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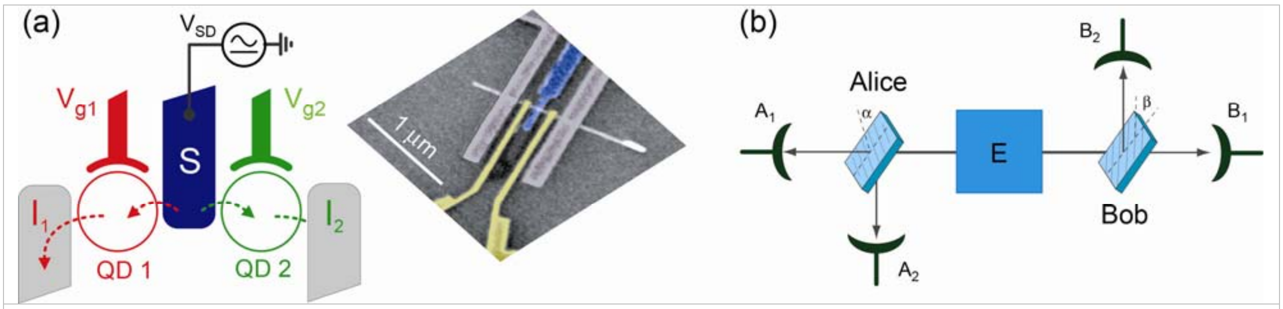
Postdoc Position

Quantum Entanglement in Electronic Solid State Devices

QUEST is a long term project with the goal to experimentally establish a continuous probe of entanglement generation in the electrical signal of quantum devices. We aim to implement **high-bandwidth current correlation** methods up to the forth moment, enabling to **test Bell-inequality** and **quantum state tomography**. Based on our long standing experience in the measurement of second-order correlations in nano devices, we are well prepared for this very challenging goal.

We are looking for a postdoc interested to build up a **cryogenic rf-setup** with which correlations in charge transport through two quantum dots coupled to a superconducting source shall be measured. We target two approaches: one based on **charge detection** using impedance reflectometry and the other on direct **high-bandwidth current measurements**. The successful candidate should have a PhD in physics and be, if possible, experienced with *GHz experiments,* with low *temperature systems*, in particular *dilution refrigerators*, *transport measurements of nanoelectronic devices*, and *nanofabrication technology*.



(a) Two quantum dots (QD1 & QD2) force the two electrons of a single Cooper pair, injected from a superconducting electrode (S), to separated due to Coulomb intercations. (b) Detectors for spin-pairs will be based on spin-filters, charge detection and fast radio-frequency electronics.

The **nanoelectronics group** at the University of Basel (**www.nanoelectronics.ch**) has many years of experience in exploring fundamental electrical properties of nano-devices and pioneered shot-noise correlation measurement early on. We performed the first shot-noise experiment in the Coulomb blockade regime of a single-electron tunnelling device, displaying charge correlation induced shot-noise suppression. This was followed by a series of noise experiments, including the textbook Hanbury-Brown-Twiss beam splitter experiment for electrons (Science 1999). We introduced quantum-dots coupled to superconducting electrodes, displaying an intriguing interplay between a superconducting and magnetic ground state, and we succeeded to realize quantum dots coupled to ferromagnets and demonstrated a gate-tunable spin FET behavior. These novel experiments were only possible, because we have realized early on the great potential of novel materials, in particular of carbon nanotubes and semiconducting nanowires, for the realization of hybrid devices embodying superconducting and ferromagnetic electrodes. The last example along this line has been the Cooper-pair splitter (Nature 2009), which is the key device in this project. The Cooper-pair splitter serves as a source for EPR electron pairs. The goal of the project is to evaluate the efficiency and degree of entanglement of this electron source.

The appointment shall start in summer to autumn 2012 and will initially be for two years with the possibility of a further extension.

Candidates should e-mail a letter of application together with a brief CV to Prof. Christian Schönenberger, Department for Physics, Klingelbergstrasse 82, CH-4056 Basel, Switzerland;
e-mail: Christian.Schoenenberger@unibas.ch.