Banff International Research Centre

Modern Developments in M-Theory
12-17 January, 2014

This version: January 12, 2014

Meals

*Breakfast (Buffet): 7:00–9:30 am, Sally Borden Building, Monday–Friday
*Lunch (Buffet): 11:30 am–1:30 pm, Sally Borden Building, Monday–Friday
*Dinner (Buffet): 5:30–7:30 pm, Sally Borden Building, Sunday–Thursday
Coffee Breaks: As per daily schedule, Foyer of Trans-Canada Pipeline Pavilion

*Please remember to scan your meal card at the host/hostess station in the dining room for each meal.

Schedule (updated January 9, 2014)

Monday January 13, 2014

9:00 AM - 9:30 AM	*Introduction to BIRS*
9:30 AM -10:30 AM	Rastelli
10:30 AM - 11:00 AM	*Coffee Break*
11:00 AM - 11:45 AM	Seok Kim
12:00 Noon - 6:00 PM	*Lunch and free time for discussions*
6:00 PM - 7:30 PM	*Dinner*
7:30 PM - 8:15 PM	Chong-Sun Chu
8:15 PM - 9:00 PM	Sorokin

Tuesday January 14, 2014

9:00 AM - 10:00 AM	Harvey
10:00 AM - 10:30 AM	*Coffee Break*
10:30 AM - 11:15 AM	Quigley
11:15 AM - 12:00 Noon	Berman
12:00 Noon - 6:00 PM	*Lunch and free time for discussions*
6:00 PM - 7:30 PM	*Dinner*
7:30 PM - 8:15 PM	Castro
8:15 PM - 9:00 PM	Nilsson

Wednesday January 15, 2013

8:30 AM - 9:30 AM	Marino
9:30 AM - 10:15 AM	Sethi
10:15 AM – 6:00 PM	*Free time*
6:00 PM - 7:30 PM	*Dinner*
7:30 PM - 8:15 PM	Robbins
8:15 PM - 9:00 PM	Tomasiello

Thursday January 16, 2013

9:00 AM - 10:00 AM	Horava
10:00 AM - 10:30 AM	*Coffee Break*
10:30 AM - 11:15 AM	Kimyeong Lee
11:15 AM - 12:00 Noon	Kovacs
12:00 Noon - 6:00 PM	*Lunch and free time for discussions*
6:00 PM - 7:30 PM	*Dinner*
7:30 PM - 8:15 PM	Papageorgakis
8:15 PM - 9:00 PM	Lambert

Friday January 17, 2013

9:00 AM - 10:00 AM	Green
10:00 AM - 10:30 AM	*Coffee Break*
10:30 AM - 11:15 AM	Basu
11:15 AM - 12:00 Noon	Van Raamsdonk
12:00 Noon - 1:30 PM	*Lunch*

** 5-day workshops are welcome to use the BIRS facilities (2nd Floor Lounge, Max Bell Meeting Rooms, Reading Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12 noon. **

Titles and abstracts:

1.1. Leonardo Rastelli: The superconformal bootstrap program

Abstract: I will outline the modern bootstrap program for four-dimensional theories with extended superconformal symmetry. The bootstrap equations neatly split into two classes. There are ``minibootstrap'' equations for supersymmetric quantities, which can be solved analytically, and full-fledged bootstrap equations for non-protected quantities, which can be studied numerically. The entire program relies on general symmetry principles, with no need for ``fields'' or Lagrangians. After a general introduction, I will mostly focus on the numerical results of the N=4 bootstrap, and on their interpretation in N=4 super Yang-Mills theory.

1.2. Seok Kim: M5-brane superconformal indices

Abstract: We study the superconformal index for the 6d (2,0) theory, counting its BPS local operators, from SYM on CP2 x S1.

