Conformal Field Theory, Integrability, and Geometry

Events for:
Monday, March 11th - Friday, March 15th

Monday, March 11th

8:30am Workshop: Breakfast - SCGP Cafe

Title: Breakfast

9:30am Workshop: Gregory Falkovich - SCGP 102

Speaker: Gregory Falkovich

Title: Broken and emerging symmetries of turbulence

Abstract: First, I shall review old results on the breakdown of reversibility and scale invariance in 3d turbulence and emergence of conformal invariance in 2d inverse cascades. Second, I describe new results on renormalization in wave turbulence and appearance of universal turbulent states.

10:30am Workshop: Coffee Break - SCGP Cafe

Title: Coffee Break

11:00am Workshop: Alexander Polyakov - SCGP 102

Speaker: Alexander Polyakov

Title: Tubulence in one dimension

Abstract: After several general comments on the fundamental physics of turbulence we will discuss one dimensional model of turbulence and attempt to extract general features of this phenomenon valid beyond the model. In particular, we argue that there exist strongly non-Gaussian tails described by the novel critical exponent.

12:00pm Workshop: Lunch - SCGP Cafe

Title: Lunch

2:30pm **Workshop: Mykola Dedushenko - SCGP 102**

Speaker: Mykola Dedushenko

Title: Integrability and vertex algebra in higher-dimensional QFT

Abstract: TBA

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

4:00pm **Workshop: Stefano Negro - SCGP 102**

Speaker: Stefano Negro

Title: A new representation of minimal form factors in Integrable QFTs

Abstract: In this talk, I will present a new representation of the minimal form factors in integrable quantum field theories. This arises from a recent study of form factors in TTbar-perturbed theories, where it was shown that the minimal form factors decompose into elementary building blocks. Here, focusing on the paradigmatic sinh-Gordon model, I will show that the standard integral representation of the minimal form factor decomposes in a combination of infinitely many elementary terms, each representing the minimal form factor of a generalised TTbar perturbation of the free fermion.

Tuesday, March 12th

8:30am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Leon Takhtajan - SCGP 102**

Speaker: Leon Takhtajan

Title: BPZ Ward identities and Kähler metrics on the moduli spaces

Abstract: I will explain how BPZ conformal Ward identities for correlation functions with insertion of holomorphic and antiholomorphic components of the stress-energy tensor give rise to Kähler metrics on moduli spaces.

10:30am **Workshop: Coffee Break - SCGP Cafe**

Title: Coffee Break

11:00am **Workshop: Paul Wiegmann - SCGP 102**

Speaker: Paul Wiegmann

Title: Finite-gap potentials, electronic crystals and the Bethe Ansatz for a large rank Lie group

Abstract: TBA

12:00pm **Workshop: Lunch - SCGP Cafe**

Title: Lunch

1:30pm **SCGP Weekly Talk: Alexander Abanov - SCGP 102**

Speaker: Alexander Abanov

Title: SCGP Weekly Talk: Limit shape phase transitions. Hydrodynamic approach.

Abstract: A limit shape phenomenon in statistical mechanics is the appearance of a most probable macroscopic state. This state is usually characterized by a well-defined boundary separating frozen and liquid spatial regions. We consider topological phase transitions in the limit shape problem of statistical mechanics. We present the hydrodynamic approach to the limit shape phenomena and associated phase transitions.

2:30pm **Workshop: Rubik Poghossian - SCGP 102**

Speaker: Rubik Poghossian

Title: On Liouville irregular states and Argyres-Douglas theories

Abstract: After a brief overview of N=2 SYM in the Omega background and its relation to 2d Liouville conformal blocks, I will show how to extend this correspondence to the case of Argiers-Douglas theories. In particular, I will focus on the simplest Argyrs-Douglas theory in ? background and find its partition function by constructing irregular Liouville 5/2 states. The results are compared with the generalized holomorphic anomaly approach, which provides an order by order expansion in ?-background parameters ?1 , ?2. Another test is carried out by comparing partition function in the self-dual point ?1 =- ?2 with the Painlevé I ?-function. The Nekrasov-Shatashvili limit ?2=0 accessible by either the deformed Seiberg-Witten curve or WKB methods, will also be discussed.

