Cluster of Excellence Precision Physics, Fundamental Interactions and Structure of Matter
PRISMA

Mainz Institute for Theoretical Physics

Geometry, Gravity and Supersymmetry

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The main goal of the topical workshop was to bring together geometers and mathematical physicists working on problems related to two related areas: the classification of supergravity backgrounds and the study of moduli spaces and special geometric structures in order to first gauge the progress that has been made so far in these research areas, and then to identify directions in which these areas can develop further.

The core of the scientific tradition is to describe physical phenomena in terms of mathematics. A very early example of this is the description of our physical space as a 3-dimensional Euclidean space. This was continued with the introduction of Einstein's general relativity and the description of spacetime as a (pseudo) Riemannian manifold. The realization that the universe at large scales is geometric has deep scientific and philosophical significance. It also has the potential to answer key questions which include the origin and the final fate of the universe. The main idea of the topical workshop was to make a contribution to this outstanding tradition.

The emergence of new theories of gravity like strings and M-theory requires new types of geometry for their description. During the topical workshop, experts of the geometry community and theoretical physicists working on strings and M-theory gathered together to discuss the new developments on these two fields in order to find common ground and identify new areas for development. The workshop was attended by about 30 participants. The workshop set out to maximize interaction between the two groups of participants but at the same time it offered a platform for researchers to present their results. A typical day of the workshop included three 45-minute talks by leading experts as well as three 30-minute talks by younger researchers. There were two breaks, a 40-minute coffee break after the first two talks of the day and a longer 4-hour break including lunch time. This arrangement worked out very well. Discussions continued during the breaks.

Several areas have been identified which suggest that further collaboration between geometers and theoretical physicists may be of useful for both fields. For example many discussions took place between those that investigating the classification of supersymmetric solutions of supergravity theories and their geometrical properties and those using these solutions to explore physical applications. The first group was

represented by the speakers Ulf Gran, Stefan Ivanov, Thomas Mohaupt, Andrea Santi, Peter Sloane, Eiril Eik Svanes and the other group by the speakers Ulf Chow, Stefan Lozano, Thomas Ortin, Andrea Tomasiello and Achilleas Passias.

Another useful collaboration was identified, namely the one between the geo-meters working on the classification and properties of homogeneous spaces (and/or the theory of G-structures) and those applying these results in the context of strings and M-theory. The first group was represented by the speakers Dmitri Alekseevsky, Wolfgang Globke, Boris Kruglikov, the other group by the researchers Alexander Haupt and Andrea Santi.

The investigation by theoretical physicists into the structure of supergravity theories continues to have applications in geometry and more specifically into special geometric structures. Such developments from the physics perspective were presented in the talk by Antoine Van. The geometric perspective was presented by Peter-Simon Dieterich, Anton Galaev, and Antoine Suhr. There were related talks to the above topics by other researchers which include Alessio Marrani, Nano Romao, Carlos Shahbazi and Mohab Abou Zeid. Several papers already acknowledged the excellent scientific environment at the meeting. These papers reach out into various scientific communities, including high energy physics theory, differential geometry and representation theory.