# JPM LYON 2014

# LECTURES:

## 1) "Wild Character Varieties and Wild Mapping Class Groups"

**Philip Boalch, École Normale Supérieure Paris**

Abstract:
The wild character varieties are a new class of symplectic/Poisson varieties that generalize the complex character varieties of Riemann surfaces. They were first defined analytically in 1999 and more recently there is a purely algebraic approach generalizing the quasi-Hamiltonian framework. I'll describe the main features of this story, including the link to meromorphic Higgs bundles/Hitchin systems/isomonodromy and the natural generalisations of the notions of "Riemann surface" and "mapping class group" that it leads to.

1) motivation, background, examples, Stokes phenomenon
2) wild nonabelian Hodge theory on curves
3) wild character varieties and Stokes local systems
4) wild mapping class groups

## 2) "Algebraic Structures in 1+1 Dimensional Massive (2,2) Theories"

**Gregory W. Moore, Rutgers University**

Lecture 1: Physical motivations for the web-formalism

A) Landau-Ginzburg models
B) Summary of questions and results (physical and mathematical).
C) Morse theory and supersymmetric quantum mechanics: Application to Landau-Ginzburg models
D) Boosted solitons and moduli spaces of zeta-instantons with fan boundary conditions
E) Motivations from knot homology
F) Movitations from spectral networks and 2d/4d wall-crossing.

Lecture 2: Webology Part 1: Plane and Half-plane webs

A) Plane webs. Convolution identity.
B) L-infinity algebra structure.
C) Representation of webs.
D) Interior amplitude and the definition of a Theory.
E) Half-plane webs: Convolution identity.

Lecture 3: Webology Part 2: Boundary amplitudes and Brane Categories

A) A-infinity algebra from half-plane webs
B) Definition of a Brane
C) A-infinity category of Branes
D) Extended webs
E) Strip webs and the complex of approximate ground states on the interval

Lecture 4: Webology Part 3: Interfaces and the Categorification of Wall-Crossing

A) Definition of an Interface
B) Composite webs and the composition of Interfaces
C) Homotopy equivalence and the A-infinity 2-category of Interfaces
D) Interfaces for vacuum homotopies of spinning weights: Categorification of 2d framed wall-crossing
E) Categorified Cecotti-Vafa wall crossing

## 3) "Quiver Moduli and BPS State Counts"

**Markus Reineke, Bergische Universität Wuppertal**

Abstract:
The aim of the course is to give a mathematical introduction to the following topics:

- quivers and their representations,
- construction and properties of quiver moduli,
- cohomology of quiver moduli,
- wall crossing formulas: HN recursion, KS wall-crossing, MPS wall-crossing, MPS degeneration,
- BPS state counts aka DT invariants of quivers,
- BPS state algebra aka COHA.

# SEMINARS

## 1) "Multicenter solutions, quivers, and their implication for black hole physics and the information paradox"

**Iosif Bena, CEA Saclay**

Abstract:
When uplifted to eleven dimensions certain multicenter solutions become smooth supergravity solutions that have the same charges and asymptotics as black holes and black rings, but do not have a horizon. I will review the construction and properties of these solutions and argue that they describe the typical microstates of extremal black holes. This in turn indicates that the classical extremal black hole solutions are just thermodynamic approximations that break down at the scale of the horizon. I will also discuss the extension of this to non-extreamal black holes and its implication for the black hole information paradox and for the recent firewall controversy.

## 2) "On cluster varieties associated with tree-shaped quivers"

**Frédéric Chapoton, Université Claude Bernard Lyon 1**

Abstract:
Cluster algebras have been introduced by Fomin and Zelevinsky around 2000, and have since then grown into a very large domain, with multiple connections to subjects of interest in mathematical physics. I will present a study of the algebraic varieties attached by the cluster theory to very simple quivers, namely those that have the shape of a tree. One can ask many questions about these varieties: are they smooth ? how many points do they have over finite fields ? what are their cohomology rings ? and so on. I will present some results on the matter.

## 3) "Progress about 4D N=2 BPS quivers"

**Michele Del Zotto, Harvard University**