International Workshop "Knots in Tsushima 2019"
Abstract

Sept. 6th (Fri)

14:10-14:40 **Fumikazu Nagasato** (Meijo Univ) *Ghost characters of knots and their periodicity*

A ghost character of a knot K is an object that can be thought of as a "fake" of the character of a trace-free $\mathrm{SL}_2(\mathbb{C})$-representation of the knot group $G(K)$. In 2016, I and Shinnosuke Suzuki (Toyota) have found two knots (torus knots) which have ghost characters. Using them, moreover, we have shown that one of the knots gives a counterexample of the conjecture given by Lenhard Ng on the abelian knot contact homology $HC_0^{ab}(K)$, which claims that $HC_0^{ab}(K) \otimes \mathbb{C}$ is isomorphic to the character ring of a certain 3-manifold. From this perspective, in the topological characterization of $HC_0^{ab}(K)$, it is interesting to research topological properties on ghost characters. This time, in a joint work with Anh T. Tran (UT Dallas) we found infinitely many torus knots that have a ghost character. We will explain the result by using a periodicity of the ghost characters.

14:45-15:15 **Taizo Kanenobu** (Osaka City Univ) and **Masafumi Matsuda** (Osaka City Univ) *Classification of ribbon 2-knots of 1-fusion with length up to seven*

We consider the classification of ribbon 2-knots of 1-fusion with length up to seven.

15:35-16:05 **Tomo Murao** (Univ of Tsukuba/JSPS Research Fellow PD) *Linear extensions of multiple conjugation quandles and MCQ Alexander pairs*

A multiple conjugation quandle (MCQ) is an algebra motivated from handlebody-knot theory. A linear extension of an MCQ plays an important role to construct handlebody-knot invariants. In this talk, we introduce a pair of maps called an MCQ Alexander pair, which yields a linear extension of an MCQ. We show that any linear extension of an MCQ can be realized by using some MCQ Alexander pair up to isomorphism.

16:15-16:45 **Yasutaka Nakanishi** (Kobe Univ) *A note on sharp move*

A sharp move is introduced by H. Murakami. Murakami and Sakai show that a sharp move makes a difference of the minor index of a knot by three or less. In this talk, we give an alternative proof and an application for virtual knots.

16:50-17:20 **Sangyoul Lee** (Pusan National Univ) *Shadow product biquandle cocycle invariants for surface-links*

In 2001, J. S. Carter, S. Kamada and M. Saito introduced the shadow quandle cocycle invariants for classical links and surface-links (including more general cases) by using the shadow (co)homology theory of quandles, which are generalizations of quandle cocycle invariants introduced by J. S. Carter et al. These invariants for links and surface-links are defined as the state-sums of all Boltzman weights that are evaluations of a given 2- and 3-cocycle at the crossings of link diagrams and triple points of broken surface diagrams modulo Roseman moves, respectively, over all quandle colorings of arcs in link diagrams and sheets in broken surface diagrams together with particularly designed region (shadow) colorings for the complementary regions of the diagrams. Recently, those shadow quandle cocycle invariants for surface-links have been reinterpreted with biquandles using marked graph diagrams modulo Yoshikawa moves by S. Kamada, A. Kawauchi, J. Kim and myself. In this talk, I'd like to discuss some properties of the shadow product biquandle cocycle invariants for surface-links.

Sept. 7th (Sat)

9:15-9:45 **Kazuhiro Ichihara** (Nihon Univ) *Minimal coloring numbers on minimal diagrams of torus links*

In this talk, I will talk about the minimal number of colors for non-trivial $\mathbb{Z}$-colorings on the standard minimal diagrams of $\mathbb{Z}$-colorable torus links. This talk is based on a joint work with Katsumi Ishikawa (RIMS, Kyoto Univ) and Eri Matsudo (Nihon Univ).

9:50-10:10 **Sanghoon Park** (Pusan National Univ/M2) *Invariants of quandle coloring quivers from the incidence matrix*

Quandles are sets with binary operations satisfying axioms derived from Reidemeister moves used to manipulate knot diagrams. Assigning a label to each arc, we can define the fundamental quandle $Q(L)$. For a link L and a finite quandle X, each element of $\mathbf{Hom}(Q(L), X)$ can be thought as a "coloring" of the diagram of L.

