Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Geometric Phase Effect in Heat Transport JIE REN, National University of Singapore, PETTER HANGGI, University of Augsburg, BAOWEN LI, National University of Singapore — Nonlinear molecular heat-pumping devices, which operate via explicitly modulating at least two parameters, are crucial for energy control in low dimensional nano-scale systems. We have applied slow two-parameter modulations on such a molecular junctions and consequently uncovered an intrinsic heat flux contribution, additional to the known, usual dynamical heat flux (from hot to cold). This additional heat flux derives from a nontrivial geometric origin that relates to a non-vanishing, so termed finite Berry phase. It provides a free lunch for the pumped heat and even can direct heat flux against the temperature bias. In addition we are able to show that this so pumped energy exhibits a novel robust fractional quantization phenomenon. Interestingly, this additional geometric heat pump mechanism is also shown to cause a breakdown of the heat-flux fluctuation theorem, which holds true for the non-driving, stationary heat flux transfer. The validity of this theorem is guaranteed whenever (i) the geometric phase contribution vanishes and (ii) the cyclic protocol preserves the detailed balance symmetry.

Jie Ren
National University of Singapore

Date submitted: 10 Dec 2010 Electronic form version 1.4