ICTS Mini Symposium on
Nonequilibrium Thermodynamics and Active Matter

Time: Monday, 2 – 6 pm, 16 April 2018

Venue: **Rm 1014**, Fong Shu Chuen Library, Ho Sin Hang Campus, HKBU

14:00 – 14:30 **Hyunggyu Park (KIAS)**
Energetics and efficiency of an information engine

14:30 – 15:00 **Jae-Dong Noh (U Seoul)**
Information Brownian heat engine in non-equilibrium steady state

15:00 – 15:30 **Penger Tong (HKUST)**
Colloidal diffusion over complex potential landscapes: From periodic, quasi-periodic and random potentials to live cell membranes and active matter

15:30 – 16:00 **Simone Pigolotti (OIST)**
Energetic funnel facilitates facilitated diffusion

16:00 – 16:20 Break

16:20 – 16:40 **Zhongying Zhao (HKBU)**
High resolution 3D imaging of C. elegans embryogenesis

16:40 – 17:00 **Yilin Wu (CUHK)**
Self-organization and long-range transport in bacterial communities

17:40 – 18:00 **Xiongfei Fu (SIAT/CAS)**
Chemotactic Fisher waves

17:00 – 17:20 **Pan-Jun Kim (HKBU)**
Time in biology: how genetic clock circuitry matters

17:20 – 17:40 **Lei-Han Tang (HKBU)**
Adapt to oscillate: an active matter perspective

Energetics and efficiency of an information engine

Hyunggyu Park
Korea Institute for Advanced Study

We study a two-level system controlled in a discrete feedback loop, modeling both the system and the controller in terms of stochastic Markov processes. We find that the extracted work, which is known to be bounded from above by the mutual information acquired during measurement, has to be compensated by an additional energy supply during the measurement process itself, which is bounded by the same mutual information from below. Our results confirm that the total cost of operating an information engine is in full agreement with the conventional second law of thermodynamics.

Information Brownian heat engine in non-equilibrium steady state

Jae-Dong Noh
University of Seoul, Korea

A Brownian information engine is a device extracting mechanical work from a single heat bath by exploiting the information on the state of a Brownian particle immersed in the bath. As for engines, it is important to find the optimal operating condition that yields the maximum extracted work or power. The optimal condition for a Brownian information engine with a finite cycle time τ has been rarely studied because of the difficulty in finding the nonequilibrium steady state. In this study, we introduce a model for the Brownian information engine and develop an analytic formalism for its steady-state distribution for any τ. We also discuss an experimental realization of the information engine.

Energetic funnel facilitates facilitated diffusion

Simone Pigolotti
Okinawa Institute of Science and Technology

Abstract: Transcription factors find their target on DNA by facilitated diffusion, i.e. by alternating 3D diffusion and 1D sliding along the DNA. This suggests that the genetic context, i.e. the DNA energy landscape around a specific target sequence can play an important role for the transcription factor kinetics. By analyzing DNA sequences from *E. Coli*, I will show how the genetic context can be exploited to speed-up target search. Predictions are tested by an extensive computational study of a stochastic model of protein sliding events. I will conclude by discussing possible evolutionary implications of this finding and implications for understanding TF specificity in eukaryotes.

Reference: M. Cencini and S. Pigolotti, Nucleic Acid Research 46(2), 558-567 (2018).