Energy equilibration in periodically driven systems

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Work done jointly with :
Vered Rom-Kedar (Weizmann Institute, Israel)
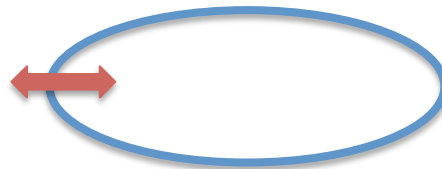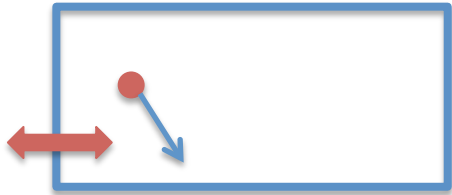Dmitry Turaev (Imperial College, London)
Vassili Gelfreich (Warwick Univ, UK)

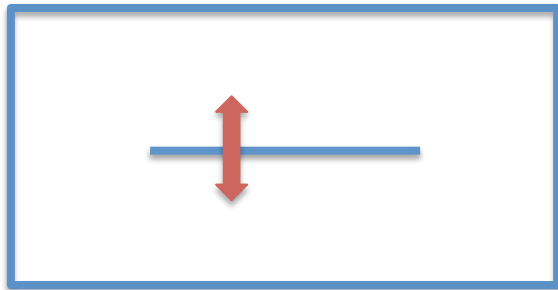**ISPC Meeting 2017 @ ICTS-TIFR, Bengaluru**

Fermi Accelerators : Periodically Oscillating Billiards

Integrable:
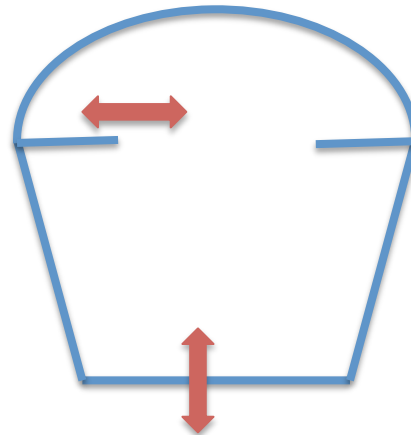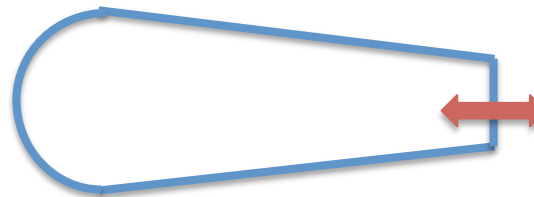1D: Bounded energy
2D: Very slow energy growth

Exponential energy growth
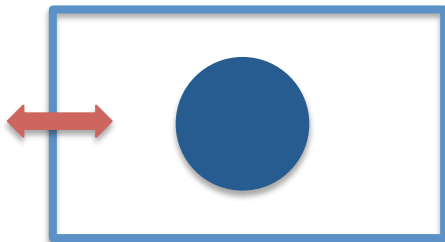
Pseudo-Integrable
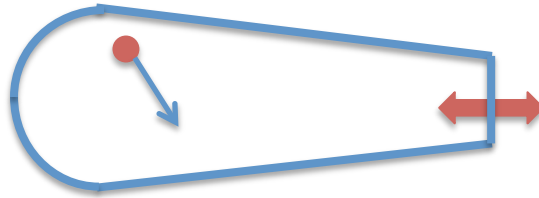
Mixed

