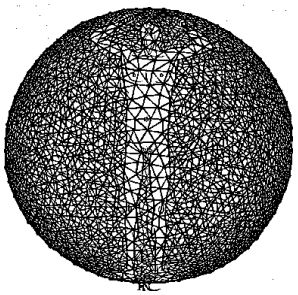
Institute for Condensed Matter Physics of the NAS of Ukraine



Webinar

STATISTICAL PHYSICS OF COMPLEX SYSTEMS

Tuan Pham Minh

Niels Bohr Institute, København, Denmark

Robustness of living systems under noisy environments

Biological networks are adaptive - their connections slowly change in response to the state of the coupled elements making up the systems. The dynamics of such adaptive networks are intriguingly complex, rendering it extremely difficult to answer the fundamental question of what the requirements for maintaining functionally robust collective states under environmental stochasticity are. Aiming to understand the essential role of noise in robust adaptation, a basic problem in evolution and learning, we present a statistical-physics theory called "double-replica theory" for such dynamical systems, thus contributing to the understanding of phase transitions in multiple-timescaled systems. As an illustration of our theory, we apply it to biological evolution for protein, where phenotypes are shaped by free-energy-minimisation-based fast dynamics that are subjected to an external noise while genotypes are encoded by the network of coupling constants. This network slowly evolves under natural selection with a mutation rate, depending on how adapted the shaped phenotypes are. Here we establish how a robust phase, where both genotype and phenotype achieve optimal values, can emerge within an intermediate level of external noise, while such a robustness is lost via a replica-symmetry-breaking mechanism at low noise.

Wednesday, November, 13 starting at 15:30 Lviv time

The webinar will take place via Zoom
We invite all interested to join the webinar