研究集会 Intelligence of Low-dimensional Topology

京都大学数理解析研究所 RIMS 研究集会として、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 26287013、研究代表者 鎌田聖一氏（大阪市立大学））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： ２０１６年 5月１８日 (水)～ ２０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１８日 (水)

13:20～14:10　鮑 園園 (東京大学大学院数理科学研究科)
Heegaard Floer homology for embedded bipartite graphs

14:30～15:20　今野 北斗 (東京大学大学院数理科学研究科 / 日本学術振興会特別研究員 DC)
A family of the Seiberg-Witten equations and configurations of embedded surfaces in 4-manifolds

15:40～16:30　Andrei Pajitnov (Université de Nantes)
On the Morse-Novikov number for 2-knots

5月１９日 (木)

10:00～10:50　河村 建吾 (大阪市立大学数学研究所)
Surface-links which bound immersed handlebodies

11:10～12:00　小鳥居 祐香 (東京大学大学院数理科学研究科)
On handlebody-links and Milnor's link-homotopy invariants

13:20～14:10　小野 薫 (京都大学数理解析研究所)
Holomorphic curve techniques in symplectic geometry

14:30～15:20　丹下 基生 (筑波大学)
Introduction to Heegaard Floer homology

15:40～　Problem Session

5月20日 (金)

10:00〜10:50　Sang Youl Lee (Pusan National University)
Surface-links and marked graph diagrams

11:10〜12:00　石川 勝巳 (京都大学数理解析研究所 / 日本学術振興会特別研究員 DC)
Quandle cocycle invariants of cabled surface knots

13:20〜14:10　野崎 雄太 (東京大学大学院数理科学研究科 / 日本学術振興会特別研究員 DC)
An explicit relation between knot groups in lens spaces and those in S^3

14:30〜15:20　安部 哲哉 (大阪市立大学数学研究所)
On annulus twists

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)、伊藤哲也 (大阪大 理学研究科)

Intelligence of Low-dimensional Topology

May 18–20, 2016
Room 420, RIMS, Kyoto University
Access: `http://www.kurims.kyoto-u.ac.jp/en/access-01.html`

Program

May 18 (Wed)

13:20–14:10 Yuanyuan Bao (Graduate School of Mathematical Sciences, University of Tokyo)
Heegaard Floer homology for embedded bipartite graphs

14:30–15:20 Hokuto Konno (Graduate School of Mathematical Sciences, University of Tokyo / JSPS research fellow DC)
A family of the Seiberg-Witten equations and configurations of embedded surfaces in 4-manifolds

15:40–16:30 Andrei Pajitnov (Université de Nantes)
On the Morse-Novikov number for 2-knots

May 19 (Thu)

10:00–10:50 Kengo Kawamura (Osaka City University Advanced Mathematical Institute)
Surface-links which bound immersed handlebodies

11:10–12:00 Yuka Kotorii (Graduate School of Mathematical Science, University of Tokyo)
On handlebody-links and Milnor's link-homotopy invariants

13:20–14:10 Kaoru Ono (RIMS, Kyoto University)
Holomorphic curve techniques in symplectic geometry

14:30–15:20 Motoo Tange (University of Tsukuba)
Introduction to Heegaard Floer homology

15:40– Problem Session

May 20 (Fri)

10:00–10:50 Sang Youl Lee (Pusan National University)
Surface-links and marked graph diagrams

11:10–12:00 Katsumi Ishikawa (RIMS, Kyoto University / JSPS research fellow DC)
Quandle cocycle invariants of cabled surface knots

13:20–14:10 Yuta Nozaki (Graduate School of Mathematical Sciences, University of Tokyo / JSPS research fellow DC)
An explicit relation between knot groups in lens spaces and those in S^3

14:30–15:20 Tetsuya Abe (Osaka City University Advanced Mathematical Institute)
On annulus twists

Scientific Committee: Akio Kawauchi, Toshitake Kohno, Taizo Kanenobu, Seiichi Kamada, Tomotada Ohtsuki

Organizers: Tomotada Ohtsuki (RIMS, Kyoto University), Tetsuya Ito (Osaka University)

Intelligence of Low-dimensional Topology

May 18–20, 2016

RIMS, Kyoto University

Abstract

Tetsuya Abe (Osaka City University Advanced Mathematical Institute)
On annulus twists

Annulus twist is an operation on knots along an annulus embedded in the 3-sphere. I will survey several results on annulus twists. In particular, via annulus twists, I give a construction of slice knots (such that corresponding slice disks have the same exterior). Also, I explain a characterization of ribbon disks in terms of handle decompositions of the 4-ball.

Yuanyuan Bao (Graduate School of Mathematical Sciences, University of Tokyo)
Heegaard Floer homology for embedded bipartite graphs

The Heegaard Floer homology for links defined by Ozsváth and Szabó, and independently Rasmussen has made great impacts on the study of links. It has also been widely used to study the properties of the manifolds obtained from Dehn surgeries. In this talk, we study this homology for an embedded bipartite graph, which can be regarded as a generalization of links. Precisely, we define the minus-version and hat-version of the Heegaard Floer homology for a balanced bipartite graph with a balanced orientation in a closed oriented rational homology 3-sphere. A combinatorial Heegaard Floer homology for a transverse graph in the 3-sphere was recently studied by Harvey and O'Donnol, by using grid diagram for a transverse graph. If we regard a grid diagram as a special Heegaard diagram in the 3-sphere, the chain complex defined here is equivalent with the one they defined.

