Twisted and quantum knot invariants

Durham, 13-15 December 2018.

Thursday	Friday	Saturday
	09:00-10:00 **Winnicka**	
	Coffee break	10:00-11:00 **Grabowski**
	10:30-11:30 **Ray**	*Coffee break*
	11:40-12:40 **Nagel**	11:20-12:20 **Politarczyk**
13:05-14:30 **Anghel**	*Lunch*	
14:45-15:45 **Aceto**	13:55-14:55 **Borodzik**	
Coffee Break	*Coffee Break*	
16:15-17:15 **Powell**	16:15-17:15 **Damiani**	
	Dinner	

Thursday December 13

- **Cristina Anghel** (Oxford University) **13:05-13:50+14:00-14:30.**

  Title: Coloured Jones polynomials and topological intersection pairings.
  Abstract: The world of quantum invariants started with the discovery of the Jones polynomial. Then, Reshitikhin-Turaev introduced a purely algebraic construction that having as input a quantum group produces link invariants. The coloured Jones polynomials $\{J_N(L,q)\}_N$ are sequences of link invariants constructed in this way using the quantum group $U_q(sl(2))$, whose first term is the original Jones polynomial. R. Lawrence introduced a sequence of topological braid group representations based on the homology of coverings of configuration spaces. Using that, Bigelow and Lawrence gave a homological model for the Jones polynomial, using its Skein relation nature. We will present a topological model for all coloured Jones polynomials. We will show that $J_N(L,q)$ can be described as graded intersection pairings between two homology classes in a covering of the configuration space in the punctured disc. This shows that the Lawrence representations are rich objects that contain enough information to encode all coloured Jones polynomials and possibly more. In the last part of the talk we will present some directions towards a geometrical categorification for $J_N(L,q)$ that can be defined out of this topological model.

- **Paolo Aceto** (Oxford University) **14:45-15:45.**

  Title: Rational cobordisms and integral homology.
  Abstract: We prove that every rational homology cobordism class in the subgroup generated by lens spaces contains a unique connected sum of lens spaces whose first homology embeds in any other element in the same class. As a consequence we show that several natural maps to the rational homology cobordism group have infinite rank cokernels, and obtain a divisibility condition between the determinants of certain 2-bridge knots and other knots in the same concordance class. This is joint work with Daniele Celoria and JungHwan Park.

- **Mark Powell** (Durham University) **16:15-17:15.**

  Title: Casson-Gordon invariants and Blanchfield pairings.
  Abstract: I will give an introduction to Casson-Gordon invariants and then explain their relationshop to twisted Blanchfield pairings.

Friday December 14

- **Kamila Winnicka** (University of Warsaw) **09:00-10:00.**

  Title: Forms over $\mathbb{C}[t, t^{-1}]$ and $\mathbb{R}[t, t^{-1}]$.
  Abstract: In this introductory talk, we recall a classification of hermitian forms over $\mathbb{F}[t, t^{-1}]$ for $\mathbb{F} = \mathbb{R}, \mathbb{C}$. The real case is well-known, while there are some subtleties concerning the complex case. The talk is based on a paper by Borodzik, Conway and Politarczyk.

- **Arunima Ray** (Max Planck Institut) **10:30-11:30.**

  Title: The 4-dimensional sphere embedding theorem.
  Abstract: The disc embedding theorem for simply connected 4-manifolds was proved by Freedman in 1982 and forms the basis for his proofs of the topological h-cobordism theorem, the topological 4-dimensional Poincaré conjecture, 4-dimensional topological surgery, and the classification of simply connected 4-manifolds. The disc embedding theorem for more general manifolds is proved in the book of Freedman and Quinn. However, the geometrically transverse spheres claimed in the outcome of the theorem are not constructed. We close this gap by constructing the desired transverse spheres. We also outline where transverse spheres appear in surgery and the classification of 4-manifolds and give a general 4-dimensional sphere embedding theorem. This is a joint project with Mark Powell and Peter Teichner.

- **Matthias Nagel** (Oxford University) **11:40-12:40.**

  Title: Slice disks in stabilized 4-balls.
  Abstract: We consider knots K which bound (nullhomotopic) slice disks in a stabilized 4-ball, that is in $D^4 \# n S^2 \times S^2$. We explain how to construct examples of such disks, and discuss bounds on the minimal number n of stabilizations needed. Then we compare this minimal number to the 4-genus of K. This is joint work with Anthony Conway.

- **Maciej Borodzik** (University of Warsaw) **13:55-14:55.**

  Title: Signatures of linking forms.
  Abstract: Given a non-degenerate form over $\mathbb{F}[t, t^{-1}]$, where $\mathbb{F} = \mathbb{R}, \mathbb{C}$ we discuss various possible definitions of signatures. We discuss the behavior under Witt equivalence. In case a form is represented by a square matrix, we show establish a relation between the signatures of forms and the signatures of the representing matrix, generalizing a classical result by Matumoto. This is a joint work with Anthony Conway and Wojciech Politarczyk.

- **Celeste Damiani** (University of Leeds) **16:15-17:15.**

  Title: Alexander invariants for ribbon tangles.
  Abstract: Ribbon tangles are proper embeddings of tori and annuli in the 4-dimensional ball, bounding 3-manifolds with only ribbon singularities. We construct an Alexander invariant for these objects that induces a functorial generalisation of the Alexander polynomial. This functor is an externsion of the Alexander functor for usual tangles defined by Bigelow-Cattabriga-Florens and studied by Florens-Massuyeau. If considered on braid-like ribbon tangles, this functor coincides with the exterior powers of the Burau-Gassner representation. On one hand, we observe that the action of cobordsms on ribbon tangles endows them with a circuit algebra structure over the operad of cobordisms, and we show that the Alexander invariant commutes with the circuit algebra's composition. On the other hand, ribbon tangles can be represented by welded tangle diagrams: this allows to give a combinatorial description of the Alexander invariant.

Saturday December 15

- **Przemyslaw Grabowski** (University of Warsaw) **10:00-11:00.**

  Title: Finite orthogonal groups and periodicity of links.
  Abstract: The talk will be on an application of p-adic orthogonal groups in theory of periodic links. This is a joint work with Maciej Borodzik, Adam Król and Maria Marchwicka.

- **Wojciech Politarczyk** (University of Warsaw) **11:20-12:20.**

  Title: Cabling formula for twisted Blanchfield forms.
  Abstract: Many interesting examples of knots are obtained with the aid of the satellite construction. Therefore it is crucial to understand how knot invariants behave under this construction. In this talk we will discuss a cabling formula for twisted Blanchfield forms and associated twisted signatures. As an example we will rederive classical cabling formulas of Litherland for Casson-Gordon signatures. This is a joint work with Anthony Conway and Maciej Borodzik.