SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Theoretical High Energy Physics

has the honor to invite you to the public defence of the PhD thesis of

Sofia Zhidkova

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Generalised Dualities in M-Theory

Promotors:
Prof. dr. Alexandre Sevrin (VUB)
Dr. Chris Blair (Instituto de Fisica Teorica UAM/CSIC, Spain)

The defence will take place on

Tuesday, July 2, 2024 at 1:30 p.m.
in auditorium D.0.08

Members of the jury

Prof. dr. Ben Craps (VUB, chair)
Prof. dr. Sophie de Buyl (VUB, secretary)
Prof. dr. Dominique Maes (VUB)
Dr. Emanuel Malek (Humboldt-Universität Zu Berlin, Germany)
Prof. dr. Giulio Collinucci (ULB)

Curriculum vitae

Sofia has obtained her Master's degree at the University of Cambridge, DAMTP in 2019, and a bachelor's degree from the Lomonosov Moscow State University at 2018. Before starting her PhD at VUB, she has focused on studying the first order formalism as a solution generating technique in gravity and cosmology.

During her PhD research at VUB, Sofia studied special type of dualities in supergravity and M-theory. Throughout this research she has managed to generate novel supergravity solutions, described in her publications. She has also assisted with various courses in theoretical physics and supervised a bachelor student.

Abstract of the PhD research

Dualities play a very important role in connecting different theoretical physics models to each other. In this thesis we discuss how to define and utilise a special type of dualities - generalised dualities in supergravity and M-theory. We study new types of generalised U-dualities, and use these to construct and analyse new dual solutions in M-theory.

We start with reviewing different types of dualities in string and M-theory, revisiting main algebraic and physics aspects of dualities and their mechanisms.

Then, we moved to exploring geometries with Exceptional Drinfeld Algebra (EDA) structure applied to studying the generalised U-duality - a special type of dualities in M theory. We provided classification of different "three-algebra geometries" that represents a specially chosen case of EDA, and studied in more depth examples that resulted in novel uplifts of seven dimensional maximal supergravity.

Using the exceptional geometry technique, we demonstrate how to generate a new solution in 11-dimensional supergravity starting with type IIA supergravity. We further analyse the features of newly generated solution and explore its AdS limit and charges.

We expanded our analysis to initial solutions with more complicated geometrical structure, generalising the results obtained earlier. We generated new solution described by an underlying 6-algebra structure.

Lastly, we conclude with some final thoughts, highlighting the contribution of the work we presented in understanding the nature of generalised dualities and how they serve as solution generating techniques, indicating a few further directions that could be interesting for further investigation.