Strings 2022

Report of Contributions

https://indico.cern.ch/e/strings22

Contribution ID: **4** Type: **Poster**

2D Vacuum Transitions and their holographic interpretation

We show that the behaviour of 2D vacuum transitions is reminiscent of the CFT_2/CFT_1 correspondence. In doing so, we perform the calculation in 3 different methods, namely the Euclidean formalism of Coleman-de Luccia and Brown-Teitelboim, and the Hamiltonian method of Fischler, Morgan and Polchinski. The bounces from the Euclidean methods are always proportional to the central charge, thereby signalling that the spacetimes involved are extremal. We then apply the Hamiltonian formalism to JT gravity, showing that it provides a holographic description in terms of $T\bar{T}$-deformed CFTs.

The extremised action on either side of the transition, is equivalent to the generalised entropy, S_{gen}, introduced by Maldacena et al. The actions for transitions involving pure AdS_2 and/or AdS_2 black hole spacetimes agree with the results obtained by Van Raamsdonk et al. within the context of mutual approximation between states belonging to different CFT_2s separated by a 1D interface CFT. In particular, for the case of pure AdS spacetimes, S_{tot} is proportional to the entropy of the ICFT, hence to the holographic central charge of the defect, c_{hol}. Generalisations of the c-theorem imply that the action diverges upon taking the flat limit, thereby showing an analogous behaviour to the information loss paradox that first motivated the island proposal.

This divergence can be cured in the Hamiltonian method by adding a constant term in the Lagrangian density, which is mapped to the black hole mass in the corresponding metric solution, and therefore agrees with the proposal made by Maldacena that false vacuum decays to a portion of AdS are allowed by the AdS/CFT correspondence. Indeed, such CFT-deformations are dual to bulk IR-cutoffs, and their relevance for our purposes is thereby twofold: it ensures the flat limit can be taken while keeping S_{tot} finite; furthermore, it legitimates our description of nucleation processes as being purely local phenomena. We further extend this argument to the case of pure dS_2 transitions, showing that the corresponding 2D cosmological horizon actually plays the role of a cutoff codimension-2 surface, which should be understood as being part of the entanglement entropy. Finiteness in the flat limit can be recovered in analogy with the AdS case.

The nucleation processes can be embedded in the wedge-holographic limit of an AdS_3 /$BCFT_2$ setup with 2 ETWs. In absence of conical defects, S_{tot} is holographically equivalent to the Hartman-Maldacena-surface anchored to the defect CFT and ending on the event horizon of the TFD in the IR-bulk. Under a shift of the spacetime parameters, S_{tot} is monotonic, resembling the Von Neumann entropy. On the other hand, in presence of conical defects, beyond a certain black hole mass threshold, S_{tot} experiences a phase transition in between the HM and the HRRT surfaces intersecting the ETW brane, thanks to the presence of additional horizon contributions which are not part of S_{EE}, and we identify with the boundary of the island.

These findings suggest that ascertained results in wedge holography, defect CFTs and confinement could also be used for describing higher dimensional vacuum transitions.

Primary author: PASQUARELLA, Veronica (DAMTP, University of Cambridge, UK)

Presenter: PASQUARELLA, Veronica (DAMTP, University of Cambridge, UK)

Session Classification: Reception & Poster session

Contribution ID: **8** Type: **Poster**

N-spike string in AdS_3 \times S^{1} with mixed flux

Sigma model in AdS_{3}× S^{3} background supported by both NS-NS and R-R fluxes is one of the most distinguished integrable models. We study a class of classical string solutions for N-spike strings moving in AdS_{3}× S^{1} with angular momentum J in S^{1} ⊂ S^{5} in the presence of mixed flux. We observe that the addition of angular momentum J or winding number m results in the spikes getting rounded off and not end in cusp. The presence of flux shows no alteration to the rounding-off nature of the spikes. We also consider the large N-limit of N-spike string in AdS_{3} × S^{1} in the presence of flux and show that the so-called Energy-Spin dispersion relation is analogous to the solution we get for the periodic-spike in AdS_{3}– pp-wave ×S^{1} background with flux.

Primary author: PANDIT, Priyadarshini (IIT kharagpur)

Co-authors: Prof. PANIGRAHI, Kamal L. (IIT Kharagpur); Dr NAYAK, Rashmi R.

Presenter: PANDIT, Priyadarshini (IIT kharagpur)

Session Classification: Reception & Poster session

Contribution ID: **9** Type: **Gong Show Talk**

A modern view on Universal Asymptotic Formulae in 2d CFTs

Two-dimensional Conformal Field Theories (CFTs) are defined via a list of primary operators, along with their scaling dimensions, spins and OPE coefficients. This set of data, along with the central charge, uniquely defines any correlation function of the theory on an arbitrary Riemann surface. Using consistency conditions like crossing symmetry and modular invariance, one can show that there are features of this data that are universal in all two-dimensional CFTs. A celebrated example of this statement is the Cardy formula for the asymptotic density of primary states at any finite value of the central charge greater than unity. The purpose of this talk is to present a new universal formula that involves the square of the OPE coefficients for heavy operators at finite central charge. The derivation bypasses the need to compute Virasoro Blocks and uses the relatively old but newly-analyzed tool of the Fusion and Modular kernels, which relate Virasoro blocks in a given channel with a linear combination of blocks in a different channel. Their closed-form expression is known at finite central charge (greater than unity) due to B.Ponsot and J.Teschner. We will also demonstrate that general crossing kernels for arbitrary Virasoro blocks on any Riemann surface can be readily constructed out of the known kernels for the sphere four-point and the torus one-point conformal blocks.

Primary authors: Prof. MALONEY, Alex (McGill University); TSIARES, Ioannis (Institut de Physique Theorique, CEA-Saclay); Dr MAXFIELD, Henry (Stanford University); Dr COLLIER, Scott (Princeton University)

Presenter: TSIARES, Ioannis (Institut de Physique Theorique, CEA-Saclay)

Session Classification: Gong Show

Contribution ID: **10** Type: **Poster**

A modern view on Universal Asymptotic Formulae in 2d CFTs

Two-dimensional Conformal Field Theories (CFTs) are defined via a list of primary operators, along with their scaling dimensions, spins and OPE coefficients. This set of data, along with the central charge, uniquely defines any correlation function of the theory on an arbitrary Riemann surface. Using consistency conditions like crossing symmetry and modular invariance, one can show that there are features of this data that are universal in all two-dimensional CFTs. A celebrated example of this statement is the Cardy formula for the asymptotic density of primary states at any finite value of the central charge greater than unity. The purpose of this talk is to present a new universal formula that involves the square of the OPE coefficients for heavy operators at finite central charge. The derivation bypasses the need to compute Virasoro Blocks and uses the relatively old but newly-analyzed tool of the Fusion and Modular kernels, which relate Virasoro blocks in a given channel with a linear combination of blocks in a different channel. Their closed-form expression is known at finite central charge (greater than unity) due to B.Ponsot and J.Teschner. We will also demonstrate that general crossing kernels for arbitrary Virasoro blocks on any Riemann surface can be readily constructed out of the known kernels for the sphere four-point and the torus one-point conformal blocks.

Primary authors: Prof. MALONEY, Alex (McGill University); TSIARES, Ioannis (Institut de Physique Theorique, CEA-Saclay); Dr MAXFIELD, Henry (Stanford University); Dr COLLIER, Scott (Princeton University)

Presenter: TSIARES, Ioannis (Institut de Physique Theorique, CEA-Saclay)

Session Classification: Reception & Poster session

Contribution ID: **11** Type: **Gong Show Talk**

Rebooting quarter-BPS operators in N=4 Super Yang-Mills

I will discuss the analytic bootstrap technique applied to holographic superconformal field theories. In particular I will focus on $\mathcal{N} = 4$ Super Yang-Mills and study correlators of quarter-BPS operators. Despite the fact that they are less protected than their half-BPS counterparts, these correlators can be constrained via the chiral algebra twist and this information is enough to recover the leading $1/c$ correction to the conformal dimensions of the unprotected multi-trace operators that are exchanged. In doing this we discovered that a certain limit involving the R-symmetry polarizations bears some similarities with its half-BPS analog.

Primary authors: Prof. BISSI, Agnese (Uppsala University); MANENTI, Andrea (Uppsala University); Dr FARDELLI, Giulia (Uppsala University)

Presenter: MANENTI, Andrea (Uppsala University)

Session Classification: Gong Show

Contribution ID: **12** Type: **Gong Show Talk**

Microstates of the Non-Supersymmetric Two-Dimensional Black Hole: A Boundary Decription

In the matrix quantum mechanics (MQM) dual to the non-supersymmetric 2d black hole, we identify a set of degenerate states as the black hole microstates. At leading order in large N, the log of number of these states (already calculated by Gross and Klebanov) matches the Bekenstein-Hawking entropy formula, and also agrees with one of two candidates found by Kazakov and Tseytlin. The mass term in Kazakov and Tseytlin's free energy also matches the energy of these states conjectured by Gross and Klebanov; we show this conjecture. We also calculate the micro-canonical entropy in a higher-energy phase, which we conjecture to be dual to the $c = 0$ phase of 2d string theory. We try to interpret our results in string theoretic terms and find that it is consistent with some arguments of Kogan, Sathiapalan and Atick and Witten regarding the phase structure of string theory. Finally, we discuss a tantalising analogy to Motzkin walk models.

Primary author: SONI, Ronak (DAMTP, University of Cambridge)

Co-authors: AHAMDAIN, Amr (DAMTP, University of Cambridge); FRENKEL, Alexander (Stanford University)

Presenter: SONI, Ronak (DAMTP, University of Cambridge)

Session Classification: Gong Show

Contribution ID: **16** Type: **Poster**

Adiabatic Solutions in General Relativity as Null Geodesics on the Space of Boundary Diffeomorphisms

We use a trick similar to that of Weinberg's for adiabatic modes, in a Manton approximation for general relativity on a spacetime whose spatial slices have a boundary. We show that this results in a description of the slow-time dependent solutions as null geodesics on the space of boundary diffeomorphisms, with respect to a metric we prove to be composed solely of the boundary data. We partially show and partially conjecture how the solutions in the bulk space are fixed via the constraint equations of general relativity. To discuss certain features, we study some simple cases in 3+1 and 2+1 dimensions and show that for the solutions we propose the harder-to-untangle Hamiltonian constraint becomes the real homogeneous Monge-Ampere equation for the latter.

Primary authors: SERAJ, Ali; VAN DEN BLEEKEN, Dieter (Bogazici University); Dr KUTLUK, Emine Seyma

Presenter: Dr KUTLUK, Emine Seyma

Session Classification: Reception & Poster session

Contribution ID: **18** Type: **Poster**

Carrollian Conformal Field Theories in Flat Space Holography

It is more than 20 years since the advent of the famed AdS/CFT correspondence, which has given a firm footing to the idea of holography. Our physical world is, however, clearly not AdS. For many applications, especially astrophysical ones, the universe can be approximated by an asymptotically flat spacetime. It is thus of great importance to extend the notion of holography from its original setting in asymptotically AdS spacetimes to flat backgrounds.
A natural way to construct a holographic quantum field theory for a general gravitational theory is to consider the symmetry structure at the spacetime boundary in which the gravitational theory lives. The Asymptotic Symmetry Group (ASG) and its associated algebra, the Asymptotic Symmetry Algebra, are formally given by these symmetries at the boundary. One can then propose that the dual field theory lives on the asymptotic boundary of the spacetime and inherits the symmetry of the ASG. For Einstein gravity in 3 and 4 dimensional Minkowski spacetime, the asymptotic symmetries at the null boundary of flat spacetime are given, not by the Poincare group but by the infinite-dimensional Bondi-Metzner-Sachs (BMS) groups. Drawing inspiration from AdS/CFT, holography in asymptotically flat spacetimes involves these infinite-dimensional symmetry algebras. The putative dual theories should be non-gravitational quantum field theories living on the null boundary and invariant under the infinite extended BMS algebras. Also, a natural avenue to explore flat holography is to investigate the singular limit where the bulk theory goes from AdS to flat space, i.e. taking the radius of AdS to infinity. This leads to an ultra-relativistic contraction of the boundary CFT, resulting in the Carrollian Conformal Field Theory (CCFT). These conformal versions of Carrollian theories are putative duals of flat space. It has also been known that the Carrollian Conformal symmetries are isomorphic to BMS symmetries. This poster focuses on aspects of Carrollian Conformal (BMS invariant) field theories in boundary dimensions d=2 and 4.

We will discuss the preliminaries (ultra-relativistic limit of CFT, finite and infinite Carrollian Conformal Algebra (CCA), its representation theory and geometric interpretation) in d=2 and higher. Then we will discuss about 2d CCFTs on the torus and its modular properties. We will show the asymptotic structure constants for general states in theory and match them with a calculation on an asymptotically flat FSC (Flat Space Cosmology) bulk. Later, we will focus on constructing CCFTs in d=4 primarily from two different approaches, namely limiting and intrinsic process. We will end this poster with a discussion on the supersymmetric formulation of CCA in d=4 and propose that the isomorphism between CCA and BMS can be extended for the supersymmetric case as well.

Primary author: Dr NANDI, Poulami (Indian Institute of Technology Gandhinagar)

Presenter: Dr NANDI, Poulami (Indian Institute of Technology Gandhinagar)

Session Classification: Reception & Poster session

Contribution ID: **20** Type: **Poster**

Chern-Simons invariants from ensemble averages

I will discuss ensemble averages of two-dimensional conformal field theories associated with an arbitrary indefinite lattice with integral quadratic form Q. I will provide evidence that the holographic dual after the ensemble average is the three-dimensional Abelian Chern-Simons theory with kinetic term determined by Q. The resulting partition function can be written as a modular form, expressed as a sum over the partition functions of Chern-Simons theories on lens spaces. For odd lattices, the dual bulk theory is a spin Chern-Simons theory, and I identify several novel phenomena in this case. I will also discuss the holographic duality prior to averaging in terms of Maxwell-Chern-Simons theories.

Primary author: LEEDOM, Jacob Michael (DESY)

Co-authors: Dr KIDAMBI, Abhiram (Kavli IPMU); ASHWINKUMAR, Meer (The University of Tokyo (Kavli IPMU)); DODELSON, Matthew (CERN); YAMAZAKI, Masahito (Kavli IPMU, University of Tokyo)

Presenter: LEEDOM, Jacob Michael (DESY)

Session Classification: Reception & Poster session

Contribution ID: **21** Type: **Gong Show Talk**

Physical Protocols for Recovering Information in Quantum Gravity

I will present two protocols, that observers localized near the boundary of a spacetime can use to recover information about bulk excitations. The first protocol will be for the case of an asymptotically AdS spacetime and the second for an asymptotically flat spacetime. Although the specifics of the two protocols differ, they both demonstrate the principle of holography of information —the fact that information about the bulk is also available near the boundary— already in the low-energy limit of a theory of quantum gravity.

Primary author: PAPADOULAKI, Olga

Presenter: PAPADOULAKI, Olga

Session Classification: Gong Show

Contribution ID: **23** Type: **Poster**

D-instanton Induced Superpotential

I will explain how one can fix the normalization of the D-instanton contribution to the superpotential in type II string theory on Calabi-Yau orientifolds using string field theory and show such normalization is holomorphic function of the moduli. I will also argue for the absence of multi-instanton contribution to the superpotential in these scenarios. Based on 2204.02981.

Primary authors: ALEXANDROV, Sergey (Montpellier University); FIRAT, Atakan Hilmi; KIM, Manki (CERN); SEN, Ashoke (Harish-Chandra Research Institute); STEFANSKI, Bogdan Benedykt (City University London (GB))

Presenter: FIRAT, Atakan Hilmi

Session Classification: Reception & Poster session

Contribution ID: **25** Type: **Poster**

The Asymptotic Structure of Gravity in Higher Even Dimensions

We investigate the notion of asymptotic symmetries in classical gravity in higher even dimensions, with $D = 6$ space-time dimensions as the prototype. Unlike in four dimensions, certain non-linearities persist which necessitates the complete non-linear analysis we undertake. We show that the free data is parametrized by a pair of symmetric trace-free tensors at future (past) null infinity. This involves a redefinition of the radiative field. We define a symplectic structure generating the radiative phase space at $\mathcal{I}^{\pm}$ with appropriate boundary conditions which are preserved by the action of supertranslations. We derive the charge associated to super-translation vector fields and this charge matches with that derived using the equations of motion in the full non-linear theory. We elaborate on the precise relationship between the super-translation charge, the Bondi mass aspect and the "gravitational memory" in six space-time dimensions, thus providing the first example of an infrared triangle in non-linear gravity beyond four dimensions.

