Research Networking Programmes

Science Meeting – Scientific Report

Scientific report (one single document in WORD or PDF file) should be submitted online within two months of the event. It should not exceed seven A4 pages.

Proposal Title: Supersymmetry, geometry and holography

Application Reference N°: Science Meeting 4794

1) Summary (up to one page)

The search for string theory solutions that might lead to low energy models of phenomenological interest has put forward the study of flux backgrounds. These are solutions of string theory characterised by non-zero values of certain gauge potentials, which are higher dimensional generalisations of the electro-magnetic potential. The application of differential geometric techniques, like G-structures and Generalised Complex Geometry, has allowed for very important progress in the understanding of such new backgrounds. Flux backgrounds of the same kind also appear in the construction of the gravity solutions relevant for the gauge/gravity duality. In this case, holography allows to map geometrical structures on the gravity side to interesting quantities in the field theory.
The aim of this workshop was to give an up-to-date overview of the recent research on different aspects of flux backgrounds, their geometry and their concrete applications to gauge/gravity duality.
The main topics according to which talks were organised are

- Recent developments in the study of supersymmetry in curved backgrounds, their application to the computation of partition functions and their gravity dual.
- New developments in consistent truncations and their applications to the gauge/gravity duality
- Generalised Geometry and it applications to the study of gauge theories

2) Description of the scientific content of and discussions at the event (up to four pages)

This workshop aimed at exploring the recent activity in the broad area of string compactifictions with fluxes, their links with geometry and their applications to holography. The main topics discussed during the workshop are

- Supersymmetric gauge theories on curved backgrounds. Coupling supersymmetric gauge theories to gravity allows computing quantities like partition functions via localisation. In the workshop recent results about the general condition that the curved manifolds have to satisfy in order to have supersymmetry have been discussed. One can use gauge/gravity duality to find the supergravity solution dual to such theories, to have alternative or complementary results. Explicit examples have been discussed as well as possible approaches to go beyond the known results.

- Generalised Geometry and its applications to the gauge/gravity duality. Understanding of the geometry of the supergravity solutions dual to gauge theories can help understanding the gauge theories themselves. Also dualities on the gravity side can be used to generate new supergravity solutions dual to deformation of new gauge theories. The proposal of using non abelian T-duality has been discussed and some examples of new background have been shown. The interpretation of the new solutions is not fully clear and has been the focus of many discussions.

- Generalised Geometry can be used to give an interpretation of the hypermultiplet's moduli space of $N=2$ gauge supergravities in terms of moment maps of symmetries of the generalised tangent bundle. This approach has interesting extensions that have been discusses in length during the workshop.

- Extension of the AdS/CFT correspondence to flat space. A proposal has been put forward about how to extend the gauge/gravity duality beyond the near horizon limit.

- The AdS/CFT correspondence for M5 branes. It is still not known what the gauge theory dual to a stack of M5 brane should be. After a summary of the existing proposals, a new one, involving periodic time, has been discussed. The proposal raised several questions and doubts, a very lively discussion followed.

- New gauged supergravities and their application to de Sitter vacua and the gauge/gravity correpondence for three-dimensional gauge theories. It is by now clear that maximally gauged supergravity is not unique. Applications of these results to have new 4d vacua relevant for phenomenology and the AdS/CFT correspondence with 3d gauge theories have been discussed.

3) Assessment of the results and impact of the event on the future directions of the field (up to two pages)

It is hard to assess what the results of a two-day workshop can be. The strength of the workshop has been to have a critical mass of scientist working on connected topics in order to have very lively and useful interactions and discussions. The participants are among the most prominent and active European researchers in the field, and the discussions during this workshop are likely to give rise to new collaborations and new ideas.
Examples of future directions are

- M-theory origins of the new phases of four-dimensional maximal gauged supergravity: it is still not clear what it is the eleven-dimensional interpretation of these new sugra solutions. The use of Extended Generalised Geometry can shed light on this question.
- Applications of (Extended) Generalised Geometry to the study of deformations of supersymmetric gauge theories. In a similar way as for the hypermultiplet structure, the condtion for having exactly marginal deformation of conformal supersymmetric theories can be given a geometric interpretation on the dual gravity side.
- Futher understanding of non-abelian T-duality and its applications to AdS/CFT.
- Extensions of the gauge/gravity correspondence to flat space. The proposal is still at infancy and many checks and analysis are required to put it on firmer groudnds.
- Susy breaking in flux compactifications and de Sitter solutions. Combing the gauge supergravity approach and the techniques of flux compactification can help in understanding how to embed de Sitter solutions in string theory.
- Further understanding of the gauge theory dual to M5-branes.

