

The Dual Mysteries of Gauge Theories and Gravity

IIT Madras 2020 Schedule

Titles and zoom links: Please note that IST = UTC + 5:30

Mon, Oct 19, Session 1:

Chair: Suresh Govindarajan

09:00--9:30 IST Opening address by David Gross and Director's welcome speech

Zvi Bern 9:30- 10:25 IST
Scattering Amplitudes as a Tool for Understanding Gravity

Aninda Sinha 10:40--11:20 IST
Rebooting the S-matrix bootstrap

Mon, Oct 19, Session 2:

Chair: Jyotirmoy Bhattacharyya

Jerome Gauntlett 14:00-14:40 IST
Spatially Modulated & Supersymmetric Mass Deformations of N=4 SYM

Elias Kiritsis 14:55-15:35 IST
Emergent gravity from hidden sectors and TT deformations

Rene Meyer 15:50 -16:30 IST
Strongly Correlated Dirac Materials, Electron Hydrodynamics & AdS/CFT

Mon, Oct 19, Session 3:

Chair: Bindusar Sahoo

Chethan Krishnan 19:30-20:10 IST
Cosmic Censorship of Trans-Planckian Field Ranges in Gravitational Collapse

Timm Wrase 20:25 - 21:05 IST
Misaligned SUSY in string theory

Thomas van Riet 21:20 -22:00 IST
A de Sitter landscape and Russel's teapot

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Tue, Oct 20, Session 1:

Chair: Nabamita Banerjee

Rajesh Gopakumar 9:00 - 9:40 IST

Branched Covers and Worldsheet Localisation in AdS₃

Gustavo Joaquin Turiaci 9:55- 10:35 IST

The gravitational path integral near extremality

Ayan Mukhopadhyay 10:50- 11:30 IST

Analogue quantum black holes

Tue, Oct 20, Session 2:

Chair: Koushik Ray

David Mateos 14:00-14:40 IST

Holographic Dynamics near a Critical Point

Shiraz Minwalla 14:55 - 15:35 IST

Fermi seas from Bose condensates and a bosonic exclusion principle in matter Chern Simons theories.

Sayantana Sharma 15:50 -16:30 IST

Topological constituents of QCD at finite temperature from the lattice

Tue, Oct 20, Session 3:

Chair: Dileep Jatkar

Cumrun Vafa 19:30- 20:25 IST

Unifying Themes in the Swampland Program

Liam McAllister 20:40 -21:20 IST

Vacua with Small Flux Superpotential

David Andriot 21:35 - 22:15 IST

Do classical de Sitter string backgrounds exist?

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Wed, Oct 21, Session 1:

Chair: Debashis Ghoshal

Ashoke Sen 9:00- 09:55 IST
Cutting Rules and Unitarity (Violation) in D-instanton Amplitudes

Gautam Mandal 10:10- 10:50 IST
On quantum quench for fermions in 1 and 2 dimensions: Lessons from $c=1$

Spenta Wadia 11:05 - 11:45 IST
Modelling black hole formation and evaporation in the Sachdev-Ye-Kitaev (SYK) model and its dual gravity theory

Wed, Oct 21, Session 2:

Chair: Amitabh Virmani

Vishnu Jejjala 14:00 - 14:40 IST
Machine learning as a discovery tool in hep-th

Matteo Baggioli 14:55 - 15:35 IST
Phases, phasons & phase relaxation in holography & EFTs

Bidisha Chakrabarty 15:50 - 16:30 IST
Out of time ordered effective dynamics of a quartic oscillator

Wed, Oct 21, Session 3:

Chair: Ayan Mukhopadhyay

Daniel Jafferis 19:30 - 20:10 IST
Inside the hologram

Raghu Mahajan 20:25 - 21:05 IST
The entropy of Hawking radiation

Sameer Murthy 21:20 - 22:00 IST
1/16-BPS index and supersymmetric phases in 4d $N=4$ SYM

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Thurs, Oct 22, Session 1:

