**BFS-TFS Colloquium *(`Pure mathematics in Norway'* programme*)*:**

**Friday, August 31, 2018, University of Bergen, Department of Mathematics:**

# Rough paths, regularity structures and combinatorial Hopf algebras

*All talks are aimed at a broader mathematical audience*

## Schedule:

**Seminarroom-δ (4A9f-lunchroom):**

09:30 – 10:00 : Opening by BFS ++
10:00 – 10:15 : Coffee
10:15 – 11:05 : A. Chandra (Warwick), *Singular Stochastic Partial Differential Equations*
11:15 – 12:05 : I. Chevyrev (Oxford), *A rough path to regularity structures*

**Seminarroom-σ (4A5d):**

14:15 – 15:05 : D. Manchon (Clermont-Ferrand), *Combinatorial Hopf algebras and rough paths*
15:15 – 16:05 : Y. Bruned (Imperial College), *Renormalisation for singular SPDEs*

Abstracts:

Ajay Chandra: *Singular Stochastic Partial Differential Equations*
Singular stochastic partial differential equations naturally arise when looking at the aggregate behavior of many types of random spatial processes evolving in time. However we have only recently understood how to make mathematically rigorous sense of these equations, a key difficulty being that in the analysis of these equations one encounters infinities which must be systematically controlled through a process called renormalization. In this talk I will give examples of how singular SPDE arise as scaling limits of random systems, how these infinites arise and what they represent, and finally sketch how a new integration theory - the theory of regularity structures - allows us to treat these equations rigorously.

Ilya Chevyrev: *A rough path to regularity structures*
Rough paths grew out of the desire to construct a deterministic and robust theory of differential equations with rough drivers. It is known, however, that even in the simplest settings, no linear theory is able to provide a deterministic and continuous map from Brownian trajectories to solutions of stochastic differential equations. These considerations led Lyons to propose that drivers must be enhanced with extra information to a non-linear space, after which corresponding differential equations can be solved deterministically. It was recently realized by Hairer how the same idea can be used to tackle long-standing problems in stochastic PDEs. In this talk I will outline these developments and the impact they have had on stochastic analysis.

Dominique Manchon: *Combinatorial Hopf algebras and rough paths*
Following the pioneering work of K. T. Chen on iterated integrals, T. Lyons developed the theory of rough paths two decades ago, in order to handle a broad class of singular differential equations on vector spaces. I will introduce a Hopf-algebraic generalisation encompassing branched rough paths introduced by M. Gubinelli in 2008, and show how rough paths in this broader sense can be used as a tool for studying singular differential equations in some particular geometric situations, e.g. on homogeneous spaces. Emphasis will be put on the rich underlying algebraic framework, in particular, bialgebras in co-interaction (alias comodule-bialgebas), which also play a prominent role in the analysis of singular partial differential equations via M. Hairer's regularity structures.

Yvain Bruned: *Renormalisation for singular SPDEs*
The theory of regularity structures invented by Martin Hairer gives a robust framework for defining unique solutions to singular SPDEs (Stochastic Partial Differential Equations) in a systematic way. This theory provides a local description of the solution and renormalises the ill-defined products appearing in the equation. Algebraic structures are needed for organising and combining these two notions of locality and renormalisation. Indeed, two combinatorial Hopf algebras in co-interaction are used and allow us to consider a large class of SPDEs. In this talk, we will present these algebraic renormalisations and explain the properties of the solution obtained from them including a new stochastic calculus.

## Saturday, September 1, 2018, University of Bergen, Department of Mathematics:

**Research Seminar**, including Rosa Preiss, Alexander Schmeding ++. Interested participants are welcome!