The 11th Graduate Student Workshop on Mathematics

Osaka City University

July 25–27, 2017

Titles & Abstracts

July 25th, 2017

Title: On a rational type of a surface-tangle

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Abstract

In 1990, Viro introduced 2-dimensional briads, called surface braids. Satoh introduced surface-tangles as a generalization of classical tangles and showed that any surface-link can be represented as the closure of a surface-tangle. In this talk, I will introduce a rational type of a surface-tangle defined as similar to surface braids via classical rational tangles and we will study some properties related to the closure of a rational type of a surface-tangle.

Title: Linear bikeis

Yudai Taishi (Osaka City University)
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Abstract

A bikei is a set with two binary operations satisfying certain conditions. The conditions correspond to Reidemeister moves in knot theory. In this talk, we consider linear bikeis over Z_p.

Title: On $(1,1)$-diagrams of $(1,1)$-knots up to 10 crossings and pretzel knots

Geunyoung Kim (Pusan National University)
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Abstract

A knot K in the 3-sphere S^3 is called a $(1,1)$-knot if K is split up into a trivial arc in each handlebody determined by a genus one Heegaard splitting of S^3. A $(1,1)$-knot in S^3 is represented by a $(1,1)$-diagram $D(a,b,c,r)$, where a, b, c, and r are nonnegative integers. In this talk, we introduce an algorithm for finding a $(1,1)$-diagram by using an unknotting tunnel of a given $(1,1)$-knot. Also, we find $(1,1)$-diagrams of $(1,1)$-pretzel knots and present a list of all $(1,1)$-diagrams of $(1,1)$-knots up to 10 crossings in Rolfsen's knot table.

Title: Young tableaux and the Robinson-Schensted-Knuth correspondence

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Abstract

The row bumping is the algorithm that is defined for Young tableaux. By this algorithm, we can get a one to one correspondence between matrices with nonnegative integer entries (or two rowed arrays) and pairs of tableaux of the same shape, known as the Robinson-Schensted-Knuth correspondence. In this talk, I introduce how to construct the R-S-K correspondence.

Title: Elliptic operators and compact groups

Masahiro Morimoto (Osaka City University)
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Abstract

Let G be a compact Lie group. A G-invariant differential operator on a compact G-manifold is said to be transversally elliptic if it is elliptic in the directions transversal to the G-orbits. In this talk, we first review the spectral properties of an elliptic operator. After that, we study the spectral properties of a transversally elliptic operator and compare them.

Title: On the colorability of $(1,1)$-tangles

Hun Lee (Kyungpook National University)
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Abstract

When a link diagram D is colored by a quandle, it is clear that the $(1,1)$-tangle T obtained by cutting an edge of D is colorable by the quandle. In this talk, we will study whether the colorability of T implies the colorability of D.

Title: On symmetric sets with midpoints

Minju Seo (Pusan National University)
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Abstract

A *symmetric set*, or *symset* for short, is a binary system $(X, \bullet)$ satisfying the first three of the following list of axioms: for all $a, b, c \in X$,

(1) $a \bullet a = a$ $(S_a a = a)$;

(2) $a \bullet (a \bullet b) = b$ $(S_a S_a = id_X)$;

(3) $a \bullet (b \bullet c) = (a \bullet b) \bullet (a \bullet c)$ $(S_a S_b = S_{S_a b} S_a)$;

(4♯) the equation $x \bullet a = b$ $(S_x a = b)$ has a solution $x \in X$.

(4) the equation $x \bullet a = b$ $(S_x a = b)$ has a unique solution $x \in X$, called the *midpoint* or *mean* of a and b, and denoted $a \sharp b$.

If the binary system $(X, \bullet)$ satisfies the first three axioms and Axiom (4♯), then X is called a *homogeneous symset*, and if it satisfies the first three axioms together with Axiom (4), then it is called a *dyadic symset*. In this talk, I would like to discuss certain properties of symmetric sets.

Title: Existence and uniqueness theorem on SDEs

Takaya Kumakawa (Osaka City University)
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Abstract

Stochastic differential equations (SDEs) are ordinary differential equations with noise terms. The main topics in this talk is the theorem on the existence and uniqueness of the solution. Some typical examples will be introduced.