Chair: Prithvi Narayan

Sunil Mukhi 9:00 - 9:55 IST

Classifying RCFT through Modularity, Holomorphy and Positivity

Sujay Ashok 10:10 - 10:50 IST

Surface Defects from Fractional Branes

Sachin Jain 11:05 - 11:45 IST

Momentum space correlation function and higher-spin equation

Thurs, Oct 22, Session 2:

Chair: Arnab Kundu

Andrea Puhm 14:00 - 14:40 IST

A Double Copy for Celestial Amplitudes

Daniel Grumiller 14:55 - 15:35 IST

Lower-dimensional holography

Sean Hartnoll 15:50 - 16:30 IST

The classical interior of black holes in holography

Thurs, Oct 22, Session 3:

Chair: K Narayan

Nathan Seiberg 19:30 - 20:25 IST

Fractons: going beyond standard QFT

Zohar Komargodski 20:40 - 21:20 IST

From QFT to the no-hair theorem

David Tong 21:35 - 10:15 IST

Comments on Chiral Fermions

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Fri, Oct 23, Session 1:

Chair: Subho Roy
Thomas Rudelius 9:00 - 9:40 IST
The Landscape of Swampland Conjectures
Keshav Dasgupta 9:55 - 10:35 IST
Constructing de Sitter space in string theory
Alok Laddha 10:50 - 11:30 IST
Polytopes and Scattering amplitudes

Fri, Oct 23, Session 2:

Chair: Arpan Bhattacharyya
Tadashi Takayanagi 14:00 - 14:55 IST
AdS/BCFT, Entanglement Wedges and Wedge Holography
Costas Bachas 15:10 - 15:50 IST
Microscopic Planck Branes and Massive Gravity
Shouvik Datta 16:05 - 16:45 IST
2d conformal blocks

Fri, Oct 23, Session 3:

Chair: Prabha Mandayam
Brian Swingle 19:30 - 20:25 IST
Chaos in Quantum Electrodynamics
Shira Chapman 20:40 - 21:20 IST
Energy Reflection and Transmission at 2D Holographic Interfaces
Pratik Rath 21:35 - 10:15 IST
The Page curve for Reflected Entropy

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Sat, Oct 24

PANEL DISCUSSION: *Fundamental Physics & Society*

09:30 - 09:45 am David Gross gives leading talk for panel discussion.

09:45 - 11:30 am Other panelists give 15 mins speeches followed by the discussion

Chair: Arul Lakshminarayan

Leading panelist: David Gross

Panel speakers:

