Abstracts

Connections Between Complex Dynamics, Statistical Physics, and Limiting Spectra of Self-similar Group Actions

Indiana University Purdue University Indianapolis
August 17-19, 2016

Pavel Bleher, Indiana University-Purdue University Indianapolis

Mini-course talk: *Renormalization Group in Statistical Mechanics*

We will review the renormalization group approach to critical phenomena and phase transitions in statistical mechanics.

Jeffrey Diller, Notre Dame Univeristy

Mini-course talk: *Two-variable rational maps: dynamics by example*

Broadly speaking, rational maps of two complex variables fall into two dynamical types, large and small topological degree. I will explain this dichotomy and illustrate it with some examples whose dynamics can be worked out more or less explicitly.

Sandrine Daurat, University of Michigan

Hyperbolic saddle measures and laminarity for holomorphic endomorphisms of $\mathbb{CP}^2$

We study the laminarity of the Green current of endomorphisms of $\mathbb{CP}^2$ near hyperbolic measures of saddle type. When these measures are supported by attracting sets, we prove that the Green current is laminar in the basin of attraction and we obtain new ergodic properties. This generalizes some results of Bedford and Jonsson on regular polynomial mappings in $\mathbb{C}^2$.

Volodymyr Nekrashevych, Texas A&M University

Mini-course talk: *Self-similar groups, dynamical systems, and spectra*

We will talk about self-similar groups and their relation to complex dynamical systems, operator algebras, and computation of spectra of operators. Self-similar groups naturally appear as iterated monodromy groups of dynamical systems, and can be seen as generalized "non-commutative" dynamical systems in the framework of operator algebras. On the other hand, the problems of computation of spectra of operators naturally associated with self-similar groups also lead to multi-dimensional dynamical systems. We will discuss these connections, and problems related to them.

Dmytro Savchuk, University of South Florida

Lamplighter groups from affine automorphisms of rooted trees

The classical lamplighter group is a connecting link between the theory of self-similar groups and the spectral theory of infinite graphs. Originally it was used as a basis in the first counterexample to the (super)-strong Atiyah conjecture on L^2-Betti numbers. As a natural generalization of the lamplighter type groups we introduce the class of automorphisms of rooted d-regular trees, arising from affine actions on their boundaries viewed as free infinite dimensional Z_d-modules. We build the automata defining these automorphisms and apply the developed techniques to completely describe the structure of a group generated by 4-state bireversible automaton that was beyond the reach of other known methods. In the case of This is a joint work with Said N. Sidki.

Robert Shrock, SUNY Stonybrook

Mini-course talk: *The Potts Model and Tutte Polynomial, and Associated Connections between Statistical Mechanics and Graph Theory*

We present an introduction to the Potts Model partition function $Z(G, q, v)$ in statistical physics and the Tutte polynomial $T(G, x, y)$ in graph theory and show the equivalence between these, where G denotes a graph, q denotes the number of possible values for a variable defined on each vertex of G, v is a temperature-dependent Boltzmann weight, and $x = 1 + (q/v)$, $y = v + 1$. This equivalence represents a fruitful confluence of physics and mathematics. One special case of particular interest is the zero-temperature Potts antiferromagnet, $Z(G, q, -1)$, which is equal to $P(G, q)$, the chromatic polynomial of G, which counts the number of ways of assigning q colors to the vertices of G such that no two adjacent vertices have the same color. Among other topics, we discuss the connection of $P(G, q)$ to the ground-state entropy of the Potts antiferromagnet.

Robert Shrock, SUNY Stonybrook

Zeros of Chromatic and Tutte (Potts) Polynomials and their Accumulation Sets for Families of Graphs

A method for calculating $Z(G, q, v)$ or equivalently $T(G, x, y)$ on infinite families of graphs is presented, and structural properties of the resultant Potts/Tutte polynomials are discussed. We give results on zeros of chromatic and Potts/Tutte polynomials in the q plane for fixed v and in the v plane for fixed q and their accumulation sets for various families of n-vertex graphs as $n \to \infty$. This area combines combinatorics and graph theory with complex analysis and algebraic geometry, as well as statistical physics. We also mention some

other related topics, including an external magnetic field. A number of open problems and areas for further research are noted.

Tzu-Chieh Wei, SUNY Stonybrook

Density of Yang-Lee zeros from tensor network methods

The distribution of Yang-Lee zeros in the ferromagnetic Ising model in both two and three dimensions is studied on the complex field plane directly in the thermodynamic limit via the tensor network methods. The partition function is represented as a contraction of a tensor network and is efficiently evaluated with an iterative tensor renormalization scheme. The free-energy density and the magnetization are computed on the complex field plane. Via the discontinuity of the magnetization, the density of the Yang-Lee zeros is obtained to lie on the unit circle, consistent with the Lee-Yang circle theorem. Distinct features are observed at different temperatures?below, above, and at the critical temperature. Application of the tensor network approach is also made to the q-state Potts models in both two and three dimensions and a previous debate on whether, in the thermodynamic limit, the Yang-Lee zeros lie on a unit circle for $q > 2$ is resolved: they clearly do not lie on a unit circle except at the zero temperature. For the Potts models ($q = 3, 4, 5, 6$) investigated in two dimensions, as the temperature is lowered the radius of the zeros at a fixed angle from the real axis shrinks exponentially towards unity with the inverse temperature.

Based on joint work with Artur Garcia-Saez, Phys. Rev. B 92, 125132 (2015)

Mei Yin, University of Denver

Phase transitions in (generalized) exponential random graphs

The exponential random graph model has been a topic of continued research interest. The past few years especially has witnessed (exponentially) growing attention in exponential models and their variations. Emphasis has been made on the variational principle of the limiting normalization constant (free energy density), concentration of the limiting probability distribution, phase transitions, and asymptotic structures. This talk is based on joint work with several collaborators, including Sukhada Fadnavis (Harvard University), Richard Kenyon (Brown University), Charles Radin (University of Texas at Austin), and Alessandro Rinaldo (Carnegie Mellon University), and will focus on the phenomenon of phase transitions in (generalized) exponential random graphs.

Andrzej Zuk, Institut de Mathématiques de Jussíeu-París Ríve Gauche

Mini-course talk: *Automata groups*

Andrzej Zuk, Instítut de Mathématíques de Jussíeu-París Ríve Gauche

Spectra of automata