Title: A theoretical study on mathematical modelling of MERS-CoV transmission with application of optimal control

Dongho Lee (Kyungpook National University)
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Abstract

In this talk, we propose and analyze a MERS-CoV epidemic problem. Using a SIR model, the basic reproduction number is obtained. Moreover, we consider two time-dependent control measures and obtain the optimal control strategy to minimize both the infected populations and the associated costs. All the analytical results are verified by simulation works.

Title: Random data final-state problem for nonlinear Shrödinger equation

Takuto Yamamoto (Osaka City University)
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Abstract

It is known that it exists the solutions to power-type nonlinear Schrödinger equations (NLS) under some assumption. In this talk, I would like to talk on the randomization of final-data and the existence of unique solution of NLS.

Title: On local times for Lévy processes

Hiroshi Tsukada (Osaka City University)
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Abstract

The local time for a stochastic process is a family of random variables that characterize the amount of time spent by the process at a given point. In this talk, we shall establish the Tanaka formula for Lévy processes from view point of the Doob-Meyer decomposition for local times.

Title: The wave equation on the de Sitter space and the integral transforms

Tomoyoshi Nakayama (Osaka City University)
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Abstract

It is known that there is a one-to-one correspondence between solutions of the wave equation on the de Sitter 3-space S^3_1 and smooth functions satisfying a certain condition over S^2 via the integral transforms (F. Nakata [1]). The goal of my research is to generalize this result to the wave equation on the de Sitter 4-space S^4_1. Very recently I have provided a construction of solution of the wave equation on the de Sitter 4-space from smooth functions satisfying a certain condition over S^3 via the method of integral transforms ([2]).

References

[1] F. Nakata, "Wave equation and the LeBrun-Mason correspondence", Trans. Amer. Math. Soc. **364** (2012) 4763-4800.

[2] T. Nakayama, "A construction of solutions to the wave equation on the de Sitter 4-space via twistor method", in preparation.

July 26th, 2017

Title: Toric Fano varieties associated to building sets

Yusuke Suyama (Osaka City University)
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Abstract

We give a necessary and sufficient condition for the nonsingular projective toric variety associated to a building set to be Fano or weak Fano in terms of the building set.

Title: Nonlinear boundary value problem involving the Laplacian and Extrinsic mean curvature operator

Jongkyu Lee (Pusan National University)
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Abstract

I will discuss the nonlinear perturbations of the laplacian and the extrinsic mean curvature operator. After introducing the notion of topological degree theory, I will present the existence and multiplicity and non-existence results for the solutions of some problems.

Title: On polynomial invariants of links of Kanenobu type

Yongjae Park (Kyungpook National University)
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Abstract

In 1986, T. Kanenobu defined a family of knots $K_{p,q}$, called Kanenobu knots, where p and q are the number of full twists. In 2005, L. Watson introduced a generalization of Kanenobu knots. In this talk, we will introduce a family of links $L_b(T,U)$ which is modified by L. Watson's generalization and a family of links $L_b(T,U)$ is obtained from $\mathbb{Z}$-action. We give some relations of Jones polynomial and HOMPLY-PT polynomial of $L_b(T,U)$ and $L_{b^n}(T,U)$.

Title: Classification of 2-bridge knots with $(1,1)$-diagrams

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Abstract

A genus one 1-bridge knot in S^3 (simply a $(1,1)$-knot) is a knot that can be decomposed into two trivial arcs embedded in two solid tori in a genus one Heegaard splitting of S^3. A $(1,1)$-knot can be described by a $(1,1)$-diagram $D(a,b,c,r)$ determined by four integers a,b,c and r. It is well-known that all 2-bridge knots are $(1,1)$-knots and have $(1,1)$-diagrams of the form $D(a,0,1,r)$. In this talk, we prove that the dual $(1,1)$-diagram of $D(a,0,1,r)$ is $D(\frac{r^{-1}}{2},0,2a+1-r^{-1},r^{-1})$ if r^{-1} is even where r^{-1} is the multiplicative inverse of $r \pmod{2a+1}$ and $D(\frac{2a+1-r^{-1}}{2},0,r^{-1},r^{-1})$, otherwise. Moreover, we classify all $(1,1)$-diagrams of 2-bridge knots up to mirror image.