In 2018, Karina Cho and Sam Nelson introduced a directed graph-valued invariant of knots and links, which is called the *quandle coloring quiver*. It is a diagram with a vertex for every element $f \in \mathbf{Hom}(Q(L), X)$ and an edge directed from f to g when $g = \phi f$ for an element $\phi \in S$ where $S \subset \mathbf{Hom}(X, X)$. In this talk, I'd like to discuss some invariants of quandle coloring quivers which are obtained from the incidence matrix.

10:20-10:40 **Minju Seo** (Pusan National Univ/D1) *Quandle coloring quivers of marked graph diagrams*

In 2018, K. Cho and S. Nelson introduced the quandle coloring quiver of an oriented knot or link diagram, which is a quiver structure on the set of quandle colorings of a knot or link diagram. Also, they gave a new invariant, called the in-degree quandle quiver polynomial, from the quiver structure. A surface-link is a closed 2-manifold smoothly embedded in $\mathbb{R}^4$ or $\mathbb{S}^4$. A surface-link can be presented by a marked graph diagram with specific condition, and a marked graph diagram is a generalization of a knot or link diagram. In this talk, we introduce a quiver structure on the set of quandle colorings of a marked graph diagram, and compute the in-degree quandle quiver polynomials of some marked graph diagrams. This is a joint work with J. Kim and S. Nelson.

10:45-11:05 **Suhyeon Jeong** (Pusan National Univ/D3) *A psybracket of pseudoknots*

In 2010, a *pseudodiagram* was introduced by Ryo Hanaki. A pseudodiagram is a knot or link diagram where we ignore over/under information at some crossings of the diagram. This definition is motivated by applications in molecular biology such as modeling knotted DNA, where data often comes inconclusive with respect to which crossing it represents.

In 2012, Allison Henrich, Rebecca Hoberg, Slavik Jablan, Lee Johnson, Elizabeth Minten, and Ljiljana Radvi extended this idea to a pseudoknot and pseudolink. A *pseudoknot* (or *pseudolink*) is an equivalence class of pseudodiagrams modulo pseudo Reidemdister moves.

In this talk, we would like to introduce a *psybracket* consisting of two maps $\langle\ ,\ ,\ \rangle_c, \langle\ ,\ ,\ \rangle_p : X \times X \times X \to X$ satisfying some axioms derived from pseudo Reidemeister moves. By using this, we define an invariant, called the *psybracket counting invariant*, of pseudolinks. This is a joint work with Jieon Kim and Sam Nelson.

11:10-11:40 Takuji Nakamura (Osaka Electro-Communication Univ) *Flow spines and virtual knot diagrams*

For a closed oriented 3-manifold with a non-singular vector field, we can construct its virtual knot diagram via a "flow spine" of the manifold. In this talk, we introduce a coloring invariant of 3-manifolds by using their virtual knot diagrams. This is a joint work with Ippei Ishii and Toshio Saito(Joetsu Univ of Education).

Sept. 8th (Sun)

9:15-9:45 Sangyop Lee (Chung-Ang Univ) *Twisted torus knots which are torus knots*

A twisted torus knot $T(p, q, r, s)$ is obtained from a torus knot $T(p, q)$ by twisting r adjacent strands of a torus knot $T(p, q)$ fully s times. We discuss the determination problem of parameters (p, q, r, s) for which $T(p, q, r, s)$ is a torus knot.

9:50-10:20 Ayako Ido (Aichi Univ of Education) *On unique geodesics in the curve complex*

The curve complex of a compact surface introduced by Harvey has been used to prove many deep results in 3-dimentional topology. In this talk, we give several methods to construct unique geodesics in the curve complex. This research is based on a joint work with Yeonhee Jang and Tsuyoshi Kobayashi.

