kirill Bolotin recently moved to Free University Berlin (Germany) from Vanderbilt University (USA); the work of the group was recognized by the US NSF Career Award (2010), the Sloan Foundation award (2011), and the ERC starting grant (2016). The group includes postdocs, PhD students (including CSC students from previous years), and Master students from 8 countries and various background. The group operates a newly-opened nanofabrication cleanroom as well as a range of measurement setups. The group believes in combining theoretical and experimental approaches to probe frontier physical phenomena.

Please Note: In a first step, the complete application should be uploaded to the [online portal](https://fuberlin.moveon4.de/form/60acfece5d328710e40bdbd5/eng) (<https://fuberlin.moveon4.de/form/60acfece5d328710e40bdbd5/eng>) for evaluation by January 15th, 2024. Please do not contact the professor before. He/she will get in contact with you after having received the complete application via the International Office of Freie Universität Berlin in January.