# The 9th KOOK-TAPU Joint Seminar on Knots and Related Topics

Osaka City University

July 25–27, 2017

## Titles & Abstracts

### July 25th, 2017

Title: A construction of invariants for surface-links

Sang Youl Lee (Pusan National University, South Korea)
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Abstract

A surface-link is a closed 2-manifold smoothly embedded in 4-space. Two surface-links are said to be equivalent if they are ambient isotopic. A marked graph diagram is a link diagram possibly with some 4-valent vertices equipped with markers. Every surface-link is presented by an admissible marked graph diagram modulo Yoshikawa moves. In this talk, I would like to introduce a construction of invariants for surface-links using marked graph diagrams and discuss its generalization to virtual marked graph diagrams modulo generalized Yoshikawa moves.

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Title: Alexander invariants for ribbon tangles

Celeste Damiani (Osaka City University Advanced Mathematical Institute, JSPS, Japan)
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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 extension 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 cobordisms 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.

Title: Toric degenerations of flag varieties: recent developments

Megumi Harada (McMaster University and Osaka City University, Canada and Japan)
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Abstract

Toric degenerations are particular types of flat families of algebraic varieties. Flag varieties are a family of algebraic varieties which carry a lot of symmetry and have intimate connections with other areas of mathematics such as representation theory and combinatorics. In this expository talk I will sketch some history of these topics as well as some recent developments.

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Title: Channel surfaces in Lie sphere geometry

Mason Pember (Technische Universität Wien, Austria)
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Abstract

Channel surfaces are the envelopes of a 1-parameter family of spheres. In this talk we shall study how these surfaces are characterised in Lie sphere geometry. Furthermore, we shall investigate Ribaucour transforms between such surfaces.

## July 26th, 2017

Title: Some polynomial invariants for Gauss diagrams

Young Ho Im (Pusan National University, South Korea)
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Abstract

We introduce a sequence of polynomial invariants for Gauss diagrams which are one-to-one correspondence with virtual knot diagrams. Also, we give some properties of these polynomials and examples.

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Title: On diagrams of immersed 2-knots with one self-intersection point

Kengo Kawamura (Osaka City University Advanced Mathematical Institute, Japan)
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Abstract

An immersed 2-knot is a 2-sphere generically immersed in 4-space, each of whose self-intersection points is an isolated double point. A diagram of an immersed 2-knot is its generic projection into 3-space, equipped with over/under information. In this talk, we study a diagram of an immersed 2-knot with one self-intersection point.

Title: On the crossing numbers of composite knots and theta curves

Benjamin Bode (University of Bristol, United Kingdom)
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Abstract

It is one of the oldest conjectures in knot theory that the minimal crossing number is additive under the connected sum, i.e. $c(K1\#K2) = c(K1) + c(K2)$ for all knots $K1$ and $K2$. While the inequality $c(K1\#K2) \leq c(K1) + c(K2)$ is almost immediate, finding lower bounds for $c(K1\#K2)$ has proven extremely challenging.

In this talk I will point out relations between $c(K1\#K2)$ and the minimal crossing numbers of embedded graphs, in particular theta curves, that could lead to lower bounds for the crossing number $c(K1\#K2)$.

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Title: Infinitely many knots with the trivial $(2,1)$-cable $\Gamma$-polynomial

Hideo Takioka (Osaka City University Advanced Mathematical Institute, Japan)
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Abstract

For coprime integers $p(>0)$ and $q$, the $(p,q)$-cable $\Gamma$-polynomial of a knot is the $\Gamma$-polynomial of the $(p,q)$-cable knot of the knot, where the $\Gamma$-polynomial is the common zeroth coefficient polynomial of the HOMFLYPT and Kauffman polynomials. In this talk, we show that there exist infinitely many knots with the trivial $(2,1)$-cable $\Gamma$-polynomial, that is, the $(2,1)$-cable $\Gamma$-polynomial of the trivial knot. Moreover, we show that the knots have the trivial $\Gamma$-polynomial, the trivial first coefficient HOMFLYPT and Kauffman polynomials and the distinct Conway polynomials.

## July 27th, 2017

Title: Biquasile Boltzmann enhancements of oriented surface-links

Jieon Kim (Osaka City University Advanced Mathematical Institute, JSPS, Japan)
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Abstract

D. Needell and S. Nelson introduced an algebraic structure called a *biquasile*, which is used to define invariants of oriented classical links via their dual graph diagrams. A biquasile is a set with six binary operations satisfying the conditions derived from Reidemeister moves. In this talk, I'd like to introduce a biquasile coloring for marked graph diagrams of oriented surface-links and counting invariants of oriented surface-links. Also, we define a Boltzman weight for crossings and marked vertices of marked graph diagrams, and biquasile Boltzmann enhancements of oriented surface-links. This is a joint work with S. Nelson.

Title: On a configuration space of a quandle homology group

Yongju Bae (Kyungpook National University, South Korea)
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Abstract

The quandle homology group is defined by using the algebraic structure. In this talk, we will introduce a CW-complex, corresponding to a quandle $Q$, whose homology group coincides the quandle homology group of $Q$.