Mainz Institute for Theoretical Physics
Johannes Gutenberg University

Scientific Program 'Stringy Geometry'
14-25 September 2015

Final Report

The field of research aimed at understanding the geometric structure that underlies perturbative and non-perturbative string theory has seen enormous and fast developments in recent years. There has been progress in the area both at a purely theoretical level, where various mathematical tools and different approaches have been worked out and used to give insights into the very nature of string theory and M-theory, and at a more phenomenological level, where these ideas have found applications in providing a better understanding of four-dimensional models that might result relevant for new physics, from a higher-dimensional (and more fundamental) perspective. The aim of the Program was to bring together leading experts in the various approaches that have been proposed, in order to stimulate exchanges of ideas and collaborations. Different lines of research in perturbative string theory go under the names of 'doubled geometry', 'generalised geometry' and 'double field theory', while the inclusion of non-perturbative effects yields additional modifications of the geometric structure, leading to the so-called 'exceptional field theory'. This variety of subjects was taken into account in inviting the scientists and in selecting the speakers.

Concerning the practical organisation of the activities, we decided to have two talks per day, in order to leave plenty of time for discussions after the talks. Moreover, we decided to put both talks in the morning, one at 10 and one at 11:30. The speakers had 45 minutes for the talk, while 15 minutes were left for discussions. There was a coffee break from 11 to 11:30, meant to stimulate further discussions after the first talk, and then the lunch break was just after the second talk. The afternoon was left free for work, discussions and collaborations. This schedule gave rise to a format which was very much appreciated by the participants. The atmosphere during the breaks was very lively and stimulating, and there were typically many questions during the discussion sessions.

In the first week we had four talks on double field theory (namely the talks by Park, Pezzella, Jeon and Aldazabal) and two on exceptional field theory (by Kleinschmidt and Cederwall), while the talks by Varela, Stelle, Massai and Tomasiello were more generally on supergravity theories and their solutions, including non-geometric ones. In the second week we had three talks on double field theory (Andriot, Grana and Hull), two on generalised geometry (Shabazi and Waldram) and one on exceptional field theory (de Wit). In the second week we also had the talks by Lozano on non-abelian T-duality, by Cardoso and Zaffaroni on black holes in string theory and M-theory and finally by Minasian on F-theory. Three talks (those of Cederwall, Massai and Shabhazi) were given at the blackboard and further contributed, in our opinion, to create an informal atmosphere which stimulated discussions during and after the talks. The slides of most other talks have been collected and made publicly available on the indico page of the program, visible at the address:

`https://indico.mitp.uni-mainz.de/conferenceDisplay.py?confId=29`

We list below the papers that have appeared on the arXiv so far, published by participants after the Program. Apart from the paper by Benincasa, all the others contain results that were presented at or developed within the Program.

1. O. Varela, "AdS$_4$ solutions of massive IIA from dyonic ISO(7) supergravity", arXiv:1509.07117;

2. A. Ashmore, D. Waldram, "Exceptional Calabi–Yau spaces: the geometry of $\mathcal{N} = 2$ backgrounds with flux", arXiv:1510.00022;

3. M. Cederwall, "Twistors and supertwistors for exceptional field theory", arXiv:1510.02298;

4. P.Benincasa, "On-shell diagrammatics and the perturbative structure of planar gauge theories", arXiv:1510.03642;

5. G. Aldazabal, M. Graña, S. Iguri, M. Mayo, C. Nuñez, J. A. Rosabal, "Enhanced gauge symmetry and winding modes in Double Field Theory", arXiv:1510.07644;

6. G. Bossard, A. Kleinschmidt, "Loops in exceptional field theory", arXiv:1510.07859.

2

As it emerges from the analysis of the scientific activity, we believe that the Program triggered new insights and ideas. Thus, we are very confident about the possibility that more publications, resulting from discussions and collaborations carried out during the Program, will appear in the near future.

The vast field of activities that goes under the name of 'stringy geometry' is still very prolific. Many questions are still open and many directions are still in their germinal state. We hope they will be the subjects of other scientific programs of similar kind in the forthcoming years.

November 10, 2015

The Organizers

Eric Bergshoeff (Groningen University)
Gianfranco Pradisi (University of Rome "Tor Vergata")
Fabio Riccioni (INFN Rome "La Sapienza")
Gabriele Honecker (JGU Mainz)