Annex 4a: Programme of the meeting

The meeting was held at the Institut Henry Poincare, Paris

Thursday 6 -- Salle 314

10.00 Nikolay Gromov
AdS/CFT spectral problem I
11.00 Coffee Break
11.30 Neil Lambert
Making Up for Lost Time:
A Euclidean View of the M5-brane
12.15 Daniel Waldram
"Hypermultiplet structures" and
the geometry of N=2 flux backgrounds

Lunch

14.30 Kyriakos Papadodimas
An infalling observer and the black hole
information paradox in AdS/CFT
15.15 Henning Samtleben
Matrix model holography: supergravity
in two dimensions
16.00 Coffee Break
16.30 Gianguido Dall'Agata
New maximal supergravities
17.15 Oscar Varela
Electric/magnetic duality in AdS4/CFT3

Friday 7 -- Salle 01

10.00 Nikolay Gromov
AdS/CFT spectral problem II
11.00 Coffee Break
11.30 Kostas Skenderis
AdS/Ricci flat correspondence
12.15 Carlos Nunez
Aspects of Gauge Strings Duality

Lunch

14.30 Jerome Gauntlett
Holographic Charge Density Waves
15.15 Alessandro Tomasiello
Supersymmetry on curved spaces
and holography
16.00 Coffee Break
16.30 Dario Martelli
Supersymmetric gauge theories on curved
manifolds and their gravity duals

17.15 Frederic Denef
On the wave function interpretation of higher spin dS holography

Annex 4b: Full list of speakers and participants

Speakers

Gianguido Dall'Agata (University of Padova)
Frederic Denef (University of Leuven)
Jerome Gauntlett (Imperial College, London)
Nikolay Gromov (King's College, London)
Neil Lambert (CERN)
Dario Martelli (King's College, London)
Carlos Nunez (University of Swansea)
Kyriakos Papadodimas (University of Groeningen)
Henning Samtleben (ENS, Lyon)
Kostas Skenderis (University of Southampton)
Alessandro Tomasiello (University of Milano-Bicocca)
Oscar Varela (University of Utrecht)
Dan Waldram (Imperial College, London)

Participants

Antonio Amariti (ENS Paris)
Benjamin Axel (ENS Paris)
Costas Bachas (ENS Paris)
Massimo Bianchi (Tor Vergata, Rome)
Iosif Bena (CEA Saclay)
Davide Cassani (King's College, London)
Sheer El Showk (CEA Saclay)
Maxime Gabella (CEA Saclay)
Mariana Grana (CEA Scaly)
Nick Halmagyi (LPTHE, Paris VI)
Harold Herbin (LPTHE, Paris)
Kazuo Hosomichi (Kyoto U., Yukawa Inst.)
Dan Israel (LPTHE, Paris)
Bernard Julia (ENS, Paris)
Amir Kashani-Poor (ENS Paris)
Vladimir Kazakov (Paris VI and ENS)
Elias Kiritsis (University of Crete and APC, Paris)
Stanislav Kuperstein (CEA Saclay)
Wenliang Li (APC, Paris)
Jakob Lorenzen (King's College, London)
Stefano Massai (CEA Saclay)
Ruben Minasian (CEA Saclay)
Ayan Mukhopadhyay (CPHT, Ecole Polytechnique)
Stam Nicolis (University of Tour)
Francesco Nitti (APC Paris)
Miguel Paulos (Brown U.)

Achilleas Passias (King's College London)
Gautier Solar (LPTHE, Paris)
Rodolfo Russo (Queen Mary London)
Vladislav Rychkov (CERN and Paris VI)
Daniel Thompson (VLB Bruxelles)
Hagen Triendl (CEA Saclay)
Ian Troost (ENS Paris)
Thomas Vanel (LPTHE, Paris)