Observation of Andreev Tunneling Effects in Current Pumping with SINIS turnstiles

T. Aref[a], V. Maisi[a], M. Gustafsson[b], P. Delsing[b], and J. Pekola[a]

[a]Aalto Univ, Low Temp Lab, Espoo, Finland
[b]Chalmers University of Technology, Göteborg, Sweden

A top priority in metrology is to develop measurement standards that are based on fundamental physical constants. Although such standards exist for resistance and voltage (the quantum Hall effect and the Josephson effect respectively), no such standard exists for current at the present time. A strong candidate for a quantum metrological standard of current is a single electron turnstile which allow electrons through one at a time. When operated at a specific frequency, they produce a current proportional to the frequency and traceable to the single electron charge. We present measurements on single electron turnstiles with superconducting aluminum leads contacting a normal copper island (SINIS). By reducing the environmental activation using on-chip filtering, we observe a second order error process: Andreev tunneling of the electrons. The data is well accounted for by numerical simulations. We can control this Andreev process by tuning the charging energy of the normal island. Raising the charging energy effectively suppresses the tunneling. Understanding and eliminating error processes in these turnstiles is vital for the achievement of a quantum metrological triangle (QMT) measurement, a key goal in metrology. In closing the QMT, the three standards of voltage, resistance and current would be compared against each other via Ohm's law.