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A. ALIKHANYAN
National Laboratory

Organiser:



The Abdus Salam
**International Centre
for Theoretical Physics**

Partner



UNION OF ADVANCED
TECHNOLOGY ENTERPRISES

Co-organiser:



With the support of the
Government of the RA

International Scientific Conference

EVOLVING LIFE: THE EVOLUTION WITH TRADE-OFFS, FRUSTRATION IN SELECTION AND GROWING COMPLEXITY

ARTIFICIAL INTELLIGENCE

MARCH 29-APRIL 3, 2019

Yerevan, Armenia



**The International organizing committee:
D.B. Saakian, E. Koonin, R. Sole**

**The local organizing committee:
D.B. Saakian, Y. Mamasakhlisov,
S. Abrahamyan, A. Hovhannisyan, G. Karyan,
R. Jafari, T. Yakushkina, S. Babajanyan, N.
Martirosyan, A. Ghulkhasyan, H. Mkrtchyan.**

CHAIRS:



David Saakian

Yerevan Physics Institute
Theoretical department



Eugene Koonin

National Center for
Biotechnology Information, USA

AGENDA

29 March, 2019

Venue: Deworkacy AOKS

- 09:00 - 09:10 Welcoming Speech by the President of RA
H.E. Armen Sarkissian
- 09:10 - 09:15 Opening Remarks:
Aleksandr Yesayan, UATE Chairman
- 09:15 - 09:20 Rouben Aroutiounian, Academician-secretary of
Division of Natural Sciences of NAS



11:30-12:45

**Session I:
Biological Aspects of Evolution
Chair: P. Hogeweg, E. Szathmary**

09:20-10:05

Evolution of biological complexity: is there a general theory in sight?
Eugene Koonin, National Center for
Biotechnology Information, USA

10:10-10:50

The filial major transitions in evolution,
Eörs Szathmáry, Eötvös Loránd University,
Budapest

- 10:50-11:10 Evolution from cytogenetic point of view ,
Rouben Aroutiounian, Natural Sciences of NAS,
Yerevan, Armenia
- 11:10-11:30 Coffee break
- 11:30-12:15 Theory of directed evolution,
Aleksy Melkikh, Ural Federal University,
Yeketerinburg, Russia
- 12:15-12:45 The genetics of Armenians,
Levon Yepiskoposyan, Institute of Molecular Biology,
NAS, Armenia
- 12:45-14:00. Lunch



14:00-17:00 **Session II:
The Mathematics of Evolution
Chair: O. Rivoire**

- 14:00-14:30 On the Evolution of Permanent Replicator
Systems, Alexander Bratus, Russian
University of Transport, Moscow
- 14:30-15:00 Global Discontinuous Generalized Solution of
the Hamilton-Jacobi Equation with a
Noncoercive Hamiltonian,
Lyubov Shagalova, Krasovskii Institute of

15:00-15:30 The Evolution with Conditions,
David Saakian, Alikhanyan National Laboratory
(YERPHI), Armenia

15:30-16:00 TBD

16:00-16:20 Coffee break

16:20-17:00 I.Nemenman



30 March

09:00-10:50 **Session III: Stochastic Thermodynamics**
Chairs: A. Allahverdyan

9:00-09:45 Kinetics, Information, and Thermodynamics of
Chemical Systems: A New Applied Mathematics for
Complex Systems,
Hong Qian, Washington University, USA

9:45-10:30 Information Thermodynamics,
Juan Parrondo, Universidad Complutense de Madrid

10:30-10:50 Coffee break

- 10:50-13:05 **Session IV: Bio-Complexity**
Chair: Thierry Mora, ENS, Paris
- 10:50-11:35 Multilevel Consistency, Dimension Reduction,
and Slow Dynamics in Biology,
Kunihiko Kaneko, Tokyo University, Japan
- 11:35-12:20 Cell-State Organization by Exploratory
Dynamics,
Erez Brawn, Technion, Israel
- 12:20-13:05 Reciprocity between Robustness and
Plasticity as a Universal Quantitative Law in
Biology
Tetsuhiro Hatakeyama, Tokyo University,
Japan
- 13:05- 14:00 Lunch
- 15:30- 17:00 City tour



31 March

- 09:00-11:10 **Session V: Information and
Complexity Aspects of Evolution**
**Chair: Oliver Rivoire , CIRB, College
de France**