Primary authors: CHOWDHURY, Chandramouli (ICTS-TIFR); Ms MISHRA, Ruchira (University of Chicago); Dr PRABHU, Siddharth (TIFR)

Presenter: CHOWDHURY, Chandramouli (ICTS-TIFR)

Session Classification: Reception & Poster session

Contribution ID: **26** Type: **Poster**

Operational islands and black hole dissipation in JT gravity

In this work, we revisit the problem of finding entanglement islands in 2d Jackiw-Teitelboim (JT) gravity. We implement the following adjustments to the traditional setup: (1) we do not explicitly couple to a non-gravitating system, instead we implement only pure absorption into a fiducial detector, (2) we utilise the operationally defined renormalised matter entanglement entropy, as defined by the boundary observer's wordline. We show that this leads to a unitary Page curve that we explicitly compute, with an island outside of the event horizon. Next, we extend the analysis to a charged and/or supersymmetric black hole. We find that in a certain regime the charged black hole grows first as it emits superradiation before eventually dissipating. We obtain similar results when embedding the system in a supersymmetric setting.

Primary authors: DE VUYST, Julian (OIST); Dr MERTENS, Thomas (Ghent University)

Presenter: DE VUYST, Julian (OIST)

Session Classification: Reception & Poster session

Contribution ID: **27** Type: **Poster**

Penrose limit of MNa solution and spin chains in three-dimensional field theories

We consider the Penrose limit of the MNa solution, a theory with spontaneous breaking of $calN = 1$ supersymmetry in 3 dimensions, a case for which the holographic map is less understood. We compare the resulting pp wave and its string eigenstates to a sector of the theory on 5-branes reduced on S^3, and a spin chain-like system. We obtain many of the features of the pp wave analysis, but a complete matching still eludes us. We suggest possible explanations for the resulting partial mismatch, and compare against other spin chains for 3-dimensional field theories with gravity duals, like ABJM and GJV, as well as to the holographic cosmology case, in order to better understand the issues involved.

Primary author: NASTASE, Horatiu

Co-author: Mr BARBOSA, Marcelo (São Paulo University)

Presenter: NASTASE, Horatiu

Session Classification: Reception & Poster session

Contribution ID: **29** Type: **Poster**

Islands with Gravitating Baths in Double Holography

We study black hole information and entanglement islands in higher dimensions (d > 2) using the bottom-up Karch-Randall-Sundrum braneworld construction. Earlier work in the double-holography literature embeds a single Randall-Sundrum brane in (d+1)-dimensional AdS gravity and uses the Karch-Randall mechanism to realize a theory of a gravitating braneworld coupled at infinity to a nongravitating conformal bath. We make the bath gravitating by introducing a *second* brane and having it act as the bath. Unlike in previous studies of black holes in doubly holographic brane/bath systems, we find no dynamics in the entanglement entropy of Hawking radiation, although we do get islands. This is evidence that the information paradox may be resolved at the semiclassical level by a constant entropy curve, in agreement with the principle of holography of information.

Primary author: SHASHI, Sanjit

Co-authors: KARCH, Andreas (University of Texas at Austin); GENG, Hao (Harvard University, University of Washington); PEREZ-PARDAVILA, Carlos (University of Texas at Austin); RAJU, Suvrat (Tata Institute of Fundamental Research); RANDALL, Lisa (Harvard University); RIOJAS, Marcos (University of Texas at Austin)

Presenter: SHASHI, Sanjit

Session Classification: Reception & Poster session

Contribution ID: **30** Type: **Gong Show Talk**

PQ Axiverse

We show that the strong CP problem is solved in a large class of compactifications of string theory. The Peccei-Quinn mechanism solves the strong CP problem if the CP-breaking effects of the ultraviolet completion of gravity and of QCD are small compared to the CP-preserving axion potential generated by low-energy QCD instantons. We characterize both classes of effects. To understand quantum gravitational effects, we consider an ensemble of flux compactifications of type IIB string theory on orientifolds of Calabi-Yau hypersurfaces in the geometric regime, taking a simple model of QCD on D7-branes. We show that the D-brane instanton contribution to the neutron electric dipole moment falls exponentially in N4, with N the number of axions. In particular, this contribution is negligible in all models in our ensemble with N>17. We interpret this result as a consequence of large N effects in the geometry that create hierarchies in instanton actions and also suppress the ultraviolet cutoff. We also compute the CP breaking due to high-energy instantons in QCD. In the absence of vectorlike pairs, we find contributions to the neutron electric dipole moment that are not excluded, but that could be accessible to future experiments if the scale of supersymmetry breaking is sufficiently low. The existence of vectorlike pairs can lead to a larger dipole moment. Finally, we show that a significant fraction of models are allowed by standard cosmological and astrophysical constraints.

Primary authors: Dr LONG, Cody (Harvard University); MORITZ, Jakob; GENDLER, Naomi; MCALLISTER, Liam (Cornell University); Dr DEMIRTAS, Mehmet (Northeastern University)

Presenter: GENDLER, Naomi

Session Classification: Gong Show

Contribution ID: **32** Type: **Poster**

The generalized first law for more general matter

In previous work, a first law of generalized entropy was derived from semiclassical gravitational dynamics around thermal setups using an assumed relation between the matter modular Hamiltonian and the gravitational stress tensor. Allowing for non-minimal coupling between curvature and any tensor matter fields, we show however, that the modular Hamiltonian of thermal states is given by the integrated bulk Noether current associated to time translation plus a spacetime boundary term. One generally cannot express this in terms of gravitational stress tensor components. Still, working with the correct expression for the modular Hamiltonian, we are able to recover a first law of generalized entropy, with added benefits over the previous result. Firstly, any Wald-Dong contributions to generalized entropy resulting from non-minimal coupling between matter and curvature are included. Secondly, in gravitational equations of motion, we allow for a non-vanishing stress tensor expectation value in the unperturbed background and state, and account for background field perturbations as part of its variation. Finally, the quantum matter is allowed to contribute nontrivially to asymptotic energy, e.g. as is necessary, even for a minimally coupled Maxwell field, to recover the expected thermodynamic first law of charged black holes.

Primary author: CHEN, Hong Zhe (Vincent) (Perimeter Institute)

Presenter: CHEN, Hong Zhe (Vincent) (Perimeter Institute)

Session Classification: Reception & Poster session

Contribution ID: **34** Type: **not specified**

Registration

Monday, July 18, 2022 8:00 AM (45 minutes)

Contribution ID: **35** Type: **not specified**

Opening Addresses

Monday, July 18, 2022 8:45 AM (15 minutes)

Presenters: GATTRINGER, Christof; HITZENBERGER, Regina

Contribution ID: **36** Type: **not specified**

Reception & Poster session

Contribution ID: **37** Type: **not specified**

Speakers' dinner

Tuesday, July 19, 2022 7:00 PM (2h 30m)

Contribution ID: **38** Type: **not specified**

Conference dinner

Wednesday, July 20, 2022 7:00 PM (2h 30m)

Contribution ID: **39** Type: **not specified**

Public talk by Netta Engelhardt [MIT]

Friday, July 22, 2022 7:00 PM (1 hour)

Contribution ID: **40** Type: **not specified**

Colloquium by Andrew Strominger [Harvard U.]

Saturday, July 23, 2022 7:00 PM (1 hour)

Contribution ID: **41** Type: **Poster**

dS2 as excitation of AdS2

I introduce a family of 2D dilaton gravity models with state-dependent constant curvature so that dS2 emerges as an excitation of AdS2. Curiously, the strong coupling region corresponds to the asymptotic region geometrically. Apart from these key differences, many features resemble the Almheiri–Polchinski model. I also discuss perturbative and non-perturbative thermodynamical stability, bubble nucleation through matter shockwaves, and semiclassical backreaction effects. In some of these models, low temperatures are dominated by AdS2 but high temperatures are dominated by dS2, concurrent with a recent proposal by Susskind.

Primary authors: GRUMILLER, Daniel; ECKER, Florian; MCNEES, Robert

Presenter: ECKER, Florian

Session Classification: Reception & Poster session

Contribution ID: **42** Type: **Poster**

Deformations of symmetric product orbifolds

We analyze how deforming symmetric product orbifolds of two-dimensional $\mathcal{N} = 2$ conformal field theories by an exactly marginal operator lifts higher spin currents present at the orbifold point. We find on the one hand that these currents are universally lifted regardless of the underlying CFT. On the other hand the details of the lifting are surprisingly non-universal, with dependence on the central charge of the underlying CFT and the specific marginal operator in use. In the context of the AdS/CFT correspondence, our results illustrate the mechanism by which the stringy spectrum turns into a supergravity spectrum when moving through the moduli space. They also provide further evidence that symmetric product orbifolds of $\mathcal{N} = 2$ minimal models are holographic.

Primary author: BINTANJA, Suzanne (University of Amsterdam)

Presenter: BINTANJA, Suzanne (University of Amsterdam)

Session Classification: Reception & Poster session

Contribution ID: **44** Type: **Poster**

Exact stringy microstates from gauge theories

We study how the microstates of BPS sectors in string theory are encoded in the dual $U(N)$ gauge theory. The microstates take the form of a coherent sum of stacks of branes and their open/closed string excitations. We propose a prescription to construct the indices of string/brane configurations by analyzing the modifications of determinant operators in gauge theory. The strings and branes should be interpreted in the tensionless limit of string theory, but their indices are exact at finite N. In various examples, we provide evidence that a sum, of the giant graviton-type recently proposed in the literature, over all such configurations gives the finite N gauge theory index. Finally, we discuss how these microstates assemble in the BPS Hilbert space and in what circumstances the branes can form bound states to produce black hole degeneracies.

Primary author: LEE, Ji Hoon (Perimeter Institute)

Presenter: LEE, Ji Hoon (Perimeter Institute)

Session Classification: Reception & Poster session

Contribution ID: **45** Type: **Poster**

Sailing past the End of the World and discovering the Island

Large black holes in anti-de Sitter space have positive specific heat and do not evaporate. In order to mimic the behavior of evaporating black holes, one may couple the system to an external bath. In this poster we explore a rich family of such models, namely ones obtained by coupling two holographic CFTs along a shared interface (ICFTs). We focus on the limit where the bulk solution is characterized by a thin brane separating the two individual duals. These systems may be interpreted in a double holographic way, where one integrates out the bath and ends up with a lower-dimensional gravitational braneworld dual to the interface degrees of freedom. Our setup has the advantage that all observables can be defined and calculated by only relying on standard rules of AdS/CFT. We exploit this to establish a number of general results, relying on a detailed analysis of the geodesics in the bulk. Firstly, we prove that the entropy of Hawking radiation in the braneworld is obtained by extremizing the generalized entropy, and moreover that at late times a so-called 'island saddle' gives the dominant contribution. We also derive Takayanagi's prescription for calculating entanglement entropies in BCFTs as a limit of our ICFT results.

Primary author: PELLICONI, Pietro (University of Geneva)

Co-authors: Dr ANOUS, Tarek (University of Amsterdam); Dr MEINERI, Marco (University of Geneva); Prof. SONNER, Julian (University of Geneva)

Presenter: PELLICONI, Pietro (University of Geneva)

Session Classification: Reception & Poster session

Contribution ID: **47** Type: **Poster**

Flavored ABJM theory on the sphere and holographic F-functions

In this poster, I will briefly review renormalization group monotones (F-functions) of three dimensional quantum field theories and present our work on this topic. In our work (arXiv:2112.08715), we consider holographic F-functions in a top-down AdS/CFT setup involving flavored ABJM theory on a Euclidean 3-sphere. For quenched flavor, the holographic dual is type IIA supergravity with probe D6-branes. The flavor degrees of freedom are given a mass that drives an RG flow whose IR endpoint is pure ABJM theory. At non-zero mass, we find that the theory on the 3-sphere exhibits a quantum phase transition at a critical value of the sphere radius. The transition corresponds to a topology change in the D6-brane embeddings whose dual interpretation is the meson-melting transition. We perform the holographic computation of the free energy on the 3-sphere and we use it to construct various candidate F-functions. We find that while the F-functions of the flavored ABJM theory have the correct UV and IR limits, they are not monotonic. We surmise that the non-monotonicity is related to the presence of the phase transition.

Primary author: KASTIKAINEN, Jani (Université Paris Cité)

Co-authors: JOKELA, Niko (University of Helsinki); KIRITSIS, Elias (APC Paris); NITTI, Francesco (APC Paris)

Presenter: KASTIKAINEN, Jani (Université Paris Cité)

Session Classification: Reception & Poster session

Contribution ID: **49** Type: **Poster**

Emergent SUSY in 2d

We propose a renormalization group flow with emergent supersymmetry in two dimensions from a non-Lagrangian theory. The ultraviolet theory does not have supersymmetry while the infrared theory does. The flow is constrained analytically by topological defect lines including a new spin constraint, and further supported by numerics from the truncated conformal space approach.

Primary author: KIKUCHI, Ken

Co-authors: Prof. CHEN, Jin; Dr XU, Fengjun; Prof. CHANG, Chi-Ming

Presenter: KIKUCHI, Ken

Session Classification: Reception & Poster session

Contribution ID: **51** Type: **Poster**

Shape Deformations of Charged Rényi Entropies from Holography

Charged and symmetry-resolved Rényi entropies are entanglement measures quantifying the degree of entanglement within different charge sectors of a theory with a conserved global charge. We use holography to determine the dependence of charged Rényi entropies on small shape deformations away from a spherical or planar entangling surface in general dimensions. This dependence is completely characterized by a single coefficient appearing in the two point function of the displacement operator associated with the Rényi defect. We extract this coefficient using its relation to the one point function of the stress tensor in the presence of a deformed entangling surface. This is mapped to a holographic calculation in the background of a deformed charged black hole with hyperbolic horizon. We obtain numerical solutions for different values of the chemical potential and replica number n in various spacetime dimensions, as well as analytic expressions for small chemical potential near n=1. When the Rényi defect becomes supersymmetric, we demonstrate a conjectured relation between the two point function of the displacement operator and the conformal weight of the twist operator.

Primary author: BAIGUERA, Stefano (Ben-Gurion University of the Negev)

Co-authors: BIANCHI, Lorenzo (Queen Mary, University of London); CHAPMAN, Shira (Ben-Gurion University of the Negev); GALANTE, Damián (King's College London)

Presenter: BAIGUERA, Stefano (Ben-Gurion University of the Negev)

Session Classification: Reception & Poster session

Contribution ID: **52** Type: **Poster**

Black Hole Thermalization and Microstructure: A Quantum Chaotic Perspective

Holographic investigations have revealed the importance of quantum chaos and random matrix theory in the unitary description of black holes. The spectral form factor associated with the $e^{S_{BH}}$ microstates that compose the black hole serve as a simple proxy for studying how perturbations to black holes thermalize. I will discuss how the details of the spectral statistics of the microstates manifest in the early and late time thermalization behaviour. Depending on the precise nature of the spectral statistics, it is possible for the spectral form factor to exhibit "regular oscillations."

In certain cases, such regular oscillations might be interpreted as being generated by Planck scale microstructure near the horizon which may be experimentally searched for in the aftermath of black hole merger events in the form of gravitational wave "echoes".

Primary author: SARASWAT, Krishan (Perimeter Institute for Theoretical Physics)

Co-author: Prof. NIAYESH, Afshordi (Perimeter Institute)

Presenter: SARASWAT, Krishan (Perimeter Institute for Theoretical Physics)

Session Classification: Reception & Poster session

Contribution ID: **54** Type: **Poster**

Towards Unreasonable Effectiveness in AdS5

We discuss four-derivative corrections to pure $\mathcal{N} = 2$, $D = 5$ gauged supergravity, up to field redefinitions. In particular, the possible four-derivative corrections can be parametrized on-shell by a basis of five terms. We have found that, up to factors of the two-derivative action, supersymmetry picks out a unique set of coefficients for these terms, ie, there is a unique five-dimensional superinvariant at the four-derivative level. Moreover, these coefficients can be verified (in the ungauged limit) on the BMPV solution.

