Statistical mechanics and its applications

October 24-28, Dilijan, Armenia

Abstracts

1. Speaker: Benjamin Doyon

Title: The hydrodynamics of many-body integrable systems

Abstract: Hydrodynamics is a powerful framework for large-wavelength phenomena in many-body systems. At its basis is the assumption that one can reduce the dynamics to that of long-lived, effective degrees of freedom obtained from the available conservation laws. This fundamental idea, applied traditionally on systems with few conservation laws, can be extended to integrable systems, which admit an extensive number. The ensuing ``generalised hydrodynamics" (GHD) is a theory for the large-scale dynamics in integrable systems. It shows that the Euler-scale hydrodynamics takes a universal form for integrable systems, which is the same for classical and quantum chains, gases and fields. In particular, it puts in a common framework previous results on the hard rod gas and soliton gases. It only depends on the structure of the factorised, elastic scattering of the model: the set of "asymptotic objects" (e.g. particles, solitons, waves) and their two-body scattering shifts. I will overview the basics of the theory, explain some its main predictions including non-equilibrium steady states and correlation functions, and present a first-principle derivation of the GHD equations in a paradigmatic model of quantum integrability, the Lieb-Liniger gas.

2. Speaker: Satya Majumdar

Title: Nonintersecting Brownian Bridges in a flat to flat geometry

Abstract: We study N nonintersecting Brownian bridges propagating from an initial configuration $a_1 < a_2 < ... < a_N$ at time $t=0$ to a final configuration $b_1 < b_2 < ... < b_N$ at time $t=t_f$, while staying non-intersecting for all $0\leq t \leq t_f$. We first show that this problem can be mapped to a non-intersecting Dyson's Brownian bridges with Dyson index $\beta=2$. For the latter we derive an exact effective Langevin equation that allows to generate very efficiently the vicious bridge configurations. In particular, for the flat-to-flat configuration in the large N limit, where $a_i = b_i = (i-1)/N$, for $i = 1, ... ,N$, we use this effective Langevin equation to derive an exact Burgers' equation (in the inviscid limit) for the Green's function and solve this Burgers' equation for arbitrary time $0 \leq t\leq t_f$. At certain specific values of intermediate times t, such as $t=t_f/2$, $t=t_f/3$ and $t=t_f/4$ we obtain the average density of the flat-to-flat bridge explicitly. We also derive explicitly how the two edges of the average density evolve from time $t=0$ to time $t=t_f$. Finally, we discuss connections to some well known problems, such as the Chern-Simons model, the related Stieltjes-Wigert orthogonal polynomials and the Borodin-Muttalib ensemble of determinantal point processes.

3. Speaker: Christophe Texier

Title: The generalized Lyapunov exponent for random matrix products of SL(2,R)

Abstract: Random matrix products arise in many problems of statistical physics involving transfer matrices and randomness. A first natural question is to characterize the typical growth, which is controlled by the Lyapunov exponent. It is also interesting to investigate the fluctuations of the random matrix product, which can be characterized through the so-called generalized Lyapunov exponent (GLE) $\Lambda(q)$, i.e. the cumulant generating function of the logarithm of the norm of the random matrix product. The main question is here to determine explicit formulas. I will review few physical motivations from statistical physics and Anderson localisation physics, which will lead me to focus on the case of matrices from the group $\mathrm{SL}(2,\mathbb{R})$. Then I will show that the GLE can be obtained by solving a spectral problem. The approach will be illustrated on transfer matrices arising from the study of the Schrödinger equation with a random potential. A possible strategy is to solve the spectral problem perturbatively in q in order to obtain recursively the cumulants of the log of the random matrix product: Lyapunov exponent

$\Lambda’(0)$, variance $\Lambda’’(0)$, etc. Finally I will discuss the case of Cauchy disorder, when it is possible to get an exact secular equation for the GLE, from which one can obtain many exact or asymptotically exact results.

