Exact Results in SUSY Gauge Theories in Various Dimensions

Report of Contributions

https://indico.cern.ch/e/292089

Contribution ID: **0** Type: **not specified**

The Physics of Sphere Partition Functions and M2-brane Surface Operators

Monday 11 August 2014 10:30 (1 hour)

We will characterize the physical content of the partition function of conformal and superconformal field theories on a sphere. These results will be used to give a complete microscopic gauge theory description of arbitrary M2-branes ending on M5-branes wrapped on a Riemann surface.

Presenter: GOMIS, Jaume (Perimeter Institute)

Contribution ID: **1** Type: **not specified**

Curved Space Supersymmetry and the Partition Function

Monday 11 August 2014 14:00 (1 hour)

The study of supersymmetric quantum field theories on compact manifolds has led to a plethora of new exact results in recent years. One of the simplest observable in this context is the supersymmetric partition function on a manifold M, Z_M, which can often be computed exactly.
In the case of theories with four supercharges in flat space, I will explain some general properties of Z_M which can be understood on general ground. This understanding explains many properties of previously obtained localization results and makes sharp predictions for future computations.

Presenter: CLOSSET, Cyril (Simons Center)

Contribution ID: **2** Type: **not specified**

Witten Index and Wall Crossing

Tuesday 12 August 2014 10:30 (1 hour)

We compute the Witten index of one-dimensional gauged linear sigma models with at least N=2 supersymmetry. In the phase where the gauge group is broken to a finite group, the index is expressed as a certain residue integral. It is subject to a change as the Fayet-Iliopoulos parameter is varied through the phase boundaries. The wall crossing formula is expressed as an integral at infinity of the Coulomb branch. The result is applied to many examples, including quiver quantum mechanics that is relevant for BPS states in d=4 N=2 theories.

Presenter: HORI, Kentaro (Kavli IPMU)

Contribution ID: **3** Type: **not specified**

Wall-Crossing, Quiver Invariants, and Index for d=1 GLSM

Tuesday 12 August 2014 14:00 (1 hour)

Witten index of d=1 N=2,4 supersymmetric gauged quantum mechanics is considered. A canonical set of examples is the N=4 quiver dynamics, well-known to capture wall-crossing behaviors of BPS states of d=4 N=2 theories. Such wall-crossing behaviors, as we change FI constants continuously, is in fact generic for these supersymmetric theories.
For N=4 quivers, index were traditionally computed either by Coulomb or Higgs approximations. However, this is neither the most efficient nor the most complete computation. The Coulomb one in particular is known to miss a large number of wall-crossing-safe states, known as quiver invariants, After outlining recent progress on this front, we turn to honest and complete Witten index computation via localization.

While the naive localization argument seems to preclude wall-crossing behvaior, this is merely due to neglecting important subtleties with new flat or runaway asymptotic direction that emerges when some of FI constant vanishes. After taking account of this subtlety, one arrives at universal index formula, via JK residue, determined entirely by field contents and R-charge assignment, which reproduces most up-to-date results in literature, also reproducing many wall-crossing formulae. We close with diverse examples, and illustrate how invariant d=2 indices and wall-crossing d=1 indices should be related. Also, we comment on the wall-crossing-safe subsector of d=1 GLSM, analogous to the quiver invariants, and propose how this invariant subsector might be counted again as a path integral.

Presenter: YI, Piljin (KIAS)

Contribution ID: **4** Type: **not specified**

The Coulomb Branch Formula for Quiver Moduli Spaces

Wednesday 13 August 2014 10:30 (1 hour)

The semi-classical description of BPS bound states of 4d N=2 supersymmetric theories naturally gives rise to a N=4 quiver quantum mechanics (QQM). The regime where the constituents of the bound states have a finite spatial separation corresponds to the Coulomb branch of the QQM. I will explain in this talk how the bound state perspective leads to the Coulomb Branch Formula. This is an explicit formula for the computation of the BPS index of BPS bound states in terms of a set of invariants associated to 'single-centered' or 'pure Higgs' states. Suitable specialization of the Coulomb Branch Formula gives topological invariants of the quiver moduli space, which parametrizes semi-stable quiver representations

Presenter: MANSCHOT, Jan (U Lyon)

Contribution ID: **5** Type: **not specified**

New Methods in Supersymmetric Theories and Emergent Gauge Symmetry

Wednesday 13 August 2014 14:00 (1 hour)

It is remarkable that light or even massless spin 1 particles can be composite. Consequently, gauge invariance is not fundamental but emergent. This idea can be realized in detail in supersymmetric gauge theories.
We will describe the recent development of non-perturbative methods that allow to test this idea. One finds that the emergence of gauge symmetry is linked to some results in contemporary mathematics. We speculate on the possible applications of the idea of emergent gauge symmetry to realistic models.

Presenter: KOMARGODSKI, Zohar (Weizmann Inst.)

