研究集会　Intelligence of Low-dimensional Topology

京都大学数理解析研究所 RIMS 共同研究（公開型）として、また、大阪市立大学数学研究所から後援をうけて、トポロジープロジェクトの一環として、標記の研究集会を開催いたします。また、この研究集会は科学研究費補助金 基盤研究 B 「グラフィクスとカンドル理論の観点からの４次元トポロジーの研究」（課題番号 19H01788、研究代表者 鎌田聖一氏（大阪大学））と科学研究費補助金 基盤研究 A 「結び目と３次元多様体の量子トポロジー」（課題番号 16H02145、研究代表者 大槻知忠（京都大学））と科学研究費補助金 挑戦的萌芽研究「ゲージ理論に関連する結び目と３次元多様体の不変量と量子トポロジー」（課題番号 16K13754、研究代表者 大槻知忠（京都大学））の援助をうけています。

日程：２０１９年 5月２２日 (水)〜 5月２４日 (金)
場所：京都大学 数理解析研究所 420 大講演室
アクセス：http://www.kurims.kyoto-u.ac.jp/ja/access-01.html

5月２２日 (水)

13:20〜14:10　新國 亮 (東京女子大学現代教養学部)
On generalizations of the Conway-Gordon theorems

14:30〜15:20　Benjamin Bode (Osaka University / JSPS Research Fellow)
Braid group actions on the n-adic integers

15:40〜16:30　吉田 はん (奈良工業高等専門学校)
Hidden symmetries of hyperbolic links

5月２３日 (木)

10:00〜10:50　古宇田 悠哉 (広島大学大学院理学研究科)
Positive flow-spines and contact 3-manifolds

11:10〜12:00　辻 俊輔 (京都大学数理解析研究所 / 日本学術振興会特別研究員 PD)
A HOMFLY-PT type invariant for integral homology 3-spheres

13:20〜14:10　Tian Yang (Texas A&M University)
Some resent progress on the volume conjecture for the Turaev-Viro invariants

14:30〜15:20　J. Scott Carter (University of South Alabama / OCAMI, Osaka City University / George Washington University)
Diagrammatic Algebra

15:40〜　Problem Session

5月24日 (金)

10:00〜10:50　鮑 園園 (東京大学大学院数理科学研究科)
The Heegaard Floer homology of a trivalent graph defined on two Heegaard diagrams

11:10〜12:00　佐野 岳人 (東京大学大学院数理科学研究科)
Rasmussen invariant and the divisibility of Lee's class

13:20〜14:10　谷口 正樹 (東京大学数理科学研究科 / 日本学術振興会特別研究員 DC)
Filtered instanton Floer homology and the homology cobordism group

14:30〜15:20　佐藤 進 (神戸大学大学院理学研究科)
Writhe polynomials and shell moves for virtual knots and links

組織委員： 河内明夫、河野俊丈、金信泰造、鎌田聖一、大槻知忠
世話人：　大槻知忠 (京大 数理研)、秋吉宏尚 (大阪市立大 理学研究科)

Intelligence of Low-dimensional Topology

May 22–24, 2019
Room 420, RIMS, Kyoto University
Access: http://www.kurims.kyoto-u.ac.jp/en/access-01.html

Program

May 22 (Wed)

13:20–14:10 Ryo Nikkuni (School of Arts and Sciences, Tokyo Woman's Christian University)
On generalizations of the Conway-Gordon theorems

14:30–15:20 Benjamin Bode (Osaka University / JSPS Research Fellow)
Braid group actions on the n-adic integers

15:40–16:30 Han Yoshida (National Institute of Technology, Nara College)
Hidden symmetries of hyperbolic links

May 23 (Thu)

10:00–10:50 Yuya Koda (Department of Mathematics, Hiroshima University)
Positive flow-spines and contact 3-manifolds

11:10–12:00 Shunsuke Tsuji (RIMS, Kyoto University / JSPS Research Fellow PD)
A HOMFLY-PT type invariant for integral homology 3-spheres

13:20–14:10 Tian Yang (Texas A&M University)
Some resent progress on the volume conjecture for the Turaev-Viro invariants

14:30–15:20 J. Scott Carter (University of South Alabama / OCAMI, Osaka City University / George Washington University)
Diagrammatic Algebra

15:40– Problem Session

May 24 (Fri)