Chaotic:
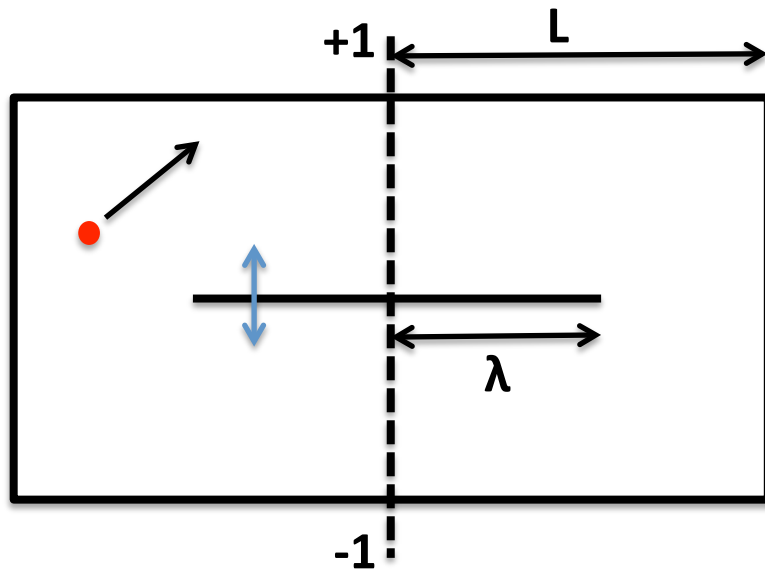Quadratic

Energy equilibration in slow-fast systems

*Presence of adiabatic invariants in ergodic systems
prevents equilibration on the time-scale $(1/m)^{0.5}$*

*On longer time-scales, higher order terms **may** dominate
and lead to equilibration*

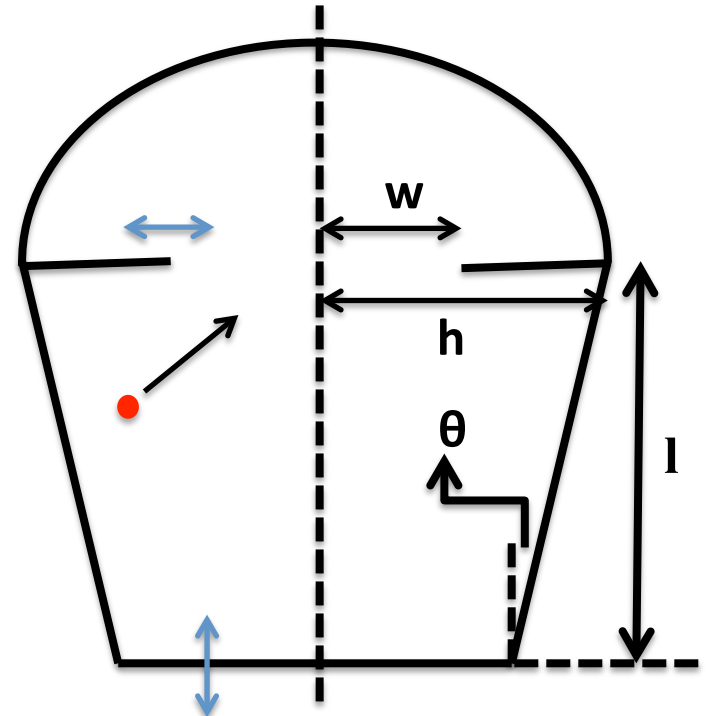[A. I. Neishtadt and Y. G. Sinai 2004; P. Wright 2007]

