MATRIX Research Program:

2D Supersymmetric Theories and Related Topics

17 - 28 Jan 2022

Talk Titles and Abstracts

Week 1

Speaker: Christian Ferko (Chicago)

Title: T Tbar and Supercurrent-Squared

Abstract: The T Tbar operator provides a universal irrelevant deformation of 2D QFTs which is under some analytic control. The theories produced by this deformation are especially interesting because they are not local QFTs but rather share some properties of string theories. These properties, as well as other interesting aspects of the T Tbar deformation, will be introduced in this review talk. We focus on cases where the deformation can be presented in a manifestly supersymmetric form known as supercurrent-squared.

Speaker: Daniel Grumiller (TU Wien)

Title: Introduction to 2d gravity

Abstract: An introduction to 2d gravity is provided, with focus on holographic aspects of 2d dilaton gravity.

Speaker: Kentaro Hori (Kavli IPMU)

Title: Introduction to 2d (2,2) supersymmetric gauged linear sigma models

Speaker: Ulf Lindström (Uppsala University)

Title: Supersymmetry and Complex Geometry

Abstract: There is a close relation between supersymmetric nonlinear sigma models and geometry. I will discuss this in the context of two dimensional models. The number of supersymmetries and their representation determine the geometry of their target space. E.g., sigma models with (2,2) chiral superfields lead to Kähler geometry on the target space. Other representations correspond to hyperkähler, bi-hermitean, generalised Kähler et.c.

Speaker: Jock McOrist (UNE)

Title: An introduction to String compactifications

Abstract: This is an introductory talk is aimed at graduate students, early career researchers and non-experts. I'll give a basic overview of a string compactification realising four-dimensional Minkowski space with minimal supersymmetry. I'll largely confine myself to heterotic supergravity.

Week 2

Speaker: Daniele Bielli

Title: Super Non-Abelian T-Duality

Abstract: Super non-Abelian T-duality of principal chiral and coset models on general Lie supergroups is analysed. We start from general principal chiral models, studying the OSp(1|2) case as a prime example and arguing that while the initial model is a proper three-dimensional supergravity background, its T-dual falls outside of this class. We then proceed by studying two families of coset models, namely symmetric and semi-symmetric spaces, highlighting where potential issues with T-duality may arise. In all these three classes of integrable models, dualisation along non-commuting bosonic and fermionic directions leads to the exchange of Maurer-Cartan equations with the equations of motion, so that integrability is preserved and the construction of T-dual Lax connections allowed.

Speaker: Jean-Emile Bourgine

Title: Vortex partition function of 2D N=(2,2) Super Yang-Mills theories and quantum groups.

Abstract: In this talk, I will present a new algebraic construction for the (K-theoretic) vortex partition function of 2D N=(2,2) Super-Yang-Mills theories. It is based on the representation theory of a shifted quantum affine sl(2) algebra, a deformation of the symmetry algebra of the XXZ integable spin chain. I will argue that shifted quantum groups can be used to introduce fundamental chiral multiplets in this framework and use this observation to propose an algebraic description of Higgsing.

Speaker: Andrea Dei

Title: String correlators on AdS3

Abstract: We revisit the computation of string worldsheet correlators on AdS3 with pure NSNS background flux. We solve all known symmetry constraints in multiple examples and for the first time provide a closed formula for 3 and 4-point functions with arbitrary winding. A non-trivial singularity structure emerges. In some cases, the full integral over the string moduli space can be performed analytically, leading to a direct contact with the dual CFT2.

Speaker: Xenia de la Ossa

Title: Black holes, periods and arithmetic of Calabi-Yau manifolds

Abstract: In this seminar I will discuss the arithmetic of Calabi-Yau 3-folds.The main goal is to explore whether there are questions of common interest in this context to physicists, number theorists and geometers. The main quantities of interest in the arithmetic context are the numbers of points of the manifold considered as a variety overa finite field. We are interested in the computation of these numbers and their dependence on the moduli of the variety. The surprise for a physicist is that the numbers of points over a finite field are also given by expression that involve the periods of a manifold. The number of points are encoded in the local zeta function, about which much is known in virtue of the Weil conjectures. I will discuss interesting topics related to the zeta function and the appearance of modularity for one parameter families of Calabi-Yau manifolds.

