DFG Deutsche Forschungsgemeinschaft

NARODOWE CENTRUM NAUKI

JOB OFFER in BEETHOVEN 2 grant
(Polish – German collaboration)

Position in the project: PhD student

Scientific disciplines: quantum optics, plasmonics, solid state physics

Job type: stipend

Number of job offers: 1

Stipend amount: 3000 PLN/month

Maximum period of stipend agreement: 6 months

Position starts earliest on: 1.09.2021.

Institution:

Nicolaus Copernicus University in Toruń, Poland
Faculty of Physics, Astronomy and Informatics
Institute of Physics

in collaboration with

Karlsruhe Institute of Technology
Institute of Theoretical Solid State Physics

Project leaders: dr. Karolina Słowik (Poland), prof. Carsten Rockstuhl (Germany)

Project title: Graphene Surface Plasmons for Tunable Cavity Quantum Electrodynamics (GRASP)

Project description: The GraSP project aims to capitalize on the unique advantages offered by plasmonics: the spectrally sensitive tailoring of the electromagnetic local density of states that opens up possibilities of strong confinement and enhancement of electromagnetic fields, to explore a new platform for strong light matter interactions. Metal-based plasmonic devices that are usually considered for this purpose suffer from poor quality factors, extremely short lifetimes, and an inability to dynamically tune their properties. We circumvent these limitations by exploring graphene based plasmonic nanostructures in the GraSP project. Graphene is a versatile, broadband, adjustable, and tunable plasmonic material. Its ability to focus electromagnetic fields into nanometric regions of space is well beyond that of noble metals. Graphene is characterized by heavily suppressed absorption losses for photon energies below a threshold corresponding to the Fermi energy. A suitable level of doping, via electric gating, or chemical means can also shift the Fermi energy on-demand. This results in a wide-range dynamic control of graphene's optical properties by merely turning a knob. Combined with the plasmonic lifetimes reaching hundreds of optical cycles, this renders graphene-based plasmonic nanostructures perfect candidates to implement nanoscale cavity QED systems that are tunable in time. Coupling strength, emission properties, spectral properties, nonlinear interactions in addition to a dynamic control of graphene

properties enables multiple applications for signal processing at the quantum level, construction of new types of quantum logic gates, generation of multiphoton nonclassical states of light, or coupling of atomic systems that could be activated ondemand. In GraSP we aim to lay down the ground for such devices.

Key responsibilities include:

1. preparation of numerical tools and simulations of optical properties of plasmonic nanoparticles, in particular based on graphene,
2. active collaboration with partners,
3. preparation of scientific articles,
4. presentation of research results at seminars and conferences.

Profile of candidates / requirements:

1. PhD student status (major: physics or related) or equivalent
2. documented scientific expertise in one of the following disciplines
    - classical electrodynamics,
    - quantum optics,
    - atomic / molecular physics,
    - quantum solid state theory,
3. experience in numerical simulations or programming,
4. strong oral and written communication skills in English,
5. willingness to include the research results in the PhD thesis.

Required documents:

1. CV,
2. motivation letter (optional),
3. contact details to at least one academic referee,
4. confirmation of the PhD student status (not required for students affiliated at the Nicolaus Copernicus University in Toruń).

Please submit the documents to: karolina@fizyka.umk.pl
(scanned or pdf versions will be accepted).
For more details please contact us by email: karolina@fizyka.umk.pl
Application deadline: 06.08.2021.

Please include the following sentence in your application:“I hereby give consent for my personal data included in my application to be processed for the purposes of the recruitment process under the Personal Data Protection Act as of 29 August 1997, consolidated text: Journal of Laws 2016, item 922 as amended.”