

SCHOOL OF PHYSICS

UNIVERSITY OF NEW SOUTH WALES



COLLOQUIUM

4-5 p.m., Tuesday, 7 July 2009

School of Physics Common Room
Room 64, Old Main Building

Professor Jukka Pekola

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“Quantum Standard for Electric Current - Development of a Hybrid Turnstile”

In the quantum metrological triangle, voltage from the Josephson effect and resistance from the quantum Hall effect would be tested against current via Ohm's law for a consistency check of the fundamental constants of nature, h and e . Several attempts to create a metrological current source that would comply with the demanding criteria of extreme accuracy, high yield and implementation with not too many control parameters have been reported. We present a hybrid normal-metal-superconductor turnstile in the form of a one-island single-electron transistor with one gate [1]. In our experiments the device demonstrates robust current plateaus at multiple levels of ef at frequency f . We discuss the various error mechanisms, based on our experiments and theoretical considerations [2-4]. Ultimately the quantization accuracy is expected to be limited by either two-electron tunneling or by Cooper-pair-electron co-tunneling. We predict that it should be possible to achieve the metrological accuracy of 10^{-8} , while maintaining the quantized current on the level above 10 pA, just by one turnstile with realistic parameters using aluminium as the superconductor. We have recently tested a parallel configuration of several turnstiles which yields the larger current levels required in the implementation of the quantum triangle.

[1] J. P. Pekola, J. J. Vartiainen, M. Möttönen, O.-P. Saira, M. Meschke, and D. V. Averin, *Nature Physics* **4**, 120 (2008).

[2] A. Kemppinen, M. Meschke, M. Möttönen, D.V. Averin, and J.P. Pekola, arXiv:0803.1563.

[3] A. Kemppinen, S. Kafanov, Yu. A. Pashkin, J. S. Tsai, D. V. Averin, and J. P. Pekola, *Appl. Phys. Lett.* **94**, 172108 (2009).

[4] D. V. Averin and J. P. Pekola, *Phys. Rev. Lett.* **101**, 066801 (2008).

The audience is invited to meet the speaker beforehand at 3.45 p.m. over coffee and biscuits in the Common Room.

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