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、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 「３次元双曲多様体上の量子トポロジー」（課題番号 21H04428、研究代表者 大槻知忠（京都大学））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））（繰越）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３次元双曲多様体の不変量」（課題番号 19K21830、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：２０２２年 5月２５日 (水)〜 5月２７日 (金)
場所：京都大学 数理解析研究所 420 大講演室
アクセス：https://www.kurims.kyoto-u.ac.jp/ja/access-01.html
研究集会ホームページ：https://www.kurims.kyoto-u.ac.jp/~ildt/

この研究集会は、ハイブリッド型（対面とオンライン (Zoom) の併用）で開催することを計画しています。会場の密を避けるために対面参加の人数制限を当日に行う可能性がありますので、遠方から参加される方にはオンライン参加をおすすめいたします。参加される方（対面もオンラインも）は、5 月 9 日までに、参加登録をお願いします。参加登録の際に「配信映像を録画・録音しないこと」のご同意をお願いします。参加登録方法について、研究集会ホームページ（上記 URL）をご覧ください。

コロナの社会情勢によって、開催方法を「完全オンライン」に変更する可能性があります。最新情報を研究集会ホームページで随時確認していただきますようお願いいたします。

5月２５日 (水)

13:20〜14:00　久野 恵理香 (大阪大学大学院理学研究科数学専攻)
Gromov hyperbolicity of fine curve graphs for nonorientable surfaces

14:15〜14:55　今野 北斗 (東京大学大学院数理科学研究科)
Floer K-theory for knots

15:10〜15:50　Stavros Garoufalidis (Southern University of Science and Technology)
The mystery of the loop invariants of a knot

5月26日 (木)

10:30〜11:10　植木 潤 (お茶の水女子大学)
Twisted Iwasawa invariants of knots and profinite rigidity

11:25〜12:05　高野 暁弘 (東京大学大学院数理科学研究科)
Properties of links from the viewpoint of R. Thompson's group F

13:20〜14:00　安原 晃 (早稲田大学商学部)
Concordance for higher dimensional welded objects and their Milnor invariants

14:15〜14:55　古田 幹雄 (東京大学大学院数理科学研究科)
Finite dimensional approximations and Floer homotopy types

15:10〜　Problem Session

5月27日 (金)

10:30〜11:10　秋吉 宏尚 (大阪公立大学大学院理学研究科)
An extension of Ford domain

11:25〜12:05　井森 隼人 (京都大学理学研究科 / 日本学術振興会特別研究員 DC1)
Rasmussen type invariant from equivariant instanton Floer homology

13:20〜14:00　野崎 雄太 (広島大学)
On the kernel of the surgery map

14:15〜14:55　伊藤 哲也 (京都大学)
Chirally cosmetic surgery: constraints and computations

15:10〜15:50　Andrew Kricker (Nanyang Technological University)
On the asymptotics of the Garoufalidis-Kashaev meromorphic 3D index

組織委員：秋吉宏尚、大槻知忠、鎌田聖一、鎌田直子、河内明夫、河野俊丈
世話人：大槻知忠 (京大 数理研)、渡邉忠之 (京大 理学研究科)

Intelligence of Low-dimensional Topology

May 25–27, 2022

This conference is planned to be held at

Room 420, RIMS, Kyoto University,

whose live streaming is distributed online.

Depending on the social situation of the corona virus, we might hold the conference as an online conference. Please verify the latest information at the website of the conference.

Program

May 25 (Wed)

13:20–14:00 Erika Kuno (Department of Mathematics, Graduate School of Science, Osaka University)
Gromov hyperbolicity of fine curve graphs for nonorientable surfaces

14:15–14:55 Hokuto Konno (The University of Tokyo)
Floer K-theory for knots

15:10–15:50 Stavros Garoufalidis (Southern University of Science and Technology)
The mystery of the loop invariants of a knot

May 26 (Thu)

10:30–11:10 Jun Ueki (Ochanomizu University)
Twisted Iwasawa invariants of knots and profinite rigidity

11:25–12:05 Akihiro Takano (Graduate School of Mathematical Sciences, The University of Tokyo)
Properties of links from the viewpoint of R. Thompson's group F

13:20–14:00 Akira Yasuhara (Faculty of Commerce, Waseda University)
Concordance for higher dimensional welded objects and their Milnor invariants

14:15–14:55 Mikio Furuta (Graduate School of Mathematical Sciences, The University of Tokyo)
Finite dimensional approximations and Floer homotopy types

May 27 (Fri)

10:30–11:10 Hirotaka Akiyoshi (Osaka Metropolitan University)
An extension of Ford domain

