Lecture 3:

Andreev reflection

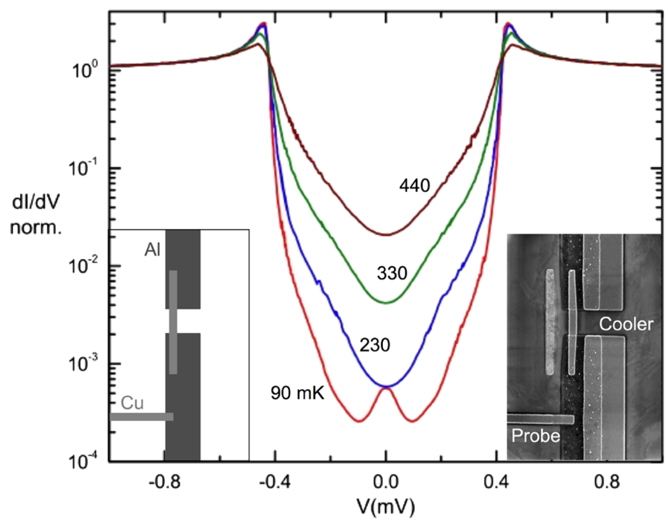
(doubling of the noise, crossed AR, MAR)

Zero-bias anomaly due to Andreev current

PRL 100, 207002 (2008) PHYSICAL REVIEW LETTERS week ending 23 MAY 2008

Andreev Current-Induced Dissipation in a Hybrid Superconducting Tunnel Junction

Sukumar Rajauria,[1] P. Gandit,[1] T. Fournier,[1] F. W. J. Hekking,[2] B. Pannetier,[1] and H. Courtois[1,3]
[1]*Institut Néel, CNRS and Université Joseph Fourier, 25 Avenue des Martyrs, B.P. 166, 38042 Grenoble, France*
[2]*LPMMC, Université Joseph Fourier and CNRS, 25 Avenue des Martyrs, B.P. 166, 38042 Grenoble, France*
[3]*Institut Universitaire de France, Paris, France*
(Received 15 February 2008; published 19 May 2008)



Time-resolved Andreev processes

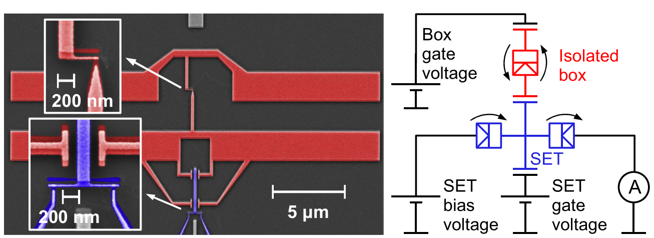
PRL **106,** 217003 (2011) PHYSICAL REVIEW LETTERS week ending 27 MAY 2011

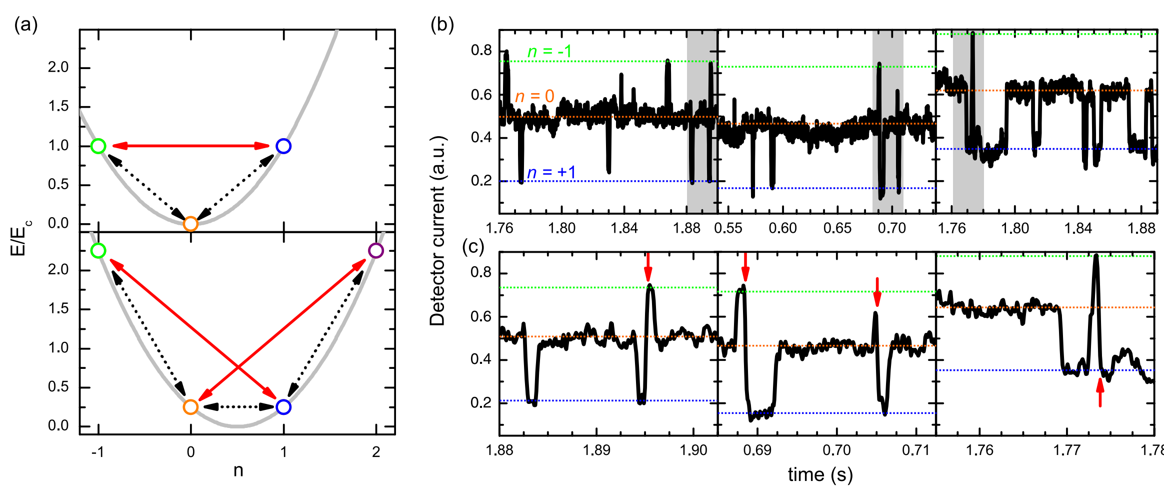
Real-Time Observation of Discrete Andreev Tunneling Events