Primary author: SASKOWSKI, Robert (University of Michigan, Ann Arbor)

Presenter: SASKOWSKI, Robert (University of Michigan, Ann Arbor)

Session Classification: Reception & Poster session

Contribution ID: **55** Type: **Poster**

Entanglement Negativity Islands and Communicating Black Holes

We advance two alternative proposals for the island contributions to the entanglement negativity of various pure and mixed state configurations in quantum field theories coupled to semiclassical gravity. The first construction involves the extremization of an algebraic sum of the generalized Renyi entropies of order half. The second proposal involves the extremization of the sum of the effective entanglement negativity of quantum matter fields and the backreacted area of a cosmic brane spanning the entanglement wedge cross section which also extremizes the generalized Renyi reflected entropy of order half. These proposals are utilized to obtain the island contributions to the entanglement negativity of various pure and mixed state configurations involving the bath systems coupled to extremal and non-extremal black holes in JT gravity demonstrating an exact match with each other. Furthermore, the results from both the proposals match precisely with the island contribution to half the Renyi reflected entropy of order half providing a strong consistency check. We then allude to a possible doubly holographic picture of our island proposals and provide a derivation of the first proposal by determining the corresponding replica wormhole contributions.

In this context, utilizing the first proposal, we obtain the holographic entanglement negativity for bipartite mixed states at a finite temperature in baths described by conformal field theories dual to configurations involving two communicating black holes in brane world geometries. We analyse the mixed state entanglement structure characterized by the information transfer between the black holes for two separate models. The first model involves communicating black holes in a Karch-Randall braneworld with $BCFT_2$s with two boundaries serving as a common bath system for the radiation flux. The second model corresponds to a configuration of two dimensional eternal JT black holes in a braneworld geometry involving two Planck branes coupled through a shared bath system described by a CFT_2. For both the models our results reproduce analogue of Page curves for the entanglement negativity obtained earlier in the context of random matrix theory and from geometric evaporation in standard JT black hole configurations.

Primary author: Mr BASAK, Jaydeep Kumar (Indian Institute of Technology Kanpur, India)

Co-authors: Mr AFRASIAR, Mir (IIT Kanpur, India); Mr BASU, Debarshi (IIT Kanpur, India); Mr CHANDRA, Ashish (IIT Kanpur, India); Dr MALVIMAT, Vinay (SINP, India); Mr PARIHAR, Himanshu (IIT Kanpur, India); Prof. SENGUPTA, Gautam (IIT Kanpur, India)

Presenter: Mr BASAK, Jaydeep Kumar (Indian Institute of Technology Kanpur, India)

Session Classification: Reception & Poster session

Contribution ID: **58** Type: **Poster**

Analysis of some intricate string-sigma models using deformed integrable Neumann-Rosochatius system

We establish 1d Neumann-Rosochatius (NR) integrable model for rotating and pulsating string ansatz in some less conventional 2d nonlinear string sigma models, specifically, the fundamental string probing the gravity background of planar ABJ theory and the manifest SL(2, Z) covariant (p,q)-type bound states of fundamental string and D1 branes in $AdS_3 \times S^3 \times T^4$ background with mixed NSNS-RR flux. The main idea of our work is to confront the spectral problem of quite complicated 2d string sigma-models in the light of an exactly solvable 1d model. With explicit formulations of Lagrangian, Hamiltonian and conserved integrals of motion, we verified that both of the above systems admit a systematic reduction into the NR integrable model in the presence of finite flux and other intricate background features. The energy spectra for our generic solutions are evaluated by solving the integrable equations of motion of the NR model. These are subsequently found to be consistent with some known local gauge-invariant operators as well as the relevant integrable spin chain descriptions, at least up to some special limits.

Primary authors: Ms CHAKRABORTY, Adrita (Indian Institute of Technology Kharagpur); Prof. PANIGRAHI, Kamal Lochan (Indian Institute of Technology Kharagpur)

Presenter: Ms CHAKRABORTY, Adrita (Indian Institute of Technology Kharagpur)

Session Classification: Reception & Poster session

Contribution ID: **61** Type: **Poster**

Holographic evidence for nonsupersymmetric conformal manifolds

We review recent progress stemming from the Type IIB S-folds program. S-folds are non-geometric backgrounds of type IIB supergravity of the form $AdS_4 \times S^1 \times \mathcal{M}$ involving a non-trivial $SL(2, \mathbb{Z})$ monodromy around the S^1. Engineering deformations of such backgrounds, we provide a mechanism for supersymmetry breaking that preserves stability. Such deformations are conjectured to be dual to *exactly* marginal deformations of the CFT dual to the S-fold. This provides a surprising holographic evidence for the existence of non-supersymmetric conformal manifolds.

Primary author: STERCKX, Colin

Presenter: STERCKX, Colin

Session Classification: Reception & Poster session

Contribution ID: **62** Type: **Poster**

A worldsheet dual for N=2 SCFTs

We consider a special family of 4-d $\mathcal{N} = 2$ superconformal theories, arising as orbifolds of $\mathcal{N} = 4$ SYM under the action of a discrete group, realizing a circular quiver theory. Following the recent Gaberdiel-Gopakumar derivation, we construct a free field worldsheet theory in the tensionless string limit which is dual to the orbifold gauge theory at the free theory point. In particular, after imposing some specific gauge constraints on the worldsheet degrees of freedom, the spectrally flowed worldsheet spectrum is in one-to-one correspondence with the single trace operators of the free quiver theory at large N, realising the first step for the AdS/CFT correspondence in $\mathcal{N} = 2$ framework in the full stringy regime.

Primary author: GALVAGNO, Francesco (ETH Zürich)

Presenter: GALVAGNO, Francesco (ETH Zürich)

Session Classification: Reception & Poster session

Contribution ID: **65** Type: **Poster**

Scattering Amplitudes: Celestial and Carrollian

Recent attempts at the construction of holography for asymptotically flat spacetimes have taken two different routes. Celestial holography, involving a two dimensional (2d) CFT dual to 4d Minkowski spacetime, has generated novel results in asymptotic symmetry and scattering amplitudes. A different formulation, using Carrollian CFTs, has been principally used to provide some evidence for flat holography in lower dimensions. Understanding of flatspace scattering has been lacking in the Carroll framework. In this work, using ideas from Celestial holography, we show that 3d Carrollian CFTs living on the null boundary of 4d flatspace can potentially compute bulk scattering amplitudes. 3d Carrollian conformal correlators have two different branches, one depending on the null time direction and one independent of it. We propose that it is the time-dependent branch that is related to bulk scattering. We construct an explicit field theoretic example of a free massless Carrollian scalar that realises some desired properties.

Primary authors: Dr BAGCHI, Arjun; Dr BASU, Rudranil; Dr BANERJEE, Shamik; DUTTA, Sudipta

Presenter: DUTTA, Sudipta

Session Classification: Reception & Poster session

Contribution ID: **67** Type: **Poster**

Black hole perturbations from Liouville correlators

Reversing the logic of the bootstrap approach in Liouville CFT we explicitly compute the connection formulae for degenerate conformal blocks. In the semiclassical limit of the theory, this amounts to solving the connection problem of Fuchsian ODEs. Generalizing to irregular insertions we solve as well for various confluences. Concentrating on the Heun equation and its confluences, we can solve the wave equations of a large class of gravitational backgrounds. Indeed, when the wave equation of a black hole or a microstate is separable, it often reduces to Heun equations, and exact connection formulae give access to several interesting quantities. In recent work we focused on the 4d Kerr black hole, and exactly computed the absorption coefficient, QNMs and Love numbers in terms of combinatorial objects exploiting the AGT duality. In works in progress we are generalizing to perturbations of asymptotically AdS spacetimes.

Primary authors: Prof. TANZINI, Alessandro (SISSA, Trieste, INFN, Trieste); IOSSA, Cristoforo (SISSA, Trieste; INFN, Trieste); PANEA , Daniel (SISSA, Trieste, INFN, Trieste); Prof. BONELLI, Giulio (SISSA, Trieste, INFN, Trieste)

Presenter: IOSSA, Cristoforo (SISSA, Trieste; INFN, Trieste)

Session Classification: Reception & Poster session

Contribution ID: **68** Type: **Gong Show Talk**

Black hole perturbations from Liouville correlators

Reversing the logic of the bootstrap approach in Liouville CFT we explicitly compute the connection formulae for degenerate conformal blocks. In the semiclassical limit of the theory, this amounts to solving the connection problem of Fuchsian ODEs. Generalizing to irregular insertions we solve as well for various confluences. Concentrating on the Heun equation and its confluences, we can solve the wave equations of a large class of gravitational backgrounds. Indeed, when the wave equation of a black hole or a microstate is separable, it often reduces to Heun equations, and exact connection formulae give access to several interesting quantities. In recent work we focused on the 4d Kerr black hole, and exactly computed the absorption coefficient, QNMs and Love numbers in terms of combinatorial objects exploiting the AGT duality. In works in progress we are generalizing to perturbations of asymptotically AdS spacetimes.

Primary authors: Prof. TANZINI, Alessandro (SISSA, Trieste, INFN, Trieste); IOSSA, Cristoforo (SISSA, Trieste; INFN, Trieste); PANEA, Daniel (SISSA, Trieste, INFN, Trieste); Prof. BONELLI, Giulio (SISSA, Trieste, INFN, Trieste)

Presenter: IOSSA, Cristoforo (SISSA, Trieste; INFN, Trieste)

Session Classification: Gong Show

Contribution ID: **70** Type: **Poster**

Phase transition of photons and gravitons in a Casimir box

A first order phase transition for photons and gravitons in a Casimir box is studied analytically from first principles with a detailed understanding of symmetry breaking due to boundary conditions. It is closely related to Bose-Einstein condensation and accompanied by a quantum phase transition whose control parameter is the chemical potential for optical helicity.

Primary authors: Mr AGGARWAL, Ankit (Universite Libre de Bruxelles, University of Amsterdam); BARNICH, Glenn (Universite Libre de Bruxelles)

Presenter: Mr AGGARWAL, Ankit (Universite Libre de Bruxelles, University of Amsterdam)

Session Classification: Reception & Poster session

Contribution ID: **71** Type: **Poster**

A Carrollian Perspective on Celestial Holography

We propose a holographic description of gravity in 4d asymptotically flat spacetime in terms of a 3d sourced conformal Carrollian field theory. The external sources encode the leaks of gravitational radiation at null infinity. The Ward identities of this theory are shown to reproduce those of the 2d celestial CFT after relating Carrollian to celestial operators. This suggests a new set of interplays between gravity in asymptotically flat spacetime, sourced conformal Carrollian field theory and celestial CFT.

Primary author: RUZZICONI, Romain

Presenter: RUZZICONI, Romain

Session Classification: Reception & Poster session

Contribution ID: **74** Type: **Poster**

Bootstrapping holographic defect correlators

Tremendous progress has been achieved during the last years in bootstrapping conformal correlators at strong coupling using analytical bootstrap methods and the AdS/CFT correspondence. In particular the development of Lorentzian inversion formulae revealed helpful in reconstructing four-point functions. In this work we present how this technology can be adapted to defect setups in order to compute scalar two-point functions in the presence of a conformal defect in the strong-coupling regime. We derive a dispersion relation that allows us to efficiently generate elegant closed-form expressions for a variety of setups, and in particular we apply this method to two-point functions of single-trace half-BPS operators in the presence of the supersymmetric Wilson line defect in $4d$ $\mathcal{N} = 4$ SYM, using minimal input from holography.

Primary authors: GIMENEZ-GRAU, Aleix (DESY); BARRAT, Julien (Humboldt Universität zu Berlin); LIENDO, Pedro (DESY)

Presenter: BARRAT, Julien (Humboldt Universität zu Berlin)

Session Classification: Reception & Poster session

Contribution ID: **76** Type: **Poster**

New supersymmetric indices from localization on orbifolds

We introduce a general systematic procedure to construct supersymmetric gauge theories on backgrounds with orbifold singularities, such as the spindle, and compute their partition functions. In addition to the presence of orbifold points, another novel aspect of our construction is that the background metric is allowed to be complex-valued. Combining this with supersymmetric localization leads to novel types of supersymmetric indices, unifying and generalizing the superconformal and topologically twisted indices. These provide new observables in supersymmetric field theories and are relevant for the microstate counting of the recently constructed supersymmetric and accelerating black holes in four-dimensional Anti-de Sitter space-time.

Primary authors: Dr PITTELLI, Antonio; MARTELLI, Dario (Unknown); INGLESE, Matteo (University of Turin)

Presenter: Dr PITTELLI, Antonio

Session Classification: Reception & Poster session

Contribution ID: **77** Type: **Poster**

Quantum Complexity as Hydrodynamics

As a new step towards defining complexity for quantum field theories, we map Nielsen operator complexity for $SU(N)$ gates to two-dimensional hydrodynamics. We develop a tractable large N limit that leads to regular geometries on the manifold of unitaries as N is taken to infinity. To achieve this, we introduce a basis of non-commutative plane waves for the $\mathfrak{su}(N)$ algebra and define a metric with polynomial penalty factors. Through the Euler-Arnold approach we identify incompressible inviscid hydrodynamics on the two-torus as a novel effective theory of large-qudit operator complexity. For large N, our cost function captures two essential properties of holographic complexity measures: ergodicity and conjugate points.

Primary author: BASTEIRO, Pablo

Co-authors: Dr GOTH, Florian; Dr MATTHAIAKAKIS, Ioannis; Prof. ERDMENGER, Johanna; Dr FRIES, Pascal; Dr MEYER, René

Presenter: BASTEIRO, Pablo

Session Classification: Reception & Poster session

Contribution ID: **79** Type: **Poster**

Worldsheet Correlators in Black Hole Microstates

One of the most important objectives of string theory is to account for the bulk entropy of the 3-charge black hole. Some microstates may not have a reliable supergravity description, and thus models that capture stringy physics may be essential. I will present an exact worldsheet model describing the propagation of a string in some non-BPS microstates, and show how to compute correlation functions of physical states in this background. From the worldsheet, we obtain a new infinite family of new non-SUSY holographic Heavy-Light correlators involving an arbitrary number of light states in the chiral multiplet, with arbitrary conformal dimension and R-charge. Some of these correlation functions appear to be accidentally protected and perfectly match very few previously known cases computed at the orbifold point of the D1D5 CFT.

Primary author: Mr BUFALINI, Davide (University of Southampton)

Presenter: Mr BUFALINI, Davide (University of Southampton)

Session Classification: Reception & Poster session

Contribution ID: **80** Type: **Poster**

Effective field theory with deformed w(1+infinity) algebra on the celestial sphere.

The material is based on the previous paper 2111.11356 and also a paper to appear collaborating with Anastasia Volovich and Akshay Yellespur. We compute the deformation of the w1+∞ algebra of soft graviton, gluon and scalar currents in the Celestial CFT due to non-minimal couplings. Such deformed algebra shares some similarities with the W(1+infinity) algebra but has essential differences. We find that the Jacobi identity of the algebra, as well as the associativity of the OPE between these soft current operators are satisfied only when the spectrum and couplings of the theory obey certain constraints. We also study the effect of these constraints on the amplitudes in the 4d bulk theory.

Primary author: REN, Lecheng (Brown University)

Presenter: REN, Lecheng (Brown University)

Session Classification: Reception & Poster session

Contribution ID: **82** Type: **Poster**

Emergent strings with broken supersymmetry

We address instabilities of AdS flux vacua arising from string theory with string-scale supersymmetry breaking. The semiclassical regime, sourced by branes, eventually decays in a chain of tunneling processes, and we study the resulting final state using holography. We connect this setting with a number of swampland conditions, most prominently the emergent string proposal: D1-brane final states lie at infinite distance in the space of vacua, according to the quantum information metric. The resulting state has a number of features in common with an expected dual heterotic string: N=(0,1) worldsheet superymmetry is restored in a free sector due to Spin(8) triality free sector, while in the limit the anomalous dimensions of scalar vertex operators and single-trace higher-spin currents vanish in a peculiar exponential fashion as predicted by the distance conjecture and its CFT variant.

Primary author: BASILE, Ivano

Presenter: BASILE, Ivano

Session Classification: Reception & Poster session

Contribution ID: **84** Type: **Poster**

Covariant Lagrangians for interacting (chiral) p-forms

A simple Lorentz-covariant formulation for abelian self-interacting p-forms is derived. This includes a democratic formulation of non-linear electrodynamics (featuring both electric and magnetic potentials) and its p-form generalizations, as well as interacting self-dual p=2k-forms in d=4k+2 dimensional Minkowski space. In particular, an explicit covariant Lagrangians for all SO(2)-duality invariant non-linear electrodynamics in four dimensions and all self-interacting self-dual two-form theories in six dimensions will be presented, as well as a simple covariant Lagrangian for type IIB SUGRA.