Energy equilibration : Finite mass effects
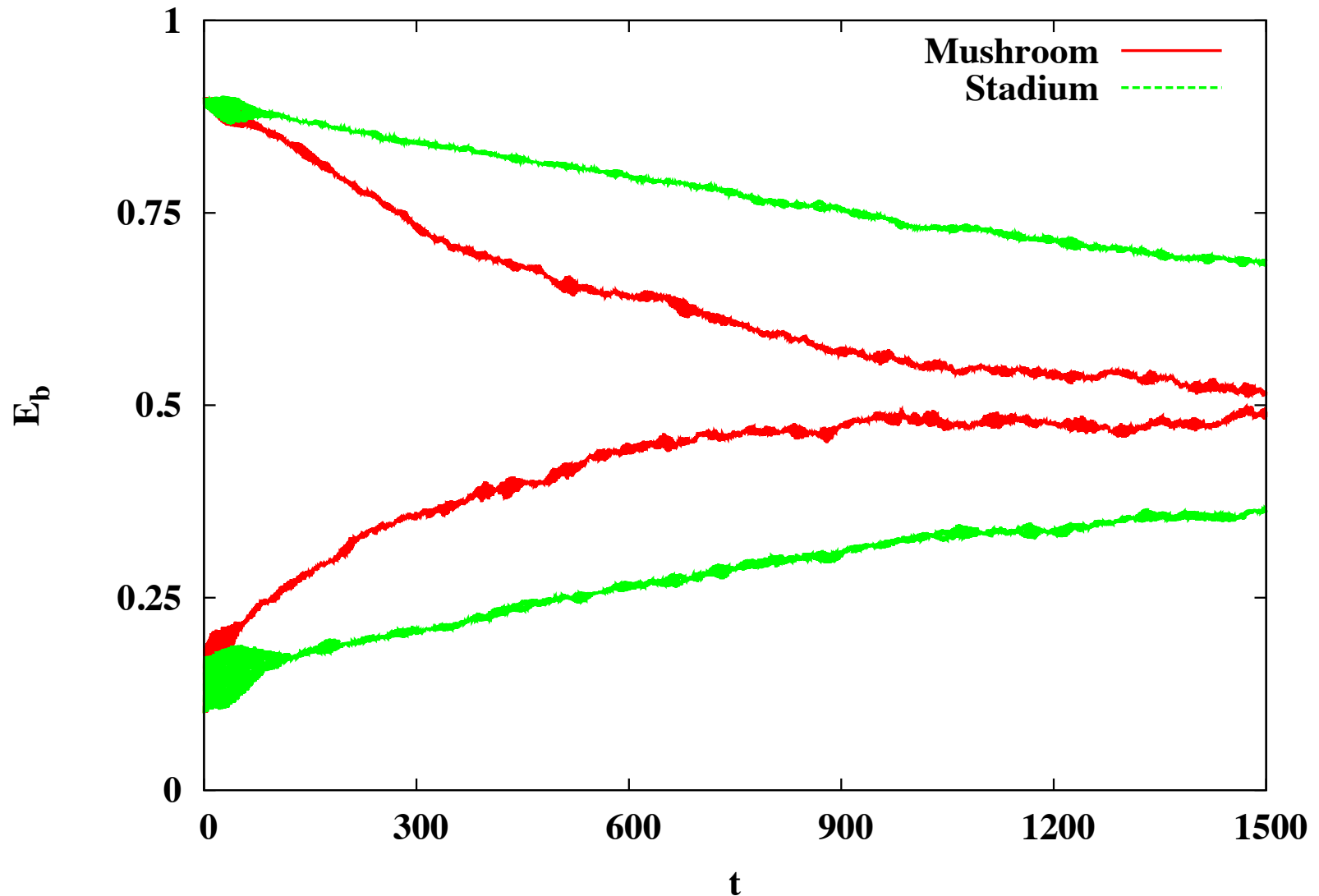

Springy ROB

Springy Mushroom + Stadium [w=h]