References:

* Christophe Texier, Fluctuations of the product of random matrices and generalized Lyapunov exponent, J. Stat. Phys. 181(3), 990--1051 (2020), math-ph arXiv:1907.08512

* Christophe Texier, Generalized Lyapunov exponent of random matrices and universality classes for SPS in 1D Anderson localisation, Europhys. Lett. 131, 17002 (2020), preprint cond-mat arXiv:1910.01989

* Alain Comtet, Christophe Texier and Yves Tourigny, Representation theory and products of random matrices in $\mathrm{SL}(2,\mathbb{R})$, preprint math-ph arXiv:1911.00117

* Alain Comtet, Christophe Texier and Yves Tourigny, The generalized Lyapunov exponent for the one-dimensional Schrödinger equation with Cauchy disorder: some exact results, Phys. Rev. E 105, 064210 (2022), preprint cond-mat arXiv:2110.01522

4. Speaker: Igor Burmistrov

Title: Phase diagram of two-dimensional flexible materials: Emergence of Nishimori-like line

Abstract: Transport and elastic properties of freestanding two-dimensional materials are determined by competition between dynamical and quenched out-of-plane deformations, i.e., between flexural phonons and ripples, respectively. They both tend to crumple the system by overcoming the strong anharmonicity which stabilizes the flat phases. Despite active research, it still remains unclear whether the rippled phase exists in the thermodynamic limit or is destroyed by thermal out-of-plane fluctuations. We demonstrate that a sufficiently strong short-range disorder stabilizes ripples, whereas in the case of a weak disorder the thermal flexural fluctuations dominate in the thermodynamic limit. Therefore the phase diagram of a flexible two-dimensional material with a quenched short-range disorder has four distinct phases. Surprisingly, the transition line between flat phases resembles to Nishimori line.

5. Speaker: Hrachya Babujian

Title: Quantum nonequilibrium dynamics from Knizhnik-Zamolodchikov equations.

Abstract: We consider a set of non-stationary quantum models. We show that their dynamics can be studied using links to Knizhnik-Zamolodchikov (KZ) equations for correlation functions in conformal field theories. We specifically consider the boundary Wess-Zumino-Novikov-Witten model, where equations for correlators of primary fields are defined by an extension of KZ equations and explore the links to dynamical systems. As an example of the workability of the proposed method, we provide an exact solution to a dynamical system that is a specific multi-level generalization of the two-level Landau-Zenner system known in the literature as the Demkov-Osherov model. The method can be used to study the nonequilibrium dynamics in various multi-level systems from the solution of the corresponding KZ equations.

6. Speaker: Anatoly Polkovnikov

Title: Defining chaos in Hamiltonian systems through adiabatic transformations.

Abstract: In this talk I will give an overview of our recent results on how one can define, probe and understand quantum and classical chaos on the same footing through adiabatic transformations. In particular, I will discuss how the norm of the Adiabatic Gauge Potential (AGP), which is defined as a generator of adiabatic transformations, can serve as a very sensitive measure of chaos and can distinguish integrable, chaotic but non-ergodic and ergodic regimes. I will also discuss direct connections of the AGP norm to the low and high frequency asymptotes of the spectral function and the Krylov complexity. The AGP also defines the geometric tensor, which in turn sets a natural (Fubini-Study) metric in the coupling space. I will briefly discuss how this metric can be used to identify integrable points as geometric singularities defined by this metric.

7. Speaker: Ivan Khayimovich

Title: Instability of delocalized phases to Anderson localization in gain-loss non-Hermitian long-range disordered models.

