SwissMAP
The Mathematics of Physics
National Centre of Competence in Research

Winter School in Mathematical Phyhsics 2019
Les Diablerets – January 6-11, 2019

Abstracts

Anne MOREAU (University of Lille – Laboratoire Paul Painlevé)

Vertex algebra and associated variety

Abstract :
The goal of this series of lectures is to introduce the theory of vertex algebras, with emphasis on their geometrical aspects.

Lecture 1
I start my lecture with the definition of a vertex algebra. I will then give various exemples of vertex algebras. Important examples of vertex algebras are those coming from Kac-Moody algebras, which are called affine vertex algebras.

Lecture 2
In the second lecture, I will talk about Poisson vertex algebras and will introduce the notion of associated variety. The associated variety of a vertex algebra is a certain Poisson variety whose geometry reflects some properties of the vertex algebra.

Lecture 3
Then I will focus on affine vertex algebras and W-algebras. The latter are certain vertex algebras attached with nilpotent elements of a simple Lie algebra. Their associated varieties are related to the geometry of Slodowy slices.

Lecture 4
In the last lecture, I will present some applications and open problems: Higgs branch conjecture, irreducibility conjecture of the associated variety, collapsing level problem for W-algebras, etc.

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Volker SCHOMERUS (University of Hamburg - DESY)

Lectures on Conformal Field Theory in D > 2

Abstract :
Many important systems in nature possess so-called critical points. The most famous example appears in the phase diagram of water. Physicists model critical points through conformal field theory. The lectures provide a basic introduction to the field, with some focus on the conformal symmetry group, its representation theory and harmonic analysis. In the first lecture I introduce the basic ingredients of conformal field theory, such as conformal symmetry, correlation functions and operator product expansions. Then I discuss conformal partial wave expansions as a central tool to analyze or even construct conformal field theories and interpret the conformal partial waves in terms of harmonic analysis on the conformal group. This re-interpretation turns out to imply a very fruitful connection with certain quantum mechanical integrable models. I employ this relation to develop a systematic theory of conformal partial waves as multi-variate hypergeometric functions. Time permitting I conclude with an outlook on recent applications, in particular within the conformal bootstrap programme.

Andras SZENES (University of Geneva)

Localization techniques and moduli spaces

Abstract :
The purpose of these lectures is to give a leisurely introduction to modern enumerative geometry. We begin by describing some classical methods, and then introduce the modern language of GIT and moduli spaces. After these preparations, we will turn to our central theme: computational methods, primarily the use of symmetries, and their applications in describing the cohomologies of moduli spaces of vector bundles over Riemann surfaces.