Title: Existence of weak solutions for elliptic equations via Lax-Milgram Theorem

Kouta Yamane (Osaka City University)
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Abstract

The Lax-Milgram Theorem is a powerful tool to show the existence of weak solutions of elliptic equations. In this talk, I introduce typical applications of Lax-Milgram Theorem to PDE Theory.

Title: The Krull dimension of composite power series rings over valuation rings

Minjae Kwon (Kyungpook National University)
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Abstract

In this talk, a ring R is always a commutative ring with identity. I introduce the history of the problem of determining the Krull dimension of polynomial rings and power series rings. We denote $\dim(R)$ as the Krull dimension of R. When $\dim(R)$ is finite, $\dim(R[X])$ was completely determined. In power series case, there are some differences. For example, the Krull dimension of $R[\![X]\!]$ may have uncountable even if $\dim(R) = 1$. After I introduce a concept for amalgamation which is a special case of pull back, I deal with some special construction of a amalgamation and observe it. Near the end of the presentation, I introduce the main results and some unsolved problems.

Title: The maximum principle

Kyongte Kim (Osaka City University)
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Abstract

Maximum principle concerns a basic property of solutions to partial differential equations. In this talk, I introduce several maximum principles.

Title: The relationship between the Radon-Nikodym derivative and the derivative of complex measures

Kazuya Akayama (Osaka City University)
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Abstract

The complex measure which satisfies appropriate conditions is represented uniquely by the Lebesgue integral. In this talk, we show that the derivative of a complex measure is related to its integral representation.

Title: On decomposed quandles as 2-cocycle abelian extensions

Byeorhi Kim (Kyungpook National University)
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Abstract

In 2003, J. S. Carter, M. Elhamdadi and M. Saito introduced an abelian extension of a quandle by using cocycle. In my previous work, I studied sufficient conditions for operation tables which have decomposed structure to be quandles and it is motivated from the paper in 2006 of S. Nelson, C. -Y. Wong and the paper in 2008 of G. Ehrman, A. Gurpinar, M. Thibault and D. N. Yetter. In this talk, I explain the decomposed structure of quandle operations as abelian extension using 2-cocycle.

Title: On the Alexander polynomial of (1,1)-knots in S^3

Sanghoon Park (Pusan National University)
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Abstract

There is a special connection between the Alexander polynomial of $(1,1)$-knots and certain polynomial (Dunwoody polynomial) associated with the Dunwoody 3-manifold. In this talk, we discuss the Dunwoody polynomial for the $(1,1)$-knot obtained by a cyclically presented group of the Dunwoody 3-manifold. We also discuss an invariant for a certain class of torus knots and all 2-bridge knots by means of the Dunwoody polynomial.

Title: Introduction to quantum invariants of knots

Hiroaki Karuo (RIMS, Kyoto University)
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Abstract

In 1980s, many invariants of knots, called "quantum invariants", were discovered. These invariants are constructed systematically by using quantum groups and their representations. These invariants can be unified by "universal invariants" whose values belong to quantum groups. In this talk, I will introduce these invariants.

Title: An introduction to a marked graph braid representation for surface-links

Suhyeon Jeong (Pusan National University)
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Abstract

A smooth embedding of a closed surface into $\mathbb{R}^4$ is called a surface-link (or a knotted surface). M. Jabłonowski introduced a monoid SSB_m whose element corresponds to a surface-link in $\mathbb{R}^4$ from its hyperbolic splitting represented by marked graph diagram in braid form on m strands [Jabłonowski, Michał. On a surface singular braid monoid. Topology and its Applications 160.13 (2013): 1773-1780]. It has 4 types of generators and 11 relations on words that follow from topological Yoshikawa moves. In this talk, I would like to introduce the monoid SSB_m with basic definitions, theorems and properties.