

WORKSHOP ON COMBINATORIAL PHYSICS

Cardiff University, 17–19 December 2013

PROGRAMME OF TALKS

Tuesday 17th December

09:45–10:00 REGISTRATION
10:00–10:10 OPENING
10:10–11:00 Cameron
11:00–11:20 Hagendorf
11:20–11:50 BREAK
11:50–12:40 Prellberg
12:40–13:00 Mortimer
13:00–15:00 LUNCH
15:00–15:50 Cantini
15:50–16:40 Striker
16:40–17:10 BREAK
17:10–18:00 Fischer

Wednesday 18th December

10:00–10:50 Martin
10:50–11:10 Tate
11:10–11:40 BREAK
11:40–12:30 Zinn-Justin
12:30–12:50 Ponsaing
12:50–15:20 LUNCH
15:20–16:10 Sportiello
16:10–16:40 BREAK
16:40–17:30 Colomo
19:00–21:30 WORKSHOP DINNER

Thursday 19th December

10:00–10:50 Nienhuis
10:50–11:40 Bousquet-Mélou
11:40–12:10 BREAK
12:10–13:00 Dukes
13:00–14:30 LUNCH

- The registration and opening sessions, and all talks, will be held in **Room M/0.40** of the Mathematics Building (building 42 in square E3 of the Cardiff University map).
- All breaks will be held in **Room M/1.02** of the Mathematics Building.
- Note that another workshop, on *Optimal Decisions in Statistics and Data Analysis*, will be held on 17 & 18 December in other nearby rooms of the Mathematics Building.

TALK DETAILS

- **Mireille Bousquet-Mélou**, CNRS, Université Bordeaux, France. *Spanning forests in regular planar maps.*

We address the enumeration of p -valent planar maps (or fat graphs) equipped with a spanning forest, with a weight z per face and a weight u per connected component of the forest. Equivalently, we count the (dual) p -angulations equipped with a recurrent sandpile configuration. This enumeration problem also corresponds to the limit $q \rightarrow 0$ of the q -state Potts model on p -angulations.

Our approach is purely combinatorial. The associated generating function, denoted $F(z, u)$, is characterised by a system of equations. We derive from this system that $F(z, u)$ is differentially algebraic in z , that is, satisfies a differential equation in z with polynomial coefficients in z and u . This has recently been proved to hold for the more general Potts model on 3-valent maps, but via a much more involved and less combinatorial proof.

For $u \geq -1$, we study the singularities of $F(z, u)$ and the corresponding asymptotic behaviour of its n -th coefficient. For $u > 0$, we find the standard asymptotic behaviour of planar maps. At $u = 0$, we witness a phase transition, and when $u \in [-1, 0)$, we obtain an extremely unusual behaviour in $n^{-3}(\ln n)^{-2}$. To our knowledge, this is a new “universality class” for planar maps.

- **Peter Cameron**, Queen Mary University of London & University of St Andrews, UK. *Combinatorial Yang–Baxter.*
- **Luigi Cantini**, Université de Cergy-Pontoise, France. *Determinantal identities for doubly-refined enumerations of alternating sign matrices.*

Multiply-refined enumerations of alternating sign matrices (ASMs) have recently received renewed attention. In this talk, I will show that certain doubly-refined enumerations of ASMs, vertically symmetric ASMs and off-diagonal symmetric ASMs enjoy remarkable determinantal identities. All these identities follow from two master equations involving determinants of so-called generalised Gaudin polynomials.

- **Filippo Colomo**, Università di Firenze, Italy. *The Arctic Circle re-visited.*
- **Mark Dukes**, University of Strathclyde, UK. *The combinatorics of web worlds and web diagrams.*
- **Ilse Fischer**, Universität Wien, Austria. *Fully packed loops on triangles and path tangles.*
- **Christian Hagendorf**, Université catholique de Louvain, Belgium. *The nineteen-vertex model: from supersymmetry to combinatorics.*
- **Paul Martin**, University of Leeds, UK. *Partition categories, combinatorics and statistical mechanics.*
- **Paul Mortimer**, Queen Mary University of London, UK. *Walks on a triangular domain.*
- **Bernard Nienhuis**, Universiteit van Amsterdam, Netherlands. *Combinatorial points of the dilute loop model?*
- **Anita Ponsaing**, Université Pierre et Marie Curie, France. *The Brauer loop scheme with boundaries.*
- **Thomas Prellberg**, Queen Mary University of London, UK. *The pressure of surface-attached polymers and vesicles.*
- **Andrea Sportiello**, CNRS, Université Paris Nord, France. *On some permutational transition monoids with two generators.*

Various linear systems for generating functions have variables indexed by combinatorial objects

$X = X[I]$, and equations involving some ‘left-’ and ‘right-simplification’ operators, L and R , acting on X as a permutation on the base set I .