V. F. Maisi,[1,2,*] O.-P. Saira,[1] Yu. A. Pashkin,[3,†] J. S. Tsai,[3] D. V. Averin,[4] and J. P. Pekola[1]

[1]*Low Temperature Laboratory, Aalto University, P.O. Box 13500, 00076 Aalto, Finland*
[2]*Centre for Metrology and Accreditation (MIKES), P.O. Box 9, 02151 Espoo, Finland*
[3]*NEC Green Innovation Research Laboratories and RIKEN Advanced Science Institute, 34 Miyukigaoka, Tsukuba, Ibaraki 305-8501, Japan*
[4]*Department of Physics and Astronomy, Stony Brook University, SUNY, Stony Brook, New York 11794-3800, USA*

(Received 28 February 2011; published 25 May 2011)



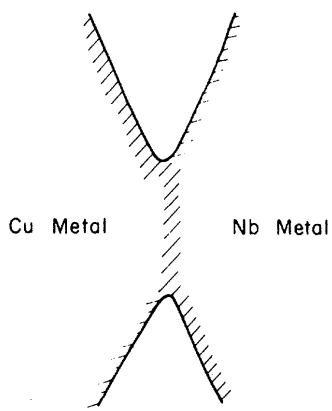


Andreev conductance of a point contact

PHYSICAL REVIEW B VOLUME 27, NUMBER 1 1 JANUARY 1983

Metallic to tunneling transition in Cu-Nb point contacts

G. E. Blonder and M. Tinkham
Department of Physics, Harvard University, Cambridge, Massachusetts 02138
(Received 24 June 1982)



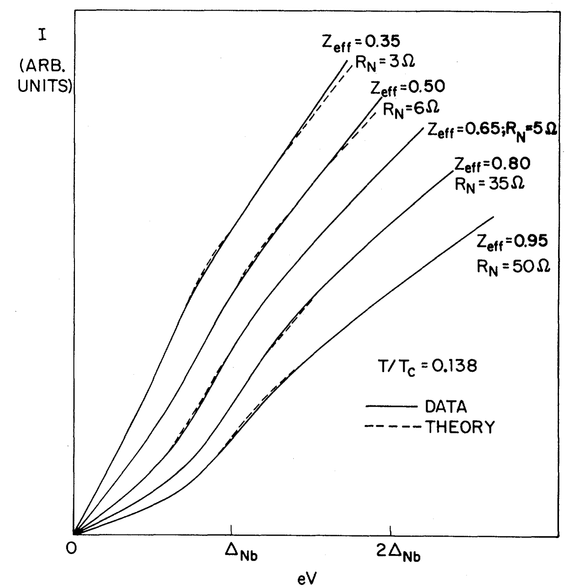


FIG. 6. Region-II I-V curves at $T/T_c = 0.138$. Solid lines are the experimental results, dotted lines are the fit to theory. Scaling of the current axis is roughly in units of Δ/eR_0, but selected in each case so as to prevent crowding of the curves. Where the experimental and theoretical curves overlap, only the experimental result is shown.

ballistic N/S junction

ARTICLE

Received 6 Mar 2016 | Accepted 8 Aug 2016 | Published 29 Sep 2016 DOI: 10.1038/ncomms12841 OPEN

Quantized conductance doubling and hard gap in a two-dimensional semiconductor–superconductor heterostructure

M. Kjaergaard[1], F. Nichele[1], H.J. Suominen[1], M.P. Nowak[2,3,4], M. Wimmer[2,3], A.R. Akhmerov[2], J.A. Folk[5,6], K. Flensberg[1], J. Shabani[7,†], C.J. Palmstrøm[7] & C.M. Marcus[1]