Abstract: Recently the interest to non-Hermitian disordered models has been revived, mostly due to the claims of instability of the many-body localization to the coupling to a thermal reservoir. To tackle such a difficult problem of a quantum system coupled to a bath (at least at finite times) the scientist usually consider just the effects of energy/particle leakage from/to the system, neglecting so-called quantum-jump contributions of the reservoir (e.g., in the Lindbladian framework). Such an approximation is equivalent to the consideration of the non-Hermitian Hamiltonians of quantum systems. The most well-known disordered non-Hermitian system is a so-called Hatano-Nelson model [1] which is a 1d Anderson tight-binding problem with the hopping to the right larger than the ones to the left and with the periodic boundary condition. Rather intuitively this model shows the breakdown of the 1d Anderson localization with the non-Hermiticity which suppresses the interference effects, crucial for the Anderson physics. The increase of the ratio between right and left hoppings controls the fraction of the delocalized states in the model. Unlike the above work, we consider the long-range random matrix models, known to carry the ergodic, localized and (some of them) non-ergodic extended (NEE) phases of matter, and put these models into the non-Hermitian setting. We start our consideration from the so-called Rosenzweig-Porter random-matrix ensemble (RP) [2], being an interpolation between a Gaussian random matrix ensemble (GRE), with ergodic eigenstates, and the Gaussian diagonal ensemble, with the single-site localized states. This model is known to carry a NEE phase [3] along with the Anderson localized and ergodic ones. First, we study the stability of this NEE phase in the non-Hermitian generalization of the RP model [4]. We analyze, both analytically and numerically, the spectral and fractal properties of the non-Hermitian case. We show that the ergodic and the localized phases are stable against the non-Hermitian nature of matrix entries. However, the stability of the fractal phase is intact to the non-Hermiticity of the off-diagonal terms, but depends on the choice of the diagonal elements. For purely real or imaginary diagonal potential the fractal phase is statistically the same as its Hermitian counterpart, while for a generic complex diagonal potential the fractal phase disappears, giving unexpectedly the way to a localized one. The understanding of this counterintuitive phenomenon is given in terms of the cavity method and in addition in simple hand-waving terms from the Fermi's golden rule, applicable, strictly speaking, to a Hermitian RP model. The main effect in this model is given by the fact that the generally complex diagonal potential forms an effectively 2d distribution, which parametrically increases the bare level spacing and suppresses the resonances. The second part of the talk is devoted to the other paradigmatic random matrix (PLRBM) model, namely, to a power-law random banded matrix ensemble [5]. This model with the random on-site disorder and random power-law decaying hopping terms is known to host an Anderson transition at the power of the hopping decay a, equal to the dimensionality of the system d and does not depend on the amplitude of the on-site disorder. This result can be obtained, e.g., by the Anderson resonance counting, resolved over the spatial distance [6]. Recently, in addition, it has been shown that the PLRBM hosts another transition at $a=d/2$ [7], separating two ergodic phases: the GRE one with the Porter-Thomas wave-function distribution and the weakly-ergodic one. The former phase is known [8] to be given by the growing spectral bandwidth, controlled by the hopping-term bandwidth. In [9] we study the non-Hermitian deformation of the PLRBM model and show that in this case the Anderson transition shifts to smaller values in the interval $d/2<a<d$ and depends on the on-site disorder. In order to analytically explain the above numerical results, we derive an effective non-Hermitian resonance counting and show that the delocalization transition is driven by so-called "bad resonances", which cannot be removed by the wave-function hybridization (e.g., in the renormalization group approach), while the usual "Hermitian" resonances are suppressed in the same way as in the non-Hermitian RP model.

[1] N. Hatano, D. R. Nelson, "Localization Transitions in Non-Hermitian Quantum Mechanics", PRL 77, 570 (1996).

[2] N. Rosenzweig and C. E. Porter, “Repulsion of energy levels” in complex atomic spectra,” Phys. Rev. B 120, 1698 (1960).

[3] V. E. Kravtsov, I. M. Khaymovich, E. Cuevas, and M. Amini, “A random matrix model with localization and ergodic transitions,” New J. Phys. 17, 122002 (2015).

[4] G. De Tomasi, I. M. K. "Non-Hermitian Rosenzweig-Porter random-matrix ensemble: Obstruction to the fractal phase", arXiv:2204.00669, accepted to PRB (2022).

[5] A. D. Mirlin, Y. V. Fyodorov, F.-M. Dittes, J. Quezada, and T. H. Seligman, “Transition from localized to extended eigenstates in the ensemble of power-law random banded matrices,” Phys. Rev. E 54, 3221–3230 (1996).

[6] L. S. Levitov "Absence of localization of vibrational modes due to dipole-dipole interaction", EPL 9, 83 (1989).

[7] E. Bogomolny and M. Sieber "Power-law random banded matrices and ultrametric matrices: Eigenvector distribution in the intermediate regime", Phys. Rev. E 98, 042116 (2018).

[8] P. von Soosten, S. Warzel, "Delocalization and continuous spectrum for ultrametric random operators", Ann. Henri Poincare, 20(9), 2877-2898 (2019)

[9] G. De Tomasi, I. M. K. "Non-Hermitian resonance counting in gain-loss power law random banded matrices", in preparation

8. Speaker: Ilya Gruzberg

Title: Anderson transitions and (lost) conformal invariance.