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

4:00pm **Workshop: Fedor Smirnov - ZOOM - SCGP 102/ZOOM**

Speaker: Fedor Smirnov

Title: Bootstrap and fermionic basis

Abstract: Actors for the sine-Gordon model in infinite volume were found by bootstrap long ago. More recent technique uses the fermionic basis. The advantage of this approach is that it can be used in the finite volume. In the limit of infinite volume the results of the fermionic basis must reproduce those obtained by bootstrap. This happens to be not quote trivial as I shall explain in this talk. First, we should use certain Grassmannian. Second, we find an unexpected new appearance of the Higher Level Bethe Ansatz.

Wednesday, March 13th

8:30am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Leonardo Rastelli - SCGP 102**

Speaker: Leonardo Rastelli

Title: Infinite Chiral Symmetry in Four Dimensional QFT

Abstract: To any four-dimensional ${\cal N=2}$ superconformal field theory (SCFT) one can canonically associate a two-dimensional vertex operator algebra (VOA). I will give a conceptual overview of the SCFT/VOA correspondence and then describe several strands of recent progress. The VOAs associated to 4d SCFTs appear to be very special, both algebraically and geometrically. Algebraically, they are conjecturally "classically free". Geometrically, they admit free field realizations that mimic the effective field theory of the 4d SCFT on its Higgs branch moduli space. Unitarity of the 4d SCFT is expected to be a crucial principle underlying these properties.

10:30am **Workshop: Coffee Break - SCGP Cafe**

Title: Coffee Break

11:00am **Workshop: Alexander Migdal - SCGP 102**

Speaker: Alexander Migdal

Title: Dual Theory of Decaying Turbulence

Abstract: This talk investigates the recently found reduction of decaying turbulence in the Navier-Stokes equation to a Number Theory problem of finding the statistical limit of the Euler ensemble. We reformulate the Euler ensemble as a Markov chain and show the equivalence of this formulation to the theory of free fermions on a ring, with an external field related to the random fractions of π. We find the solution of this system in the statistical limit $N\to \infty$ in terms of a complex trajectory (instanton) providing a saddle point to the path integral over histories of the Markov process. This results in an analytic formula for the observable correlation function of vorticity in wavevector space. The striking properties of this solution are quantum effects in the energy spectrum of the classical decaying turbulence coming from Euler's totient function in the Euler ensemble weights.

12:00pm **Workshop: Lunch - SCGP Cafe**

Title: Lunch

12:00pm **Workshop: Group Photo - SCGP Lobby**

Title: Group Photo

2:30pm **Workshop: Nikita Nekrasov - SCGP 102**

Speaker: Nikita Nekrasov

Title: BPZ equations in four dimensional physics

Abstract: TBA

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

4:00pm **Workshop: Andreas Klümper - SCGP 102**

Speaker: Andreas Klümper

Title: Logarithmic corrections arising from non-linear integral equations with singular kernels

Abstract: We present recent results for the computational treatment of the spectra of the integrable staggered six-vertex model and the integrable $3-\bar 3$ superspin chain. The staggered six-vertex model has attracted the interest of several groups of authors who derived a wealth of results. A remaining problem is how to compute the low-lying eigenvalues for arbitrary system sizes. We derive by proven means a set of non-linear integral equations (NLIE) with the unpleasant property of singular terms in the kernel. Due to this fact these equations do not lend themselves to an iterative treatment. However, we have succeeded in deriving from the singular NLIE an equivalent set of NLIE with purely regular kernel. This set can be solved for the lowest lying excitations for various system sizes. Interestingly, the singular NLIE can be used to derive the CFT data with logarithmic corrections ${\mathcal O}\left(1/(\log L)^2\right)$. Finally, we present results for the $3-\bar 3$ superspin chain intensively investigated by Essler, Frahm, Saleur (2005). Here we show how to derive two sets of NLIE, a singular one and a regular one. From the singular NLIE we derive the type of corrections to the CFT data, ${\mathcal O}\left(1/\log L\right)$. The numerical iteration of the regular NLIE is not yet successfully convergent: for the $3-\bar 3$ model not only is the genuine NLIE singular, but here some of the solutions also have singular properties.

