Four Dimensional Topology

November 24 – November 26, 2017
Room E408, Department of Mathematics, Osaka City University

Abstracts

Hokuto Konno (The University of Tokyo)
Characteristic classes of bundles of a 4-manifold via gauge theory

I will define non-trivial characteristic classes of bundles of 4-manifolds using families of gauge theoretic equations. The basic idea of the construction of the characteristic classes is to consider an infinite dimensional analogue of the Euler class used in the usual theory of characteristic classes. If time permits, I will also explain the idea to prove the non-triviality of the characteristic classes.

Masaki Taniguchi (The University of Tokyo)
Instantons for 4-manifolds with periodic end and an obstruction to embeddings of 3-manifolds

For a certain class of pairs of 3- and 4-manidfolds, we construct an obstruction in the filtered instanton Floer homology of the existence of an embedding with some homological conditions between them. In order to achieve that goal, we study the compactness of the ASD-moduli spaces over 4-manifolds with periodic ends. This compactness result is a generalization of the Taubes's in 1987.

Hironobu Naoe (Tohoku University)
Infinite family of corks having large shadow-complexity

Any exotic pair of simply-connected and closed 4-manifolds is related by an operation with a contractible 4-manifold called a cork. We study the shadow-complexity of corks. The shadow-complexity is an invariant of 3- and 4-manifolds that measures how simple/complicated they are. We studied corks having low shadow-complexities in the previous works. In this talk, we show that there are infinitely many corks with arbitrary large shadow-complexity.

Shigeru Takamura (Kyoto University)
Group actions and a geometry based on stabilizers

Recently we have developed a geometry based on stabilizers of group actions, which arose from our consideration of *quotient families* — for an introduction of quotient families, see the article (in Japanese):
`https://www.math.kyoto-u.ac.jp/~kino2017/report/TakamuraShigeru.pdf`

Given a group action on a space, to each point of the space its stabilizer (isotropy group) is associated. This forms a stratified group bundle, which reflects how stabilizers vary with points. Stabilizer-constant loci play a prominent role. For instance, for the mapping class group action on a Teichmüller space, a stabilizer-constant locus is the locus over which the Riemann surfaces with automorphism groups equal to the stabilizer lie. Viewing from "Stabic Geometry" leads to various problems concerning quotient families, such as, for a family of G-Riemann surfaces (i.e. Riemann surfaces with actions of a finite group G), when does a coalescence of ramification points occur to create a degeneration? how can we then determine the vanishing cycles?

Takayuki Okuda (The University of Tokyo)

Layer construction of multi-dimensional splitting families of degenerations of Riemann surfaces

(joint work with Shigeru Takamura)

There have been introduced several methods to construct one-parameter splitting families of degenerations of Riemann surfaces. In this talk, by "overlapping" such splitting families we construct multi-parameter splitting families — in such a way that the original splitting families form the restrictions to the parameter axes. We then observe what happens (e.g. how singular fibers split) under deformation in general direction.

Kouki Sato (Tokyo Institute of Technology)

ν^+-equivalence class of genus one knots

The ν^+-equivalence is an equivalence relation on the knot concordance group. It is known that many concordance invariants derived from Heegaard Floer theory are invariant under ν^+-equivalence. In this work, we prove that any genus one knot is ν^+-equivalent to one of the unknot, the trefoil and its mirror.

Yuanyuan Bao (The University of Tokyo)

The Alexander polynomial of a colored trivalent graph and its MOY-type relations

(joint work with Zhongtao Wu)

We generalize Kauffman's state sum formula to a trivalent spatial graph. Precisely, for an oriented framed trivalent graph G with a positive coloring c, we get an ambient isotopy invariant $\Delta_{(G,c)}(t)$. We show that $\Delta_{(G,c)}(t)$ satisfies a series of relations, which are analog to MOY's relations, and that these MOY-type relations provide a graphical definition for the single-variable Alexander polynomial of a link. In addition, we showed that these relations characterize $\Delta_{(G,c)}(t)$. (This is a joint work with Zhongtao Wu.)

Hisaaki Endo (Tokyo Institute of Technology)
Introduction to trisections of 4-manifolds

Trisections of 4-manifolds have been introduced by Gay and Kirby in 2010 as a 4-dimensional analogue to Heegaard splittings of 3-manifolds. In this talk, I would like to give a short introduction to the theory of trisection. In particular, we review definitions, basic properties, and several examples of trisections of 4-manifolds.

Wataru Yuasa (Tokyo Institute of Technology)
The classification of genus 2 trisections via Heegaard diagrams of S^3 : a review

We give a quick review on a paper "Genus-two trisections are standards" written by Meier and Zupan. In this paper, they classified $(2,0)$-trisections using classical results of Heegaard splittings of S^3. We would like to explain what results were used and how they applied them to the classification of $(2,0)$-trisections.

Kenjiro Sasaki (Kyoto University)
Quotient families of the Klein curve associated with representations of $PSL_2(\mathbb{F}_7)$
(joint work with Shigeru Takamura)

The Klein curve is a Riemann surface of genus 3 with the largest automorphism group $PSL_2(\mathbb{F}_7)$; its order is 168. From each representation of this group, a fibration of Riemann surfaces (with singular fibers) is obtained — a *linear quotient family.* In this talk, we describe such a family for the homological representation and the canonical representation (the representation on the space of holomorphic quadratic differentials). The family obtained from the canonical representation is used for describing the universal family of Riemann surfaces of genus 3 around the Klein curve.