A topic I will stress is that for these families there are values of the parameter for which the manifold becomes singular and for these values the zeta function degenerates and exhibits modular behaviour. I will report (on joint work with Philip Candelas, Mohamed Elmi and Duco van Straten) on an example for which the quartic numerator of the zeta function factorises into two quadrics at special values of the parameter which satisfy an algebraic equation with coefficients in Q (so independent of any particular prime), and for which the underlying manifold is smooth. We note that these factorisations are due to a splitting of the Hodge structure and that these special values of the parameter are rank two attractor points in the sense of type IIB supergravity. Modular groups and modular forms arise in relation to these attractor points.

To our knowledge, the rank two attractor points that were found by the application of these number theoretic techniques, provide the first explicit examples of such points for Calabi-Yau manifolds of full SU(3) holonomy.

Speaker: Christian Ferko

Title: Holography and Irrelevant Operators

Abstract: In this talk, I will present a pure gravity analysis of the brane construction which realizes an irrelevant deformation related to the single-trace version of $T \overline{T}$. We consider a class of exact solutions in type IIB supergravity which interpolate from an AdS-type bulk, to a linear dilaton throat, to an asymptotically flat region. I will propose a prescription for computing the mass of such spacetimes using the covariant phase space formalism which exactly reproduces the square-root energy formula characteristic of the usual (double-trace) $T \overline{T}$ deformation of a CFT. Finally, I will speculate about the possibility of generalizing this procedure to other brane constructions, which may give holographic correspondences to field theories deformed by other irrelevant operators.

Speaker: Daniel Grumiller

Title: Generalized dilaton gravity in 2d

Abstract: Generalized dilaton gravity in 2d is the most general consistent deformation of the Jackiw-Teitelboim model that maintains local Lorentz invariance. The action is generically not power-counting renormalizable, thus going beyond the class of models typically studied. As an example, I present a 3-parameter family of models that describe black holes interpolating between AdS2 in the UV and dS2 in the IR.

Speaker: Wei Gu

Title: On phases of 3d N=2 Chern-Simons matters theories

Abstract: In this talk, I will discuss phases of 3d N=2 CS-matters theories with/out a renormalizable superpotential. If the theory has a superpotential, we observe that taking phases, in general, does not commute with the compactification (When orbifolds are involved). We also discuss how to obtain/predict quantum K-theories from 3d CS matters theories by compactifying the theory on the spacetime R^2 times S^1.

Speaker: Kentaro Hori

Title: Grade restriction rule and applications

Speaker: Hongliang Jiang

Title: Infinite symmetries and Ward identities in celestial CFT

Abstract: Celestial holography reformulates the scattering amplitude holographically in terms of celestial conformal field theory living at boundary null infinity, thus opening up an interesting and promising avenue towards flat holography. In this talk, I will discuss various aspects of symmetry and their implications in celestial holography. I will first discuss how to realize the global symmetry of spacetime in celestial CFT, ranging from Poincare to conformal symmetry, and further to the superconformal symmetry of N=4 SYM. Then I will study the asymptotic symmetries from the celestial conformal field theory point of view. More specifically, by focusing on the soft sector of celestial OPEs, I will derive an infinite-dimensional symmetry algebra, dubbed holography chiral algebra, in supersymmetric Einstein-Yang-Mills theory. In the case of pure Einstein gravity, the holography chiral algebra turns out to be the w_{1+∞} algebra. These infinite symmetries give rise to infinite Ward identities in celestial CFT, which are equivalent to infinite soft theorems in scattering amplitudes. Finally, I will also derive general formulae for celestial OPEs and the corresponding Ward identities arising from arbitrary cubic interactions of three spinning massless particles.

Speaker: Christopher Raymond

Title: Logarithmic N=2 superconformal minimal models

Abstract: Much recent representation-theoretic work in conformal field theory has focused on logarithmic CFTs (logCFTs). Such theories can be characterised by the appearance of indecomposable yet reducible modules on which the Virasoro zero-mode operator acts non-diagonalisably in their spectra. The choice examples of logCFTs are the minimal models associated with affine vertex operator algebras (VOAs) at fractional values of the level. Using the Kazama-Suzuki coset construction, one can realise N=2 superconformal algebras via a coset involving affine sl(2) VOAs. In this talk, I will give an introduction to this particular coset construction of the N=2 superconformal minimal models, and present some recent results on the indecomposable yet reducible modules that appear in this way. This talk is based on joint work with David Ridout and Jorgen Rasmussen.