Thursday, March 14th

8:30am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Vladimir Bazhanov - SCGP 102**

Speaker: Vladimir Bazhanov

Title: A brief history of the Yang-Baxter equation

Abstract: The Yang-Baxter equation is a key mathematical concept in the theory of integrable systems in statistical mechanics and quantum field theory. In this talk I will review the most important steps in our understanding of the Yang Baxter equation as well as its connections to other fields over the past forty years. This includes connections to quantum groups and algebras, dynamical evolution systems, integrable systems in three dimensions, theory of elliptic hypergeometric functions, quantum geometry and Zamolodchikov tetrahedron equation. In conclusion I will discuss some outstanding problems in this field.

10:30am **Workshop: Coffee Break - SCGP Cafe**

Title: Coffee Break

11:00am **Workshop: Alexander Belavin (ZOOM) - SCGP 102/ZOOM**

Speaker: Alexander Belavin

Title: Conformal bootstrap and Heterotic string Gepner models

Abstract: Heterotic string Gepner models in 4-dimensions are hybrid theories of a left-moving Superstring whose additional 6-dimensions are compactified on $M_{\vec k}$, which is the product of the N-SCFTs with the complete central charge 9, and a right-moving Bosonic string, whose additional 6 dimensions are also compactified on the product $N=2$ SCFT M^R_k, and the remaining 13 dimensions of which form the torus of $E(8)xSO(10)$. Such heterotic models have $N=1$ space-time symmetry arising in its left-moving part and $E(6)$ gauge symmetry arising in its right-moving part. These symmetries are necessary for phenomenological reasons and to obtain Grand Unified Theories (GUTs). In Gepner's pioneering work, the requirement that leads to a model having the desired Spacetime symmetry and Gauge symmetry was the requirement that spacetime symmetry be compatible with Modular invariance. I will show that the requirement of mutual locality of the left-moving vertices of physical states with SUSY currents and the right-moving vertices with currents of $E(6)$-gauge symmetry, together with the requirement of mutual locality of complete (i.e.left-right) vertices of physical states among themselves leads to the same Gepner model.

12:00pm **Workshop: Lunch - SCGP Cafe**

Title: Lunch

2:30pm   **Workshop: Giuseppe Mussardo - SCGP 102**

Speaker: Giuseppe Mussardo

Title: Breaking of integrability

Abstract: We discuss two analytical techniques (semi-classical method and Form Factor Perturbation Theory) and one numerical method (Truncated Hilbert space Approach) to achieve the best control of non-integrable quantum field theories in two dimensions. We also address the confinement phenomenon in purely bosonic field theory (such as the multi-frequency Sine-Gordon) and in supersymmetric models, pointing out that in the latter case the presence of fermions tends to stabilise the topological excitations of the theory.

3:30pm   **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

6:00pm   **Workshop: Banquet Dinner - SCGP Cafe**

Title: Banquet Dinner

8:30am **Workshop: Breakfast - SCGP Cafe**

Title: Breakfast

9:30am **Workshop: Zohar Komargodski - SCGP 102**

Speaker: Zohar Komargodski

Title: Semi-Classical Physics at Large Quantum Numbers

Abstract: We will discuss excitations with large spin and/or large particle number. For conformal theories this corresponds to investigating particular trajectories of heavy operators. We will review the central results in that field. If time permits we will then discuss some recent developments regarding trajectories with large approximate degeneracy and show that they can be understood as coherent rotating fluids with approximate infinite-dimensional symmetries. The fluid admits chiral excitations which could be soon observed in nonrelativistic versions of this problem.

10:30am **Workshop: Coffee Break - SCGP Cafe**

Title: Coffee Break

11:00am **Workshop: Vladimir Korepin - SCGP 102**

Speaker: Vladimir Korepin

Title: Projector spin chains

Abstract: We study frustration-free qudit spin chains. The Hamiltonian is a sum of projectors. These spin chains have a spectral gap. They also have non-invertible symmetries. Corresponding R-matrix has both additive and non-additive parameters as they solve the colored Yang-Baxter equation.

12:00pm **Workshop: Lunch - SCGP Cafe**

Title: Lunch

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time