Contribution ID: **6** Type: **not specified**

Quantum geometry and small distances in M-theory

Thursday 14 August 2014 10:30 (1 hour)

By using localization, we derive exact and closed expressions for partition functions of N=8 Chern-Simons-matter theories. This allows us to address the nature of quantum geometry and of small distances in M-theory. We show that, although classical geometry is modified due to membranes, there is a smooth interpolation from the semiclassical gravity regime all the way down to the Planck scale. In these examples, geometry is not discretized and there is no natural notion of a minimum distance.

Presenter: MARINO BEIRAS, Marcos (Univ Geneva)

Contribution ID: **7** Type: **not specified**

Quantum Geometry of Calabi-Yau manifolds from GLSM

Thursday 14 August 2014 14:00 (1 hour)

I discuss the power of gauge theory techniques in the context of gauged linear sigma models (GLSMs) with Calabi-Yau manifolds as their target spaces, so as to analyze the string quantum geometry of Calabi-Yau manifolds, arising from perturbative and non-perturabtive string worldsheet corrections. The former corrections are associated to a certain characteristic class of the Calabi-Yau target space, which arises naturally in the GLSM picture. The latter corrections correspond to Gromov-Witten invariants of the target space. I briefly comment on higher genus Gromov-Witten invariants for Calabi-Yau threefolds.

Presenter: JOCKERS, Hans (Univ Bonn)

Contribution ID: **8** Type: **not specified**

Dualities in two-dimensional nonabelian gauge theories

Friday 15 August 2014 10:30 (1 hour)

In this talk we will discuss various advances in Seiberg-like dualities in two-dimensional gauge theories with (2,2) and (0,2) supersymmetry. We begin with a quick review of the (2,2) supersymmetric CPˆn model and nonabelian analogues, and review other (2,2) and (0,2) dualities, such as in gauge theories with both fundamentals and antifundamentals. In two dimensions, the gauge field has no dynamics, so it is possible to get a very concrete handle on IR behaviors, and also to see some phenomena one would not expect in four dimensions, such as dualities between abelian and nonabelian gauge theories. In addition, techniques such as supersymmetric localization enable for example exact partition function computations, which form a powerful tool for checking dualities, as we shall discuss. If time permits, we will also discuss 'decomposition,' relating two-dimensional nonabelian gauge theories with center-invariant matter to disjoint unions of nonabelian gauge theories with variable discrete theta angles.

Presenter: SHARPE, Eric (Virginia Tech)

Contribution ID: **9** Type: **not specified**

Self-dual Strings and 2D SYM

Friday 15 August 2014 14:00 (1 hour)

We study the system of M2-branes suspended between parallel M5-branes using ABJM model with a natural half-BPS boundary condition. For small separation between M5-branes, the worldvolume theory is shown to reduce to a 2D N=(4,4) super Yang-Mills theory with some similarity to q-deformed Yang-Mills theory. The gauge coupling is related to the position of the branes in an interesting manner. The theory is considerably different from the 2D theory proposed for multiple "M-strings". We make a detailed comparison of elliptic genus of the two descriptions and find only a partial agreement.

Presenter: HOSOMICHI, Kazuo (Yukawa Institute)

Contribution ID: **10** Type: **not specified**

Gauge theories, quantum algebras and integrable systems

Monday 18 August 2014 10:30 (1 hour)

Equivariantly deformed N=2 four-dimensional gauge theories in the limit when one epsilon-deformation parameter is set to zero relate to quantum integrable systems. I will describe in details the correspondence for a large class of N=2 theories (quiver gauge theories)

Presenter: PESTUN, Vasily (IHES)

Contribution ID: **11** Type: **not specified**

Supersymmetric Partition Sums of 2d (4,4) GLSMs

Monday 18 August 2014 14:00 (1 hour)

In the first part of this talk, we discuss the equivariant elliptic genera of ALE and ALF manifolds. The elliptic genera exhibit interesting pole structure as a function of the chemical potentials. We use this to decompose the answers into polar terms that exhibit wall-crossing and universal terms. We also discuss applications of our results to counting of BPS world-sheet spectrum of self-dual strings in the 6d N=(2,0) theories.
In the second part of the talk, we consider two-dimensional N = (4, 4) supersymmetric gauge theories which do not have classical Higgs branches. These theories however are believed to have isolated quantum Higgs vacua with a mass gap. We provide a field theoretic argument for the existence of such vacua.

Presenter: LEE, Sungjay (Univ Chicago)

Contribution ID: **12** Type: **not specified**

Cluster algebras from 2d gauge theories

Tuesday 19 August 2014 10:30 (1 hour)

In the first part of the talk we study some dualities of two-dimensional supersymmetric N=(2,2) gauge theories, reminiscent of 4d Seiberg duality, focusing on chiral and twisted chiral rings and the so-called sphere partition function. In the second part we observe that, when applied to quiver gauge theories, those dualities realize the cluster algebras of Fomin and Zelevinsky in their full completeness, with consequences in physics and mathematics.