Primary author: MKRTCHYAN, Karapet

Co-authors: EVNIN, Oleg (Chulalongkorn University, Bangkok, Thailand); AVETISYAN, Zhirayr (Ghent University)

Presenter: MKRTCHYAN, Karapet

Session Classification: Reception & Poster session

Contribution ID: **87** Type: **Poster**

Geometry of quantum complexity

In the holographic framework, the evolution of black hole interiors is supposed to be captured by computational complexity, which heuristically quantifies the difficulty of preparing the dual state from a reference one by implementing elementary transformations. Employing the differential geometry toolkit, complexity can be defined as the length of shortest paths on proper manifolds.
In this talk we consider a system of n qubits and, following the geometrical approach, we investigate the distinct but related notions of operator complexity and state complexity.
In particular, we discuss how a proper choice of penalty factors for the elementary computational gates is crucial for operator complexity to reproduce desired features of black holes physics. Then, by exploiting the formalism of Riemannian submersions, we describe what the geometry of operator complexity can teach us about state complexity, which is more relevant for the holographic application.

Primary author: ZENONI, Nicolò

Presenter: ZENONI, Nicolò

Session Classification: Reception & Poster session

Contribution ID: **88** Type: **Poster**

Delicate windows into evaporating black holes

In this work we revisit the model of AdS_2 black hole in JT gravity evaporating into an external bath. We study when and how much information about the black hole interior can be accessed in these models through different portions of the Hawking radiation collected in the bath, and we obtain the corresponding full quantitative Page curves. As a refinement of previous results, we describe the island phase transition for a semi-infinite segment of radiation in the bath, establishing the interior access for times within the regime of applicability of the model. For finite sizes segments in the bath, one needs to include the purifier of the black hole microscopic dual together with the radiation segment in order to access the interior information. We identify four scenarios of the entropy evolution in this case, including a possibility where interior reconstruction window keeps appearing and disappearing as time evolves. Analyzing the phase structure of the entropy evolution depending on the parameters of the model, we demonstrate that unlike the semi-infinite segment Page curve which accounts for almost all of the radiation, the finite segment Page curve is very fragile to changes of the parameters. We also discuss the evolution of the subregion complexity of the radiation during the black hole evaporation.

Primary author: KHRAMTSOV, Mikhail

Presenter: KHRAMTSOV, Mikhail

Session Classification: Reception & Poster session

Contribution ID: **91** Type: **Poster**

Celestial Insights into S-matrix Bootstrap

We consider 2-to-2 celestial scattering amplitudes for massless external particles in d=4 dimensions using crossing symmetric dispersion relations employed in recent studies of the S-matrix bootstrap. The crossing symmetric dispersive representation of the amplitude has spurious singularities for complex values of the celestial cross-ratio z, which need to be removed in local QFTs. We show that these locality constraints lead to novel bounds on moments of partial waves in the corresponding momentum space amplitude. Imposing the locality constraints, the crossing symmetric amplitude can be expanded in terms of so-called Feynman blocks. In terms of the celestial variables, these blocks have the remarkable mathematical property of being typically real, in the sense of Geometric Function Theory (GFT). This allows us to use GFT techniques to derive non-projective bounds on Wilson coefficients in terms of partial wave moments.

We then show that the use of celestial variables reveals a novel positivity property of the low energy expansion of 2-to-2 amplitudes in a wide class of theories. We prove that this positivity is due to the dominance of spin-zero partial waves. We also study the celestial conformal block decomposition of the EFT expansion of 4-point amplitude of massless external scalars and relate celestial CFT OPE coefficients to Wilson coefficients.

Primary author: GHOSH, Sudip (Indian Institute of Science)

Presenter: GHOSH, Sudip (Indian Institute of Science)

Session Classification: Reception & Poster session

Contribution ID: **92** Type: **Poster**

Multipoint correlators on the supersymmetric Wilson line defect CFT

One dimensional CFTs are an exceptional laboratory in which we can test novel techniques in order to solve higher dimensional CFTs. They are also relevant from an holographic point of view, as in the case of the Wilson line defect in 4d N=4 Super Yang-Mills, which has an AdS_2 holographic dual. In this context, we focus on an under-explored subject: higher-point correlation functions. At weak coupling we developed a recursion formula that encodes n-point functions of all single-trace scalar operators. Interestingly, a class of these correlators is annihilated by a special set of differential operators, constraint that we conjectured to hold non-perturbatively and to be a multipoint extension of the superconformal Ward identities satisfied by the four-point functions. This study is a first step in the direction of a multipoint conformal bootstrap program, which could be a powerful tool for solving conformal field theory in the near future.

Primary authors: PEVERI, Giulia (Humboldt University of Berlin); PLEFKA, Jan (Humboldt Unier-sity Berlin); BARRAT, Julien (Humboldt Universität zu Berlin); LIENDO, Pedro (DESY)

Presenter: PEVERI, Giulia (Humboldt University of Berlin)

Session Classification: Reception & Poster session

Contribution ID: **94** Type: **Poster**

Bootstrability for 1D Defect CFT

I will describe the "bootstrability" program, which combines integrability techniques in 4d N = 4 supersymmetric Yang-Mills (SYM) and the conformal bootstrap to study beyond-the-spectrum observables in a CFT.

Focussing on the 1d defect CFT living on the Maldacena-Wilson line in N = 4 SYM, I will show how the quantum spectral curve (QSC), a powerful integrability based method solves its spectral problem.

Then, I will show how the boostrability approach allows us to access previously unreachable quantities such as correlation functions at finite coupling — we used this method to compute with very good precision, a non-supersymmetric structure constant for a wide range of the 't Hooft coupling in the defect CFT.

Primary author: JULIUS, Julius (King's College London)

Presenter: JULIUS, Julius (King's College London)

Session Classification: Reception & Poster session

Contribution ID: **97** Type: **Poster**

Fuzzy space and spectral triples

Fuzzy spaces and matrix geometries are an evergreen topic in string theory.
They can also be arrived at from other directions, one of which is the theory of spectral triples.
In a spectral triple the geometric data of a manifold is encoded as an Algebra acting on a Hilbert space, with a compatible Dirac operator.

In this poster I will show some results on fuzzy spaces from spectral triples, and how to reconstruct the geometry in these.

Primary author: Dr GLASER, L

Presenter: Dr GLASER, L

Session Classification: Reception & Poster session

Contribution ID: **98** Type: **Gong Show Talk**

Quantum Complexity as Hydrodynamics

As a new step towards defining complexity for quantum field theories, we map Nielsen operator complexity for $SU(N)$ gates to two-dimensional hydrodynamics. We develop a tractable large N limit that leads to regular geometries on the manifold of unitaries as N is taken to infinity. To achieve this, we introduce a basis of non-commutative plane waves for the $\mathfrak{su}(N)$ algebra and define a metric with polynomial penalty factors. Through the Euler-Arnold approach we identify incompressible inviscid hydrodynamics on the two-torus as a novel effective theory of large-qudit operator complexity. For large N, our cost function captures two essential properties of holographic complexity measures: ergodicity and conjugate points.

Primary author: BASTEIRO, Pablo

Co-authors: Dr GOTH, Florian; Dr MATTHAIAKAKIS, Ioannis; Prof. ERDMENGER, Johanna; Dr FRIES, Pascal; Dr MEYER, René

Presenter: BASTEIRO, Pablo

Session Classification: Gong Show

Contribution ID: **100** Type: **Poster**

Seven dimensional super-Yang-Mills at negative coupling

It was recently suggested in [arXiv:1910.08555] that the spherical D6 brane solution of supergravity is dual to SYM on S^7 at small *negative* 't Hooft coupling. With the present work we investigate what happens to the SYM theory as one takes it from the true weak coupling regime through strong coupling to small negative coupling. Our guide is the simpler case of SYM on S^5, highlighting the importance of contact instantons in this regime and showing how this information can be extracted from the localized partition function. We motivate a conjecture for the contact instanton contribution to the partition function of SYM on squashed S^7 and study this partition function in the small negative g^2_{YM} limit. We observe that three dimensional membranes contribute to the partition function in this limit, suggesting a dual description in terms of 7d gauged supergravity.

Primary authors: THULL, Charles (Uppsala University); Prof. MINAHAN, Joseph A. (Uppsala University); Dr NASEER, Usman (Uppsala University)

Presenter: THULL, Charles (Uppsala University)

Session Classification: Reception & Poster session

Contribution ID: **104** Type: **Poster**

Color kinematics duality for Chern-Simons theory

Chern-Simons theory obeys the color-kinematics duality off-shell, and admits an off-shell double-copy. The off-shell duality is the result of there being volume preserving diffeomorphisms hidden in the Feynman rules. This can be extended to the ghost sectors by using a suitable superspace formulation of the theory. On-shell, there is an N=4 adjoint matter theory that obeys the duality and can be double-copied, giving amplitudes of (up to) maximally supersymmetric Dirac-Born-Infeld theory in 3D.

Primary author: BEN-SHAHAR, Maor (Uppsala University)

Co-author: Prof. JOHANSSON, Henrik (Uppsala University)

Presenter: BEN-SHAHAR, Maor (Uppsala University)

Session Classification: Reception & Poster session

Contribution ID: **107** Type: **Poster**

Symmetry Resolved Entanglement in Quantum Systems and Gravity

Quantum entanglement is the key resource employed in modern quantum computation. Different entanglement measures such as the entanglement entropy and Renyi entropies also provide useful information about the entanglement structure of quantum field the- ories, in particular at critical points. I will discuss the symmetry resolved entanglement and Renyi entropies, a fine-grained version of the usual entanglement and Renyi entropies, both in the context of quantum field theory and AdS/CFT. In the presence of global con- served charges, they quantify the entanglement content of the reduced density matrix in a fixed charge sector. These entanglement measures can in particular be calculated in two- dimensional conformal field theories with U(1) Kac-Moody structure at level k, and are found to not depend on the value of the charge [1, 2]. This charge independence is called equipartition of entanglement, and implies that no charge sector is distinguished in terms of its entanglement content. Finally, I will discuss the symmetry resolved entanglement in the AdS3/CFT2 dual of the U(1) Kac-Moody CFT [1, 2]. Agreement with CFT results provides a further test of the AdS3/CFT2 correspondence. I finish with recent results [3] about the violation of the equipartition property in CFTs with W3 symmetry, and their AdS3/CFT2 dual in higher spin gravity.

[1] S. Zhao, C. Northe, and R. Meyer, Symmetry-resolved entanglement in AdS3/CFT2 coupled to U(1) Chern-Simons theory, JHEP 07 (2021) 030, [arXiv:2012.11274].
[2] K. Weisenberger, S. Zhao, C. Northe, and R. Meyer, Symmetry-resolved entanglement for excited states and two entangling intervals in ads3/cft2, Journal of High Energy Physics 2021 (2021), no. 12 1–31.
[3] S. Zhao, C. Northe, K. Weisenberger, and R. Meyer, Charged moments in w3 higher spin holography, Journal of High Energy Physics 2022 (2022), no. 5 1–28.

Primary author: MEYER, Rene (JMU Würzburg)

Co-authors: ZHAO, Suting (JMU Würzburg); NORTHE, Christian (JMU Würzburg); WEISENBERGER, Konstantin (JMU Würzburg)

Presenter: MEYER, Rene (JMU Würzburg)

Session Classification: Reception & Poster session

Contribution ID: **108** Type: **Poster**

Nonlinear N=2 Supersymmetry and D2-brane Effective Actions

Dp-branes acquire effective nonlinear descriptions whose bosonic parts are related to the Born-Infeld action. This nonlinearity has been proven to be a consequence of the partial $calN = 2 \rightarrow calN = 1$ supersymmetry breaking, originating from the solitonic nature of the branes. In this work, we focus on the effective descriptions of D2-branes, which play important roles in the Type IIA string theory. Using the Goldstone multiplet interpretation of the action, we construct a 3D superspace description which makes the first supersymmetry manifest and realizes the second, spontaneously broken, supersymmetry nonlinearly. We find that the role of the 3D Goldstone multiplet can be played by the vector or tensor multiplet which are related under a duality transformation.

Primary author: HU, Yangrui

Presenter: HU, Yangrui

Session Classification: Reception & Poster session

Contribution ID: **110** Type: **Poster**

Fractons on curved spacetimes

Fracton phases of matter are characterised by excitations with restricted mobility. While much of their theoretical description remains shrouded in mystery, a robust line of attack involves their spacetime symmetries and their coupling to geometric backgrounds which realise these symmetries locally. One class of fracton theories derive their mobility constraints from a conserved dipole moment. The simplest theory with a global dipole symmetry involves a complex scalar, while gauging the dipole symmetry leads to a symmetric tensor gauge field and a scalar gauge field whose dynamics are governed by "scalar charge gauge theories" that generalise Maxwell theory. The spacetime symmetries of these theories are "Aristotelian" (which in particular means no boost symmetry), and the curved spacetimes to which these theories couple are those which locally realise the Aristotelian symmetry algebra: so-called Aristotelian geometries. These are non-Lorentzian geometries, which in particular means that there is no metric. I will show how to couple both the scalar dipole symmetric theory and the scalar charge gauge theory to curved Aristotelian backgrounds. While the scalar theory may be coupled to arbitrary backgrounds, the scalar charge gauge theory can only be coupled to curved spaces if the magnetic sector is traceless, and even then the geometry must satisfy a certain condition. If we only curve the spatial part of the background, this condition reduces to the requirement that the background has constant sectional curvature.

Primary author: HAVE, Emil

Presenter: HAVE, Emil

Session Classification: Reception & Poster session

Contribution ID: **111** Type: **Gong Show Talk**

Fractons on curved space and their soft charges

Fractons are quasiparticles with the distinctive feature of having only limited mobility. This bizarre trait and their unusual symmetries also make the coupling to curved spacetime nontrivial. I will show how aristotelian geometry provides the right framework, review the state-of-the-art on this issue, provide a novel no-go theorem for theories with linear dipole symmetry, spatial derivatives in the action, or a Gaussian action and comment on connections to carrollian and partially massless theories.

I will also emphasize that the very definition of isolated fractons requires a careful study of asymptotic symmetries. I describe asymptotic conditions that encompass all known solutions, lead to finite charges and resolve the problem of the divergent energy coming from the monopole contribution. There are, analog to electrodynamics and general relativity, infinitely many soft charges which hints at a rich infrared structure and a fracton infrared triangle.

Based on: 2111.03668, 2203.02817, work in progress

Primary author: PROHAZKA, Stefan (University of Edinburgh)

Presenter: PROHAZKA, Stefan (University of Edinburgh)

Session Classification: Gong Show

Contribution ID: **113** Type: **Poster**

Fractons, geometrically

I will discuss how fracton physics can be studied systematically within the geometric framework of double field theory (DFT). I will argue that the restricted mobility and large degeneracy of quantum states can be attributed to the generalized geodesics and infinite-dimensional isometries present in non-Riemannian backgrounds of DFT. Moreover, it turns out that a DFT Yang-Mills or Maxwell theory reduces to an ordinary one coupled to a strain tensor of elasticity theory, providing a unifying description of photons and phonons. I will show that when charged particles are minimally coupled to this photon-phonon theory, their immobility along non-Riemannian directions is lifted to a saturation velocity, and the particles acquire an effective mass even in the purely Riemannian case, yielding predictions for polaron physics and time crystals.

Primary authors: PARK, Jeong-Hyuck (Sogang University); Dr KIM, Minkyoo (Sogang University); Dr ANGUS, Stephen (Asia Pacific Center for Theoretical Physics)

Presenter: Dr ANGUS, Stephen (Asia Pacific Center for Theoretical Physics)

Session Classification: Reception & Poster session

Contribution ID: **115** Type: **Poster**

Black hole superpotential as a unifying entropy function and BPS thermodynamics

In the last few years, there has been enormous progress on the statistical description of the entropy of BPS black holes in AdS_D for $D > 3$ in terms of states in the dual field theory. The success of such developments relies on the existence of an extremisation principle in the bulk which maps to the evaluation of the partition function in the field theory in the large charge limit. I will describe an ''off-shell" approach to the study of black hole thermodynamics in AdS_5 based on an effective superpotential. This approach offers a powerful tool to analyse the thermodynamics without resorting to explicit solutions and can be in principle implemented even to non-supersymmetric configurations. For BPS black holes, it provides the framework where the aforementioned (Hosseini-Hristov-Zaffaroni) extremisation principle emerges naturally in the bulk while it also reproduces Sen's entropy function for near extremal black holes.