Speaker: Mauricio Romo

Title: GLSM, Homological projective duality and nc resolutions

Abstract: I will review the construction of homological projective duals (HPD) from GLSMs and focus mostly on the case of Fano (hypersurfaces) manifolds. In general, for such cases the HPD can be interpreted as a non-commutative (nc) resolution of a compact variety. I will give a physical interpretation of this fact and present some conjectures.

Speaker: Savdeep Sethi

Title: Toward a construction of non-classical string solutions

Abstract: The first part of the talk will overview some no-go results on the string landscape. The second part of the talk will describe a way to potentially evade those no-go results by building non-classical string solutions. Specifically, I will outline a strategy to construct a family of non-supersymmetric AdS solutions where various swampland conjectures can be examined.

Speaker: Alessandro Sfondrini

Title: A Gentle Introduction to the AdS3/CFT2 Mirror TBA

Abstract: The study of the AdS3/CFT2 correspondence by exact techniques saw many remarkable advances over the last few years. Until very recently, most results were obtained when holography is realised without any RR background fluxes, so that the strings can be described as a WZW model. A major new result was the derivation, for the first time, of the mirror thermodynamic Bethe ansatz (TBA) equations which describe the theory in the presence of RR fluxes. In this talk I will give a pedagogical introduction to the main challenges of AdS3/CFT2 holography and to the various ingredients that are needed to yield the mirror TBA equations and eventually the spectrum of generic (non-protected) string states. The talk is mostly based on recent work with Sergey Frolov.

Speaker: Eric Sharpe

Title: An Introduction to decomposition

Abstract: In this talk I will review work on `decomposition,' a property of 2d theories with 1-form symmetries and, more generally, d-dim'l theories with (d-1)-form symmetries. Decomposition is the observation that such quantum field theories are equivalent to ('decompose into') disjoint unions of other QFTs, known in this context as "universes." Examples include two-dimensional gauge theories and orbifolds with matter invariant under a subgroup of the gauge group. Decomposition explains and relates several physical properties of these theories - for example, restrictions on allowed instantons arise as a "multiverse interference effect" between contributions from constituent universes. First worked out in 2006 as part of efforts to understand string propagation on stacks, decomposition has been the driver of a number of developments since. In the first half of this talk, I will review decomposition; in the second half, I will focus on the recent application to anomaly resolution of Wang-Wen-Witten in two-dimensional orbifolds.

Speaker: Kaiwen Sun

Title: Twisted elliptic genera

Abstract: The elliptic genera of 2d (0,4) SCFTs for the BPS strings in 6d (1,0) SCFTs have been extensively studied in the past decade. By geometric engineering, they are equivalent to the refined topological string partition function on the underlying elliptic non-compact Calabi-Yau threefolds. Some 6d SCFTs allow twisted circle compactification, for example when the gauge algebra has an outer automorphism. In such cases, the elliptic genera can be generalized to twisted elliptic genera which have many extraordinary properties. We systematically study the twisted elliptic genera including their localization, Higgsing, modular bootstrap, spectral flow symmetry and twisted elliptic blowup equations. This is based on a joint work with Kimyeong Lee and Xin Wang.

Speaker: Eirik Eik Svanes

Title: Heterotic Moduli without Field Redefinitions

Abstract: I will review recent breakthroughs in understanding on-shell heterotic moduli from the past decade, many of which required thinking in terms of generalised geometry, doubled field theory and L-infinity algebras. In most of these formulations an extra set of End(TX)-valued are needed for the description to make sense. These unphysical fields are often given the interpretation of field redefinitions. I will take some modest steps towards an understanding of the moduli problem without these spurious degrees of freedom. In particular, I will describe the cohomology which counts the infinitesimal massless modes.

Speaker: James Tener

Title: Quantum fields from Haag-Kastler nets in 2d chiral conformal field theory

Abstract: In this talk I will present joint work in progress with André Henriques which compares axiomatizations of unitary two-dimensional chiral conformal field theories. In particular, I'll explain how fields (i.e. unitary vertex operator algebras) can be constructed from the data of Haag-Kastler nets of algebras (i.e. conformal nets). As a consequence, every Haag-Kastler net is generated by smeared fields. The arguments involved are entirely model independent, and give a comparison of the notions of unitary VOAs and conformal nets in full generality.

Speaker: Rikard von Unge

Title: TTbar and nonlinearly realized symmetries

Abstract: We investigate the idea that TTbar deformations lead to theories that have nonlinearly realized symmetries. We will pedagogically introduce the formalism of nonlinear realizations and explain how it could play a role in TTbar deformed theories.