

Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Lagrange formalism of memory circuit elements: classical and quantum formulations GUY COHEN, Department of Physics, University of California, San Diego, YURIY PERSHIN, Department of Physics and Astronomy and USC Nanocenter, University of South Carolina, MASSIMILIANO DI VENTRA, Department of Physics, University of California, San Diego — The general Lagrange-Euler formalism for the three memory circuit elements, namely the memristor, memcapacitor, and meminductor [1,2] is introduced for circuits with voltage or current sources. In addition, *mutual meminductance*, i.e., mutual inductance with a state depending on the past evolution of the system, is introduced. The Lagrange-Euler formalism for a general circuit network and the corresponding work-energy theorem are also obtained. We provide examples of this formalism applied to specific circuits both in the classical and quantum regimes showing under which conditions the quantum excitations of the memory degrees of freedom can be observed experimentally. Work was supported in part by NSF.

[1] M. Di Ventra, Y. V. Pershin, and L. O. Chua, *Proc. IEEE* **97**, 1717 (2009).

[2] Y.V. Pershin and M. Di Ventra, *Advances in Physics* **60**, 145-227 (2011).

Guy Cohen
University of California San Diego

Date submitted: 04 Nov 2011

Electronic form version 1.4