Primary author: NTOKOS, Praxitelis (University of Edinburgh)

Co-author: Prof. PAPADIMITRIOU , Ioannis (Beijing Institute of Mathematical Sciences and Applications (BIMSA))

Presenter: NTOKOS, Praxitelis (University of Edinburgh)

Session Classification: Reception & Poster session

Contribution ID: **116** Type: **Poster**

Celestial Holography and Celestial Fermions

Celestial holography conjectures a duality between a theory of quantum gravity living in the bulk of an asymptotically flat spacetime and a codimension 2 conformal field theory living on its boundary. I will present some motivation to this correspondence, namely by looking at the soft sector of scattering amplitudes and their relation to asymptotic symmetries. These can be seen as generated by 2D boundary operators which I will show how to construct explicitly from 4D bulk operators, in the context of fermionic symmetries. Finally I will discuss the global conformal multiplet structure of the boundary CFT which is more commonly referred to as celestial CFT.

Primary authors: Dr PUHM, Andrea (CNRS - Ecole Polytechnique - CPHT); PANO, Yorgo; PASTERSKI, Sabrina (MIT CMS)

Presenter: PANO, Yorgo

Session Classification: Reception & Poster session

Contribution ID: **123** Type: **Poster**

Holographic RG from Exact RG

Holographic RG is the interpretation of the AdS-CFT correspondence as RG evolution of boundary theory. The radial coordinate is interpreted as the scale of the boundary theory. This allows a new physical way of looking at the correspondence. But, the precise regularisation of the boundary theory that allows this interpretation hasn't been looked at. I will show one such regularisation using ERG formalism. I will write down the ERG equation for the scalar, vector and tensor of boundary O(N) theory. I will explicitly redefine the Exact RG evolution operator that corresponds to this equation as the bulk AdS action, thus making the connection precise. This will be to lowest order in kinetic theory.

Primary authors: Prof. SATHIAPALAN, Bala (IMSc, Chennai); DHARANIPRAGADA, Pavan (IMSc Chennai); Ms DUTTA, Semanti (IMSc, Chennai)

Presenter: DHARANIPRAGADA, Pavan (IMSc Chennai)

Session Classification: Reception & Poster session

Contribution ID: **124** Type: **Poster**

Constraining Weil-Petersson volumes by universal random matrix theory correlations in low dimensional quantum gravity

In the last years the discovery of the duality between JT quantum gravity and a double-scaled matrix model [1] has led to an intense cross-fertilization between the fields of holography and quantum chaos. Starting on the quantum chaos side, we investigate the implications imposed by the universal RMT behaviour of the matrix model [2] on JT gravity. Specifically we show how the consistency of both sides of the duality imposes a set of constraints on the volumes of the moduli space of hyperbolic 2-manifolds for all genera. These volumes, known as Weil-Petersson volumes, are polynomial functions and can be computed using the celebrated nonlinear recursion formula due to Mirzakhani [3] which for larger genus becomes increasingly difficult to analyse. Since our results take the form of *linear* relations between the coefficients of the Weil-Petersson volumes, they therefore provide both a stringent test for their symbolic calculation and a possible way of simplifying their construction.

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[1] P. Saad, S. Shenker, D. Stanford, arXiv:1903.11115
[2] See e.g. F. Haake, Quantum Signatures of Chaos, Springer, 2000
[3] M. Mirzakhani, Inventiones mathematicae 167.1, pp. 179-222

Primary authors: WEBER, Torsten (University of Regensburg); HANEDER, Fabian (University of Regensburg)

Co-authors: Prof. URBINA, Juan-Diego (University of Regensburg); Prof. RICHTER, Klaus (University of Regensburg)

Presenter: WEBER, Torsten (University of Regensburg)

Session Classification: Reception & Poster session

Contribution ID: **127** Type: **Poster**

Quantum complexity and topological phases of matter

We find that the complexity of quantum many-body states, defined as a spread in the Krylov basis, may serve as a probe that distinguishes topological phases of matter. We illustrate this analytically in one of the representative examples, the Su-Schrieffer-Heeger model. Moreover, in the same setup, we analyze exactly solvable quench protocols where the evolution of the spread complexity shows distinct features depending on the topological vs non-topological phase of the initial state as well as the quench Hamiltonian.

Primary authors: CAPUTA, Paweł (University of Warsaw); LIU, Sinong (Faculty of Physics, University of Warsaw)

Presenter: LIU, Sinong (Faculty of Physics, University of Warsaw)

Session Classification: Reception & Poster session

Contribution ID: **128** Type: **Poster**

Phenomenology of Krylov complexity

Krylov complexity is a notion of complexity that characterizes the spread of an operator over the algebra of observables by measuring its projection over a suitable orthonormal basis of this algebra built out of nested commutators of the Hamiltonian with the operator. Using this basis, operator dynamics can be mapped to a one-dimensional hopping problem. I will present recent results on the time evolution of Krylov complexity away from the thermodynamic limit for both chaotic and integrable systems. While the former display the complexity profile expected in the context of the butterfly effect in AdS/CFT, the latter feature a late-time suppression of complexity due to an enhanced localization effect in the afore-mentioned hopping problem.

Primary author: SANCHEZ GARRIDO, Adrian (Universite de Geneve (CH))

Presenter: SANCHEZ GARRIDO, Adrian (Universite de Geneve (CH))

Session Classification: Reception & Poster session

Contribution ID: **129** Type: **Poster**

Flat higher-spin algebras in any dimensions

We present higher-spin algebras containing a Poincaré subalgebra and with the same set of generators as the Lie algebras that are relevant to Vasiliev's equations in any space-time dimension $D \geq 3$.

Primary author: PEKAR, Simon (UMONS)

Presenter: PEKAR, Simon (UMONS)

Session Classification: Reception & Poster session

Contribution ID: **132** Type: **Poster**

Wormhole corrections to the Unruh effect

I will describe how topologically non-trivial contributions to the semiclassical gravitational path integral modify the Unruh effect, which is a phenomenon whereby an accelerating observer experiences a thermal state. In particular, I consider topologies in the Schwinger-Keldysh formalism involving wormholes connecting the forward and backward evolving branches. These wormholes may, under certain conditions, be traversed by an Unruh-DeWitt detector, leading to novel phases in the spectrum of its transition probabilties. I discuss how this phenomenon may resolve a certain 'paradox' that is analogous to the information paradox in black hole evaporation.

Primary author: KIRKLIN, Josh

Presenter: KIRKLIN, Josh

Session Classification: Reception & Poster session

Contribution ID: **135** Type: **Poster**

Integrability as a new method for exact results on quasinormal modes of black holes

In the last couple of years, a new very surprising connection emerged between $\mathcal{N} = 2$ supersymmetric gauge theory and black hole physics. Initially, it was found that quasinormal modes of black holes - as observed in the gravitational wave signal of the final ringdown phase of a merging - can be related and computed from quantization conditions on the so-called gauge theory Seiberg-Witten periods (the building blocks of the $\mathcal{N} = 2$ supersymmetric gauge prepotential). A lot of exciting developments followed, among which new theoretical and computational results on both sides of the correspondence. We in particular have been able first of all to give a mathematical proof of the connection, through the further connection we previously found of such gauge theories to quantum integrable models. Indeed, using the so called ODE/IM correspondence between Ordinary Differential Equations and Integrable Models, we related the mathematically precise definition of quasinormal modes (not so-widely known) to quantization conditions (Bethe roots condition) on various (Baxter's-) integrable functions, which we are able to relate in turn to gauge periods, thus proving the connection among three apparently very different physical theories (which however share in different ways the same ODE). Moreover, thanks to such essential identification it follows simply and elegantly a new powerful exact method to compute quasinormal modes: the Thermodynamic Bethe Ansatz nonlinear integral equation, a classic celebrated tool of quantum integrability. We compare this method to other standard and new ones and sometimes find it convenient. We do this in all details for a gravitational model which is a generalization of extremally charged (Reissner-Nördstrom) black holes. We expect in the future to be able to extend it to many other spacetimes, confident of the nowadays much larger application of the aforementioned correspondence with $\mathcal{N} = 2$ supersymmetric gauge theory. Moreover, in our approach other black hole physical quantities and observables beyond quasinormal modes (like the greybody factor, directly connected to Hawking radiation) seem essentially related to quantum integrability structures. Thus in perspective this new application of exact non-perturbative techniques from quantum integrability and $\mathcal{N} = 2$ supersymmetric gauge theory promises to give some new deeper understanding of black holes, modelled in either General Relativity or String Theory and testable through new high precision gravitational waves observations, eventually hopefully helping to discriminate between standard and new physics.

Based on:

1. D. Fioravanti, D. Gregori, arXiv:2112.11434 (2021)
2. D. Fioravanti, D. Gregori, arXiv:1908.08030, Phys.Lett.B 804, 135376 (2020)
3. D. Fioravanti, D. Gregori, H. Shu, to appear soon

Primary author: GREGORI, Daniele

Co-author: Prof. FIORAVANTI, Davide (INFN)

Presenter: GREGORI, Daniele

Session Classification: Reception & Poster session

Contribution ID: **137** Type: **Poster**

Gopakumar-Vafa invariants and Simple Flops of all Lengths

The problem of explicitly computing Gopakumar-Vafa (GV) invariants of Calabi-Yau threefolds is, in most cases, challenging.
We propose a novel way to fully characterize the GV invariants of singular Calabi-Yau threefolds arising from deformations of ADE singularities, employing a completely linear-algebraic method that computes zero-modes of an adjoint Higgs scalar, associated to the singularity.
Building on this result, we are able to analyze the GV invariants of simple flops of all lengths, namely singular deformed ADE singularities admitting only one exceptional complex curve, furnishing concrete examples and cross-checking with the existing mathematical literature. This also permits to inspect the Higgs branches of the rank-0 5d $\mathcal{N} = 1$ SCFTs engineered by M-theory on simple flops threefolds.

Primary author: SANGIOVANNI, Andrea (University of Trieste)

Presenter: SANGIOVANNI, Andrea (University of Trieste)

Session Classification: Reception & Poster session

Contribution ID: **140** Type: **Poster**

5d Higgs Branches from M-theory on quasi-homogeneous cDV threefold singularities

We classify rank zero 5d SCFTs geometrically engineered from M-theory on quasi-homogeneous compound Du Val isolated threefold singularities. For all such theories, we characterize the Higgs Branch, by computing the dimension, the continuous and discrete symmetry groups, as well as more refined details such as the charges of the hypermultiplets under these groups. We derive these data by means of a gauge-theoretic method, that we have recently introduced, based on establishing a correspondence between an adjoint Higgs field and the M-theory geometry. As a byproduct, this further allows us to construct several T-brane backgrounds, that yield inequivalent 5d spectra but are associated with the same geometry.

Primary authors: Dr SANGIOVANNI, Andrea; DE MARCO, Mario (SISSA); Prof. VALANDRO, Roberto

Presenter: DE MARCO, Mario (SISSA)

Session Classification: Reception & Poster session

Contribution ID: **142** Type: **Poster**

Classification of Monodromies in Lorentzian CFT correlators

We will explain that the Lorentzian CFT (time-ordered and OTOC) has a far richer structure and becoming more and more important. In CFT correlators generically there are branch points at $0, 1$, and ∞ in the correlators. Whenever two operators cross their lightcones they go through a monodromy around one of the branch points. A natural and very important question is,

1. Can one access all possible non-trivial monodromies (or complex sheets) around these branch points by moving in configuration space (boundary of AdS)?
2. Is there a possibility that one does move around in configuration space and comes back to the same configuration with a non-trivial monodromy. Demanding the uniqueness of the correlator in the same position we can derive non-trivial bounds.

So the challenge is

1. Either show that the correlator is indeed unique and the monodromy in cross-ratio space does not depend on the path one takes to go from one configuration to another configuration.
2. Or, show that there indeed exist non-trivial bounds on the correlators.

After an extensive study of the monodromies, we conclude that in two dimensions the monodromy does not depend on the path. We have proved it for all possible simply connected paths. We classified all possible causal structures in configuration space and the monodromies associated with them. We have done it for both time-ordered and OTOC cases. We will also comment on higher dimensions.

Primary authors: Mr NAVHAL, Abhishek (Tata Institute of Fundamental Research, Mumbai); Prof. MINWALLA, Shiraz (Tata Institute of Fundamental Research, Mumbai); KUNDU, Suman (TIFR, Mumbai)

Presenter: KUNDU, Suman (TIFR, Mumbai)

Session Classification: Reception & Poster session

Contribution ID: **143** Type: **Poster**

Jackiw-Teitelboim gravity with matter as a matrix integral and the Eigenstate Thermalization Hypothesis

I argue for the existence of single-trace, two-matrix models that are dual at the level of the disk to Jackiw-Teitelboim gravity minimally coupled to a massive scalar field. One matrix is interpreted as the Hamiltonian of the boundary quantum mechanical theory, while the other matrix is an operator that is dual to the bulk field. In one of the models, before the double-scaling limit is taken, the disk correlators agree with those computed by Berkooz et al in the double-scaled SYK model. I explain how one can determine the connected two-boundary (double-trumpet) correlators of these models without knowing the detailed form of the matrix potential. These models refine the Eigenstate Thermalization Hypothesis.

Primary authors: MUKHAMETZHANOV, Baur; JAFFERIS, Daniel (Harvard University); KOLCHMEYER, David (Harvard University); SONNER, Julian (University of Geneva)

Presenter: KOLCHMEYER, David (Harvard University)

Session Classification: Reception & Poster session

Contribution ID: **144** Type: **Poster**

Berry phases, wormholes and factorization in AdS/CFT and quantum mechanics

The AdS/CFT correspondence states that certain CFTs admit a description in terms of a gravitational theory in asymptotically AdS geometries of one dimension more. one of the most fascinating examples of this correspondence is the ER = EPR proposal that relates entanglement in the boundary gauge theory to a gravitational wormhole connecting two asymptotic regions of an eternal black hole in its bulk AdS dual. This gives rise to a puzzle questioning the apparently factorized structure of the boundary Hilbert space. We attempt to probe deeper into this puzzle using a particular topological tool, namely the Berry phase. In their most general form, Berry phases are geometric phases acquired by states due to the presence of holonomies when parallel transported around a closed loop in parameter space. Wormholes in the bulk AdS spacetime, which are geometric duals of two identical CFTs maximally entangled with each other, can be associated with a holonomy, giving rise to the Berry phase. We show that these Berry phases also find their natural description in terms of symmetries of the dual boundary CFT. While this correspondence plays a pivotal role in understanding the origin of the factorization puzzle, this also encompasses the dynamics of entanglement in a generic quantum system following a fascinating, still mathematically robust group theoretical description. We establish this using quantum mechanical systems, as simple as two coupled spins in a magnetic field.

Primary authors: WEIGEL, Anna-Lena (Julius-Maximilians University Würzburg); Dr NOGUIERA, Flavio (IFW Dresden); Prof. VAN DEN BRINK, Jeroen (IFW Dresden); Prof. ERDMENGER, Johanna (Julius.Maximilians University Würzburg); DORBAND, Moritz (Julius-Maximilians University Würzburg); Dr MEYER, René (Julius-Maximilians University Würzburg); Dr BANERJEE, Souvik (Julius-Maximilians University Würzburg)

Presenter: DORBAND, Moritz (Julius-Maximilians University Würzburg)

Session Classification: Reception & Poster session

Contribution ID: **145** Type: **Poster**

Reflected entropy and Random Tensors

Reflected entropy is a new quantum informatic quantity that has been shown to be dual to the area of entanglement wedge cross-section in holographic theories.
We study reflected entropy of various states built form various Random Tensor Networks, a toy model that exhibits various features of holographic duality and show that the same result also holds.
For states built from a single (double) random tensor, we calculate the reflected entanglement spectrum and important non-perturbative effects around the entanglement wedge phase transition.
The reflected entanglement spectrum can be organized into different superselection sectors with the interpretation of a superposition of network states with different bulk geometry.
In the case of single random tensor there are two such sectors, whereas in the double tensor case we identify an infinite tower of sectors, each corresponding to different wedge cross-sectional area.
Moreover, we give a recipe for finding reflected entropy in arbitrary networks in classical limit using the language of linear programming.
We show that the reflected entropy of such states can be found by the solution of a integer program defined on the associated network graph.
The difference between this integer program and the relaxed linear program bounds the Markov gap of the state, which is dual to the number of corners of wedge cross-section in holographic theories.

