Christian Krattenthaler: Combinatorics

Christian Krattenthaler offers Ph.D. thesis topics in the general areas of *Enumerative, Algebraic*, and *Asymptotic Combinatorics*. Specific topics of possible Ph.D. projects may be in:

- Enumeration of rhombus tilings, enumeration of domino tilings
- Bijections and tableaux combinatorics
- Symmetric functions
- Lattice path enumeration
- Partition theory
- Hypergeometric and basic hypergeometric series

A sample project is described in greater detail below. Depending on the taste and/or preferences of the Ph.D. student, also other thesis projects may be chosen.

Thesis project: Combinatorial Inequalities. The combinatorial literature is rich of — often conjectural — statements saying that there are more combinatorial objects of one kind then there are combinatorial onbjects of another kind. This includes positivity statements of combinatorially defined polynomials, unimodality statements, log-concavity or log-convexity statements, and variations thereof. Such statements appear frequently in (integer) partition theory, but they may also concern other classical combinatorial objects such as set partitions, permutations, or Young tableaux.

The set of available ready-to-use tools for the proof of combinatorial inequalities is relatively small. It includes:

- injections;
- an "asymptotic" approach in which one establishes an inequality for large values of (the) parameter(s), and then verifies it for the remaining, finitely many values with the help of a computer;
- the theory of stable polynomials;
- algebraic methods coming from combinatorial and algebraic geometry.

The goal of this project is to extend the available tools and methods and develop new ones in order to settle open conjectures in this area, including recent conjectures that arose around the Borwein Conjecture and the Bressoud Conjecture in partition theory.