11:25–12:05 Hayato Imori (Department of Mathematics, Kyoto University / JSPS Research Fellow DC1)
Rasmussen type invariant from equivariant instanton Floer homology

13:20–14:00 Yuta Nozaki (Hiroshima University)
On the kernel of the surgery map

14:15–14:55 Tetsuya Ito (Kyoto University)
Chirally cosmetic surgery: constraints and computations

15:10–15:50 Andrew Kricker (Nanyang Technological University)
On the asymptotics of the Garoufalidis-Kashaev meromorphic 3D index

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Abstract

Hirotaka Akiyoshi (Osaka Metropolitan University)

An extension of Ford domain

The Ford domain of a Kleinian group is defined to be the common exterior to the isometric hemispheres of the group elements. It is the geometric dual to the Epstein-Penner's canonical decomposition for a hyperbolic manifold of finite volume with a single cusp, and to the Euclidean subcomplex of the EPH-decomposition of a manifold of infinite volume. In this talk we consider a natural extension of the Ford domain to the outside of the hyperbolic space identified with a subspace of the real projective space, and show basic properties. We also discuss applications to deformations of infinite volume hyperbolic manifolds possibly with cone singularity.

Mikio Furuta (Graduate School of Mathematical Sciences, The University of Tokyo)

Finite dimensional approximations and Floer homotopy types

We would like to review/discuss the next topics:
-Floer theory as infinite dimensional geometry
-Discrepancies between "finite dimensional" and "infinite dimensional"
-Floer homotopy types
-Applications in low dimensional topology
-Problems in Floer theory as infinite dimensional geometry

Stavros Garoufalidis (Southern University of Science and Technology)
The mystery of the loop invariants of a knot

A main problem in quantum topology is the Volume Conjecture which asserts that an evaluation of the colored Jones polynomial (known as the Kashaev invariant) is a sequence of complex numbers that grows exponentially at the rate of the hyperbolic volume of a knot complement. This conjecture connects the Jones polynomial with hyperbolic geometry. The loop invariants are the refinement of the above conjecture to all orders in perturbation theory, and take values in the trace field of a knot. Hence, the loop invariants have topological, but also mysteriously geometric origin. A geometric definition of them is currently unknown. In the talk we will discuss how these invariants behave under finite cyclic covers, and give clues about their possible geometric definition. Joint work with Seokbeom Yoon.

Hayato Imori (Department of Mathematics, Kyoto University / JSPS Research Fellow DC1)
Rasmussen type invariant from equivariant instanton Floer homology

In the context of framed instanton Floer homology, Kronheimer-Mrowka introduced the knot concordance invariant $s^{\#}$, which was at first expected to coincide with the Rasmussen invariant in Khovanov homology. In this talk, we provide a new formulation of Kronheimer-Mrowka's $s^{\#}$-invariant from the viewpoint of equivariant instanton Floer homology. Our formulation enables us to show deeper structures of $s^{\#}$-invariant, including the connected sum formula. Moreover, these properties on $s^{\#}$-invariant can be applied to topological problems related to linear independent families in the concordance group and the extendency of $SU(2)$-representation of knot groups over the concordance complement. This talk is based on joint work with Aliakbar Daemi, Kouki Sato, Christopher Scaduto, and Masaki Taniguchi.

Tetsuya Ito (Kyoto University)
Chirally cosmetic surgery: constraints and computations

Two different Dehn surgeries on the same knot is called chirally cosmetic (resp. purely cosmetic) if they are orientation reversingly (resp. preservingly) homeomorphic. Unlike purely cosmetic surgeries, whose non-existence is a famous conjecture, there are several examples of chirally cosmetic surgeries. In this talk we provide various constraints for chirally cosmetic surgeries, and present several computations to illustrate to non-existence of chirally cosmetic surgeries for many knots. This talk is based on a joint work with I. Kazuhiro (Nihon University) and T. Saito (Joetsu University of Education).

Hokuto Konno (The University of Tokyo)
Floer K-theory for knots

This talk is based on joint work with Jin Miyazawa and Masaki Taniguchi (arXiv:2110.09258) where we established a version of Seiberg-Witten Floer K-theory for knots. This framework is used to prove a version of "10/8-inequality for knots", which effectively extracts difference between topological and smooth categories in knot theory. I will explain concrete applications, such as relative genus bounds and stabilization numbers, and sketch how to construct this framework.