- 09:00-09:45 TBD, Erik wan Nimwegen, University of Basel, Switzerland
- 9:45-10:30 Long- term information integration in Evolution,
Pauline Hogeweg, Utrecht University, the
- 10:30-11:10 Emergence of Leadership in Communication,
Armen Allahverdyan, Alikhanyan National Laboratory
(YERPHI)
- 11:10-11:30 Coffee break



11:30-12:30

**Session VI:
Finite Population Problem in Evolution
Chair: Thierry Mora, ENS, Paris**

11:30-12:00

Some results for Wright-Fisher model,
David Saakian, Alikhanyan National Laboratory
(YERPHI), Armenia

12:00-12:30

Consensus formation with signaling: phase
diagram and comprehension-production
asymmetry,
Shahin Rouhani, Shadid Univ. Tehran, Iran

12:30-13:30

Lunch



**Venue: Kamar" Business Center
Only for Artificial Intelligence session**

13:30-17-30

**Session VII: Artificial Intelligence
Chair: D. B. Saakian**

13:30-14:15

Evolutionary ideas in AI,
Mikhail Burtsev, FIZTEKH, Moscow, Russian

14:15-15:15

TBD
Matteo Marsili, ICTP, Trieste, Italy

15:15-15:45

Model of Interaction between Learning and Evolution
Vladimir Redko, Scientific Research Institute for System
Analysis, NAR Russia, Moscow, Russia

15:45-16:05

Statistical physics of reinforcement learning,
Edgar Vardanyan, Alikhanyan National Laboratory
(YERPHI)

16:05-16:20

Coffee break

16:20-17:00

AI evolution in IBM technologies
Ivan Kopyev, IBM, Timur Usaty, IBM

17:00-17:30

AI (Skype talk)
Stefan Thurne, Medical University of Vienna, Austria



April 1

10:30-13:30

Session VIII: Phase Transitions in Evolution, and Dynamic Landscapes
Chair:
Ao Ping, Shanghai University, China

10:30-11:00

Paradoxical Persistence - Losing life strategies that can be combined to win, Kang Hao Cheong, Singapore University of Technology and Design

11:00-11:30

Fixation probability on fluctuating landscapes, Tatyana Yakushkina, High School of Economy, Moscow, Russia

11:30-12:15

Evolutionary scenarios for the origin of allostery and coevolution patterns in proteins
Oliver Rivoire , CIRB, College de France

12:15-12:45

Why the emergence of a new species is a rare event: a local dynamics approach from sociophysics,
Serge Galam, CEVIPOF, Centre for Political Science at Sciences Po, Paris

12:45-13:30

Prediction and memory in well-adapting immune systems
Thierry Mora, ENS. Paris

13:30-14:30

Lunch
Trip to Garni, Geghard



April 2

10:30-13:30

**Session IX:
Complexity Aspects of Cancer
Chair: Kunihiro Kaneko, Tokyo
University, Japan**

11:00-11:45

Debunking mathematically the logical fallacy that cancer risk is just "bad luck"
Didier Sornette, ETH, Zurich, Switzerland

11:45-12:30

Frustration Phenomenon of Gene-Gene Interactions in the Cancerous Cells,
G. Reza Jafari, G Shahid Beheshti University, Tehran

12:30-13:00

Synthetic Evolutionary transitions,
Ricard Sole, Barcelona University and Santa Fe Institute, Spain

13:00-13:30

The complexity aspects of cancer,
Ao Ping, Shanghai University, China

13:30-14:30

Lunch
Trip to Edjmiadsin



April 3

09:00-16:40

**Session XI: Disordered Quantum matter and complexity,
Chair: A. Sedrakian, Frankfurt Institute for Advanced Studies, Germany**

09:00-09:55

Many-body, localization
Dmitry Polyakov, Karlsruhe Institute of Technology, Germany

9:55-10:50

The statistical physics of Sachdev-Ye-Kitaev model,
Konstantin Tikhonov, Landaw Institute and Karlsruhe Institute of Technology, Germany

10:50-11:10

Coffee break

11:10-12:05

Neuromorphic functionality of antiferromagnets
Mikhail Titov, Radboud University, Nimjegen, Netherlands

12:05-13:00

Holographic local quench and effective complexity,
Andrei Bagrov, Radboud University, Nimjegen, Netherlands

