Workshop

Events for:
Monday, December 14th - Friday, December 18th

Monday, December 14th

10:00am **Dalimil Mazac**

Speaker: Dalimil Mazac

Title: Introduction to the Conformal Bootstrap for Mathematicians

Abstract: Conformal field theories are a rich class of quantum field theories in general number of dimensions which can be defined and studied fully rigorously. In fact, the definition of a conformal field theory fits in one line: It is a unitary representation V of the conformal group G (G=the universal cover of SO(2,n)), which is a direct sum of irreducible lowest-weight modules, and which admits a certain kind of G-invariant multiplication. In my talk, I will explain this definition and some of its consequences. In particular, I will review that the definition implies stringent bounds on the weights of the irreducible components in V. These bounds are typically obtained using linear and/or semi-definite programming. The bounds are often sharp -- saturated by physical conformal field theories. In certain special cases, the sharpness of the bounds can be proved using magic functions for sphere packing in 8 and 24 dimensions. The ultimate goal of the conformal bootstrap is to classify conformal field theories starting from the above definition. The most tantalizing finding is that the bounds reveal the existence of many non-trivial solutions of the axioms, yet no explicit description of any non-trivial solution is presently known.

1:00pm **Amir Tajdin**

Speaker: Amir Tajdini

Title: Fast Conformal Bootstrap and High-dimensional Sphere Packing

Abstract: The conformal bootstrap program seeks to map the space of possible conformal field theories and to identify those on the boundary of theory space. In this talk, I will discuss a numerical method that is applicable to certain bootstrap problems, such as the spin-less modular bootstrap in two dimensions. This method extends the conformal bootstrap to the regime of a large number of degrees of freedom which is relevant to the physics of black holes in three-dimensional gravity. The same method applies to the sphere packing problem and gives new bounds on the packing density in high dimensions. I will talk about these new bounds and give a summary of existing bounds for these problems.

Tuesday, December 15th

10:00am **Henry Cohn**

Speaker: Henry Cohn

Title: TBA

1:00pm **David Simmons-Duffin**

Speaker: David Simmons-Duffin

Title: Introduction to the crossing equation in higher dimensional CFTs

Abstract: In a continuation of Dalimil's talk on Monday, I will discuss the crossing equation for higher dimensional CFTs and explain some analytical results that have been derived from it.

Wednesday, December 16th

10:00am **Fernando Oliveira**

Speaker: Fernando Oliveira

Title: A Quick Introduction to Conic Programming

Abstract: Conic programming is a general optimization framework that encompassesboth linear and semidefinite programming. I will give a brief overview of the theory of conic programming, with an eye towards applications to problems like the kissing number problem or the sphere-packing problem.

1:00pm **Alex Maloney**

Speaker: Alex Maloney

Title: The Siegel-Weil Formula and Quantum Gravity as an Average

Abstract: I will explore the idea that certain theories of gravity are not traditional quantum theories, but are instead averages over ensembles of quantum theories. I will consider the average over free boson conformal field theories in two dimensions, and compute the genus g partition function using the Siegel-Weil formula. The result is a real analytic Eisenstein series which can be interpreted as the sum over geometries in a certain exotic - but in a sense exactly solvable - theory of quantum gravity. The techniques used are similar to those used to study high dimensional sphere packing by averaging over spaces of lattices, suggesting an analogy between semi-classical gravity and a theory of random lattices (or sphere packings) in high dimensions.

Thursday, December 17th

10:00am **Sylvia Serfaty**

Speaker: Sylvia Serfaty

Title: Microscopic description of Coulomb gases

Abstract: I will review some results on the arrangements of systems of points with Coulomb, logarithmic or more generally Riesz interactions (i.e. inverse powers of the distance), possibly with temperature. Motivations come from quantum physics, statistical mechanics, random matrix theory, approximation theory... We will take a point of view based on the detailed expansion of the interaction energy to describe the microscopic patterns formed by the points and local laws on the discrepancies. This allows to observe the effect of the temperature as it gets very large or very small, and to connect with crystallization questions.

1:00pm **Maryna Viazovska (colloquium)**

Speaker: Maryna Viazovska

Title: Sphere packings, universal optimality, and Fourier interpolation

Friday, December 18th

10:00am **Sridip Pal**

Speaker: Sridip Pal

Title: Modular bootstrap at High energy and Beurling-Selberg Extremization

Abstract: We consider the universality of existence and saturation of asymptotic bounds in various quantities in 2D conformal field theory (CFT) . In particular, we obtain the lower and upper bounds on the number of operators within a high energy interval [???,?+?], of a modular invariant 2D CFT with a positive spectral density. These bounds depend on a choice of functions that majorize and minorize the characteristic function of the interval [???,?+?] and have Fourier transforms of finite support. The optimization of the bounds over this choice turns out to be exactly the Beurling-Selberg extremization problem, widely known in analytic number theory. We review solutions of this problem and present the corresponding bounds on the number of operators. When 2? ? Z?0 the bounds are saturated by known partition functions with integer-spaced spectra. Similar results apply to operators of fixed spin and Virasoro primaries in c > 1 theories. If time permits, I will briefly sketch over how the analysis can be generalized for asymptotics of OPE coefficient, possibly with some additional numerical input and for CFTs with global symmetry.

1:00pm **Felipe Gonçalves**

Speaker: Felipe Gonçalves

Title: Sign Uncertainty

Abstract: ll talk about the recent developments of the sign uncertainty principle and its relation with sphere packing. Time permitting we will explore some of the new results in [New Sign Uncertainty Principles, arxiv.org/abs/2003.10771].