Abstract: Anderson transitions (ATs) between metals and insulators or between topologically distinct insulators, share common features with conventional second-order phase transitions, such as the critical point of the Ising model for a magnet. However, ATs also exhibit many unusual features including the multifractal scaling of the critical wave functions. Conventional critical points possess conformal invariance which constrain their properties to the extent that they can be obtained exactly in two dimensions and to very high precision in three dimensions. Until recently, researchers assumed that Anderson transitions also possess conformal invariance and can be described by conformal field theories (CFTs). I will review recent progress in understanding the relation between conformal invariance and mutifractal wave functions. The emerging picture puts serious doubt on the ability of CFTs to properly describe multifractality at ATs in both two and three dimensions.

9. Speaker: Michael Tamm

Title: Steady state of TASEP with open boundary conditions is determined by the zero of the partition function of 1D lattice gas

Abstract: We demonstrate here a series of exact mappings between particular cases of four statistical physics models: equilibrium 1-dimensional lattice gas with nearest-neighbor repulsion, (1+1)-dimensional combinatorial heap of pieces, random walks on half-plane and totally asymmetric simple exclusion process (TASEP) in one dimension (1D). In particular, we show that generating function of a steady state of one-dimensional TASEP with open boundaries can be interpreted as a quotient of partition functions of 1D hard-core lattice gases with one adsorbing lattice site and negative fugacity. This result is based on the combination of (i) a representation of the steady-state TASEP configurations in terms of (1+1)-dimensional heaps of pieces and (ii) a theorem connecting the partition function of (1+1)-dimensional heaps of pieces with that of a single layer of pieces, which in this case is a 1D hard-core lattice gas.

10. Speaker: Alexander Gorsky

Title: Dualities in many-body systems and their applications

Abstract: We first review the dualities known for integrable many-body systems. There are two families of many-body systems - spin chains and Calogero-Ruijsenaars models. The dualities act within the family and between the families. On the other hand the dualities between the pairs of stochastic processes involve

one representative from Macdonald-Schur family, while the second representative is from stochastic higher spin six-vertex model of TASEP family. We argue that these dualities are counterparts and generalizations of the familiar quantum-quantum (QQ) dualities between pairs of integrable systems. One integrable system from QQ dual pair belongs to the family of inhomogeneous XXZ spin chains, while the second to the Calogero-Moser-Ruijsenaars-Schneider (CM-RS) family.As an example, we consider a new duality between the discrete-time inhomogeneous multispecies TASEP model on the circle and the quantum Goldfish model from the RS family. We present the precise map of the inhomogeneous multispecies TASEP and 5-vertex model to the trigonometric and rational Goldfish models respectively, where the TASEP local jump rates get identified as the coordinates in the Goldfish model.

11. Speaker: Vladimir Kravtsov

Title: Spectral and eigenfunction response to variation of random Hamiltonians in the non-ergodic regimes

Abstract: We consider the response of quantum data for the variation of random Hamiltonians in the region of parameters where the eigenfunctions are non-ergodic. Specifically, we consider the Gaussian Rosenzweig-Porter ensemble whose diagonal or off-diagonal entries are randomly changed. We found an exact expressions for the correlation function of the local and the global densities of states before and after the change of the Hamiltonian. We also consider the fidelity susceptibility to the local density variation and show that it is strongly peaked as a function of disorder near the localization transition. As a function of the system size the typical fidelity susceptibility increases in the fractal phase while it is constant in the ergodic phase. In the localized phase we found a new fixed point W* such that for disorder larger than W* the typical fidelity susceptibility decreases with increasing the system size and vanishes in the thermodynamic limit but it is increasing with the system size and diverges in the thermodynamic limit for disorder smaller than W*. This behavior is also observed in systems with few body interaction like spin chains and in the Anderson model on Random Regular Graph. The role of Mott’s resonant pairs for this phenomenon in systems with short-range hopping in the Hilbert space is discussed.

[1] M.A.Skvortsov, M. Amini and V.E. Kravtsov, Phys. Rev. B 106, 054208 (2022)

12. Speaker: Anton Zabrodin

Title: Logarithmic gas on a curved contour and Loewner energy.

Abstract: We introduce and study the model of a logarithmic gas at arbitrary temperature on a smooth closed contour in the plane. This model generalizes Dyson's gas on the unit circle. We compute the non-vanishing terms of the large N expansion of the free energy (N is the number of particles) by iterating the loop equation that is the Ward identity with respect to reparametrizations of the contour. Similarities with conformal field theory will be outlined. The leading and subleading contributions to the free energy are expressed through the conformal radius of the domain surrounded by the contour. The O(1)-contribution is expressed through the spectral determinant of the Neumann jump operator associated with the contour. It coincides with the Loewner energy of the contour as it was defined in the recent works by Y. Wang. This is the joint work with P. Wiegmann.