1.3. Chong-Sun Chu: A non-abelian self-duality equation in six-dimensions and multiple M5-branes

Abstract: The low energy theory for a system of multiple M5-branes contains a non-abelian self-dual 3-form field strength. In this talk I will discuss a proposal for its equation of motion. Various solutions of the equation have been

constructed. We will discuss how these solution has properties that match precisely with the physics of the M5-branes system obtained from other analysis, such as the 11 dimensional supergravity and string theory.

1.4. Dmitri Sorokin: The M5-brane action revisited

Abstract: We will present an alternative form of the M5--brane action in which the six--dimensional worldvolume is subject to a covariant split into 3+3 directions by a triplet of auxiliary fields and discuss the relation of this action to the original form of the M5--brane action and to a Nambu--Poisson 5--brane action based on the Bagger--Lambert--Gustavsson model with the gauge symmetry of volume preserving diffeomorphisms.

2.1. Jeff Harvey: Mathieu moonshine, umbral moonshine and M5-branes

2.2. Callum Quigley: Mathieu moonshine and M5-branes

Over the past few years, a mysterious connection dubbed Mathieu Moonshine has emerged between the elliptic genus of K3 and representations of the sporadic group M24. Recently, this relation has been extended to N=2 string compactifications, where it was shown that dimensions of M24 reps appear in the new supersymmetric index of heterotic strings on K3xT2 and the Gromov-Witten invariants of their type IIA duals. I will report on work in progress that relates these results to the elliptic genus of a wrapped M5-brane. Along the way, we will see that the dimensions of M24 reps appear very naturally again in IIA, but now as counting the degeneracies of D4-D2-D0 bound states (ie. the Donaldson-Thomas invariants). Generalizations of these results will also be explored.

2.3. David Berman: Recent developments in double field theory and extended geometry for M-theory

Abstract: The talk will cover recent work on the global structure of DFT and extended geometry along with an exploration the role of local symmetries in these theories.

2.4. Alejandra Castro: Wilson lines in higher spin gravity

In this talk I will review the interpretation of Wilson line operators in the context of higher spin gravity in 2+1 dim and holography. I will show how a Wilson line encapsulates the thermodynamics of black holes. Furthermore it provides an elegant description of massive particles. This opens a new window of observables which will allow us to probe the true geometrical nature of higher spin gravity.

2.5. Bengt Nilsson: Topologically gauged CFTs in 3d: solutions, AdS/CFT and higher spins

We review the coupling of conformal supergravity to CFTs in three dimensions with eight supersymmetries. The so obtained SO(N) models have a new kind of scalar potential that gives rise to a number of possible background geometries. These are specified by a sequence of values for the parameters in the standard topologically massive gravity action that arises after the conformal symmetry breaking. Solutions corresponding to these values are identified, all of which are critical or special in some sense. Connections to AdS/CFT are also discussed including the role of Neumann boundary conditions and conformal higher spins in 3d.

3.1. Marcos Marino: Exact results and non-perturbative effects in M-theory

Abstract: The partition function on ABJM theory on a three-sphere can be computed by localization in terms of a matrix integral, and this leads to a derivation of the N^{3/2} behavior for a theory of M2 branes. This partition function contains however much more information, and in the last year its complete large N expansion has been determined, including non-perturbative, exponentially small effects at large N. These effects correspond to non-perturbative corrections due to worldsheet and membrane instantons in string theory/M-theory. The resulting expansion shows in a manifest way that perturbative strings are radically insufficient in a complete theory: their contribution is divergent at finite string coupling, and membrane instantons are needed to cure these divergences. Mathematically, these non-perturbative effects turn out to be connected to topological string theory and its refinements, and to the quantization of algebraic curves.

3.2. Savdeep Sethi: Acceleration in string theory

3.3 Daniel Robbins: Constraining higher derivative corrections with T-duality

From a target space perspective, T-duality relates certain pairs of string theory backgrounds with a U(1) isometry. If we perform a Kaluza-Klein reduction on the corresponding circle, T-duality then acts as a symmetry of the reduced theory, and this symmetry can be argued to constrain the higher derivative couplings, which in turn constrains the couplings of the higher dimensional theory. I will explain an unsophisticated brute force implementation of this procedure and show how it can be used to completely fix the four-derivative action of type II O-planes coupling to NS-NS sector bulk fields.