Cumrun Vafa

Mani Bhaumik

Rajesh Gopakumar

Sandip Trivedi

Shiraz Minwalla

Spenta Wadia

Sunil Mukhi

YOUTUBE LINK: <https://www.youtube.com/watch?v=ROyLcBXpX5E&feature=youtu.be>

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| | Oct 19 | Oct 20 | Oct 21 | Oct 22 | Oct 23 |
|---------------------------------|-------------------------------|--------------------------|----------------------------|--------------------------|-----------------------------|
| Session 1 9:00-11:30 IST | Chair: Suresh Govindarajan | Chair: Nabamita Banerjee | Chair: Debashis Ghoshal | Chair: Prithvi Narayan | Chair: Subho Roy |
| | Opening address ** | <u>Rajesh Gopakumar</u> | <u>Ashoke Sen #</u> | <u>Sunil Mukhi #</u> | <u>Thomas Rudelius</u> |
| | <u>Zvi Bern #</u> | <u>Gustavo Turiaci</u> | <u>Gautam Mandal</u> | <u>Sujay Ashok</u> | <u>Keshav Dasgupta</u> |
| | <u>Aninda Sinha</u> | <u>Ayan Mukhopadhyay</u> | <u>Spenta Wadia</u> | <u>Sachin Jain</u> | <u>Alok Laddha</u> |
| Session 2 14:00-16:30 IST | Chair: Jyotirmoy Bhattacharya | Chair: Koushik Ray | Chair: Amitabh Virmani | Chair: Arnab Kundu | Chair: Arpan Bhattacharyya |
| | <u>Jerome Gauntlett</u> | <u>David Mateos</u> | <u>Vishnu Jejjala</u> | <u>Andrea Puhm</u> | <u>Tadashi Takayanagi #</u> |
| | <u>Elias Kiritsis</u> | <u>Shiraz Minwalla</u> | <u>Matteo Baggioli</u> | <u>Daniel Grumiller</u> | <u>Costas Bachas</u> |
| | <u>Rene Meyer</u> | <u>Sayantan Sharma</u> | <u>Bidisha Chakrabarty</u> | <u>Sean Hartnoll</u> | <u>Shouvik Datta</u> |
| Session 3 19:30-22:00 IST | Chair: Bindusar Sahoo | Chair: Dileep Jatkar | Chair: Ayan Mukhopadhyay | Chair: K Narayan | Chair: Prabha Mandayam |
| | <u>Chethan Krishnan</u> | <u>Cumrun Vafa #</u> | <u>Daniel Jafferis</u> | <u>Nathan Seiberg #</u> | <u>Brian Swingle #</u> |
| | <u>Timm Wrase</u> | <u>Liam McAllister</u> | <u>Raghu Mahajan</u> | <u>Zohar Komargodski</u> | <u>Shira Chapman</u> |
| | <u>Thomas van Riet</u> | <u>David Andriot</u> | <u>Sameer Murthy</u> | <u>David Tong</u> | <u>Pratik Rath</u> |

** - Opening address by Prof. David Gross
and welcome speech by Bhaskar Ramamurthi (Director IIT Madras)

- Indicates hour long talks, all other talks will be 45 minutes long

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Abstracts: [Day 1](#)

Zvi Bern: [Scattering Amplitudes as a Tool for Understanding Gravity](#)

Abstract: TBA

Aninda Sinha : [Rebooting the S-matrix bootstrap](#)

Abstract: TBA

Jerome Gauntlett: [Spatially Modulated and Supersymmetric Mass Deformations of N=4 SYM](#)

Abstract: TBA

Elias Kiritsis: [Emergent gravity from hidden sectors and TT deformations](#)

Abstract: *We investigate emergent gravity extending the paradigm of the AdS/CFT correspondence. The emergent graviton is associated to the (dynamical) expectation value of the energy-momentum tensor. We derive the general effective description of such dynamics, and apply it to the case where a hidden theory generates gravity that is coupled to the Standard Model.*

In the linearized description, generically, such gravity is massive with the presence of an extra scalar degree of freedom. The propagators of both the spin-two and spin-zero modes are positive and well defined.

The associated emergent gravitational theory is a bi-gravity theory, as is (secretly) the case in holography. The background metric on which the QFTs are defined, plays the role of dark energy and the emergent theory has always as a solution the original background metric.

The background metric yields also a dark energy contribution.

In the case where the hidden theory is holographic, the overall description yields a higher-dimensional bulk theory coupled to a brane.

The effective graviton on the brane has four-dimensional characteristics both in UV and IR and is always massive.

Rene Meyer: [Strongly Correlated Dirac Materials, Electron Hydrodynamics & AdS/CFT](#)

Abstract: TBA

Chethan Krishnan: [Cosmic Censorship of Trans-Planckian Field Ranges in Gravitational Collapse](#)

Abstract: TBA

Timm Wrase: [Misaligned SUSY in string theory](#)

Abstract: *Non-supersymmetric string theory configurations have received relatively little attention in string phenomenology community. However, such non-supersymmetric string theory setups might provide interesting and new testing grounds for the swampland program. Given the non-observation of supersymmetry at the LHC they might also give us insight into how our own universe works. I will review idea of misaligned (or asymptotic) supersymmetry, which denotes the following perplexing fact: String theories without any spacetime supersymmetry lead to finite values for the 1-loop corrected cosmological constant and can give rise to vanishing supertraces. I will exemplify how and why this happens in two examples: an anti-Dp-brane on top of an Op-plane and for the heterotic SO(16)xSO(16) string theory.*

Thomas van Riet: [A de Sitter landscape and Russel's teapot](#)

Abstract: This non-technical and conceptual talk is about vacuum energy both from the viewpoint of the Swampland ideas in string theory and effective field theory. I will argue that both viewpoints

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should match eventually. I will discuss issues relating to both the sign of the cosmological constant and its size.