13. Speaker: Vladimir Kazakov

Title: Flows in forests on planar graphs.

Abstract: I will formulate and solve a one matrix matrix model for which the perturbation theory describes the massive spinless fermions on dynamical planar graphs. This is also the lattice version of 2d quantum gravity coupled то such fermionic field. Alternatively, due to the matrix Kirchhoff theorem, it is equivalent to the ensemble of spanning forests on the same graphs. We compute the one point functions and disc partition functions in the limit when both the graphs and the trees in the forests are macroscopically big. They are given by the universal scaling functions describing the flow between the regimes with c=-2 (large trees) and c=-2 (small trees) of conformal matter coupled to 2d gravity.

14. Speaker: Dmitry Gangardt

Title: Topological limit shape phase transitions: melting of Arctic Circles

Abstract: A limit shape phenomenon in statistical mechanics is the appearance of a most probable macroscopic state. An iconic example of this phenomenon is given by the Arctic Circle Theorem [1] of random tilings which, in the certain scaling limit, can be mapped to the imaginary time evolution of free fermions. A limit shape is usually characterized by a well-defined boundary separating frozen and liquid spatial regions. The earliest studies related to this phenomenon in the context of crystal shapes are in works by Pokrovsky and Talapov [2]. In this talk, I will present a phase transition of limit shape, which can be visualized as merging two melted regions (Arctic circles). By mapping onto a free fermionic problem and calculating correspondent correlation functions we identify the transition as the third-order transition known in lattice QCD [3]. We make connections to algebraic geometry, stressing the topological nature of the transition and identifying universal features of the limiting shape [4].

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[2] V. L. Pokrovsky and A. L. Talapov, Phys. Rev. Lett. 42, 65 (1979). "Ground State, Spectrum, and Phase Diagram of Two-Dimensional Incommensurate Crystals."

[3] D. J. Gross and E. Witten, Phys. Rev. D, 21 (2): 446, 1980. "Possible third-order phase transition in the large-n lattice gauge theory."; S. R. Wadia, "N = ∞ phase transition in a class of exactly soluble model lattice gauge theories", Phys. Lett. 93, 403 (1980)

[4] J. Pallister, D.M. Gangardt and A. Abanov, J. Phys. A 55, 304001, 2022 "Limit shape phase transitions: a merger of arctic circles"

15. Speaker: Ara Sedrakyan (25-26 October)

Title: Three dimensional Ising model (3DIM) as a non-critical string theory

Abstract: I will discuss the sign factor problem in the 3D gauge Ising model, present the corresponding fermionic model on random surfaces, which leads to the formulation of non-critical fermionic string theory on the basis of induced Dirac action. I will demonstrate how the sign factor model is linked to an ordinary and spin quantum Hall plateau transitions, tying them also to non-critical string theory. Based on the sign-factor model new type of matrix model will be formulated, which allows consideration of any spin chain models on random surfaces. This approach opens the way to cross the c=1 barrier in non-critical string theory.

16. Speaker: Alexander I. Bufetov

Title: The gaussian multiplicative chaos for the sine-process

Abstract: To almost every realization of the sine-process one naturally assigns a random entire function, the analogue of the Euler product for the sine, the scaling limit of ratios of characteristic polynomials of a random matrix. The main result of the talk is that the square of the absolute value of our random entire function converges to the Gaussian multiplicative chaos. As a corollary, one obtains that almost every realization with one particle removed is a complete and minimal set for the Paley-Wiener space, whereas if two particles are removed, then the resulting set is a zero set for the Paley-Wiener space. Quasi-invariance of the sine-process under compactly supported diffeomorphisms of the line plays a key role. In joint work with Qiu, the Patterson-Sullivan construction is used to interpolate Bergman functions from a realization of the determinantal point process with the Bergman kernel, in other words, by the Peres-Virág theorem, the zero set of a random series with independent complex Gaussian entries. The invariance of the zero set under the isometries of the Lobachevsky plane plays a key rôle. Conditional measures of the determinantal point process with the Bergman kernel are found explicitly (cf. arXiv:2112.15557, Dec. 2021).

