Talks in theoretical sciences

Friday, 23 November 2018
ETH-ITS, seminar room, CLV B4

Speaker: Oles Shtanko (Massachusetts Institute of Technology)

Time: 08:15 – 08:45

Title: Free probability theory helps to find the energy gap

Abstract: Suppose the eigenvalues/energies distributions of two Hamiltonians H1 and H2 are known. What is the eigenvalue distribution of the joint Hamiltonian H1+H2? Free probability theory (FPT) answers this question under certain conditions. My goal is to show that this result is helpful in physical problems, especially finding the energy gap and predicting quantum phase transitions. As an example, I will consider generic artificial topological systems created by a periodic drive, including Floquet Majorana modes, and show how FPT can be used to predict and characterize disorder-driven phase transitions.

Speaker: Dominik Schröder (IST Austria)

Time: 09:15 – 09:45

Title: Cusp Universality for Wigner-type Random Matrices

Abstract: For Wigner-type matrices, i.e. Hermitian random matrices with independent, not necessarily identically distributed entries above the diagonal, we show that at any cusp singularity of the limiting eigenvalue distribution the local eigenvalue statistics are universal and form a Pearcey process. Since the density of states typically exhibits only square root or cubic root cusp singularities, our work complements previous results on the bulk and edge universality and it thus completes the resolution of the Wigner-Dyson-Mehta universality conjecture for the last remaining universality type.

Speaker: Conner Behan (Stony Brook University)

Time: 10:30 – 11:00

Title: New approaches to conformal manifolds in one and two dimensions

Abstract: The bootstrap program for quantum field theories can be broadly divided into two complementary efforts. One is concerned with classifying isolated conformal field theories and the other seeks to understand deformations away from these CFTs along a renormalization group flow. I will discuss the borderline case in which a manifold of CFTs can be traversed by an exactly marginal deformation. While these conformal manifolds were first studied in the context of string worldsheets, they have also become important in more bottom-up physical systems. Throughout this talk, I will focus on a set of nonlinear differential equations that apply whenever there is a discrete non-degenerate spectrum of operators with data depending on an exactly marginal coupling. These equations present a scenario in which conformal perturbation theory can be used to infer non-perturbative results. They also offer a tantalizing hope of computing the spectrum of a non-trivial conformal manifold to

arbitrary precision. I will carry out a survey of some of the known conformal manifolds with the goal of identifying particular theories that are most amenable to this approach.

Speaker: Yi-Jun Chang (University of Michigan)

Time: 11:30 – 12:00

Title: Locality of Distributed Graph Problems

Abstract: In the LOCAL model of distributed computing, the topology of the communication network G=(V,E) is unknown, and each computing device is only aware of its neighbors initially. The complexity measure for a distributed problem is the number of rounds it takes to solve the problem. In this talk, we will consider some fundamental problems about the LOCAL model such as the following: (1) How to classify the problems according to their complexities? (2) How much does randomness help? (3) Can we solve more problems given more time?

Speaker: Stefan Glock (University of Birmingham)

Time: 14:15 – 14:45

Title: Decompositions of graphs and hypergraphs

Abstract: Combinatorial designs are systems of finite sets which satisfy some specified balancedness or symmetry condition. Some well-known examples include block designs, finite projective planes, Latin squares and Hadamard matrices. Such structures can often be formulated as hypergraph decomposition problems. In this talk, I will present some of my work on decompositions of graphs and hypergraphs. I will focus on a new proof of the Existence conjecture on combinatorial designs, which dates back to a question of Steiner from 1853.

Speaker: Anna Seigal (University of California, Berkeley)

Time: 15:15 – 15:45

Title: Structured Tensors and the Geometry of Data

Abstract: The matrix is the traditional way to organize and analyze data, via algorithms grounded in linear algebra. However, matrices are two-dimensional, and multi-dimensional techniques are needed to capture the higher-order structure in complex systems. A tensor is a multi-dimensional array, or hypermatrix, which encodes the relations between multiple variables. In this talk, I present my work on finding structure in tensors. I characterize tensors of interest via semi-algebraic sets, given by polynomial equations and inequalities, and show how to use this description to answer questions from numerical analysis and statistics.

Speaker: Jakub Tarnawski (EPFL)

Time: 16:30 – 17:00

Title: Approximation Algorithms for the Asymmetric Traveling Salesman Problem

Abstract: In the traveling salesman problem (TSP), we are given a graph with metric distances on edges, and wish to find the shortest cyclic tour that visits all vertices of the graph. It is one of the best-known and hardest NP-complete problems in combinatorial optimization. In the quest towards understanding it from a theoretical perspective, it is a notorious open problem to develop the best possible approximation algorithms for TSP. I will discuss the (more general and difficult) asymmetric version, where the given graph is directed. I will show how to harness the structure of the problem via the lens of convex relaxations and polyhedral combinatorics to obtain a constant-factor approximation algorithm for asymmetric TSP.