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**Thermometry and Refrigeration using Quantum Dots** AQUILA MAVALANKAR, CHARLES SMITH, SIMON CHORLEY, JONATHAN GRIFFITHS, GEB JONES, IAN FARRER, DAVID RITCHIE, Semiconductor Physics Group, Department of Physics, JJ Thomson Avenue, Cambridge CB3 0HE — The 2D electron gas in GaAs/AlGaAs heterostructures has diverse applications at cryogenic temperatures, but is heated by unintended noise in the measurement set up. Our work involves the fabrication of a quantum dot refrigerator (QDR) which can cool the gas to below the ambient lattice temperature [1]. Lithographically defined gates define three quantum dots tunnel-coupled to an enclosed, macroscopic reservoir of electrons 100 $\mu$m$^2$ in area. Energy selective transport of electrons via the discrete energy levels of two quantum dots through the electron reservoir modifies its Fermi-Dirac distribution, thus cooling it. The third quantum dot (the 'thermometer') probes the temperature of the reservoir being cooled by monitoring the current flowing through an adjacent quantum point contact. We have demonstrated measuring electronic temperatures in the range 100 mK to 300 mK, with an estimated error of about 10%. We have also investigated the variation in electron temperature as a function of the energies of the entrance and exit dots. Our results are consistent with cooling an area of 64$\mu$m$^2$ by 30 mK, starting from 150mK, and agree qualitatively with theory [2].

[1] Prance e. a. Phys. Rev. Lett. 102 146602
[2] Edwards e. a. Phys. Rev. B 52 5714

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