Recent Trends in String Theory and Related Topics

May 8-11 2017, School of Physics, Institute for Research in Fundamental Sciences (IPM), Tehran

Monday (May 8th 2017)		
Time	**Speaker**	**Title of talk**
8:30 – 9:00	***Registration***	
9:00 – 10:00	*M. Henneaux*	Remarks on exotic theories of gravity in 6 dimensions
10:00 – 10:40	*S. Değer*	Homogeneous solutions of minimal massive 3D gravity
10:40 – 11:30	***Break***	
11:30 – 12:30	*A. Tomasiello*	Superconformal theories from six to four dimensions
12:30 – 14:30	***Lunch***	
14:30 – 15:00	*M. R. Mohammadi Mozaffar*	Entanglement in Lifshitz-type QFTs
15:00 – 15:30	*A. Mollabashi*	Entanglement in field space
15:30 – 16:00	*M. H. Vahidinia*	On complexity for F(R) and critical gravity

Tuesday (May 9th 2017)		
Time	**Speaker**	**Title of talk**
9:00 – 10:00	*M. Gürses*	Construction of universal metrics
10:00 – 10:40	*R. Fareghbal*	The stress tensor of BMS invariant field theories
10:40 – 11:30	***Break***	
11:30 – 12:30	*B. Oblak*	Berry phases of boundary gravitons
12:30 – 14:30	***Lunch***	
14:30 – 15:00	*M. Noorbakhsh*	Ultraspinning black holes at EVH limit and their 2d CFT duals
15:00 – 15:30	*S. Sadeghian*	(A)dS3 in the near horizon of asymptotically de Sitter solutions
15:30 – 16:00	*M. Ghodrati*	Phase transitions and entanglement entropy in WAdS3/WCFT2

Wednesday (May 10th 2017)		
Time	**Speaker**	**Title of talk**
9:00 – 10:00	*J. Jankowski*	Dynamics, phase transitions and holography
10:00 – 10:40	*A. V. Osorio*	On the shape of things: from holography to elastica
10:40 – 11:30	***Break***	
11:30 – 12:30	*A. Sagnotti (via Skype)*	Brane SUSY breaking: old puzzles and some recent progress
12:30 – 14:30	***Lunch***	
14:30 – 15:00	*H. Soltanpanahi*	Real time dynamics and phase separation in a holographic first order phase transition
15:00 – 15:30	*N. Abbasi*	Chiral effcts in QCD Plasma
15:30 – 16:00	*J. Abedi*	Echoes from the Abyss: Evidence for Planck-scale structure at black hole horizons

Thursday (May 11th 2017)		
Time	**Speaker**	**Title of talk**
9:00 – 10:00	*G. Barnich*	BMS current algebra and central extension
10:00 – 10:40	*H. Afshar*	Horizon fluff, semi-classical black hole microstates
10:40 – 11:30	***Break***	
11:30 – 12:00	*S. M. Hosseini*	Microstates of AdS black holes and supersymmetric localization
12:00 – 12:30	*A. Arabi Ardehali*	The four-dimensional Cardy formula and its violation through an asymptotic Higgs mechanism
12:30 – 14:30	***Lunch***	

Abstracts: Recent Trends in String Theory and Related Topics

May 8-11 2017, School of Physics, Institute for Research in Fundamental Sciences (IPM), Tehran

Monday, May 8th 2017

Marc Henneaux
Université Libre de Bruxelles and International Solvay Institutes, Belgium

Remarks on exotic theories of gravity in 6 dimensions

Some time ago, C. Hull constructed new, intriguing, exotic theories of gravity in six spacetime dimensions with fascinating properties. These arise in the strong coupling limit of five-dimensional maximal supergravity. Only the equations of motion of these theories are known, however, and only in the linearized limit. (Free) exotic gravities reduce to ordinary (free) gravity in five dimensions but involve chiral exotic tensors of mixed Young symmetry type in six dimensions instead of the standard graviton described by a symmetric tensor. The talk will review some properties of these somewhat mysterious theories and address the construction of an action principle.

