

Visitor, Associates and Students' Programme (VASP) presents Webinar Series on
Quantum Materials & Devices



17 AUGUST 2022
04:00 PM (IST)



<https://meet.google.com/kjz-ajug-rmy>



<https://www.youtube.com/c/SNBoseNationalCentreforBasicSciences>

TITLE

Cooper-pairs are nice, but split ones are even nicer!
Why it is interesting to "unpair" a Cooper-pair

ABSTRACT

An elegant concept for the creation of entangled electrons in a solid-state device is to split Cooper pairs by coupling a superconductor to two parallel quantum dots (QDs) in a Y-junction geometry [1]. Cooper pair splitting (CPS) was investigated in recent years in devices based on InAs nanowires [2,3] and carbon nanotubes (CNTs) [4,5] and identified by a positive correlation between the currents through the QDs. I will first review these experiments and demonstrate that high splitting efficiencies $> 90\%$ can be achieved [5].

A high CPS efficiency is a prerequisite for Bell state measurements [6], a clear way of proving that Cooper pairs can be extracted coherently, leading to spatially separated entangled electron pairs. Further requirements on entanglement measurements will be addressed in the talk as well [6] and a future perspective will be given.

My aim is to give a historical view of research that started around 12 years ago in my lab, hopefully understandable by a general audience interested in solid-state physics in general. This journey shows how scientific research evolves, where one often takes detours and where one constantly must reflect the finding in the lab based on either physical intuition (simple minded models) or, if available, good theory.

This is a collaborative effort with many people, see my group website www.nanoelectronic.ch and other groups as well. I would like to mention in particular the groups of Szabolcs Csonka, Budapest University of Technology and Economy, Jesper Nygard, Nano-Science Center, Niels Bohr Institute of the University of Copenhagen, and Jan Martinek- IFM-PAN, Poznan, Polen. I acknowledge funding from the Swiss NFS, SNI, NCCR-QSIT, FP7-SE2ND and ERC-QUEST.

[1] P. Recher, E.V. Sukhorukov and D. Loss, Phys. Rev. B 63, 165314 (2001).

[2] L. Hofstetter, S. Csonka, J. Nygård and C. Schönenberger, Nature 461, 960 (2009).

[3] L. Hofstetter, S. Csonka, A. Baumgartner, G. Fülöp S. d'Hollosy, J. Nygård and C. Schönenberger, Phys. Rev. Lett. 107, 136801 (2011).

[4] L.G. Herrmann, F. Portier, P. Roche, A. Levy Yeyati, T. Kontos and C. Strunk, Phys. Rev. Lett. 104, 026801 (2010).

[5] J. Schindele, A. Baumgartner, and C. Schönenberger, Phys. Rev. Lett. 109, 157002 (2012).

[6] W. Kłobus, A. Grudka, A. Baumgartner, D. Tomaszewski, C. Schönenberger, and J. Martinek, Phys. Rev. B 89, 125404 (2014).

[7] G. Fülöp, S. d'Hollosy, A. Baumgartner, P. Makk, V. A. Guzenko, M. H. Madsen, J. Nygård, C. Schönenberger, and S. Csonka, Phys. Rev. B 90, 235412 (2014).

[8] J. Schindele, A. Baumgartner, R. Maurand, M. Weiss, and C. Schönenberger, Phys. Rev. B 89, 045422 (2014).

SPEAKER

Professor Christian Schönenberger

Department of Physics and Swiss Nanoscience Institute, University of Basel



Professor Christian Schönenberger holds a degree as an electrical engineer in applied sciences (1979) and a diploma in physics (1986). He did his PhD at the IBM Zurich Research Lab in the group of Dr. H. Rohrer and Dr. S. Alvarado. His PhD is entitled "Understanding Magnetic Force Microscopy" which was awarded with a medal from the ETH-Zurich and the Swiss Physical Society price (1991). Subsequently, he worked at the Philips Research Lab. at Eindhoven (NL), first as a postdoc, and later as a permanent staff member. In 1994

he was awarded a fellowship from the Swiss National Science Foundation (Profil-II). Soon afterwards he was elected to a full chair at the Univ. of Basel (1995). Since then, Christian Schönenberger has setup a group whose research focuses on charge transport in nanoscaled devices. He has co-authored over 80 refereed journal publications. He has participated in several EU programs and is currently directing the Swiss Nanoscience Institute at the University of Basel and the Swiss-NSF center on Nanoscale Science and Technology.