10:30-11:00 Akio Kawauchi (OCAMI) *Knotting probability of a spatial arc*

A spatial arc is understood as a polygonal arc in 3-space, which is considered as models of a linear polymer and a protein. In this talk, a recent definition of the knotting probability of an arc diagram is explained. The definition uses the fact that every arc diagram induces a chord diagram and every chord diagram induces a ribbon surface-link in 4-space. Then the knotting probability measures how many non-trivial genus two ribbon surface-knots occur from the chord diagram induced from the arc diagram. For most simple arc diagrams, the knotting probabilities are easilycalculable. Any orthogonal projection image of any spatial arc is approximated to an arc diagram determined uniquely from the spatial arc and the projection arrow up to isomorphisms. Any oriented spatial arc except an interval uniquely specifies three mutually orthogonal projection arrows. Thus, the knotting probability of every spatial arc is defined.

11:05-11:35 Ayumu Inoue (Tsuda Univ) *The twist-spinning of classical knots whose knot quandles are finite*

Cardinalities of knot quandles can be finite, while those of knot groups are always infinite. In this talk, the speaker gives a necessary and sufficient condition for a classical knot k and a positive integer m so that the knot quandle of the m-twist-spun k is finite.

11:40-12:10 Naoko Kamada (Nagoya City Univ) *Converting virtual knots to almost classical virtual knots*

Any classical knot diagram admits an Alexander numbering. If a virtual knot diagram admitsan Alexander numbering, it is said to be almost classical. In this talk, we introduce the map from the set of virtual knot diagrams to that of almost classical virtual knot diagrams. This map induce the map from the set of virtual knots to that of almost classical virtual knots.

14:00-14:30 Seiichi Kamada (Osaka Univ) *Generators of the motion groups of H-trivial links and application to surface-knot theory*

The motion group of a trivial link was studied by D. M. Dahm and D. L. Goldsmith. We discuss the motion group of an H-trivial link. An H-trivial link is a link in 3-space which is ambient isotopic to the split union of some Hopf links and some trivial links. We give generators of the group and application to surface-knot theory. This research is a joint project with C. Damiani and R. Piergallini.

14:35-15:05 Benjamin Bode (Osaka Univ/JSPS International Research Fellow) *On real algebraic links in* $\mathbb{S}^3$

Links of isolated singularities of complex plane curves are quite well studied. Their real counterpart however, real algebraic links, i.e., links of isolated singularities of real polynomial maps $f : \mathbb{R}^4 \to \mathbb{R}^2$, are not classified yet. In this talk I am going to show that every link in an infinite family (the closures of squares of homogeneous braids) is real algebraic.

15:30-16:00 Jieon Kim (Pusan National Univ/Post-Doc) *On a bi-Gauss diagram of surface-links*

Classical links can be described by a Gauss diagram. Surface-links are described by a marked graph diagram, which is a diagram of a finite spatial regular graph with 4-valent rigid vertices such that each vertex has a marker. For a marked graph diagram, we have two classical links, called a positive resolution and negative resolution. In this talk, by using the Gauss diagrams of two resolutions of a marked graph diagram of a surface-link, we introduce a new method of describing surface-links, called a bi-Gauss diagram. This is a joint work with S. Bost, B. Garbuz and S. Nelson.

16:05-16:35 Teruhisa Kadokami (Kanazawa Univ) *Knot theory in 3-manifold via virtual knot theory*

Let M be a compact oriented 3-manifold, and L a link in M. Let $M = V \cup W$ be a compression body decomposition of M, and F the Heegaard surface of the decomposition. Then L can be situated in a regular neighborhood of F. By G.Kuperberg's theorem on virtual knot theory [AGT3 (2003), 587-591], we can correspond L to a set of virtual links. Hence it may be possible to study knot theory in 3-manifold via virtual knot theory.

16:40-17:10 Shin Satoh (Kobe Univ) *On the three loop framed isotopy invariant of a virtual knot*

In 2014 Christian and Dye introduced two kinds of invariants of a virtual knot called the “three loop isotopy invariant” and the “three loop framed isotopy invariant.” We studied the latter invariant and proved that the three loop invariant is weaker than the writhe polynomial of a virtual knot. In fact, we give a precise description of the three loop framed isotopy invariant by using the coefficients of the writhe polynomial in this talk.