Primary author: LIN, Simon

Presenter: LIN, Simon

Session Classification: Reception & Poster session

Contribution ID: **148** Type: **Poster**

Towards an "AdS_1/CFT_0" correspondence from the D-1/D7 system

We argue that an Euclidean supergravity vacuum solution of the form $\mathbb{R} \times S^1 \times \mathbb{T}^8$ with imaginary self-dual F_1-flux through $\mathbb{R} \times S^1$ is the natural end to the chain of AdS$_d \times S^d \times \mathbb{T}^{10-2d}$-vacua with imaginary self dual F_d flux, where $d \leq 5$. Such vacua come from the near-horizon of D($d-2$)/D($8-d$) branes and are supersymmetric for odd values of d. For $d = 1$ we suggest that the hallmark of conformal symmetry for the matrix model dual is a vanishing partition function. The matrix dual was recently constructed by [Billo et al., 2021] by adding matrix interactions coming from strings stretching between the D-1 and D7 branes to the IKKT matrix model. We find that the corresponding supergravity solution indeed has vanishing on-shell action. Specific F_5 fluxes need to be switched on as a consequence of a T-dual version of the Hanany-Witten effect.

Primary authors: Mr PARMENTIER, Klaas (Columbia University); BOBEV, Nikolay (KU Leuven Association); Mr AGUILAR GUTIERREZ, Sergio Ernesto (KU Leuven); Prof. VAN RIET, Thomas (KU Leuven)

Presenter: Mr AGUILAR GUTIERREZ, Sergio Ernesto (KU Leuven)

Session Classification: Reception & Poster session

Contribution ID: **149** Type: **Poster**

Global Symmetries and Partial Confinement

In gauge theories, spontaneous breaking of the centre symmetry provides a precise definition of deconfinement. In large-N gauge theories, evidence has emerged recently that between confined and deconfined phases a partially-deconfined phase can appear, in which only a subset of colours deconfine. In the partially-deconfined phase, the centre symmetry is spontaneously broken, raising the question of whether an order parameter exists that can distinguish completely- and partially-deconfined phases. We present two examples in gauge theories of global symmetries that are spontaneously broken in the confined phase and preserved in the deconfined phase, and we show that this symmetry is spontaneously broken in the partially-deconfined phase. As a result, in these theories the transition from complete to partial deconfinement is accompanied by the spontaneous breaking of a global symmetry. The two examples are CP symmetry in $\mathcal{N} = 1$ super-Yang-Mills with a massive gluino and theta-angle $\theta = \pi$, and chiral symmetry in a strongly-coupled lattice gauge theory. For $\mathcal{N} = 1$ SYM we also present numerical evidence that the same phenomenon occurs at finite $N \geq 30$. We thus conjecture that global symmetries may provide order parameters to distinguish completely and partially deconfined phases generically, including at finite N.

Primary author: HOLDEN, Jack

Presenter: HOLDEN, Jack

Session Classification: Reception & Poster session

Contribution ID: **150** Type: **Poster**

Vacua without supersymmetry: codimension-one and systematic approaches

We investigate codimension-one vacua resulting from low energy effective actions in ten-dimensional string models without tachyons.
The main target is the non-supersymmetric Sugimoto USp(32) model, whose nine-dimensional solution is believed to contain backreacting 8-branes. We discuss the defects that interpolate between different vacua, possibly playing the role of the aforementioned 8-branes, and we comment on the Cobordism conjecture.
We also explore other frameworks that break supersymmetry, exhibiting a new solution for the heterotic so(16)xso(16) model and a deformation of the D8 brane in massive type IIA.
Motivated by the general picture emerging in codimension-one, we advance to the general case aiming at a systematic approach to find consistend backgrounds and probe their stability.
We can only take a first step in that direction in models with a dilaton tadpole, that is, we manage to account for the scalar potential. The general case is still work in progress.

Primary author: RAUCCI, Salvatore (Scuola Normale Superiore)

Presenter: RAUCCI, Salvatore (Scuola Normale Superiore)

Session Classification: Reception & Poster session

Contribution ID: **151** Type: **Poster**

Rectifying No-Hair Theorems in Gauss-Bonnet theory

We revisit the no-hair theorems in Einstein-Scalar-Gauss-Bonnet theory with a general coupling function between the scalar and the Gauss-Bonnet term in four dimensional spacetime. We first resolve the conflict caused from the incomplete derivation of the old no-hair theorem by taking into account the surface term and restore its reliability. We also clarify that the novel no-hair theorem is always evaded for regular black hole solutions without any restrictions as long as the regularity conditions are satisfied.

Primary author: PARK, Miok (Institute for Basic Science (IBS))

Co-authors: Dr PARK, Chan (IBS); Dr PAPAGEORGIOU, Alexandros (IBS)

Presenter: PARK, Miok (Institute for Basic Science (IBS))

Session Classification: Reception & Poster session

Contribution ID: **153** Type: **Poster**

Multi-partite entanglement measures and their holographic duals

We classify multi-partite entanglement measures and count them for large dimensional quantum systems. We compute these measures for two dimensional conformal field theories using twist operators and find that they are given by the lightest Virasoro conformal block in appropriate channel. In the limit of large central charge c, these blocks reduce to geodesic networks on the hyperbolic spatial slice of the dual bulk theory. For a general multi-partite entanglement measures the geodesics involved are generically heavy i.e. of tension $\mathcal{O}(c)$ and backreact on the geometry. We find a special any-partite measure, dubbed multi-entropy, that has the following desirable properties: 1) It is symmetric with respect to all the parties involved. 2) For two parties, it reduces to the von Neumann entropy. 3) The geodesics describing its holographic dual are light probes of the background geometry. The holographic dual of multi-entropy has a natural extension to account for the quantum excitations in the bulk and admits an elegant generalization to higher dimensions as "minimal area soap-film". We also describe how previously known measures of multi-partite entropies such as reflected entropy fit naturally in our framework. We believe that this is the beginning of a program that will be useful to shed light on entanglement structure of the holographic duality, in particular on encoding of the gravitational Hilbert space in the conformal field theory Hilbert space.

Primary authors: SHARMA, Trakshu (Tata Institute of Fundamental Research, Mumbai); Prof. GADDE, Abhijit (Tata Institute of Fundamental Research, Mumbai); Mr KRISHNA, Vineeth (Tata Institute of Fundamental Research, Mumbai)

Presenter: SHARMA, Trakshu (Tata Institute of Fundamental Research, Mumbai)

Session Classification: Reception & Poster session

Contribution ID: **154** Type: **Poster**

Bounds on quantum evolution complexity via lattice cryptography

In recent years, complexity has gained a lot of interest in the study of holography and has been subject to a number of holographic proposals. While first defined and studied in the context of quantum computation in terms of discrete operations in the form of gates, a continuous generalization of complexity has been introduced by Nielsen et al. In this picture, the complexity of given unitary operators is defined as the length of the shortest geodesic on the unitary group manifold connecting the given unitary to the identity. While this definition is conceptually very simple, direct computation is infeasible for all but very small Hilbert spaces.
We therefore derived a bound on this minimal distance and thereby on complexity and showed how this bound can be computed with algorithms originally developed in the field of lattice optimization.
On our poster we will explain the main ideas of how the bound is derived and present numerical work where our bound is applied to the SYK model and bosonic quantum resonant systems. The numerical results demonstrate clearly how the bound distinguishes reliably between chaotic and integrable systems.

Primary authors: PAVLOV, Maxim (Vrije Universiteit Brussel); HACKER, Philip (Vrije Universiteit Brussel)

Presenters: PAVLOV, Maxim (Vrije Universiteit Brussel); HACKER, Philip (Vrije Universiteit Brussel)

Session Classification: Reception & Poster session

Contribution ID: **155** Type: **Poster**

Dynamical Wald Entropy and Conformal Killing Horizons

We investigate the dynamical gravitational Wald entropy associated with spacetimes imbued with conformal killing horizons by using covariant phase space methods. We extend the Frobenius surface gravity formula to conformal Killing horizons, yielding a new generalized expression involving the conformal factor. The Wald entropy takes a modified form, with dependence on the conformal factor. We find a first law of thermodynamics for planar (cosmological) de Sitter, where the temperature is one half that of static de Sitter. We then connect the entropy associated with conformal Killing horizons to quantum extremal surfaces and the island formula. This offers an interesting new perspective on spacetimes with conformal symmetry, such as planar de Sitter, dilaton gravity models and Vaidya.

Primary author: NAGLE, Ian (Macquarie University)

Presenter: NAGLE, Ian (Macquarie University)

Session Classification: Reception & Poster session

Contribution ID: **158** Type: **Poster**

The Singular Limit of Smooth Microstate Geometries

One of the proposed resolutions of the information paradox is that black holes are described by ensembles of horizonless fuzzballs. Suitably coherent superpositions of such objects can be described within supergravity. Explicit examples are superstrata: smooth and horizonless microstates of the supersymmetric D1-D5-P black hole, which have a well defined dual description in terms of pure states of the D1-D5 CFT. However, in a particular limit of their parameter space, these geometries seemingly develop a horizon and this contradicts the main idea of the fuzzball proposal. In this talk I will describe a resolution to this contradiction. I will briefly introduce superstrata and describe the limit in which they form a finitely-sized horizon. The appearance of the horizon is a consequence of neglecting certain degrees of freedom in the construction of these geometries. One can avoid the horizon formation by working in a different duality frame and show that the neglected degrees of freedom are crucial in the limit where superstrata degenerate. As an example, I will present a solution which has the same asymptotic charges and SO(4) rotational symmetry as the F1-NS5-P black hole, but has a vanishing horizon area. The formation of a large horizon is prevented by additional D0-D4 brane charge densities which are localised on the NS5-brane. I will then argue that this provides evidence that a horizon does not form in the degenerate limit of superstrata. Finally, I will discuss progress in the construction of microstate geometries in the new duality frame. I will present the relevant six-dimensional BPS equations and show that these can be organised in several layers of linear differential equations. In addition, one can look for the uplifts to higher-dimensional supergravities. Finally, I will present possible explicit horizonless solutions and discuss future directions.

Primary author: ČEPLAK, Nejc (IPhT Saclay)

Co-authors: TOULIKAS, Dimitrios (IPhT); BENA, Iosif (IPhT); WARNER, Nicholas P. (USC and IPhT); HAMPTON, Shaun D.; LI , Yixuan (IPhT)

Presenter: ČEPLAK, Nejc (IPhT Saclay)

Session Classification: Reception & Poster session

Contribution ID: **159** Type: **Gong Show Talk**

Celestial Operator Product Expansions and $w_{1+\infty}$ Symmetry

The Lorentz symmetry of four-dimensional (4D) scattering is isomorphic to two-dimensional (2D) global conformal symmetry. As a consequence, amplitudes in 4D momentum space can be naturally recast via a Mellin transform as correlation functions of 2D ''celestial" conformal primary operators. In this talk, I will describe results (with M. Pate and K. Singh) on operator product expansions of massless celestial primary operators with arbitrary spin and arbitrary 4D three-point couplings. For such operators, Poincare symmetry implies a set of recursion relations on the operator product expansion coefficients of the leading singular terms at tree-level in a holomorphic limit. The symmetry constraints are solved by an Euler beta function with arguments that depend simply on the right-moving conformal weights of the operators in the product. These symmetry-derived coefficients precisely match those derived from momentum-space tree-level collinear limits, and they respect an infinite number of additional constraints associated with an underlying $w_{1+\infty}$ algebra. I will also comment on ongoing work (with M. Pate) to generalize the $w_{1+\infty}$ symmetry action to massive amplitudes.

Primary author: HIMWICH, Elizabeth

Co-authors: SINGH, Kyle (University of Pennsylvania); PATE, Monica (Harvard University)

Presenter: HIMWICH, Elizabeth

Session Classification: Gong Show

Contribution ID: **160** Type: **Poster**

TTbar deformations in the Warped AdS/ Warped CFT correspondence

An interesting class of integrable deformations of 2-dimensional quantum field theories are $\overline{T}T$ deformations. These deformations are well defined in any translationally invariant quantum field theory, including those without Lorentz invariance, such as Warped CFTs. Warped CFTs are the boundary dual to Warped AdS spacetimes, which are solutions to lower spin gravity. By adapting the deformed boundary conditions recently discussed in the context of holographic dual $\overline{T}T$ deformed CFTs, we investigate how $\overline{T}T$ deforming a Warped CFT affects its bulk dual. We also explore some non-holographic examples of $\overline{T}T$ deformed WCFTs.

Primary author: PODDAR, Rahul

Presenter: PODDAR, Rahul

Session Classification: Reception & Poster session

Contribution ID: **162** Type: **Gong Show Talk**

Where is the minimal 5d pure supergravity?

The five dimensional pure supergravity with 8 supercharges contains no dilaton making its string theory realization hard to get.
I will be discussing previous attempts to realize the theory through non geometric constructions and provide reasons why this approach will fail. Additionally, I will discuss properties of the mysterious theory to assess its potential consistency as a quantum theory of gravity, perhaps outside the string landscape.

Primary author: TARAZI, Houri Christina

Presenter: TARAZI, Houri Christina

Session Classification: Gong Show

Contribution ID: **164** Type: **Poster**

Reading Between The Lines, Holographically

On the bulk side of the AdS/CFT correspondence, there is a TFT that controls which combinations of line operators are mutually local in the gauge theory side. We show that this TFT can be used to reproduce the line-operator classification of 4d gauge theories of Aharony, Tachikawa, and Seiberg.

Primary author: ETHEREDGE, Muldrow (University of Massachusetts Amherst)

Co-authors: Prof. HEIDENREICH, Ben (UMass Amherst); GARCÍA ETXEBARRIA, Iñaki (Durham University); Mr RAUCH, Sebastian (UMass Amherst)

Presenter: ETHEREDGE, Muldrow (University of Massachusetts Amherst)

Session Classification: Reception & Poster session

Contribution ID: **165** Type: **Gong Show Talk**

Degenerate Microstate Solutions: At Moduli Space's End

Large classes of supergravity solutions that appear to be coherent microstates of the D1-D5-P black hole have been found by the Microstate Geometries program. These solutions have a smooth cap at the bottom of a long but finite throat, replacing the black hole's horizon lying at the bottom of an infinitely-long throat. Because of gravitational blueshift, a small amount of energy as seen from the asympotics will become large at the bottom of their throat; this energy could perturb the smooth structure replacing the horizon, and force the solution to move in moduli space. One possible outcome is that the solution approaches a locus in the boundary of the moduli space where its smooth microstructure degenerates into a horizon.
In this gong-show presentation, I will tell how our work [2202.08844] brings to light new degrees of freedom that prevent the horizon to form in the limit where a class of microstate geometries – the so-called superstrata – seem to degenerate into black holes. These correspond, in a dual frame, to local brane density modes along the common D1-D5 circle. The degenerate microstate solutions, carrying these modes, behave locally as two-charge solutions and have vanishing horizon area; while asymptotically, they have the same charges as the three-charge F1-NS5-P black hole.

Based on [arXiv:2202.08844] with Iosif Bena, Nejc Ceplak, Shaun Hampton, Dimitrios Toulikas and Nick Warner.

Primary author: LI, Yixuan (IPhT Saclay)

Co-authors: BENA, Iosif (CEA-Saclay); TOULIKAS, Dimitrios (IPhT); HAMPTON, Shaun D.; WARNER, Nicholas P. (USC and IPhT); ČEPLAK, Nejc (IPhT Saclay)

Presenter: LI, Yixuan (IPhT Saclay)

Session Classification: Gong Show

Contribution ID: **166** Type: **Poster**

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This poster will show how our work [2202.08844] brings to light new degrees of freedom that prevent the horizon to form in the limit where a class of microstate geometries – the so-called superstrata – seem to degenerate into black holes. These correspond, in a dual frame, to local brane density modes along the common D1-D5 circle. The degenerate microstate solutions, carrying these modes, behave locally as two-charge solutions and have vanishing horizon area; while asymptotically, they have the same charges as the three-charge F1-NS5-P black hole.