$$\ddot{y}_b + ky_b = F\left(y_b, E_p\right) = -\frac{dE_p}{dy_b}$$
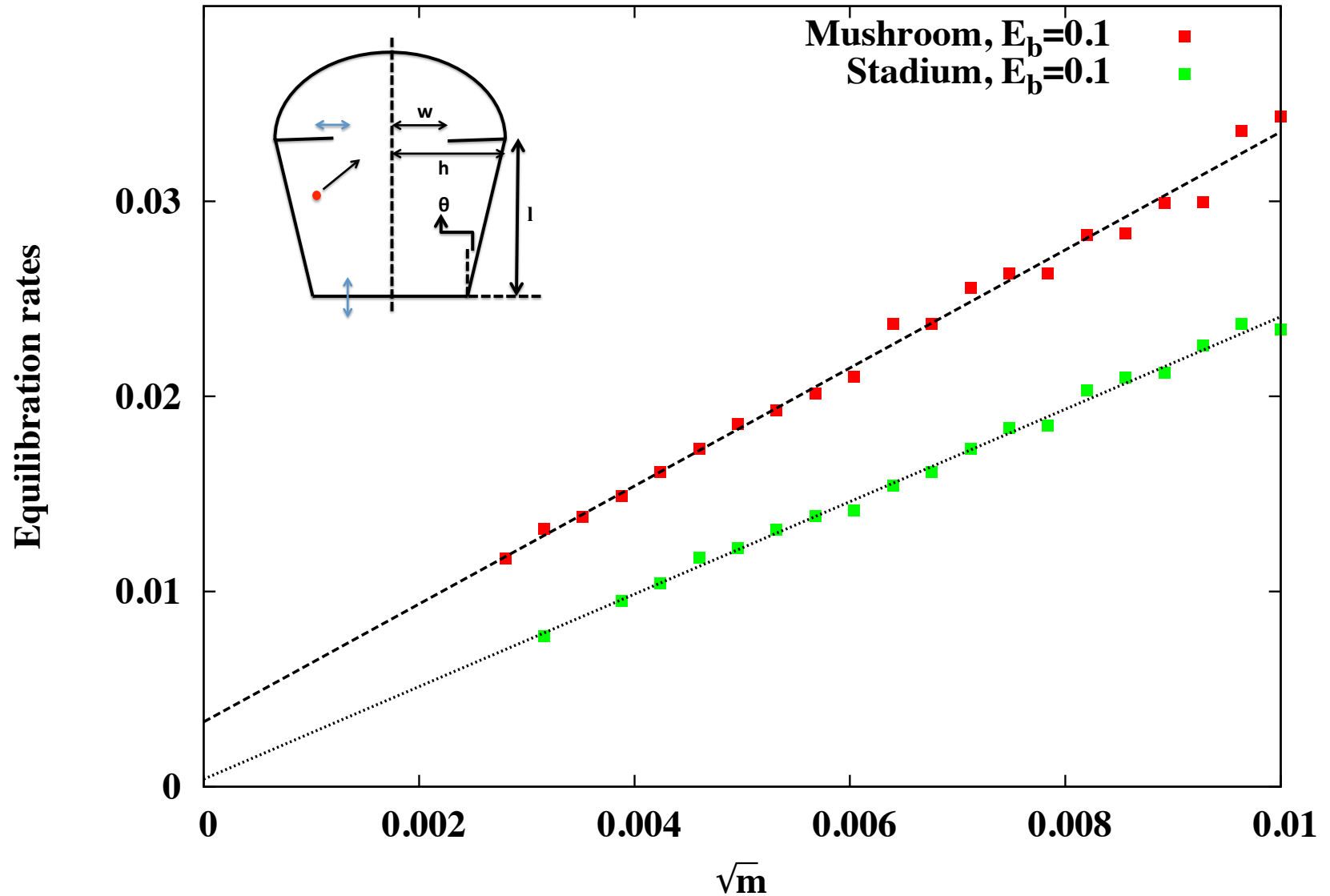
Anosov-Kasuga Invariant : $J = E_p^{d/2} V_c$