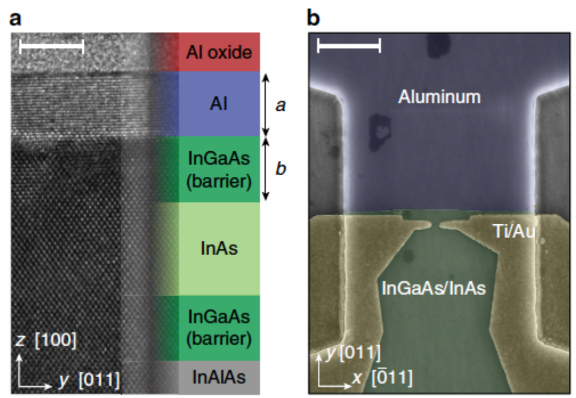
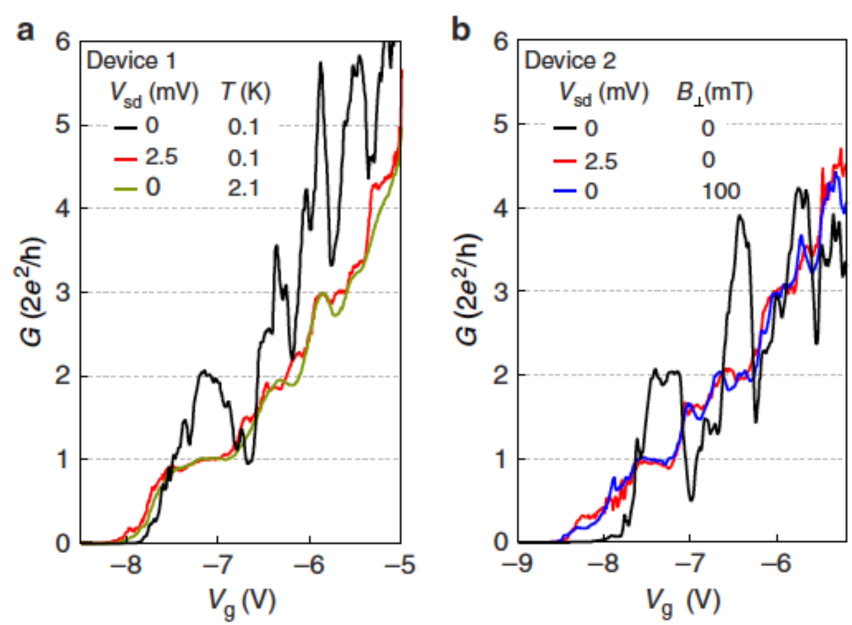


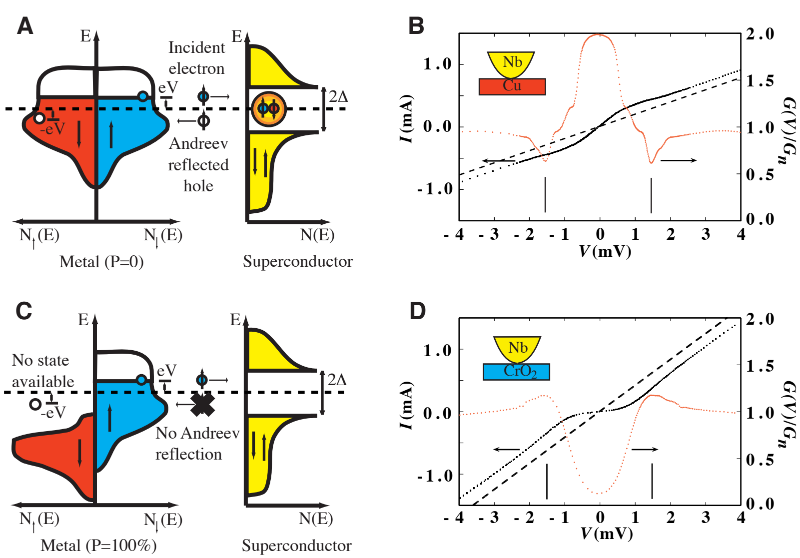
Figure 1 | Epitaxial aluminium on InGaAs/InAs and device layout. (**a**) Cross-sectional transmission electron micrograph of epitaxial Al on InGaAs/InAs. On the wafer imaged here, the height of the InGaAs barrier is $b = 5$ nm and Al film thickness $a \sim 5$ nm. Scale bar, 5 nm. (**b**) False-colour scanning electron micrograph of Device 1 (see main text for details). Scale bar, 1 µm.

