μK regime in nanoelectronic devices

Open position available
in the Quantum Coherence Group (Zumbühl Group) in Basel:

Metallic coulomb blockade thermometer mounted on a copper nuclear refrigerator able to reach temperatures down to 150 μK [1]. The device itself consists of an array of AlO, tunnel junctions and cools down to the published world record electronic temperature of 2.8 mK (1.8 mK have been obtained more recently).

We are looking for a highly motivated and talented physicist with strong laboratory skills for the study of tunnel junction devices and GaAs two dimensional electron gases (2DEGs) at ultra-low temperatures, obtained by means of on-chip adiabatic nuclear demagnetization (AND).

AND is a well-established technique for cooling bulk metals down to μK temperatures which has been adapted in our group for quantum transport measurements [1]. The electronic temperature is inferred from conductance measurements using metallic coulomb blockade thermometers (CBTs), reliable and precise thermometers [2] down to the low mK regime [4]. Employing on-chip AND to a CBT [3], temperatures as low as 2.8 mK were demonstrated [5], while normal metal–insulator–superconductor tunnel junctions (NIS) cooled down to 7 mK [6]. The suitable candidate will further push this limit by cooling CBT and NIS devices to below 1 mK, thus opening the door for quantum transport measurements at μK temperatures. The project involves electrical transport measurements, mechanical works on a cryogen-free dilution refrigerator with adapted nuclear stage. Furthermore, the ultra-low temperature regime in GaAs 2DEGs is explored.

This project involves
- Working with a He-3/He-4 dilution refrigerator adapted for AND transport experiments
- Performing transport experiments at ultra-low (world record) temperatures
- Physics of tunnel junctions, superconductors, nuclear spins (magnetic cooling), Coulomb blockade, thermal material properties at interfaces and in the bulk
- Analyzing experimental data and developing thermal models of the devices
- Presentation of the results at international conferences and publication in high quality journals

References

Contact
If you are interested to join our group, do not hesitate to send an email to dominik.zumbuhl@unibas.ch to initiate further discussions.