A simple case is as follows. Let X be a matching on $I = [2n]$, and say $(1, i)$ and $(j, 2n)$ are in X . Then L cyclically rotates $1, \dots, j - 1$, while R cyclically rotates $2n, 2n - 1, \dots, i + 1$. Clearly, L acts on X and LX with the same permutation, so $L^d = 1$ for some d , L^{-1} and R^{-1} can be defined, and L and R generate a group. This transition group on the set of matchings has remarkably many ergodic components, some of which are completely characterised. Variants and generalisations show similar properties. A partial comprehension of the components is achieved through a remarkably fine invariant of the dynamics, valued on integer partitions of $2n$.

The talk will be based on work done in collaboration with Quentin de Mourgues.

- **Jessica Striker**, North Dakota State University, USA. *Promotion, rowmotion and alternating sign matrices.*
- **Stephen Tate**, University of Warwick, UK. *Combinatorics and statistical mechanics.*
- **Paul Zinn-Justin**, CNRS, Université Pierre et Marie Curie, France. *The geometry of loop models.*

REFRESHMENTS

- Coffee, tea, soft drinks and snacks will be available free-of-charge throughout the workshop in Room M/1.02.
- Participants are also welcome to use the School of Mathematics Common Room, M/1.04. This room contains a Flavia drink machine, which provides a range of hot drinks at 20 pence per cup.

LUNCHES

Possible lunch venues are:

- The Maths Cybercafé on the Ground Floor of the Mathematics Building.
- The Cardiff city centre (squares D1, D2, E1 & E2 on the Cardiff University map). There are numerous cafes and restaurants in Queen Street, the St David’s Shopping Centre and the Capitol Shopping Centre.
- The University cafeteria in the Trevithick Building (building 58 in square E3 of the Cardiff University map). This is open for lunch until 14:00 each day, and is easily accessible from the back of the Mathematics Building by following a path along the railway line and using the footbridge shown in square E3 of the Cardiff University map.
- The University cafeteria in the Main Building (building 39 in square D3 of the Cardiff University map). This is open for lunch until 14:15 each day, and is easily accessible from the Mathematics Building by following Senghennydd Road to Cathays Station, and then crossing the railway line on a footbridge to reach Park Place.
- The cafeteria at the National Museum of Wales (building 58 in square E3 of the Cardiff University map). Open for lunch until 14:30 each day, except Monday.

DINNERS

- Possible dinner venues are restaurants in the Cardiff City Centre, or the University cafeteria in the Trevithick Building, which is open for dinner until 19:00 each day.

- For participants who are in Cardiff on the evening of Monday 16th December and wish to go for dinner in the Cardiff City Centre as a group, please meet at 19:30 in the foyer of the Maldron Hotel. The hotel is located in the triangular area between Penarth Road, St Mary Street and the railway line, in square D1 of the Cardiff University map.
- For participants who wish to go for dinner in the Cardiff City Centre as a group on Tuesday 17th December, please meet at 18:30 in the foyer of the Mathematics building.

WORKSHOP DINNER

- The workshop dinner will be held at 19:00–21:30 on Wednesday 18th December at the Maldron Hotel. Participants who wish to attend should provide a completed menu choice form and £25.00, in cash or cheque, to Christian Korff by 11:30 on Wednesday 18th December.

INTERNET AND COMPUTER ACCESS

- Access to the Cardiff University wireless network will be available free-of-charge throughout the workshop. Usernames and passwords will be provided at the start of the workshop.
- Internet access can also be obtained through *Eduroam*.
- Computer terminals will be available in Room M/0.35 of the Mathematics Building and the Maths Cybercafe throughout the workshop. For usernames and passwords which provide access to these terminals, please see Roger Behrend.

DISCUSSION ROOMS

- Rooms M/1.02 and M/1.10 of the Mathematics Building will be available to participants for discussions throughout the workshop. These rooms contain tables, chairs, whiteboards and whiteboard markers.

WALKING TOURS

- Walking tours of central Cardiff will be held at 13:45–14:45 on Tuesday 17th December, and 13:30–14:30 on Thursday 19th December. Further details will be provided during the workshop.

TOURIST ATTRACTIONS

Tourist attractions in Cardiff include:

- The National Museum of Wales, including the National Museum of Art. Building 52 in square D3 of the Cardiff University map. Open 10:00–17:00 each day, except Monday. Free admission.
- Cardiff Castle. Building 64 in square D2 of the Cardiff University map. Open 9:00–17:00 each day. Admission £11.00 (standard ticket) or £14.00 (premium ticket).
- The Millennium Stadium. Building 81 in square D1 of the Cardiff University map. Open 10:00–17:00 each day. Tours £9.50.

- Cardiff Bay, including the Wales Millennium Centre and the Wales National Assembly Building. Can be reached by foot (an approximately 30-minute walk), bus or train.

INSTITUTE OF PHYSICS GROUP AGM

- The Annual General Meeting of the Mathematical and Theoretical Physics Group of the Institute of Physics will be held at 13:30 in Room M/1.25 on Wednesday 18th December, followed by a Group Committee Meeting. The AGM is open to all Institute of Physics members.

WORKSHOP PHOTO

- A group photo of workshop participants will be taken at the start of the lunch break on Wednesday 18th December.