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Abstracts: Day 2

Rajesh Gopakumar: Branched Covers and Worksheet Localisation in AdS₃

Abstract: TBA

Gustavo Joaquin Turiaci: The gravitational path integral near extremality

Abstract: TBA

Ayan Mukhopadhyay: Analogue quantum black holes

Abstract: TBA

David Mateos: Holographic Dynamics near a Critical Point

Abstract: TBA

Shiraz Minwalla: Fermi seas from Bose condensates and a bosonic exclusion principle in matter Chern Simons theories.

Abstract: *We generalize previous results for the thermal free energy of bosonic and fermionic large N Chern-Simons theories with fundamental matter, to values of the chemical potential larger than quasiparticle thermal masses. We present a simple explicit formula for the occupation number for a quasiparticle state of any given energy and charge as a function of the temperature and chemical potential. This formula is a generalization to finite 't Hooft coupling of the famous result of Bose-Einstein statistics, and implies the following exclusion principle for Chern Simons coupled bosons: the total number of bosons occupying any single state cannot exceed the Chern Simons level. Specializing to zero temperature, we construct the phase diagrams of these theories as a function of chemical potential and the UV parameters. The phase diagram includes a Bose condensed phase runaway instability of free theories at large chemical potential is cured by the bosonic exclusion principle. This phase is the bosonic dual of the Fermi sea.*

Sayantana Sharma: The topological constituents of QCD at finite temperature from the lattice

Abstract: TBA

Cumrun Vafa: Unifying Themes in the Swampland Program

Abstract: TBA

Liam McAllister: Vacua with Small Flux Superpotential

Abstract: TBA

David Andriot: Do classical de Sitter string backgrounds exist?

Abstract: A classical solution of string theory with a 4d de Sitter space-time could be a simple and well-controlled setting, where to connect to cosmological models. So far however, no such solution has been found. As will be reviewed, attempts in this direction are plagued by many no-go theorems, or by the difficulty for concrete 10d supergravity solutions to fit in the classical string

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regime. This situation agrees with recent de Sitter swampland conjectures. As will be shown, the latter can actually be verified quantitatively, with a surprisingly good agreement. This may hint at a deeper reason against classical de Sitter backgrounds, even though not all possibilities have for now been excluded.

Abstracts: Day 3

Ashoke Sen: Cutting Rules and Unitarity (Violation) in D-instanton Amplitudes

Abstract: TBA

Gautam Mandal: On quantum quench for fermions in 1 and 2 dimensions: Lessons from $c=1$

Abstract: TBA

Spenta Wadia: Modeling black hole formation and evaporation in the Sachdev-Ye-Kitaev (SYK) model and its dual gravity theory

Abstract: *We will present a detailed calculation of gravitational collapse in the SYK model that is holographic to a model of 2-dim gravity. The model of collapse involves perturbing the SYK hamiltonian model with a time dependent hamiltonian that depends on the microscopic state of the black hole. The temperature of the final state can be explicitly calculated and exhibits a Choptuik scaling form. We also formulate the evaporation process by coupling the SYK model to an external bath.*

Abstract: TBA

Vishnu Jejjala: Machine learning as a discovery tool in hep-th

Abstract: *Machine learning provides a new tool for analyzing Big Data and Small Data in mathematics and theoretical physics. I discuss two case studies. The first predicts the volume of the knot complement of hyperbolic knots from the Jones polynomial. The second predicts the masses of baryons such as the proton and neutron from knowledge only of the meson spectrum and distinguishes between different composition hypotheses for exotic QCD resonances. Both investigations point to the existence of new analytic formulae.*

