Recent Trends in String Theory and Related Topics

7-11 May 2018 (17-21 Ordibehesht 97), IPM, Tehran, Iran

Program

Monday (May 7th 2018)		
Time	**Speaker**	**Title of talk**
8:30 – 9:00	***Registration***	
9:00 – 10:00	S. Vaidya	New Results from SU(2) and SU(3) Gauge Matrix Models
10:00 – 10:45	P. Diaz Benito	Tensor and matrix models romance
10:45 – 11:30	***Break***	
11:30 – 12:30	B. Tekin	Linearization Instability in non-linear theories
12:30 – 14:30	***Lunch***	
14:30 – 15:15	H. Soltanpanahi	Dynamics of first order phase transition within holography
15:15 – 16:00	N. Petri	Surface defects in massive IIA

Tuesday (May 8th 2018)		
Time	**Speaker**	**Title of talk**
9:00 – 10:00	O. Lechtenfeld	Rational Maxwell knots via de Sitter space
10:00 – 10:45	M. Geiller	Edge modes, boundary dynamics, and entanglement entropy
10:45 – 11:30	***Break***	
11:30 – 12:30	M. Mirbabayi	Asymptotic Fragility, Near AdS2 Holography and T Tbar
12:30 – 14:30	***Lunch***	
14:30 – 15:15	W. Merbis	Supersymmetric GCA2/BMS3 blocks
15:15 – 16:00	K. Hajian	Cosmological constant is a conserved charge

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Wednesday (May 9th 2018)		
Time	**Speaker**	**Title of talk**
9:00 – 10:00	D. Van Den Bleeken	Plat du jour
10:00 – 10:45	I. Gahramanov	TBA
10:40 – 11:30	***Break***	
11:30 – 12:30	A. Tomasiello	A massive class of N = 2 AdS4 IIA solutions
12:30 – 14:30	***Lunch***	
14:30 – 15:00	V. Hosseinzadeh	Soft Charges and Electric-Magnetic Duality
15:00 – 15:30	E. Esmaili	Asymptotic Symmetries in p-Form Theories
15:30 – 16:00	B. Soueres	The action principle and the supersymmetrisation of Chern-Simons terms in eleven-dimensional supergravity.

Thursday (May 10th 2018)		
Time	**Speaker**	**Title of talk**
9:00 – 10:00	G. Shiu	TBA
10:00 – 10:45	H. González	Boundary dynamics of two-dimensional Dilaton gravity models
10:45 – 11:30	***Break***	
11:30 – 12:30	D. Grumiller	Soft hair on black hole and cosmological horizons in any dimension
12:30 – 14:30	***Lunch***	
14:30 – 15:00	A. Faraji	Holographic aspects of boundary conformal field theories
15:00 – 15:30	F. Dundar	Gravitational collapse of thin shell of dust in shape dynamics
15:30 – 16:00	R. Mohammadi Mozaffar	Entanglement evolution after a quantum quench in Lifshitz harmonic models

Friday (May 11th 2018)
Excursion

Titles and Abstracts:

Monday, May 7th 2018

Sachin Vaidya, *Indian Institute of Science, Bangalore*

New Results from SU(2) and SU(3) Gauge Matrix Models

We discuss a matrix model for QCD which first arose in the study of the Gribov problem. When coupled to fermions, the SU(2) model can be used to investigate the phase structure of QCD-like theories. The low-lying spectrum of the SU(3) model is in surprisingly good agreement with the lattice prediction of glueball masses.

Pablo Diaz, *Institute of Basic Science (IBS)*

Tensor and matrix models romance

We will see that the energy spectrum of free tensor models is organized by the Kronecker coefficients. It is known that the spectrum of free multimatrix models is organized by the Littlewood-Richardson numbers. Using recent results of group theory and combinatorics we derive a formula that relates those sets of numbers. The identity we obtain has a straightforward physics interpretation: there is a sector within tensor models whose states are in one-to-one correspondence with fluctuations of 1/2 BPS states in matrix models. This nontrivial fact is a strong hint for a close relation between both theories, which we will discuss.

