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Quantum dot based refrigeration of a 2D electron gas JONATHAN R. PRANCE[1], CHARLES G. SMITH, JONATHAN P. GRIFFITHS, SIMON J. CHORLEY, DAVE ANDERSON, GEB A. C. JONES, IAN FARRER, DAVE A. RITCHIE, Cavendish Laboratory, University of Cambridge — The concept of cooling a 2D electron gas (2DEG) using energy-selective transport through quantum dots was first proposed by Edwards et al. [1]. Their scheme utilized two dots: one to remove hot electrons from an isolated 2DEG, the other to remove hot holes. The resulting current removes heat from the 2DEG and dissipates it in adjacent reservoirs. We will present measurements of a device designed to cool a $6\mu m^2$ 2DEG using this scheme [2]. The measurements reveal a complication not previously considered: the charging energy of the cooled 2DEG itself. We will outline a model that accounts for this, and shows that the device can still achieve cooling. We will also show how the temperature of the cooled region can be inferred from the line-shape of the current through the device. By comparing measured line-shapes with predictions, we find the data to be consistent with cooling of the isolated 2DEG by over 90mK in the best case. [1] Edwards et al. Phys. Rev. B 52(8) p5714 (1995) [2] Prance et al. Phys. Rev. Lett. 102, 146602 (2009)

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