Sadik Değer
Department of mathematics, Boğaziçi University, Turkey

Homogeneous solutions of minimal massive 3D gravity

In this talk we explain construction of simply transitive homogeneous solutions of the three-dimensional Minimal Massive Gravity (MMG) model. In addition to those that have analogs in Topologically Massive Gravity, such as warped AdS and pp-waves, there are several solutions genuine to MMG. Among them, there is a stationary Lifshitz metric with the dynamical exponent z=-1 and an anisotropic Lifshitz spacetime where all coordinates scale differently. Moreover, we identify a homogeneous Kundt solution at the chiral point of the theory. We also show that in a particular limit of the physical parameters in which the Cotton tensor drops out from the MMG field equation, homogeneous solutions exist only at the merger point in the parameter space if they are not conformally flat.

Alessandro Tomasiello
Dipartimento di Fisica, Università di Milano–Bicocca, Italy

Superconformal theories from six to four dimensions

Following recent progress in classifying six-dimensional superconformal field theories and their gravity duals, I will describe various recent results in understanding theories obtained in four dimensions upon compactification on Riemann surfaces, sometimes in the presence of punctures. For one notable case, I will present a gravity dual where several nontrivial brane sources are present simultaneously. The 6d theory in this case is a massive IIA analogue of the so-called E-string theory. For a larger class of theories, torus compactifications can be guessed by comparing moduli space dimensions and anomalies.

Mohammad Reza Mohammadi Mozaffar
School of physics, IPM, Iran
Entanglement in Lifshitz-type QFTs

In this talk we discuss about different aspects of quantum entanglement and its measures in the vacuum state of a certain Lifshitz free scalar theory. We show that the scaling of entanglement in such theories depends on the value of the dynamical exponent as a characteristic parameter of the theory. The scaling is such that for a massless scalar and in Lorentzian limit it gives an area law and in the large dynamical exponent limit it tends to a volume law.

Ali Mollabashi
School of physics, IPM, Iran
Entanglement in Field Space

Field theories with more than one field may have entanglement in their field space. I will present some solvable examples in the context of massless scalar theories in generic dimensions.

Mohammad Hasan Vahidinia
School of physics, IPM, Iran
On Complexity for F(R) and Critical Gravity

Using ``complexity=action'' proposal we study complexity growth of certain gravitational theories containing higher derivative terms. These include critical gravity in diverse dimensions. One observes that the complexity growth for neutral black holes saturates the proposed bound when the results are written in terms of physical quantities of the model. We will also study effects of shock wave to the complexity growth where we find that the presence of massive spin-2 mode slows down the rate of growth.

Tuesday, May 9th 2017

Metin Gürses
Department of Mathematics, Faculty of Science, Bilkent University, Turkey
Construction of universal metrics

A special class of metrics, called universal metrics, solve all gravity theories defined by covariant field equations purely based on the metric tensor. Since we currently lack the knowledge of what the full of quantum-corrected field equations of gravity are at a given microscopic length scale, these metrics are particularly important in understanding quantum fields in curved backgrounds in a consistent way. But, finding explicit universal metrics has been a hard problem as there does not seem to be a procedure for it. In this work, we overcome this difficulty and give a construction of universal metrics of d-dimensional spacetime from curves constrained to live in a (d-1)-dimensional Minkowski spacetime or a Euclidean.

Reza Fareghbal
Shahid Beheshti University, Iran
The stress tensor of BMS invariant field theories

It was proposed that the asymptotically flat space times are holography dual to the BMS invariant field theories in one lower dimension. In this talk we introduce a method for the calculation of stress tensor correlators of these theories by starting from the metric formulation of the Gravity theory.

Blagoje Oblak
Institut für Theoretische Physik, ETH Zürich, Switzerland
Berry phases of boundary gravitons

This talk is devoted to the Berry phases that appear in unitary representations of the Virasoro group and the BMS group in three dimensions. They are obtained by acting on a coherent state with symmetry transformations that trace a closed path on a suitable infinite-dimensional orbit, and they can be evaluated exactly thanks to the corresponding Maurer-Cartan forms. Since the Virasoro and BMS groups are asymptotic symmetries of gravity, their Berry phases can be seen as extensions of Thomas precession associated with gravitational vacua.