Bayram Tekin, *METU, Turkey*

Linearization Instability in non-linear theories

Perturbation theory is often our main tool in studying the classical and quantum aspects of non-linear theories which are otherwise intractable except for highly symmetric cases. But it turns out that perturbation theory can fail as a method if certain criteria are not met on the particular theory and the background solution about which perturbation is carried developed. Besides a general discussion of this issue, I will give a couple of recent examples such as the chiral and critical gravities. Further details can be found in the paper E. Altas and B. Tekin, ``Linearization instability for generic gravity in AdS spacetime," Phys. Rev. D 97, 024028 (2018) and ``Linearization Instability of Chiral Gravity,"arXiv:1804.05602.

Hesam Soltanpanahi, *School of physics, IPM*

Dynamics of first order phase transition within holography

In this talk I will show the features of first order phase transition of a strongly coupled field theory using its bulk gravity dual. At the linearized level, the quainormal modes of the black hole solutions are considered and it shows the sign of bubble formation. Then we will see the true bubbles as the mixed state living at the critical temperature. And finally I will show you how the boost invariant expansion wash outs the bubbles.

Nicolo Pertri, *Bogazici University*

Surface defects in massive IIA

In this talk we will introduce a new class of supersymmetric solutions within N=1, d=7 minimal gauged supergravity characterized by a non-trivial radial profile for the 3-form gauge potential included into the supergravity multiplet. Many of these solutions reproduce locally the AdS_7 vacuum in the UV regime and they are described by a 7d background characterized by an AdS3 slicing. Within this class we will take in consideration two particular examples and we will use one of these to show how the embedding in M-theory works in presence of the running 3-form and the other to construct the holographic interpretation of the AdS3 slicing in massive type IIA string theory. To this aim we will present a new 10d brane solution describing a bound state D2-D4-NS5-D6-D8 whose physics is fully captured by our 7d flow and, in particular, we will show that its near-horizon is realized by two different regimes: one reproducing the AdS7 vacuum and the other giving rise to a warped background with AdS3 slicing. Starting from this construction we will interpret the N=(4,0) SCFT2 dual to the AdS3 as a conformal surface defect within the N=(1,0) SCFT6 dual to the AdS7 vacuum.

Tuesday, May 8th 2018

Olaf Lechtenfeld, *Leibniz University Hannover*

Rational Maxwell knots via de Sitter space

We set up a correspondence between solutions of the Yang-Mills equations on $\mathbbm{R} \times S^3$ and in Minkowski spacetime via de Sitter space. Some known Abelian and non-Abelian exact solutions are rederived. For the Maxwell case we present a straightforward algorithm to generate an infinite number of explicit solutions, with fields and potentials in Minkowski coordinates given by rational functions of increasing complexity. We illustrate our method with some nontrivial examples.

Marc Geiller , *Perimeter Institute*

Edge modes, boundary dynamics, and entanglement entropy

The computation of entanglement entropy in gauge theories is complicated due to the presence of constraints, which imply the spatial non-factorizability of the Hilbert space. It has been known for a while that this difficulty can be bypassed by resorting to the extended Hilbert space formalism, where one keeps track of extra would-be gauge degrees of freedom living on the entangling surface, and that these edge modes do in turn contribute to the entanglement entropy. In this talk we will retrace this construction starting from the classical picture. For this, we will first present the classical counterpart of the extended Hilbert space, which is an extended phase space obtained from the requirement of gauge invariance in the presence of boundaries. This will be done for theories having Abelian, non-Abelian, and diffeomorphism gauge symmetry. We will then discuss the construction of boundary actions, and show that the contribution of the edge modes to the entanglement entropy is described by their boundary dynamics.