Matteo Baggioli: Phases, phasons & phase relaxation in holography and EFTs

Abstract: TBA

Bidisha Chakrabarty: Out of time ordered effective dynamics of a quartic oscillator

Abstract: *Recently the connection of Out of Time Ordered Correlators (OTOCs) to scrambling, quantum chaos, thermalisation etc has been realised. With the increasing interest in OTOCs, it will be useful to develop a systematic prescription to compute them. In this talk I will discuss techniques of effective theory to compute OTOCs in open quantum systems. In particular, I will focus on the problem of a quantum Brownian particle interacting with a dissipative bath composed of two sets of harmonic oscillators via cubic coupling. Integrating out the bath's degrees of freedom, we get an effective theory of the particle that is in general non-local in time. However for appropriate choice of distributions of bath oscillators, all the bath correlators decay exponentially fast at late times. Hence after the decay of the bath correlators has set in, one can write down a suitable 1-PI effective action of the particle which is temporally local. The correlators computed from the microscopic theory evolve the same way as the correlators computed from this 1-PI effective action. If the bath has microscopic time-reversal invariance and thermality, it imposes constraints on the 1-PI effective action. These constraint*

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relations between the effective couplings of 1-PI action are OTO generalisations of the well-known Onsager-Casimir reciprocal relations and fluctuation-dissipation relations. Combining these relations, the non-Gaussianity of the thermal noise gets related to the thermal jitter in the damping constant of the Brownian particle.

Daniel Jafferis: [Inside the hologram](#)

Abstract: TBA

Raghu Mahajan: [The entropy of Hawking radiation](#)

Abstract: TBA

Sameer Murthy: [1/16 BPS index and supersymmetric phases of 4D N=4 SYM](#)

Abstract: TBA

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Abstracts: Day 4

Sunil Mukhi: [Classifying RCFT through Modularity, Holomorphy and Positivity](#)

Abstract: TBA

Sujay Ashok: [Surface Defects from Fractional Branes](#)

Abstract: TBA

Sachin Jain: [Momentum space correlation function and higher-spin equation](#)

Abstract: TBA

Andrea Puhm: [A Double Copy for Celestial Amplitudes](#)

Abstract: TBA

Daniel Grumiller: [Lower-dimensional holography](#)

Abstract: TBA

Sean Hartnoll: [The classical interior of black holes in holography](#)

Abstract: TBA

Nathan Seiberg: [Fractons: going beyond standard QFT](#)

Abstract: TBA

Zohar Komargodski: [From QFT to the no-hair theorem](#)

Abstract: TBA

David Tong: [Comments on Chiral Fermions](#)

Abstract: TBA

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Abstracts: [Day 5](#)

Thomas Rudelius: [The Landscape of Swampland Conjectures](#)

Abstract: TBA

Keshav Dasgupta: [Constructing de Sitter space in string theory](#)

Abstract: TBA

Alok Laddha: [Polytopes and Scattering amplitudes](#)

Abstract: TBA

Tadashi Takayanagi: [AdS/BCFT, Entanglement Wedges and Wedge Holography](#)

Abstract: TBA

Costas Bachas: [Microscopic Planck Branes and Massive Gravity](#)

Abstract: TBA

Shouvik Datta: [2d conformal blocks](#)

Abstract: TBA

Brian Swingle: [Chaos in Quantum Electrodynamics](#)

Abstract: TBA

Shira Chapman: [Energy Reflection and Transmission at 2D Holographic Interfaces](#)

Abstract: *Scattering from conformal interfaces in two dimensions is universal in that the flux of reflected and transmitted energy does not depend on the details of the initial state. In this talk I will present a gravitational calculation of the energy reflection and transmission coefficients for interfaces with thin-brane holographic duals. I will demonstrate that the result for the reflection coefficient depends monotonically on the tension of the dual string anchored at the interface, and obeys the lower bound recently derived from the ANEC in conformal field theory. I will describe how to recover the boundary CFT limit from this calculation.*

Pratik Rath: [The Page curve for Reflected Entropy](#)

Abstract: TBA