Maryam Noorbakhsh
Semnan University, Iran
Ultraspinning black Holes at EVH limit and their 2d CFT duals

By employing two different ultra-spinning limits we find novel classes of black holes having a noncompact event horizons. These ultra-spinning limits can be understood as a sort of simple generating solution technique fallowed in independent approaches called super-entropic and hyperboloid membrane limits. We investigate the geometric structure of the obtained new black hole solutions including their horizon and conformal boundary. Also we explore the extremity conditions and the near horizon limit under both ultra-spinning limits. We also demonstrate the ultra-spinning black holes, despite the non-compactness of their horizons, exhibit the well-defined Kerr/CFT correspondence. Moreover we construct other particular families of geometry as (near) extremal vanishing horizon (EVH) solutions at ultra spinning limits. We also discuss whether the EVH limit can be commuted with each of ultra-spinning limits. We show that the near horizon geometries of our ultra-spinning solutions at (near) EVH limit contain (BTZ) AdS$_3$ throats.

Saeedeh Sadeghian
School of physics, IPM, Iran
(A)dS3 in the near horizon of asymptotically de Sitter solutions

We consider two solutions of Einstein-Λ theory which admit extremal vanishing horizon (EVH) limit: odd-dimensional multi-spinning Kerr black hole (in the presence of cosmological constant) and cosmological soliton. We show that the near horizon EVH geometry of Kerr has a three dimensional maximally symmetric subspace whose curvature depends on rotational parameters and the cosmological constant. In the Kerr-dS case, this subspace interpolates between AdS$_3$, 3d flat and dS$_3$ by varying rotational parameters. However, the near horizon of EVH cosmological soliton always has a dS$_3$. The feature of EVH cosmological soliton is that it is regular everywhere on the horizon. In the near EVH case, these 3d parts turn into the corresponding locally maximally symmetric spacetimes with a horizon: Kerr-dS$_3$, flat space cosmology or BTZ black hole. We show their thermodynamics match with thermodynamics of the original near EVH black holes. We also briefly discuss the holographic 2d CFT dual to the near horizon of EVH solutions.

Mahdis Ghodrati
School of particles and accelerators, IPM, Iran
Phase transitions and entanglement entropy in WAdS3/WCFT2

In this talk, first, I review the different aspects of Warped CFTs and also WadS/WCFT duality. Then I discuss the Hawking-Page phase transitions for asymptotically Warped AdS3 black holes (plus other solutions) in the Topological and New Massive Gravities, in two different thermodynamical ensembles. Then, I will discuss the recent results in calculating the holographic entanglement entropy of Warped CFTs, with special emphasis to solutions of New Massive Gravity.

Wednesday, May 10th 2017

Jakub Jankowski
Institute of Theoretical Physics, University of Wroclaw, Poland
Dynamics, phase transitions and holography

I will give an elementary introduction to concepts of the AdS/CFT correspondence with particular focus on dynamics of systems exhibiting equilibrium phase transitions. The existence of the spinodal region related to a first order phase transition is demonstrated within linear response theory. In addition I will shortly discuss the novel type of instability appearing of a confining theory. The applicability of hydrodynamics in the critical region of the phase diagram is discussed.

Alvaro Veliz Osorio
Institute of Physics, Jagiellonian University, Poland
On the shape of things: from holography to elastica

We explore the question of which shape a manifold is compelled to take when immersed in another one, provided it must be the extremum of some functional. We consider a family of functionals which depend quadratically on the extrinsic curvatures and on projections of the ambient curvatures. These functionals capture a number of physical setups ranging from holography to the study of membranes and elastica.

Augusto Sagnotti
Scuola Normale Superiore and INFN, Pisa, Italy
Brane SUSY breaking: old puzzles and some recent progress

I shall describe some general features of supersymmetry breaking in String Theory, with emphasis on "brane SUSY breaking" (BSB), which results from the simultaneous presence of mutually non-BPS configurations of branes and orientifolds in the vacuum. All these mechanisms, and BSB in particular, bring along serious technical and conceptual difficulties, together with amusing coincidences that afford potential lessons for Cosmology and Particle Physics.

Hesam Soltanpanahi
School of physics, IPM, Iran
Real time dynamics and phase separation in a holographic first order phase transition

Fully nonlinear time evolution of a holographic system possessing a first order phase transition will be investigated. The initial state is chosen in the spinodal region of the phase diagram, and includes an inhomogeneous perturbation in one of the field theory directions. The final state of the time evolution shows a clear phase separation in the form of domain formation. The results indicate the existence of a very rich class of inhomogeneous black hole solutions.