Mehrdad Mirbabayi, *ICTP, Italy*

Asymptotic Fragility, Near AdS2 Holography and T Tbar

We present the exact solution for the scattering problem in the flat space Jackiw-Teitelboim (JT) gravity coupled to an arbitrary quantum field theory. JT gravity results in a gravitational dressing of field theoretical scattering amplitudes. The exact expression for the dressed S-matrix was previously known as a solvable example of a novel UV asymptotic behavior, dubbed asymptotic fragility. This dressing is equivalent to the $T\bar{T}$ deformation of the initial quantum field theory. JT gravity coupled to a single massless boson provides a promising action formulation for an integrable approximation to the worldsheet theory of confining strings in 3D gluodynamics. We also derive the dressed S-matrix as a flat space limit of the near AdS2 holography. We show that in order to preserve the flat space unitarity the conventional Schwarzian dressing of boundary correlators needs to be slightly extended. Finally, we propose a new simple expression for flat space amplitudes of massive particles in terms of correlators of holographic CFT's.

Wout Merbis, *ULB, Belgium*

Supersymmetric GCA2/BMS3 blocks

The conformal bootstrap program is an effective and successful way to constrain the space of consistent conformal field theories (CFTs). Constraints on the CFT operator weights and structure constants can be obtained by imposing the conformal blocks to be consistent with conformal invariance and crossing symmetry. These bootstrap techniques can be modified to apply outside the relativistic CFTs. In this talk we will formulate the bootstrap equations for supersymmetric theories with non- and ultra-relativistic scale invariance relevant for tensionless superstrings and flat holography. We will construct the supersymmetric Galilean conformal blocks, the non-relativistic analogue of superconformal blocks in two different supersymmetric extensions of the Galilean conformal algebra.

Kamal Hajian, *IPM, Iran*

Cosmological constant is a conserved charge

Cosmological constant can be considered as the on-shell value of a top form in gravitational theories. The top form is the field strength of a gauge field, and the theory enjoys a gauge symmetry. We will show that cosmological constant is the charge of global part of the gauge symmetry of the top form, and is conserved irrespective of the dynamics of the metric and other fields. In addition, I will introduce its conjugate chemical potential, and prove the generalized first law of thermodynamics which includes variation of cosmological constant as a conserved charge. At the end, I will discuss how our new term in the first law is related to the volume-pressure term. This talk is based on the paper arXiv:1710.07904 in collaboration with Dmitry Chernyavsky.

Wednesday, May 9th 2018

Dieter Van den Bleeken, *Bogazici U. Turkey*

Plat du jour

In case of a continued flow of ideas and inspiration I will present some fresh work on renormalons*, that is expected to be 'a point' by the time of the meeting. Otherwise I will serve a local favorite that is composed of a mixture of global gauge symmetries in Yang-Mills theory, cooked in an adiabatic approximation and served with some interesting geometry.
*divergent contributions to perturbation theory as appear in for example QCD

Ilmar Gahramanov, *Mimar Sinan Uni., Turkey*

TBA

Alessandro Tomasiello, *Uni. Di Milano, Italy*

A massive class of N = 2 AdS4 IIA solutions

Recently, a lot of progress was achieved regarding classifications of AdS solutions in higher dimensions. One might guess that this is thanks to their large amount of supersymmetry. For this reason, I recently initiated a classification program for solutions with extended supersymmetry in four dimensions, using pure spinor techniques. For IIA, this produces as a byproduct a significant number of new families of solutions, regular as well as with localized O8-plane and conical CY singularities.

Vahid Hosseinzadeh, *IPM, Iran*

Soft Charges and Electric-Magnetic Duality

We extend the analysis of soft charges of Maxwell theory to include magnetic charges and their soft modes. Imposing appropriate asymptotic falloff conditions, we compute the electric and magnetic soft charges and their algebra both at spatial and at null infinity. While the commutator of two electric or two magnetic soft charges vanish, the electric and magnetic charges satisfy an infinite copies of Heisenberg algebra. We repeat the charge analysis in the duality symmetric Maxwell theory, where the magnetic charge is a Noether charge and the algebra is extended by the generator of duality transformation. We discuss physical meaning and implication of our charges and their algebra.