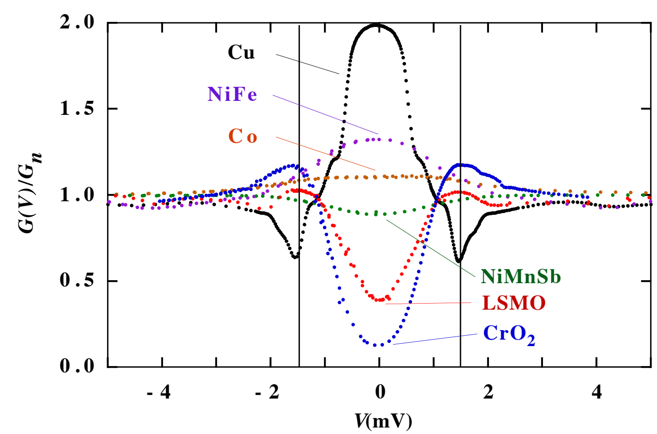


F/S junction

Measuring the Spin Polarization of a Metal with a Superconducting Point Contact

R. J. Soulen Jr., J. M. Byers,* M. S. Osofsky, B. Nadgorny,
T. Ambrose, S. F. Cheng, P. R. Broussard, C. T. Tanaka, J. Nowak,
J. S. Moodera, A. Barry, J. M. D. Coey



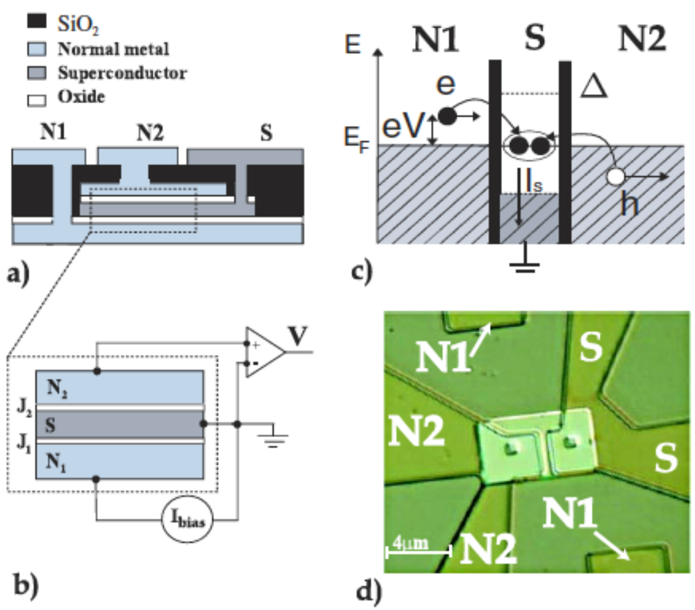


Crossed Andreev reflection and elastic cotunneling

PRL 95, 027002 (2005) PHYSICAL REVIEW LETTERS week ending 8 JULY 2005

Experimental Observation of Bias-Dependent Nonlocal Andreev Reflection

S. Russo, M. Kroug, T. M. Klapwijk, and A. F. Morpurgo
Kavli Institute of Nanoscience, Delft University of Technology, Lorentzweg 1, 2628 CJ Delft, The Netherlands
(Received 21 January 2005; published 8 July 2005)



