A. I. Alikhanyan National Science Laboratory (Yerevan Physics Institute) Foundation

Evolution of Complexity from the Statistical Physics Perspective June 29-July 2, 2022 Yerevan

with the support of the State Science Committee of RA and Division of the Natural Sciences of NAS RA

Chairmen	David B. Saakian and Eugene Koonin
Organizing committee	D. Saakian, E. Koonin, M. Katsnelson
Local organizing committee	D. Saakian, A. Allahverdyan,R. Aroutiounian , Y. Mamasakhlisov, V.Korogodina, A. Piloyan
Participation format	hybrid, either online or personally at AANL
Venue	Armenia, 0036, Yerevan, 2 Br. Alikhanyan str.
Contact	saakian@yerphi.am, (37410) 341 500

Planned sessions:

1. Multilevel selection, learning and major transitions
2. Evolution, information thermodynamics
3. Evolution on fluctuating landscapes, with groups and tradeoffs

Confirmed participants:

Eugene Koonin, Michael Lynch, Nigel Goldenfeld , Mikhail Katsnelson, David Saakian, Armen Allahverdyan, Mehran Kardar, Kunihiko Kaneko, Sergey Gavrilets, David Wolpert, Ricard Sole, Michael Lassig, Paulien Hogeweg, Fernando Fontanari, Oliver Rivoire, Jaroslav Ispolatov, Nobuto Takeuchi, Bartlomiej Waclaw, Artemy Kolchinsky, Matteo Marsilli, Mikhail Burtsev, Vladimir Redko, Vitaly Vanchurin,Tony Coolen, Alexey Melkikh, Alexandr Panov, Samir Suweis, Reza Jafari, Shahin Rouhani, Sergey Inge- Vechtomov, Klaus Rajewsky, Qi Wu

Program

June 29, 2022

8:30 Welcome speech by AANL director A. Aprahamian, R. Aroutiounian, Academican-secretary of the division of natural sciences of NAS RA, the chairman of the conference, E. Koonin.

Species, general principles

9:00 N. Goldenfeld, UC San Diego, USA, Topological scaling laws and the statistical mechanics ofevolution.

9:30 N. Takeuchi, University of Auckland, New Zealand, Universal biology and the generalized centraldogma

10:00 J. Ispolatov, University of Santiago Chile, Emergence of predation.

10:30 A. Kolchinsky, Tokyo University, Thermodynamics of Darwinian evolution.

11:00-11:15 Coffee break

Adaptation and learning

11: 15 A.S. Bratus **(** Moscow Transport University)**,** I. Samokhin, T. Yakushkina (HSE). Evolution adaptation of replicator system with multiple phenotypes and mutation to death rate variation.

Evolution Adaptation of Replicator Systems to DeathRates Variation.

11:45 M. Burtsev, Moscow Institute of Physics and Technology, Learning drives evolution of complexity.

12:15 A. I. Panov, P. Kuderov, Moscow Institute of Physics and Technology, Hierarchical IntrinsicallyMotivated Agent based on Free Energy Principles

12: 45 V. G. Red'ko, Z. B. Sokhova, Scientific Research Institute for System Analysis, Russian Academy of Sciences (SRISA RAS)., Multilevel cognitiveprocesses.

Adaptation, immunity, cancer

13:15 A. Melkikh, Ural Federal University, Yekaterinburg, Russia, Viruses, immunity and evolution
13.45 R. Jafari, Shahid Beheshti University, Higher-order genetic interactions and their contribution to cancerous cells.

Information and stochastic thermodynamics

15:30 O. Rivoire, Sex as information processing.

16:00-16:30, D. Wolpert, Santa Fe Institite, USA, The stochastic thermodynamics of distributed Systems

June 30, 2022

Microbial evolution

13:30 Qi Wu, pan-genome based genotyping illustrates qualitative and quantitative genetic diversity of structural variation in Baker's yeast

14:00 M. Gelfand, Skoltech, Evolutionary dynamics of bacteria.

14:30 S. Suweis, University of Padova, Dynamic metabolic adaptation and species coexistence incompetitive microbial communities

15:00 B. Waclaw, Institute of Physical Chemistry PAN, Warsaw, Phenotypic switching as a mechanismto circumvent fitness valleys

15:30-16:00 Coffee break

Multilevel selection and learning

16:00 V. Vanchurin, National Center for Biotechnology Information, National Library of Medicine,Bethesda USA, Biological evolution as learning and a thermodynamic origin of life.

16:30 M. Marsili, ICTP, Italy, REM approach to learning

17:00 D. Czégel, Eötvös Loránd University, Hungary, From selection to sentience and back

17:30 D. B. Saakian, AANL, Armenia, Solution of evolutionary dynamics in case of two level selection

Cognition

18:00-18:45 Ricard Sole,Universitat Pompeu Fabra, Liquid Brains: searching the cognition space

July 01, 2022

15:00-17:00 Round table "Looking for international level advanced science and advancedtechnologies for the progress of Armenia."

Greetings from the President of theNational Academy of Sciences of Armenia A. Saghyan, Director of A.I. Alikhanyan National Science Laboratory (Yerevan Physics Institute) Foundation Ani Aprahamian

15:00-16:00 Optimizing the scientific politics: the priorities, the grant versions choice, the refereeingsystem.

16:00-16:15 Coffee break

16:15- 17:30 Optimizing the science- industry-new technologies relations

Complexity and biological evolution

17:30 P. Hogeweg, Utrecht University, The Netherlands, Evolution of individual and/or ecosystem basedcomplexity

18:00 M. Lassig, University of Cologne, Germany, Adaptive ratchets and the evolution of molecularcomplexity.

18:30-19:15, E. Koonin, NCBI, NLM,NIH, USA, Evolution of complexity

July 02, 2022

Statistical physics and evolution

12:30 A. Allahverdyan, AANL, Armenia, Thermodynamic selection: mechanisms and scenarios

13:00 A. Oganov, The evolution as a method to predict the structure of crystals and molecules

13:30 T. Coolen, Radboud University, The Netherlands, Evolution and replicas.

14:00-14:15 Coffee break

14:15 K. Kaneko, Niels Bohr Institute, Denmark, Harnessing Complexity through EvolutionaryDimensional Reduction

14:45 M. M. Katsnelson, Radboud University, The Netherlands, Origin of complexity in physics andbiology: Similarities and dissimilarities

15:45 M. Kardar,MIT, USA, Competitive growth on a rugged front.

16:15-16:30 Coffee break

Social systems

16:30 F. Fontanari, University of Sao Paulo, Brazil, The threat of disinformation to epistemic security:an exactly solvable model.

17:00 S. Gavrilets, University of Tennessee, USA, Coevolution of actions, personal norms, and beliefsabout others in social dilemmas.

17:30 S. G. Inge-Vechtomov, Institute of Genetics, Sankt Peterburg, Timofeev-Ressovsky, a scientist and supervisor.

17:50 Klaus Rajewsky, On memory of Timofeev-Ressovsky

18:10-18:40 E. Koonin, the concluding remarks.