Erfan Esmaili, *School of physics, IPM*

Asymptotic Symmetries in p-Form Theories

We consider (p+1)-form gauge fields in flat (2p+4)-dimensions. Imposing appropriate falloff behavior on fields, we compute conserved surface charges and the corresponding asymptotic charge algebra associated with nontrivial gauge transformations. We show that for $p \geq 1$ cases we have three sets of conserved asymptotic charges associated with exact, coexact and zero-mode parts of the corresponding p-form gauge transformations on the asymptotic S2p+2. The coexact and zero-

mode charges are higher form extensions of the four dimensional electrodynamics case (p=0), and are commuting. Charges associated with exact gauge transformations have no counterparts in four dimensions and form infinite copies of Heisenberg algebras.

Bertrand Soueres, *Lyon University, IPNL*

The action principle and the supersymmetrisation of Chern-Simons terms in eleven-dimensional supergravity

Eleven dimensional supergravity is considered to be the low-energy limit of M-theory. In that sense, it should receive an infinite tower of high-energy corrections in power of the string length. However, unlike in 10 dimensional supergravities, the high-energy limit is not fully formulated. There is no systematic way to find those corrections, and one often have to rely on alternative methods to build (some of the) terms. Several methods grouped under the name "spinorial cohomology" already exist, and were used to build supersymmetric corrections in several supergravity theories. In my work, I developed computational tools for calculating the full supersymmetric higher-order derivative corrections to eleven-dimensional supergravity using the "action principle". It is a promising approach for finding the full superinvariant correction to the supergravity action in eleven dimensions.

Thursday, May 10th 2018

Gary Shiu, *Wisconsin U., Madison*

TBA

Hernán González, *TUW, Austria*

Boundary dynamics of two-dimensional Dilaton gravity models

We consider generalizations of the Jackiw-Teitelboim model in the BF formulation. These theories do not propagate bulk degrees of freedom, therefore, its classical dynamics corresponds to one-dimensional actions located at the boundary of the space-time. We analyze and compare the properties of these actions with similar features observed in the semi-classical behavior of the SYK model and its suitable extensions.

D. Grumiller , *TUW, Austria*

Soft hair on black hole and cosmological horizons in any dimension

Starting from a generic near horizon expansion in any spacetime dimension greater than two we derive all near horizon symmetries and discover a wealth of novel results: 1. Any non-extremal horizon has an infinite set of near horizon symmetries and associated soft hair excitations. 2. The near horizon symmetries can be represented as generalization of the Bondi-Metzner-Sachs algebra. 3. For horizons that are either flat or non-rotating the near horizon symmetries can be represented as Heisenberg algebras, with one quarter of the inverse of Newton's constant playing the role of Planck's constant. 4. Not only black holes, but also cosmological horizons are equipped with soft hair. We discuss implications of soft hair for horizon thermodynamics and entropy, and comment on open problems and further developments.

Amin Faraji, *Arak University and IPM*

Holographic aspects of boundary conformal field theories

In this talk I will present our holographic prescription for computing the conformal anomaly charges as well as the holographic entanglement entropy in the presence of boundaries.

Furkan Semih Dündar, *Bogazici U. Turkey*

Gravitational collapse of thin shell of dust in shape dynamics

We studied the gravitational collapse of a shell of dust in shape dynamics. We found out static and oscillatory solutions. In the large momentum limit we found out that the shell never reaches the singularity when the momentum of the shell is much larger than the mass of the shell in magnitude. The shell does not reach to the origin in a finite amount of time however when the momentum of the shell becomes comparable to minus the mass of shell, the large momentum approximation breaks down. Therefore more detailed future works hopefully may be able to answer the question of singularity formation in this setup.

Mohammad Reza Mohammadi Mozaffar, *IPM, Iran*

Entanglement evolution after a quantum quench in Lifshitz harmonic models

We explore different aspects of entanglement in quantum field theories with particular focus on Lifshitz-type QFTs. We consider a generalized harmonic lattice model which is introduced as a discrete approximation of bosonic field theories with Lifshitz symmetry with a generic dynamical exponent "z". We study the time evolution of entanglement entropy after a global quantum quench in this model and especially investigate the role of z in quasi-particle picture.