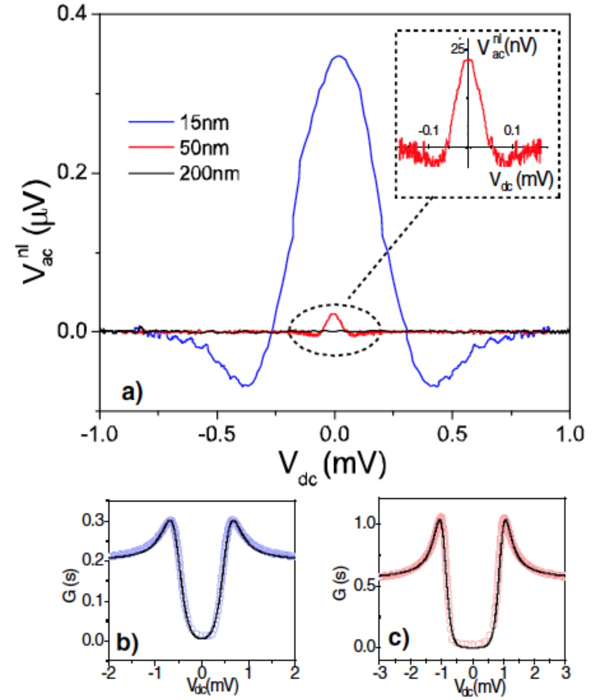


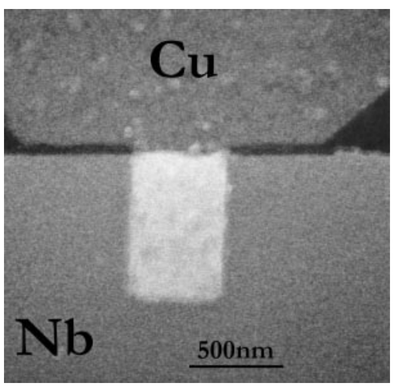
FIG. 3 (color online). (a) Nonlocal voltage V_{ac}^{nl} measured at $T = 1.6$ K on three samples with different thickness of the superconducting layer ($d = 15$, 50, 200 nm, with a normal state resistance of 4.8, 1.7, and 0.9 Ω respectively). Panels (b) and (c) show the tunneling characteristics of junctions, measured in two devices with $d = 15$ and 50 nm, respectively. The solid line is a fit based on the BCS density of states and shows that good agreement is found with $\Delta = 0.9$ and 1.45 mV for the two different thicknesses of the Nb layer [22]. The suppression of the gap in the $d = 15$ nm sample is typical of these thin superconducting films [16].

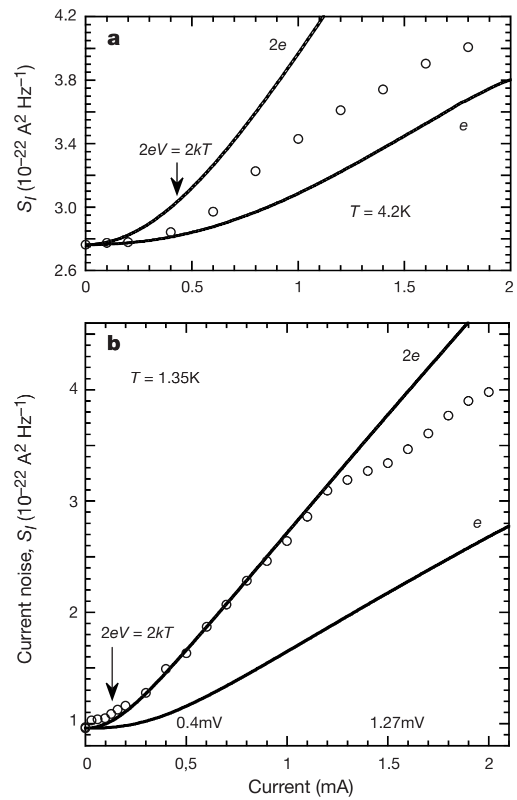
Doubling of the noise

Detection of doubled shot noise in short normal-metal/ superconductor junctions

X. Jehl*, M. Sanquer*, R. Calemczuk* & D. Mailly†

** DRFMC-SPSMS, CEA-Grenoble, F-38054 Grenoble, France*
† Laboratoire de Microstructures et de Microélectronique, CNRS-LMM, F-92225 Bagneux, France





Multiple Andreev reflections

VOLUME 78, NUMBER 18 PHYSICAL REVIEW LETTERS 5 MAY 1997

Conduction Channel Transmissions of Atomic-Size Aluminum Contacts

E. Scheer, P. Joyez, D. Esteve, C. Urbina,* and M. H. Devoret
Service de Physique de l'Etat Condensé, Commissariat à l'Energie Atomique, Saclay, F-91191 Gif-sur-Yvette Cedex, France
(Received 4 February 1997)