13:00-14:00

Lunch



16:00-16:40

Panel discussions

14:00-16:00

Advanced Quantum Physics and Stochastic Thermodynamic aspects of Evolution,
David Saakian, Alikhanyan National Laboratory (YERPHI), Yerevan, Armenia
Erik van Nimwegen, University of Basel, Switzerland

16:00-16:40

Conclusion

Eugene Koonin, National Center for Biotechnology Information, USA

SPEAKERS:



Armen Sarkissian

President of Armenia



Kunihiko Kaneko

Tokyo University, Japan

SPEAKERS:



Serge Galam
Sciences Po Paris, France



Didier Sornette
ETH, Zurich, Switzerland



Armen Alahverdyan
ANL (YerPhI), Yerevan, Armenia



Eörs Szathmáry
Eötvös Loránd University, Hungary

SPEAKERS:



Paulien Hogeweg

Utrecht University,
The Netherlands



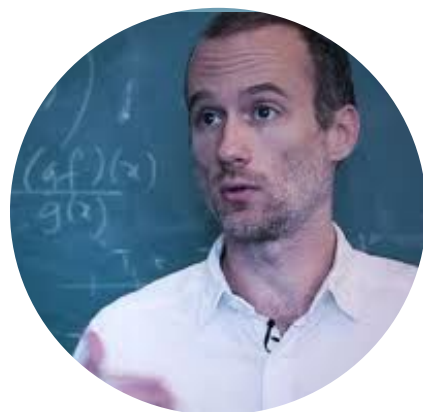
Ricard Solé

University Pompeu Fabra,
Barcelona (UPF), Spain



Thierry Mora

Ecole Normale Supérieure de
Paris, France



Olivier Rivoire

CIRB, College de France, France

SPEAKERS:



Ao Ping

Shanghai Center for Systems
Biomedicine, Shanghai, China



Juan Parrondo

Madrid University, Spain



Tetsuhiro Hatakeyama

The University of Tokyo, Japan



Erik van Nimwegen

University of Basel, Switzerland

SPEAKERS:



Erez Braun

Technion Israel Institute of
Technology, Israel



Matteo Marsili

Abdus Salam ICTP, Trieste, Italy



Kang Hao Cheong

Tsinghua University of
Technology and Design,
Singapore



Hong Qian

Washington University, USA

SPEAKERS:



Mikhail Burtsev

Moscow Institute of Physics
and Technology, Russia



Vladimir Redko

Scientific Research Institute
for System Analysis, NAR
Russia, Moscow



Ivan Kopiev

Watson Commerce, IBM,
Moscow, Russia



Timur Usaty

IBM, Moscow, Russia

SPEAKERS:



Alexander Bratus

Moscow State University of
Transportation (MIIT), Russia



Alexey Melkikh

Ural Federal University,
Yekaterinburg, Russia



Liubov Shagalova

Krasovskii Institute of
Mathematics and Mechanics,
Russia



Tatyana Yakushkina

National Research University
Higher School of Economics,
Moscow, Russia

SPEAKERS:



Shahin Rouhani

Sharif University of
Technology, Tehran, Iran



Rouben Aroutiounian

Yerevan State University,
Nas, Armenia



Levon Yepiskoposyan

Institute of Molecular
Biology, NAS, Armenia



Edgar Vardanyan

Alikhanyan National
Laboratory (YERPHI), Armenia

SPEAKERS:



Dmitry Polyakov

Karlsruhe Institute of
Technology, Germany



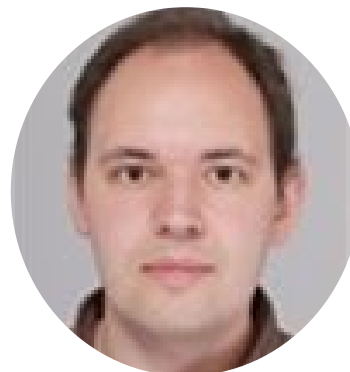
Konstantin Tikhonov

Landaw Institute and
Karlsruhe Institute of
Technology, Germany



Mikhail Titov

Radboud University
Nijmegen, the Netherlands



Andrei Bagrov

Radboud University
Nijmegen, the Netherlands

SPEAKERS:



G. Reza Jafari

Shahid Beheshti University,
Tehran



Armen Sedrakian

Fellow, Frankfurt Institute
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