17. Speaker: Baruch Meerson (Racah Institute of Physics, Hebrew University of Jerusalem)

Title: Fluctuations of “Brownian bees” and of some other N-particle systems

Abstract: The “Brownian bees” model is a relatively new member of a family of Brunet-Derrida particle systems which mimic different aspects of biological selection. The model describes an ensemble of N independent branching Brownian particles. When a particle branches into two particles, the particle farthest from the origin is eliminated so as to keep the number of particles constant. In the limit of $N \to \infty$, the coarse-grained particle density is governed by the solution of a free boundary problem for a simple reaction-diffusion equation. At long times the particle density approaches a spherically symmetric steady-state solution with a compact support. We studied fluctuations of the “swarm of bees” due to the random character of the branching Brownian motion in the limit of large but finite N. We considered a one-dimensional setting and focused on the fluctuations of the swarm radius l(t) [1]. We found that the autocorrelation function of l(t) in the steady state, $g(t_1 - t_2)$, exhibits a logarithmic scaling with $\tau = t_1 - t_2$, which corresponds to a 1/f noise in the frequency domain. In its turn, the variance of l(t) exhibits an anomalous scaling (1/N) ln N with N. These anomalies appear because all spatial scales of the system contribute to the fluctuations. I will also briefly discuss some large-deviation properties of the model [2] Finally, I will point out to another model (an N-particle system with reset of particles to the origin), which shares these anomalies with the Brownian bees [3].

[1] M. Siboni, P. Sasorov and B. Meerson, Fluctuations of a swarm of Brownian bees. Phys. Rev. E 104, 054131 (2021).

[2] B. Meerson and P. Sasorov, Persistent fluctuations of the swarm size of Brownian bees. Phys. Rev. E 103, 032140 (2021).

[3] O. Vilk, M. Assaf and B. Meerson, Fluctuations and first-passage properties of systems of Brownian particles with reset. Phys. Rev. E 106, 024117 (2022).

18. Speaker: Yan Fyodorov

Title: Escaping the crowds: emergent outliers in rank-1 non-normal deformations of GUE/CUE.

Abstract. Rank-1 non-normal deformations of GUE/CUE provide simplest model for describing resonances in a quantum chaotic system decaying via a single open channel. We provide a detailed description of the abrupt restructuring of the resonance density in the complex plane as the function of channel coupling. In the case of CUE we are able to study the Extreme Value Statistics of the "widest resonances" and find that in the critical regime it is described by distribution nontrivially interpolating between Gumbel and Frechet. The presentation is based on the joint works with Boris Khoruzhenko and Mihail Poplavskyi.

19. Speaker: Alexander Povolotsky

Title: Boundary watermelons in the spanning forests in quiet weather and in the wind.

Abstract: Watermelons are an important class of correlation functions characterizing the long-range behavior of polymer models. We discuss the asymptotic behavior of the probabilities of watermelons in the uniform spanning forests as well as anisotropic spanning forests near the open and closed boundary of the 2D square lattice. Also they correspond to a probability for several loop-erased random walks to connect two distant groups of vertices without intersections. The critical exponents obtained for the uniform case verify earlier predictions of the Coulomb Gas Theory and $c=0$ Conformal Field Theory. An addition of a drift to the lattice changes the large-scale behavior. For some cases we obtain the critical exponents known from the 1D non intersecting random walks (vicious walkers). For the others, the critical exponents are yet to be understood.

20. Speaker: Sergei Nechaev

Title: Devil’s staircase and modular invariance: from random operators to phyllotaxis and Hubbard model on a ring.

Abstract: I will discuss the spectral statistics of the Anderson-like model with random hopping on a line paying attention to its relationship with some number-theoretic properties of the Riemann-Thomae function, the Dedekind eta-function and phyllotaxis. I will introduce the generalized Riemann-Thomae function and will show that its integral exhibits the Devil's staircase structure and coincides with the ground state of the Hubbard system of particles on a ring interacting with a long-ranged 1/r-potential.

21: Speaker: Artem Aleksandrov

Title: On phase transitions and information geometry in Kuramoto model

Abstract**:** I will present some new and quite interesting results for the paradigmatic model of synchronization, Kuramoto model. My talk covers the interplay between continuous and discontinuous phase transition, and the discussion of information geometry description of synchronization transition in Kuramoto model.