SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Theoretical High Energy Physics

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

Sibylle DRIEZEN

to obtain the degree of Doctor of Sciences

Joint PhD with Swansea University

Title of the PhD thesis:

Geometrical approach to integrable and supersymmetric sigma models

Promotors:

Prof. Alexander Sevrin
Prof. Daniel C. Thompson

The defence will take place on

Tuesday September 17 2019 at 16.00h

in Auditorium E.0.12 at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. Steven Lowette (chairman, VUB)
prof. Prem Kumar (chairman, Swansea Univ.)
Prof. Sophie De Buyl (secretary, VUB)
Prof. Chris Blair (VUB)
Prof. Ivonne Zavala Carrasco (Swansea Univ.)
Prof. Stéphane Detournay (ULB)
Prof. Chris Hull (Imperial College London)

Curriculum vitae

Sibylle Driezen obtained her BSc. and Msc. degree in Physics from the University of Antwerp in 2015. She started her PhD in 2015 in the Theoretical High Energy Physics (TENA) research group of the Vrije Universiteit Brussel. In 2017 she enrolled in a joint PhD programme with Swansea University. Her research was funded by an aspirant fellowship of the FWO-Vlaanderen and dealt with integrable and supersymmetric sigma models with a focus on string theory. During her PhD she has published 5 peer-reviewed papers in international journals and 1 conference article. She participated at 15 conferences, workshops and schools and gave 7 oral presentations.

Abstract of the PhD research

One of the great successes of twentieth-century physics was the profound understanding of three of the four fundamental forces in a unified framework known as the Standard Model. The gravitational force, on the other hand, is well described only at longer distances by General Relativity while a satisfactory quantum mechanical description at short distances is still lacking. Such an obstacle begs for the unification of both descriptions, and ultimately all four forces, into a new theory of Quantum Gravity. At this moment, it is widely accepted that String Theory is the prime candidate to provide such a theory.

In String Theory, elementary particles are little vibrating strings. A string propagating through the universe sweeps out a two-dimensional surface called the worldsheet. The worldsheet dynamics is described by an intricate quantum field theory known as a sigma model. Quite remarkably, these tiny little strings are pretty demanding: the properties of the sigma model – such as its symmetries -- largely determine the geometry of the spacetime in which the string itself moves.

We consider various aspects of sigma model symmetries with an eye on their applications in string theory. For instance, supersymmetric sigma models enable us to describe the known matter content of our universe. These particular sigma models constrain the spacetime in which the string is allowed to propagate even more severely. In this way, a deep relationship with the area of fundamental mathematics starts to unravel. In particular, we will be able to encode the full local geometry of the spacetimes associated with supersymmetric sigma models into a single potential. Additionally, we can consider sigma models with boundaries to study the propagation of open strings. Open strings end on higher-dimensional surfaces, known as D-branes, whose geometry is hard to identify in general. As a guiding principle, we will use integrable sigma models, which have a large hidden symmetry, to dictate their geometry. Hence, in many ways, we study the intense relationship between geometries and sigma model symmetries.