3.4. Alessandro Tomasiello: All AdS7 solutions of type II supergravity

In M-theory, the only AdS7 supersymmetric solutions are AdS7 × S4 and its orbifolds. In this talk, I will describe a classification of AdS7 supersymmetric solutions in type II supergravity. While in IIB none exist, in IIA with Romans mass (which does not lift to M-theory) there are many new ones. The classification starts from a pure spinor approach reminiscent of generalized complex geometry. Without the need for any Ansatz, the method determines uniquely the form of the metric and fluxes, up to solving a system of ODEs. Namely, the metric on M3 is that of an S2 fibered over an interval; this is

consistent with the Sp(1) R-symmetry of the holographically dual (1,0) theory. One can obtain numerically many solutions, with D8 and/or D6 brane sources; topologically, the internal manifold M3 = S^3. Finally, I will describe some work in progress about the CFT6 duals to these solutions.

4.1. Petr Horava: TBA

4.2. Kimyeong Lee: The 6-dim (1,0) and (2,0) superconformal field theories.

We represent and explore these theories on R x S5/Zk by the supersymmetric 5-dim theories on R x CP2.

4.3. Stefano Kovacs: Membranes from monopole operators in ABJM theory

The duality proposed by Aharony, Bergman, Jafferis and Maldacena (ABJM), relating M-theory in an AdS4 x S7 background to an N=6 Chern-Simons matter theory, raised the possibility of using the AdS/CFT correspondence to gain new insights into aspects of the dynamics of M-theory. I will present a proposal for studying the ABJM duality in a genuinely M-theoretic regime. By focussing on a large angular momentum sector, it is possible to study the duality in a regime in which the gravitational background is eleven-dimensional and the physical states correspond to M2-brane excitations. On the gravity side this sector is well approximated by the pp-wave matrix model, which is weakly coupled. The dual gauge theory description involves monopole operators and a perturbative expansion can be constructed in the form of a Born-Oppenheimer approximation. I will show how the spectra computed on the two sides agree at leading order, thus verifying the validity of the ABJM duality beyond the previously considered type IIA limit. The agreement also provides a non-trivial independent test of the matrix model approach to M-theory.

4.4. Costis Papageorgakis: Revisiting soliton contributions to perturbative amplitudes

Abstract: It is often said that soliton contributions to perturbative processes in QFT are exponentially suppressed by a form-factor. Our aim is to provide a derivation of this statement by studying the soliton-antisoliton pair-production amplitude in diverse dimensions. This reduces to the calculation of a matrix element in the quantum mechanics on the soliton moduli space. We will investigate the conditions under which the latter leads to exponential suppression. We will also discuss how it suggests that the instanton-solitons of N = 2 SYM in 5D will not be suppressed and the implications for its relation to the (2,0) theory in 6D.

4.5. Neil Lambert: 5D Euclidean Yang-Mills and the M5-brane

There is a Euclidean 5D Maximally supersymmetric Yang-Mills theory with SO(5) R-symmetry. We study this theory and its relation to the (2,0) super algebra in 5+1 dimensions. We argue that, in analogy to the familiar case of 4+1D Super-Yang-Mills, this theory contains a hidden time-like dimension.

5.1. Michael Green: String scattering amplitudes, Feynman diagrams and M-theory

5.2. Anirban Basu: Constraining gravitational interactions in the M theory effective action

I shall discuss the nature of certain purely gravitational interactions in the derivative expansion of the M theory effective action. Based on assumptions about the structure of supersymmetry, this leads us to obtain the expressions for certain non-BPS operators in the effective action, part of the structure of which is fixed by superstring perturbation theory.

5.3. Mark van Raamsdonk: TBA