Sussex OPSFOTA

Titles and abstracts

Tuesday 4th June 2019

Morning session

10:00-10:30 *Coffee*

10:30-11:20 Walter Van Assche

Discrete orthogonal polynomials and Painlevé equations

Abstract: Orthogonal polynomials on the real line always satisfy a three-term recurrence relation

$$xP_n(x) = P_{n+1}(x) + b_n P_n(x) + a_n^2 P_{n-1}(x).$$

The discrete orthogonal polynomials of Charlier and Meixner have nice recurrence coefficients a_n^2, b_n which are rational functions in n. We consider semi-classical extensions of these discrete orthogonal polynomials and investigate the recurrence coefficients of polynomials P_n satisfying the orthogonality

$$\sum_{k=0}^{\infty} P_n(k)P_m(k)\frac{(\alpha)_k(\beta)_k a^k}{(\gamma)_k k!} = 0, \qquad m \neq n,$$

and various limit cases. This gives generalized Charlier and Meixner polynomials and orthogonal polynomials with hypergeometric weights. We show that the recurrence coefficients satisfy discrete Painlevé equations in the variable n and also Painlevé differential equations in the continuous variable a. The solution needed for these orthogonal polynomials correspond to special function solutions involving Bessel functions, confluent hypergeometric functions and hypergeometric functions.

11:20-11:40 Coffee Break

11:40-12:30 Thomas Bothner

The finite-temperature Airy kernel determinant

Abstract: We will discuss recent advances in the analysis of the finite-temperature Airy kernel Fredholm determinant based on operator-valued Riemann-Hilbert techniques. The kernel itself appeared first in Johansson's 2007 work on edge scaling limits in the grand-canonical Moshe-Neuberger-Shapiro random matrix model, subsequently in the 2011 resolution of the KPZ scaling hypothesis for the KPZ equation with narrow wedge initial data by Amir, Corwin, Quastel and quite recently in the analysis of non-interacting fermions (Dean, Le Doussal, Matjumdar, Schehr 2016 - 2018) and Schur processes (Betea, Bouttier 2018).

12:30-2:00 Lunch

Afternoon session

2:00-2:50 Ali Taheri

Special Functions and Orthogonal Polynomials: Some Spectral Geometric Questions on Lie Groups and their Symmetric Spaces

Abstract: In the study of Lie groups and their symmetric spaces, special functions and orthogonal polynomials appear naturally in the description of irreducible unitary representations as well as the spectral resolution of invariant operators, in particular, the Laplace-Beltrami operator. In this talk, being motivated by applications of harmonic analysis and Littlewood-Paley theory to the context, I present a differential-spectral identity on the hypergeometric series (along with its various generalisations) that directly links to the zonal spherical functions on the these space and unifies and extends certain results on the scale of Legendre, Gegenbauer and Jacobi polynomials. I will then specialise to compact Lie groups and discuss and prove an improved Avakumovic-Hormander-Weyl type asymptotics for theis Weyl spectral counting function.

2:50-3:20 Coffee Break

3:20-4:10 Raffael Hagger

On Random Jacobi Matrices and Toeplitz Operators

Abstract: In the first part of my talk I will explain how to compute or approximate the spectrum of random Jacobi matrices using limit operator methods. It turns out that, in some sense, random Jacobi matrices have the 'largest' possible spectrum among all matrices. I will make this statement precise and show some examples. In the second part I will show that the same method can also be applied to Bergman and Fock spaces to compute essential spectra of Toeplitz operators, determine compactness of Hankel operators and more. In particular, I will present some recent results obtained together with Jani Virtanen.

4:10-5:00 Bernhard Beckermann

Spectral methods with orthogonal rational functions for solving equilibrium problems

Abstract: We are interested in computing the unknown density of an equilibrium problem in logarithmic potential theory where the support of the equilibrium measure is a finite union of disjoint intervals. Inspired by a Riemann-Hilbert approach, we reduce the problem to the solution of a system of singular integral equations with Cauchy kernels. We will recall a variant of the polynomial spectral method used by Sheehan Olver in a JAT paper from 2011, and introduce a new spectral method based on orthogonal rational functions, where an appropriate choice of the poles allows for speeding up the computations.

Joint work with Ana Matos (Lille)

7:30 Dinner in Brighton