We define the Alexander grading for a graph. The differential of the chain complex for a graph preserves the Alexander grading. For some graphs, the chain complex can be regarded as the associated graded object of the chain complex for the ambient manifold, with respect to the Alexander grading. In the end, we study the Euler characteristic of the hat-version complex. In particular, when the ambient manifold is the 3-sphere, we show a combinatorial description of the Euler characteristic by using the "states" of a given graph projection.

Katsumi Ishikawa (RIMS, Kyoto University / JSPS research fellow DC)
Quandle cocycle invariants of cabled surface knots

We modify quandle spaces to define invariants of surface links, which have universality among quandle 2-cocycle invariants and (component-wise version of) 3-cocycle invariants. Furthermore, we explain that quandle 3-cocycle invariants of cabled surface knots and rack 3-cocycle invariants of framed surface knots are described by those invariants.

Kengo Kawamura (Osaka City University Advanced Mathematical Institute)
Surface-links which bound immersed handlebodies

In 1960s, Yajima and Yanagawa studied ribbon surface-links. Recently, Kamada and I defined ribbon-clasp surface-links, which are generalization of ribbon surface-links. It is known that ribbon surface-links and ribbon-clasp surface-links are the boundary of immersed handlebodies. In this talk, we firstly introduce ribbon surface-links and ribbon-clasp surface-links. After that, we introduce known results for ribbon surface-links and our results for ribbon-clasp surface-links.

Hokuto Konno (Graduate School of Mathematical Sciences, University of Tokyo / JSPS research fellow DC)
A family of the Seiberg-Witten equations and configurations of embedded surfaces in 4-manifolds

We introduce a family of the Seiberg-Witten equations obtained from several surfaces embedded to a suitable configuration in a 4-manifold. By using this family, we can grasp the wall crossing phenomena for a general b^+. As an application, we give the adjunction inequalities for surfaces in a 4-manifold whose Seiberg-Witten invariant vanishes.

Yuka Kotorii (Graduate School of Mathematical Science, University of Tokyo)
On handlebody-links and Milnor's link-homotopy invariants

A handlebody-link is a disjoint union of embeddings of handlebodies in S^3 and HL-homotopy is an equivalence relation on handlebody-links generated by self-crossing changes. A. Mizusawa and R. Nikkuni classified the set of HL-homotopy classes of 2-component handlebody-links completely using the linking numbers for handlebody-links. In this talk, by using Milnor's link-homotopy invariants, we give an invariant for handlebody-links and give a bijection between the set of HL-homotopy classes of handlebody-links with some assumption and hypermatrices modulo the elementary transformations, especially for handlebody-links with 3-components or more. This is joint work with Atsuhiko Mizusawa at Waseda University.

Sang Youl Lee (Pusan National University)
Surface-links and marked graph diagrams

A surface-link is a closed 2-manifold smoothly (or piecewise linearly and locally flatly) embedded in four space. A marked graph diagram is a link diagram possibly with marked 4-valent vertices. A surface-link can be described by a marked graph diagram modulo Yoshikawa moves. In this talk, I would like to take a glance at representations of surface-links via marked graph diagrams and then discuss some recent works on this topic.

Yuta Nozaki (Graduate School of Mathematical Sciences, University of Tokyo / JSPS research fellow DC)
An explicit relation between knot groups in lens spaces and those in S^3

We consider a p-fold cyclic covering map $(S^3, K) \to (L(p,q), K')$ and describe the knot group $\pi_1(S^3 \setminus K)$ in terms of $\pi_1(L(p,q) \setminus K')$. As a consequence, we give an alternative proof for the fact that a certain knot in S^3 cannot be represented as the preimage of any knot in a lens space. In the proof, the subgroup of a group G generated by the commutators and the pth power of each element of G plays a key role.

Kaoru Ono (RIMS, Kyoto University)
Holomorphic curve techniques in symplectic geometry

Since Gromov's seminal work, the thoery of (pseudo)holomorphic curves has revealed many important features of symplectic structures. After showing naive ideas, I would like to explain Floer theory for Lagrangian submanifolds through some examples.

Andrei Pajitnov (Université de Nantes)
On the Morse-Novikov number for 2-knots

Let $K \subset S^4$ be a 2-knot, that is, a smoothly embedded 2-sphere in S^4. The Morse-Novikov number $\mathcal{MN}(K)$ is the minimal possible number of critical points of a Morse map $S^4 \setminus K \to S^1$ belonging to the canonical class in $H^1(S^4 \setminus K)$. We give a lower bound for the number $\mathcal{MN}(K)$ in terms of the Novikov homology of the complement to K. We give an upper bound for $\mathcal{MN}(K)$ in terms of a simple geometric invariant of the knot, *the saddle number of* K. We prove that for a classical knot $K \subset S^3$ the Morse-Novikov number of the spun knot $S(K)$ is $\leq 2\mathcal{MN}(K)$. This enables us to compute $\mathcal{MN}(S(K))$ for every classical knot K with tunnel number 1.

This is a joint work with Hisaaki Endo.

Motoo Tange (University of Tsukuba)
Introduction to Heegaard Floer homology

In the beginning of 2000's, Ozsvath and Szabo defined Heegaard Floer homology as Lagrangian intersection Floer theory using the information of the Heegaard splitting of 3-manifolds, knots or links. For more than ten years from their definition, various low-dimensional topics related to this invariants have been developed up to now. In this talk, we will begin with the original definition of Heegaard Floer homology and explain several applications, computations, and relationship with other topological invariants. If time permitted, we are going to touch Upsilon invariant.