10:00–10:50 Yuanyuan Bao (Graduate School of Mathematical Sciences, the University of Tokyo)
The Heegaard Floer homology of a trivalent graph defined on two Heegaard diagrams

11:10–12:00 Taketo Sano (Graduate School of Mathematical Sciences, the University of Tokyo)
Rasmussen invariant and the divisibility of Lee's class

13:20–14:10 Masaki Taniguchi (Graduate School of Mathematical Sciences, the University of Tokyo / JSPS Research Fellow DC)
Filtered instanton Floer homology and the homology cobordism group

14:30–15:20 Shin Satoh (Department of Mathematics, Kobe University)
Writhe polynomials and shell moves for virtual knots and links

Intelligence of Low-dimensional Topology

May 22–24, 2019

RIMS, Kyoto University

Abstract

Yuanyuan Bao (Graduate School of Mathematical Sciences, the University of Tokyo)

The Heegaard Floer homology of a trivalent graph defined on two Heegaard diagrams

In the study of the Heegaard Floer homology of a trivalent graph, two types of Heegaard diagrams turn out to be of special interest. In this talk, we provide partial information on what the Heegaard Floer complexes on these two Heegaard diagrams look like. The Euler characteristic, which we call the Alexander polynomial of a trivalent graph, has two state sum models that we can construct from these two Heegaard diagrams. We briefly introduce these two state sum models. This work is a generalization of Ozsvath-Stipsicz-Szabo's "Floer homology and singular knots". (A part of the talk is a joint work of Zhongtao Wu)

Benjamin Bode (Osaka University / JSPS Research Fellow)

Braid group actions on the n-adic integers

In this talk I am going to construct several actions of the braid group with n strands on the n-adic integers. This leads to new relations between the topology of certain subspaces of the space of complex polynomials (or equivalently subspaces of a configuration space) and normal subgroups of the braid group. It also allows us to construct infinite families of real algebraic links, the real analogue of Milnor's algebraic links of isolated complex singularities.

J. Scott Carter (University of South Alabama / OCAMI, Osaka City University / George Washington University)

Diagrammatic Algebra

Diagrammatic Algebra is the method of computing with which many of us are familiar. Knot diagrams are manipulated via Reidemeister moves, and they represent calculations in a braided tensor category. Two dimensional TFQTs correspond to Frobenius Algebras. The Frobenius Algebra axioms (and indeed the Hopf algebra axioms) can be represented as equalities between diagrams. In this talk, I demonstrate various techniques for encoding the algebraic relations via foams. These are surface-like diagrams in which three sheets are joined along a seam, and two seams cross at a vertex. The higher order relations are encrypted by foam moves. Special attention will be paid to swallow-tail and horizontal cusp relations.

Yuya Koda (Department of Mathematics, Hiroshima University)

Positive flow-spines and contact 3-manifolds

We discuss a relationship between positive flow-spines and contact structures of 3-manifolds. A contact structure on a 3-manifold is a non-integrable plane field. There is a well-known relationship between open book decompositions of 3-manifolds and contact structures, called Giroux correspondence. On the other hand, a flow-spine of a 3-manifold is a special kind of spine, which defines a non-singular flow on the manifold in such a way that the flow is transverse to the spine, and the flow in the complement of the spine is diffeomorphic to a constant flow in an open ball. We say that a contact structure is supported by a flow-spine if the flow of a Reeb vector field for the contact structure is defined by the flow-spine. In this talk, we show that:
(1) Every positive flow-spine of a 3-manifold supports a unique contact structure up to isotopy; and
(2) Every contact structure on a 3-manifold is supported by a positive flow-spine.
This is joint work with I. Ishii, M. Ishikawa and H. Naoe.

Ryo Nikkuni (School of Arts and Sciences, Tokyo Woman's Christian University)

On generalizations of the Conway-Gordon theorems

Conway-Gordon theorems, which are very famous theorems in spatial graph theory, say that for every spatial complete graph on 6 vertices, the sum of the linking numbers over all of the constituent 2-component links is odd, and that for every spatial complete graph on 7 vertices, the sum of the Arf invariants over all of the Hamiltonian knots is odd. In 2009, the speaker gave integral lifts of the Conway-Gordon theorems in terms of the square of the linking number and the second coefficient of the Conway polynomial. In this talk, we generalize the integral Conway-Gordon theorems to complete graphs with arbitrary number of vertices greater than or equal to 6, and give some applications for rectilinear spatial complete graphs. This is a joint work with H. Morishita.

