

2018 Helmholtz – OCPC – Program for the involvement of postdocs in bilateral collaboration projects

Title of the project:

On/inter-chip photonic coupling of spin qubits in gate-defined quantum dot

Helmholtz Centre and institute:

Forschungszentrum Jülich, JARA Institute for Quantum Information (PGI-11), in cooperation with branch of the Institute at RWTH Aachen.

Project leader: Prof. Dr. Hendrik Bluhm

Web-address:

[JARA Institute for Quantum Information, Bluhm group](#)

Description of the project:

The spin qubit in gate defined quantum dot (GDQD) is a strong candidate for quantum computer and quantum network. However, a key issue limiting the scalability of the GDQD is the lack of a scheme coupling distant ($> 10 \mu\text{m}$) spin qubits in GDQDs. In the proposed project, we aim to develop an on-chip photonic coupling scheme for spin qubits in GaAs GDQDs. Our approach will combine a new type of single photon sources (SPSs) based on optically-active GDQDs, one of the most advanced on-chip SPS design based on a photonic crystal platform and the state-of-the-art exchanged coupled single/two-qubit gate based on GaAs GDQDs. The scalability of our scheme is ensured by the entire top-down fabrication. Furthermore, this scheme will be extended to establish a high-efficiency inter-chip photonic coupling scheme.

The postdoc candidate will primarily work on the simulation/fabrication of the photonic crystal structure. The postdoc candidate will also have the opportunity of conducting quantum optical/transport measurements to demonstrate the entanglement between two distant spin qubits.

Description of existing or sought Chinese collaboration partner institute:

The desired Chinese partner institutes should be the world-leading institutes in nanophotonics or solid-state quantum computing. Specifically, the strength of the partner institutes should be the cavity quantum electrodynamics (CQED) theory, fabrication of GaAs nanophotonic structures or the development of solid-state qubits, such as spin qubits in GDQD/diamond and superconducting qubits.

Required qualification of the post-doc:

- PhD in Physics or Engineering.
- Experience with simulation/fabrication of photonic crystal structures and/or quantum optics/transport measurement.

PART B

Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team