Energy equilibration in springy Mushroom & Stadium
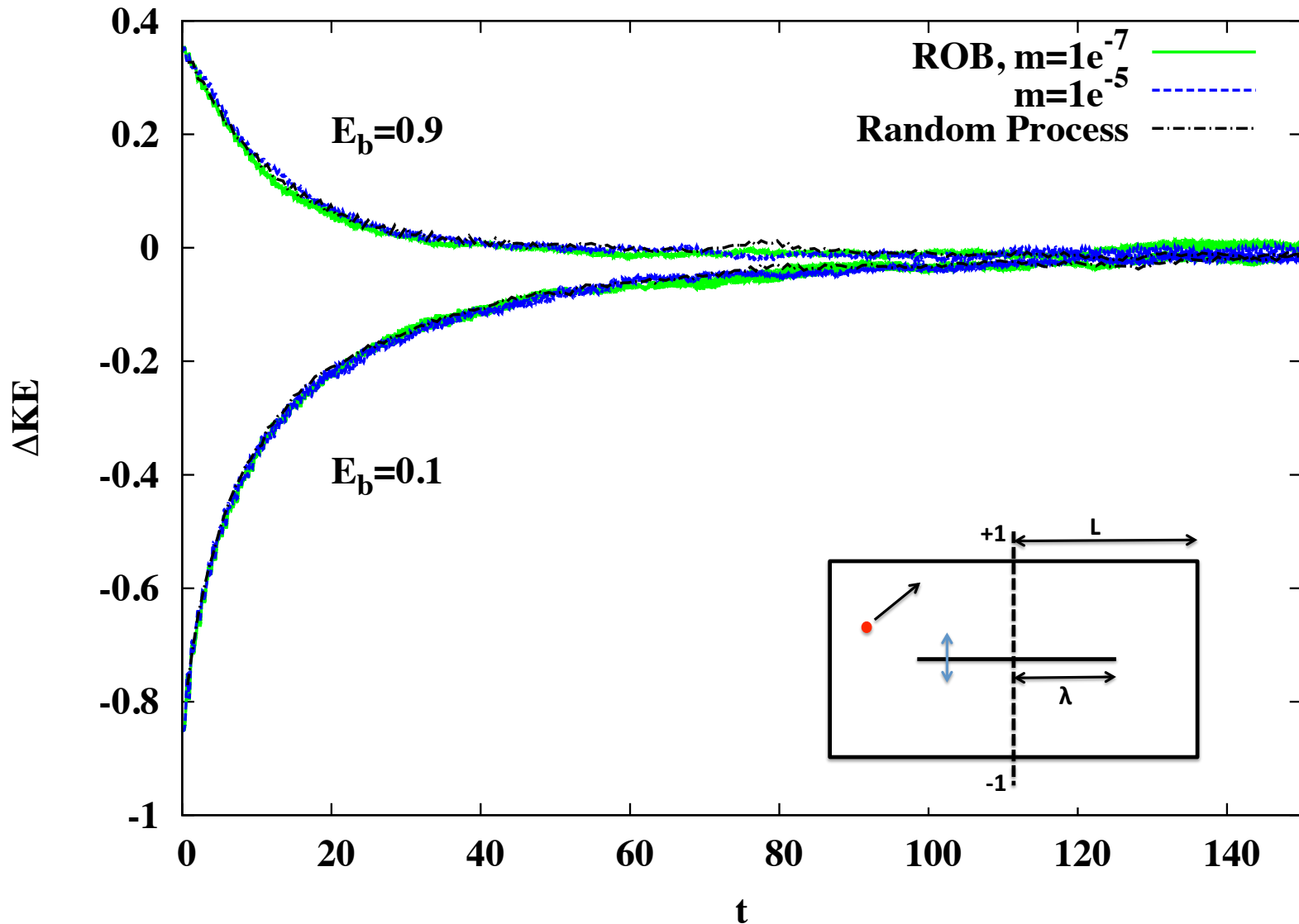

E_b : Energy of oscillating bar   Total Energy, E = 1

Equilibration rates in springy Mushroom & Stadium

Energy equilibration in springy ROB

ΔKE : Difference between KE of bar and particle (vertical)

Energy equilibration : Finite mass effects

❖ Non-ergodic accelerators equilibrate faster than ergodic
  accelerators

❖ Energy equilibration rate remains non-zero for non-ergodic
  accelerators even when mass ratio tends to zero
  - Is the springy stadium ergodic/mixing?

❖ Equilibration rate in ROB accelerator is independent of mass-ratio

Open Problem :
❖ How to incorporate finite mass effects into the random process
  model for mushroom/stadium?

[manuscript under preparation]