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Tunable Quantum Temperature Oscillations in Graphene Nanostructures JUSTIN BERGFIELD, MARK RATNER, Northwestern University, CHARLES STAFFORD, University of Arizona, MASSIMILIANO DI VENTRA, University of California, San Diego — Thermal scanning probe microscopy techniques are now capable of nanometer spatial resolution and millikelvin temperature accuracy, raising the fundamental question: What is the meaning of temperature for a quantum system operating far from equilibrium? We investigate this question theoretically using a realistic model[1] of a scanning thermal microscope with atomic resolution, operating in the tunneling regime in ultrahigh vacuum. The thermometer acts as an open third terminal in a thermoelectric circuit. We investigate the temperature distributions in molecular junctions and graphene nanoribbons[2] under thermal bias, and find that the local temperature in these systems exhibits quantum oscillations; quantum interference mimics the actions of a Maxwell Demon, allowing electrons from the hot electrode to tunnel onto the temperature probe when it is at certain locations near the system, and blocking electrons from the cold electrode, or vice versa.

[1]J.P. Bergfield, S.M. Story, R.C. Stafford, C.A. Stafford, ACS Nano 7, 4429-4440 (2013)
[2]J.P. Bergfield, M.A. Ratner, C.A. Stafford, M. Di Ventra, arXiv:1305.6602.

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