Andrew Kricker (Nanyang Technological University)
On the asymptotics of the Garoufalidis-Kashaev meromorphic 3D index

This talk will introduce arXiv:2109.05355, which is joint work with Craig Hodgson and Rafael Siejakowski. Garoufalidis and Kashaev have defined a fascinating topological invariant which associates to a 3-manifold with toroidal boundary a meromorphic function of two complex variables. It is defined from an ideal triangulation by a state-integral where a state is an element of S^1 assigned to every edge of the triangulation and the integrand is product of quantum dilogarithms obtained from the combinatorics of the triangulation. This invariant is a sort of generating function for the q-series 3D-index of Dimofte, Gaiotto and Gukov, and in fact proves topological invariance of it. We have studied a certain asymptotic limit of this function at the origin as the quantum parameter q approaches 1. Based on numerical investigations and integral heuristics we propose a conjecture for this asymptotic expansion involving surprisingly rich structure from the geometry of the manifold and its collection of boundary parabolic $\mathrm{PSL}(2,\mathbb{C})$-representations. We prove a number of theorems about the expressions we obtain. A key structure we develop for this analysis is the concept of an S^1-valued angle structure which was introduced by Feng Luo.

Erika Kuno (Department of Mathematics, Graduate School of Science, Osaka University)
Gromov hyperbolicity of fine curve graphs for nonorientable surfaces

Bowden, Hensel, and Webb define a new curve graph called fine curve graph, and they prove that it is uniformly hyperbolic for any closed orientable surface. In this talk we explain how to generalize their result to closed nonorientable surfaces. Especially we would like to talk about differences from the case of orientable surfaces. This is a joint work with Mitsuaki Kimura.

Yuta Nozaki (Hiroshima University)
On the kernel of the surgery map

Claspers in 3-manifolds enable us to define the surgery map from the module of Jacobi diagrams to the graded quotient of the Y-filtration of the monoid of homology cylinders. We determine the kernel of the surgery map restricted to the 1-loop part after taking a certain quotient of the target. The key tools are a homomorphism defined via the LMO functor and a refinement of the surgery map. In this talk, I will highlight open questions about homology cylinders. This is joint work with Masatoshi Sato and Masaaki Suzuki.

Akihiro Takano (Graduate School of Mathematical Sciences, The University of Tokyo)

Properties of links from the viewpoint of R. Thompson's group F

Recently, Jones introduced a method of constructing links from elements of R. Thompson's group F. Also, Aiello showed an analogy of Alexander's theorem that every oriented link can be represented as a closed braid. However, this theory is still unfamiliar and it is generally difficult to find an element for a non-trivial link. In this talk, we introduce a "good" subset of F and show that links obtained from these elements preserve some properties. This is joint work with Yuya Kodama (Tokyo Metropolitan University).

Jun Ueki (Ochanomizu University)

Twisted Iwasawa invariants of knots and profinite rigidity

Let p be a prime number and m an integer coprime to p. In the spirit of arithmetic topology, we introduce the notions of the twisted Iwasawa invariants λ, μ, ν of GL_N-representations and $\mathbb{Z}/m\mathbb{Z} \times \mathbb{Z}_p$-covers of knots. We assert among other things that the set of Iwasawa invariants determine the genus and the fiberedness of a knot, yielding their profinite rigidity. Several intuitive examples will be exhibited. We further asserts the $\mu = 0$ theorem for SL_2-representations of twist knot groups and ask several questions. (joint work with R. Tange)

Akira Yasuhara (Faculty of Commerce, Waseda University)

Concordance for higher dimensional welded objects and their Milnor invariants

We will introduce cut-diagrams, that generalize welded links to higher dimensions. A 2-dimensional cut-diagram is a 1-dimensional diagram D on a surface Σ such that each arc of D is labeled by a region of $\Sigma \setminus D$ with some natural labeling condition. This is an enhancement and 'virtual' extension of the notion of labeled lower decker set for an embedding of Σ. We can also define n-dimensional cut-diagrams for any positive integer n. In particular, 1-dimensional cut-diagrams correspond to Gauss diagrams up to 'welded moves', or equivalently, to welded link diagrams. So we may regard n-dimensional cut-diagrams as n-dimensional welded objects. In this talk, we study n-dimensional cut-diagrams up to natural equivalence relations, called (self-singular) concordance, defined via $(n+1)$-dimensional cut-diagrams. We give Milnor type invariants for n-dimensional cut-diagrams, and show that these are (self-singular) concordance invariants. While our arguments are purely combinatorial, our results can be applied to topological object. We give several concrete applications to the study of surface links in S^4 up to concordance and link-homotopy. This is joint work with Benjamin Audoux (Aix-Marseille Université) and Jean-Baptiste Meilhan (Université Grenoble Alpes).