Realization of an efficient quantum-dot heat engine

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It has been known for some time that a perfect (delta-function) energy filter allows, in principle, thermal-to-electric energy conversion near ideal (Carnot) efficiency. [1,2] I will introduce this concept and report on a recent experiment where we realized a near-ideal quantum-dot heat engine in devices based on single nanowires, realizing power production at maximum power with Curzon-Ahlborn efficiency, and reaching more than 70% of Carnot efficiency at maximum efficiency settings [3]. I will also discuss potential applications in the context of hot-carrier solar cells.

[1] Mahan, G. D., and Sofo, J. O. (1996). The best thermoelectric. Proceedings of the National Academy of Sciences of the United States of America, 93(15), 7436-7439.

[2] Humphrey, T. E., Newbury, R., Taylor, R. P., and Linke, H. (2002). Reversible Quantum Brownian Heat Engines for Electrons. Physical Review Letters, 89(11), 116801. http://doi.org/10.1103/PhysRevLett.89.116801

[3] Martin Josefsson, Artis Svilans, Adam M. Burke, Eric A. Hoffmann, Sofia Fahlvik, Claes Thelander, Martin Leijnse, Heiner Linke: A quantum-dot heat engine operated close to thermodynamic efficiency limits. Nature Nanotechnology (2018) https://doi.org/10.1038/s41565-018-0200-5