Based on [arXiv:2202.08844] with Iosif Bena, Nejc Ceplak, Shaun Hampton, Dimitrios Toulikas and Nick Warner.

Primary author: LI, Yixuan (IPhT Saclay)

Co-authors: TOULIKAS, Dimitrios (IPhT); BENA, Iosif (CEA-Saclay); HAMPTON, Shaun D.; WARNER, Nicholas P. (USC and IPhT); ČEPLAK, Nejc (IPhT Saclay)

Presenter: LI, Yixuan (IPhT Saclay)

Session Classification: Reception & Poster session

Contribution ID: **167** Type: **Poster**

Quantum Circuits and Berry Phases in AdS3

Quantum circuits can be constructed from Virasoro symmetry transformations in a two-dimensional CFT. Employing the holographic dictionary we realize such circuits in AdS3 as a non-trivial time evolution of the bulk spacetime. This allows us to find holographic duals to CFT cost functionals such as the Fubini-Study metric.
The same transformations we use to construct the circuits also give rise to Berry phases. These Virasoro Berry phases play a pivotal role in realizing the holographic features of bulk wormholes. The holonomy induced by the wormholes can be interpreted in terms of a coupling between Virasoro orbits which become manifest through a Virasoro Berry phase of the coupled orbits. For an eternal black hole in AdS, the coupling parameter, giving rise to a non-trivial Berry phase, is related to the expectation value of the energy-momentum tensor of the holographic CFT.

Primary authors: WEIGEL, Anna-Lena; ERDMENGER, Johanna (Julius.Maximilians University Würzburg); FLORY, Mario (Jagiellonian University); GERBERSHAGEN, Marius (University of Würzburg); HELLER, Michal P. (Max Planck Institute for Gravitational Physics (Albert Einstein Institute)); DORBAND, Moritz (Julius-Maximilians University Würzburg); MEYER, René (Julius-Maximilians University Würzburg); BANERJEE, Souvik (Julius-Maximilians University Würzburg)

Presenter: WEIGEL, Anna-Lena

Session Classification: Reception & Poster session

Contribution ID: **168** Type: **Gong Show Talk**

Large-charge expansions and Resurgence.

The conformal data of generic CFTs involving heavy charged operators can be organised as a series in inverse powers of the global charges involved. When extrapolating these expansions to light low-charge sectors, is it relevant to ask whether these series are divergent and Borel-summable. In this talk, I will show that the O(N) scalar CFT has a large-charge expansion which is not Borel-summable with non-perturbative ambiguities cured by Worldline instantons. These are discussed using Resurgence methods and shown to have an exact semi-classical expansion.

Primary author: DONDI, Nicola Andrea (University of Bern)

Co-authors: ORLANDO, Domenico; REFFERT, Susanne (Universitaet Bern (CH)); Mr KALOGERAKIS, Ioannis (University of Bern)

Presenter: DONDI, Nicola Andrea (University of Bern)

Session Classification: Gong Show

Contribution ID: **170** Type: **Poster**

String theory on time-dependent backgrounds: a Big-Bang type singularity

The study of cosmological singularities in the context of string theory has been widely addressed on different time-dependent spacetime backgrounds and has never proved completely successful. Here we investigate the Null Boost Orbifold, which reproduces a Big-Bang type singularity but unfortunately suffers from unusual divergences when dealing with scattering amplitudes both in the closed and open string sector. We trace back the origin of this pathological behaviour to the non-existence of a well-defined perturbative expansion into ordinary Feynman diagrams of the underlying effective QFT. Then we show that the introduction of a background Kalb-Ramond B-field, with the help of the well-known Seiberg-Witten map, may be the key towards the resolution of the singularity.

Primary author: Mr ARDUINO, Andrea (University of Turin)

Presenter: Mr ARDUINO, Andrea (University of Turin)

Session Classification: Reception & Poster session

Contribution ID: **172** Type: **Poster**

Hidden symmetry, soft hair and Love numbers beyond Kerr

Hidden conformal symmetry (HCS) is the backbone of the proposed Kerr/CFT correspondence away from extremality. Recently this topic has gained a new lease on life, for three reasons: 1) the connection with the soft hair program, in which HCS acts non-trivially on the black hole horizon to generate soft hair, 2) the discovery of a set of globally defined HCS generators with a link to tidal Love numbers, and 3) the relationship between HCS and the hidden symmetries generated by Killing-Yano tensors responsible for the separability of equations of motion. Here we present results of forthcoming work which elucidate the physical meaning behind the choice of the standard HCS generators versus the Love symmetry generators. As these Love generators have a smooth Schwarzschild limit, we use them to study a class of slowly-rotating black holes that admit exact Killing symmetries, thereby strengthening the connection between HCS, the Killing tensors of separability, and Love numbers. As an intriguing contrast, we discuss hidden symmetries in the context of a non-separable black hole background: the dipole and doubly-spinning black ring.

Primary author: MARTIN, Victoria

Presenter: MARTIN, Victoria

Session Classification: Reception & Poster session

Contribution ID: **173** Type: **Gong Show Talk**

Cauchy Slice Holography

We show how to construct an explicit map between boundary states and quantum gravity states in AdS/CFT via a specific field theory path integral on a bulk Cauchy slice, rather than on the asymptotic boundary. The field theory is constructed from the boundary CFT via an irrelevant deformation, which is the analogue of the well-known $T\bar{T}$ operator in two boundary dimensions. Our construction generalises to quantum gravity theories with any Hamiltonian constraint, provided the usual algebra closure with the momentum constraints holds. This approach provides a manifestly background-independent definition of the quantum gravity theory in terms of the deformed field theory.

Primary author: ARAUJO-REGADO, Goncalo (University of Cambridge)

Co-authors: Mr KHAN, Rifath (University of Cambridge); WALL, Aron (University of Cambridge (DAMTP))

Presenter: ARAUJO-REGADO, Goncalo (University of Cambridge)

Session Classification: Gong Show

Contribution ID: **174** Type: **Poster**

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Primary author: ARAUJO-REGADO, Goncalo (University of Cambridge)

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Presenter: ARAUJO-REGADO, Goncalo (University of Cambridge)

Session Classification: Reception & Poster session

Contribution ID: **175** Type: **Gong Show Talk**

Holomorphic QFTs: Higher Structures and Bootstrap

4d holomorphic QFTs (such as those obtained from twisting N=1 QFTs) are endowed with extra structures and symmetries which are a 4d analogue of a 2d chiral algebra. In this talk, I will describe these holomorphic theories, higher structures that arise in studying loop corrections to the BRST differential, and a recursive "bootstrap" procedure for systematically computing these loop corrections. Based on forthcoming work with Kasia Budzik, Davide Gaiotto, Brian Williams, Jingxiang Wu and Matthew Yu.

Primary author: Mr KULP, Justin (Perimeter Institute)

Presenter: Mr KULP, Justin (Perimeter Institute)

Session Classification: Gong Show

Contribution ID: **176** Type: **Poster**

Holomorphic QFTs: Higher Structures and Bootstrap

4d holomorphic QFTs (such as those obtained from twisting N=1 QFTs) are endowed with extra structures and symmetries which are a 4d analogue of a 2d chiral algebra. In this poster, I will describe these holomorphic theories and their motivation, higher homological structures (analogous to L_∞ algebras) that arise in studying loop corrections to the BRST differential, and a recursive "bootstrap" procedure for systematically computing these loop corrections. Based on forthcoming work with Kasia Budzik, Davide Gaiotto, Brian Williams, Jingxiang Wu and Matthew Yu.

Primary author: Mr KULP, Justin (Perimeter Institute)

Presenter: Mr KULP, Justin (Perimeter Institute)

Session Classification: Reception & Poster session

Contribution ID: **177** Type: **Poster**

Constructing Non-BPS Microstate Geometries

Microstate geometries in string theory replace the black-hole horizon with a smooth geometric "cap" at the horizon scale. Famous examples of such geometries include so-called "superstrata", which are microstates of the extremal three-charge black hole in six dimensions, and whose holographic duals are very well understood.
Because of the huge simplifications provided by the BPS equations, most of the currently known microstates are supersymmetric. The current challenge is to get beyond supersymmetry and extremality.
Based on 2107.09677 and 2112.03287, I will present a new way to construct non-BPS microstate geometries, using a consistent truncation to a theory of gauged supergravity in three dimensions.

Primary author: HOUPPE, Anthony

Presenter: HOUPPE, Anthony

Session Classification: Reception & Poster session

Contribution ID: **179** Type: **Poster**

AdS/CFT at all worldsheet topologies

Much recent progress has been made in understanding the 'tensionless' limit of the AdS_3/CFT_2 correspondence directly using powerful worldsheet CFT methods. For closed strings, the correspondence between partition functions and correlation functions is fairly well understood. Using methods of boundary conformal field theory, we explore the dynamics of strings in D-brane and O-plane backgrounds and find a correspondence to special boundary states and crosscaps in the dual CFT_2.

Primary author: KNIGHTON JR, Robert

Presenter: KNIGHTON JR, Robert

Session Classification: Reception & Poster session

Contribution ID: **182** Type: **Poster**

Thermalization with the Inclusion of Conserved Charges

We study the effect of conserved charges on thermalization in quantum chaotic systems. Holographically, in the presence of a chemical potential, a non-monotonicity appears in the thermalization time as a function of chemical potential for small regions. To shed light on this behavior from the quantum side we study the dynamics of out of equilibrium states in finite-dimensional spin chains. Our constructed Hamiltonian embeds a mixed field Ising model of qubits into a larger qutrit Hilbert space, admitting a variable conserved charge Q. We find that a non-monotonicity is present in the entropy saturation times as a function of Q, and find corresponding behavior in the entanglement velocities as well. Additionally, we find that the entropy saturation value grows with the size of the charge superselection sector, maximizing when Q is $1/3$ of its maximal value. We also study the behavior of Pauli matrices acting on the qubit subsystem of each lattice site and show the behavior matches the nearly time-independent behavior of local operators predicted by the Eigenstate Thermalization Hypothesis.

Primary author: RACZ, Sarah (University of Texas at Austin)

Co-authors: Dr CACERES, Elena (University of Texas at Austin); Dr POLLACK, Jason (University of Texas at Austin); Dr ECCLES, Stefan (Okinawa Institute of Science and Technology Graduate University)

Presenter: RACZ, Sarah (University of Texas at Austin)

Session Classification: Reception & Poster session

Contribution ID: **184** Type: **Poster**

Holomorphic twist of 4d N = 1 pure gauge theory

Holomorphic twists of $\mathcal{N} = 1$ QFTs are defined by restricting to the cohomology of one supercharge, capturing the quarter-BPS operators that are counted by the supersymmetric index. We focus on the example of the holomorphic twist of pure $SU(N)$ gauge theory. We observe that the differential in the holomorphic twist receives loop corrections at all orders which make the theory topological. This can be interpreted as a sign of confinement of the original theory. We also present a holographic realization of the holomorphic theory in the topological B-model. This is joint work with Davide Gaiotto, Justin Kulp, Brian Williams, Jingxiang Wu and Matthew Yu.

Primary author: BUDZIK, Kasia (Perimeter Institute)

Presenter: BUDZIK, Kasia (Perimeter Institute)

Session Classification: Reception & Poster session

Contribution ID: **185** Type: **Poster**

Reconstruction of spectra and an algorithm based on the theorem of Darboux

Assuming only a known dispersion relation of single mode in the spectrum of a two-point function in some quantum field theory, we investigate when and how a reconstruction of the complete spectrum of physical excitations is possible. In particular, we develop a constructive algorithm based on the theorem of Darboux that allows for such a reconstruction when the associated spectral curve is non-factorised and all modes can be connected by level-crossings. For concreteness, we focus on theories in which the known mode is the gapless excitation described by the hydrodynamic gradient expansion. We numerically apply the algorithm to a few simple examples of reconstructions and then to the example of transverse momentum excitations in the holographic theory describing a stack of M2 branes, which includes momentum diffusion as its gapless excitation.

Primary authors: GROZDANOV, Saso; LEMUT, Timotej

Presenter: LEMUT, Timotej

Session Classification: Reception & Poster session

Contribution ID: **187** Type: **Poster**

Quantization of the Zigzag Model

The zigzag model is a relativistic integrable N-body system describing the leading high-energy semiclassical dynamics on the worldsheet of long confining strings in massive adjoint two-dimensional QCD. We discuss quantization of this model. We demonstrate that to achieve a consistent quantization of the model it is necessary to account for the non-trivial geometry of phase space. The resulting Poincar\'e invariant integrable quantum theory is a close cousin of $T\bar{T}$ deformed models.

Primary author: DONAHUE, John (New York University)

Presenter: DONAHUE, John (New York University)

Session Classification: Reception & Poster session

Contribution ID: **189** Type: **Poster**

Higher-spin minimal coupling in higher dimensions and 5D on-shell amplitudes

Recent developments in massive on-shell scattering amplitudes in 4D have opened the door to understanding particle physics efficiently and theory-agnostically from an on-shell point-of-view, including on-shell notions of minimal coupling and black holes as elementary particles. Important special structures, like the x-factor, only appear when the masses of the particles look like they come from a tower, which arises from compactifying a 5D theory. We develop the groundwork for an on-shell spinor-helicity formalism for scattering amplitudes in 5 space-time dimensions and present a systematic treatment of on-shell 5D amplitudes of massless particles at tree-level. We discover special structures of 5D massless amplitudes, which generalize the on-shell notion of minimal coupling to 5D, and connect these to massive 4D amplitudes with special kinematics. These structures for higher-spin minimal coupling are different in nature than those of lower spins and have been missed by previous studies of higher-dimensional on-shell amplitudes and have direct implications for the on-shell minimal coupling of 5D massive particles and 5D black objects.

Primary author: ZHAO, Weiming (Princeton University)

Presenter: ZHAO, Weiming (Princeton University)

Session Classification: Reception & Poster session

Contribution ID: **192** Type: **Invited Talk**

4d physics from 2d chiral correlators

Monday, July 18, 2022 10:00 AM (30 minutes)

Presenter: PAQUETTE, Natalie

Session Classification: Invited talks

Contribution ID: **193** Type: **Invited Talk**

An Algebra of Observables for de Sitter Space

Monday, July 18, 2022 11:00 AM (30 minutes)

Presenter: WITTEN, Edward

Session Classification: Invited talks

Contribution ID: **194** Type: **not specified**

Holographic Complexity and de Sitter Space

Monday, July 18, 2022 11:30 AM (30 minutes)

Presenter: CHAPMAN, Shira

Session Classification: Invited talks

Contribution ID: **195** Type: **not specified**

Complexity, chaos, and black holes

Monday, July 18, 2022 12:00 PM (30 minutes)

Presenter: BALASUBRAMANIAN, Vijay

Session Classification: Invited talks

Contribution ID: **196** Type: **Review Talk**

The branes behind black holes

Monday, July 18, 2022 9:00 AM (1 hour)

Presenter: MARTINEC, Emil

Session Classification: Review talks

Contribution ID: **197** Type: **not specified**

$T\bar{T}$ deformations and holography: review and open questions

Monday, July 18, 2022 2:00 PM (1 hour)

Presenter: GUICA, Monica

Session Classification: Review talks

Contribution ID: **198** Type: **not specified**

A theory of the black hole interior

Monday, July 18, 2022 3:00 PM (30 minutes)

Presenter: HARLOW, Daniel

Session Classification: Invited talks

Contribution ID: **199** Type: **not specified**

Dark matter identification efforts

Monday, July 18, 2022 4:00 PM (30 minutes)

Presenter: POSPELOV, Maxim

Session Classification: Special talks

Contribution ID: **200** Type: **not specified**

Consequences of No Global Symmetries in Quantum Gravity

Monday, July 18, 2022 4:30 PM (30 minutes)

Presenter: RUDELIUS, Tom

Session Classification: Invited talks

Contribution ID: **201** Type: **not specified**

Small Cosmological Constants in String Theory

Monday, July 18, 2022 5:00 PM (30 minutes)

Presenter: MCALLISTER, Liam

Session Classification: Invited talks

Contribution ID: **202** Type: **not specified**

Randall-Sundrum Branes and Holography

Tuesday, July 19, 2022 9:00 AM (1 hour)

Presenter: KARCH, Andreas

Session Classification: Review talks

Contribution ID: **203** Type: **not specified**

Line Operators in Chern-Simons-Matter Theories and Bosonization in Three Dimensions

Tuesday, July 19, 2022 10:00 AM (30 minutes)

Presenter: SEVER, Amit

Session Classification: Invited talks

Contribution ID: **204** Type: **Invited Talk**

The emergence of space and time in holography

Tuesday, July 19, 2022 11:00 AM (30 minutes)

Presenter: LIU, Hong

Session Classification: Invited talks

Contribution ID: **205** Type: **not specified**

Holography for Multi-Representation and Chiral Matter

Tuesday, July 19, 2022 11:30 AM (30 minutes)

Presenter: EVANS, Nick

Session Classification: Invited talks

Contribution ID: **206** Type: **not specified**

From statistical mechanics to microstate counting for extremal and near-extremal black holes

Tuesday, July 19, 2022 12:00 PM (30 minutes)

Presenter: ILIESIU, Luca

Session Classification: Invited talks

Contribution ID: **207** Type: **Review Talk**

News from the higher D SQFT frontier

Tuesday, July 19, 2022 2:00 PM (1 hour)

Presenter: RAZAMAT, Shlomo

Session Classification: Review talks

Contribution ID: **208** Type: **not specified**

Black hole entropy functions and spinning spindles

Tuesday, July 19, 2022 3:00 PM (30 minutes)

Presenter: SPARKS, James

Session Classification: Invited talks

Contribution ID: **209** Type: **Review Talk**

Recent developments in gauge-gravity duality applied to quantum many-body systems

Thursday, July 21, 2022 9:00 AM (1 hour)

Presenter: GÜRSOY, Umut

Session Classification: Review talks

Contribution ID: **210** Type: **Invited Talk**

Finding Gravity in Large N Theory Space

Thursday, July 21, 2022 10:00 AM (30 minutes)

Presenter: PERLMUTTER, Eric

Session Classification: Invited talks

Contribution ID: **211** Type: **Invited Talk**

What happens when you look at supersymmetric black holes for a long time?

