Julius-Maximilians-
UNIVERSITÄT WÜRZBURG

The Chair of Technische Physik at the University of Würzburg, Germany invites applications for a

TeP UniWü

PhD and postdoc position

Demonstration of a Quantum-Repeater based on Semiconductor Quantum Dots

Privacy and secure data communication are based on computational complexity on standard PC architectures. However, modern encryption is relatively easy to hack with a sufficiently big quantum computer using an algorithm proposed by Shor [1]. In the last few years, some big players in industry got interested in researching on quantum computers and thus, the implementation of Shor's algorithm is only a matter of time.

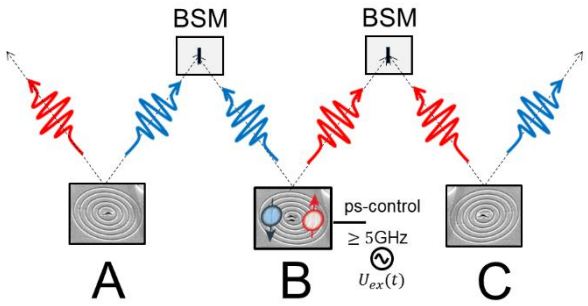

Figure 1: Schematic overview of the envisioned experiment. Three stations A, B and C get connected via entanglement swapping. The stations A and C produce entangled photon pairs, while the station B hosts a quantum dot molecule that acts as a local quantum memory.

One possible solution to recover security is the use of quantum mechanics. It is possible to create communication protocols, based solely on physical principles, which are genuinely secure [2]. The drawback of these protocols is, that they need a direct connection between the sender and the receiver, because it is physically forbidden to copy (and amplify) the signal. To overcome this problem and to build up larger networks, a quantum repeater was proposed [3].

We will show that epitaxially grown semiconductor quantum dots can be used as building blocks for a quantum repeater. Their high light-matter interaction makes them a very efficient interface between matter spin qubits and flying photonic qubits. Our goal is to establish a demonstrator with 3 nodes as schematically depicted in Fig.1. Here, station B hosts a quantum dot molecule in which 2 single spins will be entangled with photons from station A and C and after successful spin-photon entanglement creation on both sides, the spin-spin system will perform an entanglement swap, such that there is shared entanglement between the most left and the most right photon.

Your contribution will be the investigation of spin dynamics of quantum dots and quantum dot molecules embedded in circular Bragg grating cavities, entanglement creation, and setting up of the demonstrator experiment.

We are looking for excellent students with a background in quantum physics or optics who have demonstrated originality and productivity in research, who are qualified to start a PhD program in physics and postdocs with a background in semiconductors, quantum dots, quantum optics, photonics or AMO physics.

The University of Würzburg is an equal opportunity employer. Thus, all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability, or age. Please submit your complete application documents (cover letter, CV, list of publications, possibly recommendation letters) by email as one, single, attached .pdf file (no more than 10 MB) to Kristina Haub (kristina.haub@uni-wuerzburg.de)

[1] P. W. Shor, „Polynomial-Time Algorithms for Prime Factorization and Discrete Logarithms on a Quantum Computer," *SIAM J.Sci.Statist.Comput.,* Bd. 26, p. 1484, 1997.

[2] G. Brassard und C. H. Bennett, „Quantum cryptography: Public key distribution and coin tossing," *Proceedings of IEEE International Conference on Computers, Systems and Signal Processing,* Bd. 175, p. 8, 1984.

[3] H. J. Briegel, W. Dür, J. I. Cirac und P. Zoller, „Quantum Repeaters: The Role of Imperfect Local Operations in Quantum Communication," *Phys. Rev. Lett.,* Bd. 81, p. 5932, 1998.

Person of contact:
Kristina Haub kristina.haub@uni-wuerzburg.de