Mizuki Fukuda (Tohoku University)
On representations of a certain class of fibered 2-knots

A 2-knot in the 4-sphere is fibered if the knot complement of the 2-knot has a fibration over the circle. Pao constructed examples of a 2-knot, called branched twist spin, whose monodromy is periodic, and Hillman and Protnick showed all fibered 2-knots with periodic monodromy are branched twist spins. In this talk, from the presentation shown by Lin and Nagasato and Yamaguchi for branched cover of the 3-sphere along a 1-knot, we determine the number of the conjugacy classes of irreducible $SL(2,\mathbb{C})$-metabelian representations of the knot group of a branched twist spin.

Celeste Damiani (Osaka City University)
Moving towards unexplored motion groups

A motion in M of a subspace N consists of an (ambient) isotopy of N through M which returns N to itself, and it can be related to the notion of loop in a space of configurations of the connected components of N. In a joint work with Seiichi Kamada, we propose to calculate the group of motions of an H-trivial link in a 3-dimensional space, where a link is called H-trivial if it is a split union of trivial knots and Hopf links. Moreover, we propose to find a group presentation for it. Our motive lies in the fact that Kamada and Kawamura proved that any immersed surface-link can be described by a normal form involving H-trivial links. Our aim is thus to shed light on the information that this normal form could carry. This is a work in progress.

Kenta Hayano (Keio University)
New counterexamples to Stipsicz's conjecture on fiber-sum indecomposable Lefschetz fibrations
(joint work with Refik İnanç Baykur and Naoyuki Monden)

Stipsicz conjectured that any fiber-sum indecomposable Lefschetz fibration over the sphere has a (-1)–section. This conjecture is known to be false: there exist counterexamples with genus 2 (due to Y. Sato) and genus 3 (due to Baykur-Hayano). In this talk, we will explain how to construct counterexamples with any higher genera. If time permits, we will discuss Kodaira dimensions of these examples.

Toshifumi Tanaka (Gifu University)
On composite symmetric unions

A symmetric union is obtained from a knot in the 3-space and its mirror image, which are symmetric with respect to a 2-plane, by connecting them with some 2-string tangles along the plane. It is known to be an example of a slice knot. We introduce the minimal twisting number of a symmetric union and show that if a knot K is a composite symmetric union with minimal twisting number one, then K has a non-trivial knot and its mirror image as connected summands. As an application, we show that the connected sum of two prime symmetric unions with minimal twisting number one has minimal twisting number two if and only if they are not mirror images of one another.

Kimihiko Motegi (Nihon University)
Slice genera versus Seifert genera of knots in twist families
(joint work with Kenneth L. Baker)

Twisting a knot K in S^3 along a disjoint unknot c produces a twist family of knots $\{K_n\}$ indexed by the integers. Comparing the behaviors of the Seifert genus $g(K_n)$ and the slice genus $g_4(K_n)$ under twistings, we prove that if $g(K_n) - g_4(K_n) < C$ for some constant C for infinitely many integers $n > 0$ or $g(K_n)/g_4(K_n) \to 1$ as $n \to \infty$, then either the winding number of K about c is zero or the winding number equals the wrapping number. As a key application, if $\{K_n\}$ or the mirror twist family $\{\overline{K_n}\}$ contains infinitely many tight fibered knots, then the latter must occur. We further develop this to show that c is a braid axis of K if and only if both $\{K_n\}$ and $\{\overline{K_n}\}$ each contain infinitely many tight fibered knots. This is joint work with Ken Baker.

Kouki Sato (Tokyo Institute of Technology)
Bridge trisections of knotted surfaces

Meier and Zupan introduced bridge trisections, which are new descriptions of knotted surfaces in S^4 and related to trisections of closed 4-manifolds. In this talk, we give a short survey of their results on bridge trisections.

Kokoro Tanaka (Tokyo Gakugei University)
A relation between biquandle colorings and quandle colorings
(joint work with Katsumi Ishikawa)

Biquandles are generalizations of quandles. As well as quandles, biquandles give us many invariants for classical/virtual/surface knots. Some invariants derived from biquandles are known to be stronger than those from quandles for virtual knots. However, we have not found an essentially refined invariant for classical/surface knots. In this talk, we give an explicit one-to-one correspondence between biquandle colorings and quandle colorings for classical/surface knots. This implies that a biquandle coloring number is equal to a quandle coloring number for classical/surface knots. If time permits, we explain a relation between the fundamental biquandle and the fudamental quandle, and also a relation between a biquandle cocycle invariant and a shadow quandle cocycle invariant. This is a joint work with Katsumi Ishikawa (RIMS, Kyoto University).

Organizers: Seiichi Kamada, Kouichi Yasui and Takao Matumoto
skamada(*)sci.osaka-cu.ac.jp
kyasui(*)ist.osaka-u.ac.jp
matumoto(*)math.sci.hiroshima-u.ac.jp
(*)⇒@