Wednesday, July 20, 2022 11:00 AM (30 minutes)

Presenter: MALDACENA, Juan

Session Classification: Invited talks

Contribution ID: **212** Type: **not specified**

Concrete Calculables in Quantum dS

Wednesday, July 20, 2022 11:30 AM (30 minutes)

Presenter: ANNINOS, Dionysios

Session Classification: Invited talks

Contribution ID: **213** Type: **not specified**

AdS/CFT @ loop order

Wednesday, July 20, 2022 12:00 PM (30 minutes)

Presenter: SKENDERIS, Kostas

Session Classification: Invited talks

Contribution ID: **214** Type: **not specified**

Adiabatic continuity, anomaly preserving compactifications, and confinement in Yang-Mills theory

Wednesday, July 20, 2022 12:30 PM (30 minutes)

Presenter: ÜNSAL, Mithat

Session Classification: Invited talks

Contribution ID: **215** Type: **not specified**

Fluxes, holography and uses of Exceptional Generalized Geometry

Wednesday, July 20, 2022 9:00 AM (1 hour)

Presenter: WALDRAM, Daniel

Session Classification: Review talks

Contribution ID: **216** Type: **not specified**

Dualities from dualities: sequential deconfinement & the mirror dualisation algorithm

Wednesday, July 20, 2022 10:00 AM (30 minutes)

Presenter: PASQUETTI, Sara

Session Classification: Invited talks

Contribution ID: **217** Type: **Invited Talk**

Top-Down Celestial Holograms

Thursday, July 21, 2022 11:00 AM (30 minutes)

Presenter: STROMINGER, Andrew

Session Classification: Invited talks

Contribution ID: **218** Type: **Invited Talk**

Towards Positive Geometry of the massive S matrix

Thursday, July 21, 2022 11:30 AM (30 minutes)

Presenter: LADDHA, Alok

Session Classification: Invited talks

Contribution ID: **219** Type: **Invited Talk**

Celestial amplitudes from flat space limits of AdS Witten diagrams

Thursday, July 21, 2022 12:00 PM (30 minutes)

Presenter: RACLARIU, Ana-Maria

Session Classification: Invited talks

Contribution ID: **220** Type: **not specified**

Quantum information and spacetime

Thursday, July 21, 2022 2:00 PM (1 hour)

Presenter: WALTER, Michael

Session Classification: Review talks

Contribution ID: **221** Type: **Invited Talk**

Nonperturbative Amplituhedron Geometries

Thursday, July 21, 2022 3:00 PM (30 minutes)

Presenter: TRNKA, Jaroslav

Session Classification: Invited talks

Contribution ID: **222** Type: **Invited Talk**

Classical Physics from Scattering Amplitudes

Thursday, July 21, 2022 3:30 PM (30 minutes)

Presenter: KOSOWER, David

Session Classification: Invited talks

Contribution ID: **223** Type: **Review Talk**

Black Hole Microstate Counting in AdS

Friday, July 22, 2022 9:00 AM (1 hour)

Presenter: BENINI, Francesco

Session Classification: Review talks

Contribution ID: **224** Type: **not specified**

Line Defects in QFT: an Entropy Function, Conformality, and Constraints from Symmetries

Friday, July 22, 2022 10:00 AM (30 minutes)

Presenter: KOMARGODSKI, Zohar

Session Classification: Invited talks

Contribution ID: **225** Type: **not specified**

Crossing symmetric dispersion relations

Friday, July 22, 2022 11:00 AM (30 minutes)

Presenter: SINHA, Aninda

Session Classification: Invited talks

Contribution ID: **226** Type: **not specified**

From N=2 supersymmetry to adjoint QCD

Friday, July 22, 2022 11:30 AM (30 minutes)

Presenter: NARDONI, Emily

Session Classification: Invited talks

Contribution ID: **227** Type: **not specified**

On towers of light states at infinite distance

Friday, July 22, 2022 12:00 PM (30 minutes)

Presenter: LEE, Seung-Joo

Session Classification: Invited talks

Contribution ID: **228** Type: **not specified**

The Large-charge expansion

Friday, July 22, 2022 2:00 PM (30 minutes)

Presenter: REFFERT, Susanne

Session Classification: Invited talks

Contribution ID: **229** Type: **Invited Talk**

Non-invertible Symmetry in Our Dimensions

Friday, July 22, 2022 2:30 PM (30 minutes)

Presenter: OHMORI, Kantaro

Session Classification: Invited talks

Contribution ID: **230** Type: **Invited Talk**

Generalised Symmetries from String Theory

Friday, July 22, 2022 3:00 PM (30 minutes)

Presenter: GARCÍA-ETXEBARRIA, Iñaki

Session Classification: Invited talks

Contribution ID: **231** Type: **not specified**

BIMSA

Friday, July 22, 2022 4:20 PM (5 minutes)

Presenter: YAU, Shing-Tung

Session Classification: Concluding Session

Contribution ID: **232** Type: **not specified**

GenHET

Friday, July 22, 2022 4:00 PM (20 minutes)

Presenter: BISSI, Agnese

Session Classification: Concluding Session

Contribution ID: **233** Type: **not specified**

Integrability and the Bootstrap

Tuesday, July 19, 2022 4:00 PM (1h 30m)

Presenters: MINAHAN (CHAIR), Joe; BISSI, Agnese; CHESTER, Shai; GROMOV, Nikolay; KOMATSU, Shota

Session Classification: Discussion sessions

Contribution ID: **234** Type: **not specified**

Strings and the Real World

Tuesday, July 19, 2022 4:00 PM (1h 30m)

Presenters: VAFA (CHAIR), Cumrun; KRISHNAN, Chethan; MONTERO, Miguel; VAN RIET, Thomas

Session Classification: Discussion sessions

Contribution ID: **235** Type: **not specified**

Factorization and Ensembles

Tuesday, July 19, 2022 4:00 PM (1h 30m)

Presenters: SONNER (CHAIR), Julian; BELIN, Alexandre; EBERHARDT, Lorenz; MALONEY, Alexander; PAPADOULAKI, Olga

Session Classification: Discussion sessions

Contribution ID: **236** Type: **not specified**

Perspectives and Prospects

Friday, July 22, 2022 4:30 PM (20 minutes)

Presenter: GOPAKUMAR, Rajesh

Session Classification: Concluding Session

Contribution ID: **237** Type: **not specified**

Perspectives and Prospects

Friday, July 22, 2022 4:50 PM (20 minutes)

Presenter: OOGURI, Hirosi

Session Classification: Concluding Session

Contribution ID: **239** Type: **Poster**

Twisted Elliptic Genera

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.

Primary author: SUN, Kaiwen

Presenter: SUN, Kaiwen

Session Classification: Reception & Poster session

Contribution ID: **240** Type: **Poster**

A simple technique to improve the calculation of holographic collisions

Further progress in simulating heavy ion collisions via holography, beyond the collision of localized, broad, Gaussian shocks, is held back by numerical difficulties of solving 5D Einstein equations with initial conditions corresponding to localized projectiles with a large difference between longitudinal and transverse scales. Recent techniques are discussed which turn this obstacle into an advantage. We apply this to work towards colliding holographic models of heavy ions with realistic aspect ratios and a realistic, granular structure, corresponding to individual nucleons.

Primary author: Dr WAEBER, Sebastian (University of Washington & Technion - Israel Institute of Technology)

Presenter: Dr WAEBER, Sebastian (University of Washington & Technion - Israel Institute of Technology)

Session Classification: Reception & Poster session

Contribution ID: **241** Type: **Poster**

Features of Rotating Supersymmetric AdS5 Black Holes

Motivated by recent studies of supersymmetric black holes, we revisit the phase diagram of AdS5 black holes, whether BPS or not, with particular emphasis on the role of rotation. We develop BPS thermodynamics systematically and note the differences and similarities with the thermodynamics of more familiar AdS black holes. We also explore the role of rotation in the attractor flow formalism for AdS5 supersymmetric black holes.

Primary author: EZROURA, Nizar

Co-authors: Dr DAVID, Marina (University of Michigan); Prof. LARSEN, Finn (University of Michigan); LIU, Zhihan (Cambridge University); Dr ZENG, Yangwenxiao (University of Michigan)

Presenter: EZROURA, Nizar

Session Classification: Reception & Poster session

Contribution ID: **242** Type: **Poster**

Thermal Equilibrium in String Theory in the Hagedorn Phase

In string theory, a thermal state is described by compactifying Euclidean time on a thermal circle S^1_β, of fixed circumference. However, this circumference is a dynamical field which could vary in space, therefore thermal equilibrium is not guaranteed. We discuss a thermal state of type II string theory near and above the Hagedorn temperature and show that the circumference of the thermal circle can indeed be fixed and stabilized in the presence of a uniform isotropic flux.
We solve the equations of motion derived from an action that reproduces the tree-level string S-matrix. We find solutions with the topologies of $S^1_\beta \times S^2 \times calM^{d-2}$ at a fixed temperature, which include a space-filling winding-mode condensate and a uniform Neveu-Schwarz Neveu-Schwarz flux supported on $S^1_\beta \times S^2$. The solutions that we find have either a linear dilaton or a constant dilaton, in which case, we find solutions with either a cosmological constant or a Ramond-Ramond flux. We then compare our solutions to the cigar and cylinder backgrounds associated with the $SL(2,R)/U(1)$ coset theory, which include a winding-mode condensate but without flux. We also compare and contrast our solutions with the non-uniform Horowitz-Polchinski solution, which also possesses a winding-mode condensate and is characterized by an approximate thermal equilibrium near the Hagedorn temperature.

Primary author: ZIGDON, Yoav (Ben-Gurion University)

Co-author: BRUSTEIN, Ramy (Ben-Gurion University of the Negev (IL))

Presenter: ZIGDON, Yoav (Ben-Gurion University)

Session Classification: Reception & Poster session

Contribution ID: **243** Type: **Poster**

11D Supergravity Scattering Amplitudes with Pure Spinors

In this contribution I will explain how to use 11D pure spinors to compute 3-point scattering amplitudes of 11D supergravity physical states in a manifestly super-Poincare covariant manner. I will also discuss some work in progress which aims to generalize these ideas to an arbitrary number of external states, and its implications for the pure spinor supermembrane.

Primary author: GUILLEN, Max (Uppsala University)

Presenter: GUILLEN, Max (Uppsala University)

Session Classification: Reception & Poster session

Contribution ID: **245** Type: **Poster**

Type IIB at Eight Derivatives: Insights from Superstrings, Superfields and Superparticles

We study the non-linear structure of Type IIB eight-derivative couplings involving the metric and the complexified three-form G_3. We show that, at the level of five-point string amplitudes, the kinematics in the maximally R-symmetry-violating sector is fully matched by standard superspace integrals and by superparticle amplitudes in M-theory on a two-torus. The latter approach is used to determine the complete effective action in this sector and to verify its invariance under SL(2,Z) duality. We further comment on the general structure of the higher-point kinematics. Compactifications to lower dimensions provide both tests for our results and the arena for their applications. We verify that K3 reductions are fully consistent with the constraints of six-dimensional supersymmetry, and derive the four-dimensional flux scalar potential and axion kinetic terms at order $(\alpha')^3$ in Calabi-Yau threefold reductions.

Primary author: SCHACHNER, Andreas (Cambridge University)

Co-authors: Prof. LIU, James T. (Leinweber Center for Theoretical Physics, Randall Laboratory of Physics, University of Michigan); MINASIAN, Ruben (CEA Saclay); Prof. SAVELLI, Raffaele (Dipartimento di Fisica and Sezione INFN, Universit'a di Roma "Tor Vergata")

Presenter: SCHACHNER, Andreas (Cambridge University)

Session Classification: Reception & Poster session

Contribution ID: **246** Type: **Poster**

Bare-Bones de Sitter

Despite two decades of efforts, constructing metastable de Sitter vacua in String Theory continues to be a great challenge and the almost twenty-year-old construction of Kachru, Kallosh, Linde and Trivedi (KKLT), although not uncontested, remains the prototypical example. This proposal is a three-step construction that combines fluxes, non-perturbative phenomena and anti-D3 branes in a warped Calabi-Yau compactifaction with a deformed conifold-type throat. The first step, where the complex structure moduli are stabilized by fluxes that need to break supersymmetry in order to generate a very small Gukov-Vafa-Witten superpotential W0, has been criticized on both theoretical and practical counts. I will present a new, more minimalist de Sitter construction that does not require these additional supersymmetry-breaking (0,3) fluxes. This construction is based on the key observation that the addition of anti-D3 branes at the tip of a Klebanov-Strassler throat, which is necessary to uplift the cosmological constant, generates moreover three-form fluxes that precisely give rise to a non-trivial small superpotential as well as to F-terms for the dilaton and the conifold modulus parametrizing the size of the tip of the throat. I will describe these terms from both a first-principle ten-dimensional and a four-dimensional perspective, finding the same parametric dependence, and I will show that upon including Kahler-moduli stabilization, the resulting potential admits de Sitter minima with a small cosmological constant.

Primary author: TOULIKAS, Dimitrios (IPhT, Universite Paris-Saclay, CEA)

Co-authors: DUDAS, Emilian (Ecole Polytechnique); Dr LO MONACO, Gabriele (IPhT, CEA Saclay); BENA, Iosif (CEA-Saclay); GRANA, Mariana (CEA/Saclay)

Presenter: TOULIKAS, Dimitrios (IPhT, Universite Paris-Saclay, CEA)

Session Classification: Reception & Poster session

Contribution ID: **247** Type: **not specified**

Optional afternoon program

Wednesday, July 20, 2022 2:30 PM (3 hours)

For possible afternoon program activities please look in the “Outdoor activities” for more information.

Contribution ID: **248** Type: **not specified**

Joe Polchinski Memoir

Friday, July 22, 2022 4:25 PM (5 minutes)

Presenter: ALMHEIRI, Ahmed

Session Classification: Concluding Session

Contribution ID: **249** Type: **Poster**

CO_2 Emissions from Theoretical Physics Research?

Global Warming is a clear and present danger for humankind. Halting it in time will require technological advances and societal changes at impressive scales and rates. Both, Global Warming and mitigation efforts will have an impact on the way we conduct research. What should we do? What will you do?

Primary authors: BEISERT, Niklas (ETH Zürich); CARQUEVILLE, Nils (University of Vienna)

Presenter: BEISERT, Niklas (ETH Zürich)