Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Nanoelectronic primary thermometry below 4 millikelvin
MATTHEW SARSBY, RICHARD HALEY, DAVID IAN BRADLEY, RICHARD GEORGE, YURI PASHKIN, JONATHAN PRANCE, University of Lancaster, UK, DAVID GUNNARSSON, HANNELE HEIKKINEN, MIKA PRUNNILA, VTT Technical Research Centre of Finland, PENTTIL JARI, LEIF ROSCHIER, Aivon Oy, Finland. — We present measurements of nanoelectronic Coulomb Blockade Thermometers that are optimised for operation below 10 mK. Their design incorporates on-chip electronic filters and cooling fins with a high electron-phonon coupling. By immersing the devices in the 3He/4He mixture of a dilution refrigerator, and by minimising electrical noise in the measurement circuit, the on-chip electron temperature reaches a value of 3.7 mK, the lowest yet measured in any nanoelectronic device. Above 7 mK the devices are in good thermal contact with their environment and are not susceptible to self-heating. Below 7 mK the device continues to provide accurate thermometry of the on-chip electron temperature, which is seen to diverge from the ambient temperature. In this regime the device provides valuable information about noise and heat-leaks from the environment, which points the way towards cooling nanoelectronic structures to lower temperatures.

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Date submitted: 05 Nov 2015 Electronic form version 1.4