Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

A friction driven Brownian ratchet[1] ALBERTO PETRI[2], ANDREA GNOLI, FERGAL DALTON[3], GIACOMO GRADENIGO, GIORGIO PONTUALE, ALESSANDRO SARRACINO, ANDREA PUGLISI[4], Istituto dei Sistemi Complessi - CNR, Rome, Italy — Exploiting thermal fluctuations to produce mechanical work requires statistical non-equilibrium conditions. We propose a new mechanism where an asymmetric wheel in a thermal bath exhibits a preferential direction of rotation because of the Coulomb friction at solid-on-solid contacts. The presence of a net drift induced by friction is demonstrated by numerical simulations and analytical calculations. If the thermal bath is replaced by a granular gas, the well-known granular ratchet effect also occurs, and becomes dominant at high collision rates. Depending on the wheel shape, the granular medium can act in opposite direction with respect to the friction-induced torque, resulting in the inversion of the ratchet motion as the collision rate increases. Both these ratchet effects and the predicted inversion are observed in the novel granular ratchet that we have realized experimentally (A.Gnoli et al., Phys.Rev. Lett. 110, 120601 (2013)). This also suggests the possibility of micro and sub-micrometer Brownian motors in equilibrium fluids, based purely upon nano-friction.

[1]The authors acknowledge the support of the Italian MIUR under the Grants FIRB-IDEAS No. RBID08Z9JE, FIRBs No. RBFR081IUK and No. RBFR08M3P4, and PRIN No. 2009PYYZM5
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Date submitted: 16 Nov 2013 Electronic form version 1.4