Presenter: BENINI, Francesco (Simons Center)

Contribution ID: **13** Type: **not specified**

General instanton counting and 5d SCFT

Tuesday 19 August 2014 14:00 (1 hour)

Instanton partition functions of 5d N=1 gauge theories are Witten indices for the ADHM gauged quantum mechanics with (0,4) SUSY. We derive the integral contour prescriptions for these indices using the Jeffrey-Kirwan method, for gauge theories with hypermultiplets in various representations. The results can be used to study various 4d/5d/6d QFTs. In this paper, we study 5d SCFTs which are at the UV fixed points of 5d SYM theories. In particular, we focus on the Sp(N) theories with N_f <8 fundamental and 1 antisymmetric hypermultiplets, living on the D4-D8-O8 systems. Their superconformal indices calculated from instantons all show E type symmetry enhancements.It is crucial to understand the UV incompleteness of the 5d SYM, coming from small instantons in our problem. We explain in our examples how to fix them.

Presenter: PARK, Jaemo (Postech)

Contribution ID: **14** Type: **not specified**

Exact Solutions of 2d Supersymmetric Gauge Theories

Thursday 21 August 2014 10:30 (1 hour)

We study dynamics of two-dimensional non-abelian gauge theories with N=(0,2) supersymmetry that include N=(0,2) supersymmetric QCD and its generalizations. For a range of parameters where supersymmetry is not dynamically broken at low energies, we give a complete description of the low-energy physics in terms of 2d N=(0,2) SCFTs using anomaly matching and modular invariance.

Presenter: GADDE, Abhijit (Caltech)

Contribution ID: **15** Type: **not specified**

Confinement and 4-manifolds

Wednesday 20 August 2014 14:00 (1 hour)

In this talk I will survey a connection between two very challenging problems, one in physics and one in math. The physics problem involves quantitative understanding of confinement in a system with least amount of supersymmetry that has been studied so far and that has a wide range of applications, from semi-realistic string models to qualitatively new examples of gauge-gravity duality. Surprisingly, the rich physics of this system translates into incredibly rich mathematics of the only remaining unsolved case of the Poincare conjecture.

Presenter: GUKOV, Sergei (Caltech)

Contribution ID: **16** Type: **not specified**

On M5-branes

Wednesday 20 August 2014 10:30 (1 hour)

Presenter: LEE, Kimyeong (KIAS)

Contribution ID: **17** Type: **not specified**

Coulomb branch and the moduli space of instantons

Thursday 21 August 2014 14:00 (1 hour)

I will explain how the Coulomb branch of certain 3d N=4 generalised quiver gauge theories can be used to compute the Hilbert series of the moduli space of k G-instantons, for any simple Lie group G (including non-simply laced ones). The generalized quivers are over-extended untwisted affine Dynkin diagrams.

Presenter: CREMONESI, Stefano (Imperial College)

Contribution ID: **18** Type: **not specified**

Exact results for probes of Conformal Field Theories

Friday 22 August 2014 10:30 (1 hour)

We consider a heavy probe coupled to a general four-dimensional conformal field theory, and argue that a variety of interesting quantities are determined in terms of a single function, the Bremsstrahlung function, that depends on the probe and on the theory. For the particular case of a heavy probe coupled to N=4 super Yang Mills, we use localization techniques to determine the corresponding Bremsstrahlung function exactly for various gauge groups and representations. We present a number of applications, from computations of exact transport coefficents to a novel prediction for string perturbation theory.

Presenter: FIOL, Tomeu (Univ Barcelona)

Contribution ID: **19** Type: **not specified**

The N=8 superconformal bootstrap in three dimensions

Friday 22 August 2014 14:00 (1 hour)

There has been a lot of recent progress in applying the conformal bootstrap technique to obtain exact non-perturbative information about various conformal field theories. In this talk, I will use the conformal bootstrap to study superconformal field theories with N=8 supersymmetry in three dimensions. In particular, I will provide bounds on various operator dimensions and OPE coefficients in these theories.

Presenter: PUFU, Silviu (Univ Princeton)

Contribution ID: **20** Type: **not specified**

Exact results for 5D supersymmetric Yang-Mills on toric Sasaki-Einstein manifolds

Tuesday 19 August 2014 15:30 (1 hour)

I will review the localization on 5D Yang-Mills theory with matter on toric Sasaki-Einstein manifolds. I wil review some contact toric geometry, briefly explain the calculation and its relation to Calabi-Yau cone. I will discuss the conjecture for the full answer and some other open problems.

Presenter: ZABZINE, Maxim (Univ Uppsala)

Contribution ID: **21** Type: **not specified**

Localization and quantum AdS_4/CFT_3 holography

Thursday 21 August 2014 15:30 (1 hour)

I will review the calculation of the partition function of 3d supersymmetric field theories on Sˆ3 using the fermi-gas approach to solve the matrix integral. The resulting expression is an Airy function and is valid perturbatively to all orders in 1/N for a wide class of theories (including ABJM). This suggests that a similar formula can be derived by studying quantum gravity on AdS_4. I will explain several of the steps needed to implement this idea and some intriguing results.

Presenter: DRUKKER, Nadav (Humboldt University)