

# 2022 Winter School in Mathematical Physics



**Sunday 9 January 2022 - Friday 14 January 2022**

**Les Diablerets**

## **Scientific Programme**

## Matthias Gaberdiel, "Deriving AdS/CFT"

I will explain recent progress towards deriving the AdS/CFT correspondence in the tensionless limit. In particular, I will explain in detail the duality between string theory on  $AdS_3 \times S^3 \times T^4$  with one unit of NSNS flux, and the symmetric orbifold of  $T^4$ . The key ingredients in showing this equivalence are a detailed understanding of the  $psu(1,1|2)$  worldsheet theory and its free field realisation. In particular, I will explain how to determine the spacetime spectrum of this string theory, thereby reproducing the single particle spectrum of the symmetric orbifold. I will also show that its correlation functions localise to those points in the string moduli space that allow for a holomorphic covering map to the spacetime sphere, and why this then reproduces exactly the symmetric orbifold correlators. Towards the end of the lectures I will also sketch how these ideas can be generalised to the case of tensionless strings on  $AdS_5 \times S^5$  that are dual to free  $N=4$  SYM in 4d.

## Marco Gualtieri, "Applications of Lie groupoids and Morita equivalence in mathematics and physics "

Lie groupoids and the Morita equivalences between them underlie the theory of stacks, and they form a good foundation for understanding the world of infinity-groupoids and higher stacks.

In this course we will explore two areas where Lie groupoids have recently been applied: the theory of singular differential equations and generalized complex geometry.

We will begin with an introduction to singular differential equations, exploring the differences between the regular and the irregular cases and how these are related to properties of the corresponding Lie groupoids.

We then move the topic of generalized complex and Kahler geometry, where Lie groupoids and Morita equivalences between them allow us to resolve several key questions in the subject, especially the local classification of generalized complex structures and the description of generalized Kahler metrics in terms of a generalized Kahler potential.

This will be a good opportunity to learn the basics of Lie groupoids and some interesting applications of the theory.

## Giovanni Felder - Yang-Baxter equation, Howe duality and dynamical Weyl group

After an introduction to the theory of the Yang-Baxter equation, Yangians and quantum loop groups, I will discuss some duality aspects in representation theory such as Schur-Weyl and (skew) Howe duality. I will explain how this duality appears in the hidden  $SO(4)$ -symmetry of the 1-dimensional Hubbard model, in the theory of the dynamical Weyl group and in the calculation of R-matrices for Fock spaces. The latter is work in progress with Tommaso Botta and Rea Dalipi.