Navid Abbasi
School of particles and accelerators, IPM, Iran
Chiral effcts in QCD Plasma

Motivated by fluid/gravity duality results, the chiral transport phenomena have been broadly studied in the context of relativistic hydrodynamic in recent years. After a brief review of relativistic hydrodynamics, I will discuss about the chiral transport in rotating QCD fluid when coupled to an external magnetic field. Specifically, I will explain how the microscopic anomalies may be macroscopically detected in the physical observable in QGP experiments, due to the chiral effects.

Jahed Abedi
Department of physics, Sharif University of Technology, Iran
Echoes from the Abyss: Evidence for Planck-scale structure at black hole horizons

In classical General Relativity (GR), an observer falling into an astrophysical black hole is not expected to experience anything dramatic as she crosses the event horizon. However, tentative resolutions to problems in quantum gravity, such as the cosmological constant problem, or the black hole information paradox, invoke significant departures from classicality in the vicinity of the horizon. It was recently pointed out that such near-horizon structures can lead to late-time echoes in the black hole merger gravitational wave signals that are otherwise indistinguishable from GR. We search for observational signatures of these echoes in the gravitational wave data released by advanced Laser Interferometer Gravitational-Wave Observatory (LIGO), following the three black hole merger events GW150914, GW151226, and LVT151012. In particular, we look for repeating damped echoes with time-delays of 8M logM (+spin corrections, in Planck units), corresponding to Planck-scale departures from GR near their respective horizons. Accounting for the “look elsewhere" effect due to uncertainty in the echo template, we find tentative evidence for Planck-scale structure near black hole horizons at 2.6-2.9 significance level (corresponding to false detection probability of 1 in 100-270). Future data releases from LIGO collaboration, along with more physical echo templates, will definitively confirm (or rule out) this finding, providing possible empirical evidence for alternatives to classical black holes, such as in firewall or fuzzball paradigms.

Glenn Barnich
Université Libre de Bruxelles and and International Solvay Institutes, Belgium
BMS current algebra and central extension

The Bondi mass loss formula has been central in the context of early research on gravitational waves. We show how it can be understood as a particular case of BMS current algebra and discuss the associated central extension.

Hamid Afshar
School of physics, IPM, Iran
Horizon fluff, semi-classical black hole microstates

According to the horizon fluff proposal microstates of a generic black hole belong to a certain subset of near horizon soft hairs that cannot be extended beyond the near horizon region. In this talk we clarify further this picture for BTZ black holes and their microstates. In particular, we show that BTZ black hole microstates are in general among the set of conic defects or their Virasoro descendants, provided we impose a (Bohr-type) quantization condition of the angular deficit. We provide canonical and microcanonical descriptions of the statistical mechanical system associated with BTZ black holes and their microstates, and relate them. As a further non-trivial check we show that the horizon fluff proposal precisely reproduces the expected logarithmic corrections to the BTZ entropy.

Seyed Morteza Hosseini
Dipartimento di Fisica, Università di Milano–Bicocca, Italy
Microstates of AdS black holes and supersymmetric localization

The gauge/gravity duality provides a nonperturbative definition of quantum gravity. On the other hand, supersymmetric localization allows one to reduce the path integral of a quantum field theory into a matrix integral, and compute some exact results for supersymmetric observables in the strongly coupled regime. It thus gives very precise predictions for the gauge/gravity duality. In this talk I explain how to use the combination of these ideas in order to derive the black hole entropy in asymptotically Anti de Sitter spacetimes in four and five dimensions.

Arash Arabi Ardehali
School of physics, IPM, Iran
The four-dimensional Cardy formula and its violation through an asymptotic Higgs mechanism

There have been arguments in the literature implying a universal Cardy formula for 4d superconformal field theories (SCFTs). In this talk I will explain the formula, and show that the arguments for it do not apply in general, and that in fact the formula receives a modification in certain interesting 4d SCFTs. The previously overlooked mechanism through which this modification occurs is an "asymptotic Higgs mechanism".