Taketo Sano (Graduate School of Mathematical Sciences, the University of Tokyo)

Rasmussen invariant and the divisibility of Lee's class

We define a link invariant $\bar{s}_c(L)$ of a link L that possesses many properties common to the Rasmussen's s-invariant. Let c be a non-zero, non-invertible element in an integral domain R. Take any diagram D of a link L. First we define the α-class of D (generalized Lee's class) and its c-divisibility $k_c(D)$. Then we define $\bar{s}_c(L)$ by a specific linear combination of $k_c(D)$ and some classical diagram invariants of D. Similar to s, our invariant is a link concordance invariant, provides a lower bound for the slice genus, and the equality holds for positive knots. Also the Milnor conjecture follows as a corollary. In particular if $(R, c) = (\mathbb{Q}[h], h)$, then as knot invariants $\bar{s}_c$ coincides with s. We do not know at the time of writing, whether there exists any (R, c) such that $\bar{s}_c$ is distinct from s.

Shin Satoh (Department of Mathematics, Kobe University)
Writhe polynomials and shell moves for virtual knots and links

The writhe polynomial is one of fundamental invariants of an oriented virtual knot. We introduce a kind of local moves for virtual knots called *shell moves*. The aim of this talk is to prove that two oriented virtual knots have the same writhe polynomial if and only if they are related by a finite sequence of shell moves. Furthermore we study equivalent classes virtual *links* up to shell moves. This is a joint work with Professors Nakamura and Nakanishi.

Masaki Taniguchi (Graduate School of Mathematical Sciences, the University of Tokyo / JSPS Research Fellow DC)
Filtered instanton Floer homology and the homology cobordism group

Fintushel-Stern and Furuta developed orbifold gauge theory and proved that infinitely many Brieskorn 3-spheres are linearly independent in the homology cobordism group. In this work, by translating their work into the words of filtered instanton Floer homology, we introduce a real-valued homology cobordism invariant r_+. The value of r_+ is contained in the Chern-Simons invariants, and we have a negative definite cobordism inequality and connected sum formula for r_+, which give several new results on the homology cobordism group. As one of colloraries, we give infinitely many homology 3-spheres which cannot bound any definite 4-manifold. As another collorary, we show that if the 1-surgery of a knot has negative Froyshov invariant, then all positive $1/n$-surgeries of the knot are linearly independent in the homology cobordism group. Moreover, as a hyperbolic example, we compute an approximate value of r_+ for the 1/2-surgery of the knot 5_2 in the Rolfsen's table, and distinguish its homology cobordism class from a huge number of Seifert homology 3-spheres. This is a joint work with Yuta Nozaki and Kouki Sato.

Shunsuke Tsuji (RIMS, Kyoto University / JSPS Research Fellow PD)
A HOMFLY-PT type invariant for integral homology 3-spheres

We construct an invariant for an integral homology 3-sphere which is an element of $\mathbb{Q}[\rho][[h]]$ using the HOMFLY-PT skein algebra. This invariant and the HOMFLY-PT polynomial, which is an invariant for links, are equivalent to the collection of quantum invariants associated with the Lie algebra $sl(n)$.

Tian Yang (Texas A&M University)
Some resent progress on the volume conjecture for the Turaev-Viro invariants

In 2015, Qingtao Chen and I conjectured that at the root of unity $\exp(2\pi\sqrt{-1}/r)$ instead of the usually considered root $\exp(\pi\sqrt{-1}/r)$, the Turaev-Viro and the Reshetikhin-Turaev invariants of a hyperbolic 3-manifold grow exponentially with growth rates respectively the hyperbolic and the complex volume of the manifold. In this talk, I will present a recent joint work with Giulio Belletti, Renaud Detcherry and Effie Kalfagianni on an infinite family of cusped hyperbolic 3-manifolds, the fundamental shadow links complement, for which the conjecture is true.

Han Yoshida (National Institute of Technology, Nara College)

Hidden symmetries of hyperbolic links

W. Neumann and A. Reid conjectured that the figure-eight knot and the two dodecahedral knots are the only hyperbolic knots in S^3 admitting hidden symmetries. E. Chesebro and J. DeBlois constructed infinitely many two components link complements admitting hidden symmetries. In this talk, we show that there exist n-component link complements admitting hidden symmetries. ($n \geq 4$)