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**Path integral simulations for nanoelectronics**[1]

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As computer circuits shrink, devices are entering the nanoscale regime and quantum physics is becoming important. The biggest barrier to further decreases in size and increases in clock speed is excessive heat generation. Some physicists are proposing that many-body correlated quantum states of electrons may be exploited to make more energy efficient switches. In our research we are developing new simulation techniques to study highly correlated electron states in realistic device geometries and finite temperatures. The simulations are based on Feynman path integrals, which cast quantum statistical mechanics as a sum over worldlines, a mathematically equivalent alternative Schroedinger's differetial equation. Using Monte Carlo sampling on dozens to hundreds of electrons, we can simulate properties of an interacting electron fluid in a nanowire. Linear response theory relates fluctuations about equilibrium to conductivity. This gives us a new perspective on quantum phenomena, including quantized conductance steps and spin-charge separation.

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