Four Dimensional Topology

November 15 – November 17, 2013
Hiroshima University

Abstracts

Logarithmic transformations and generalized complex structures (joint work with Ryushi Goto)

Kenta Hayano (Hokkaido University)

Generalized complex structures are geometric structures on even-dimensional manifolds which can be regarded as generalizations of both complex and symplectic structures. In this talk, we will explain how logarithmic transformations change generalized complex structures. We will also give new examples of generalized complex structures using log transforms together with (broken) Lefschetz fibration structures.

On negative-definite cobordisms among lens spaces (joint work with Mikio Furuta)

Yoshihiro Fukumoto (Ritsumeikan University)

In 2007, P. Lisca classified connected sums of three-dimensional lens spaces which smoothly bound rational homology 4-balls. In this talk, we consider the statement with replacement of "rational homology 4-balls" by "negative-definite cobordism to an integral homology 3-sphere" under a rather strong condition: we need a restriction of the type of lens spaces, in which $L(m, \pm 1)$ plays an important role, and a technical condition on H_1. Our argument uses instantons and the Chern-Simons invariants. This is a joint work with Mikio Furuta.

Manolescu-Floer spectra for Seiberg-Witten monopoles

Tirasan Khandhawit (Kavli IPMU)

In this talk, I will try to give an overview of the construction of stable homotopy type for monopole Floer homology. The construction associates a stable homotopy object to 3-manifolds, which will recover the Floer groups by appropriate homology theory. The main ingredients are finite dimensional approximation technique and Conley index theory. If time permitted, I will demonstrate construction for certain 3-manifolds such as the 3-torus.

Higher-dimensional torus knots, vanishing cycles and uniformization of singularities

Shigeru Takamura (Kyoto University)

Higher-dimensional torus knots play an important role in describing smooth fibers of degenerating families: They are used for describing the degenerating process, and also for describing monodromies of degenerations.

Classification of degenerations of Riemann surfaces associated with regular polyhedra

Ryota Hirakawa (Kyoto University)

A new method to construct degenerations of Riemann surfaces is presented: To an automorphism of a regular polyhedron, we associate a degeneration of Riemann surfaces whose topological monodromy is periodic. Moreover, we completely classify such degenerations of Riemann surfaces.

Bilinear-form invariants of Hurwitz equivalence classes

Takefumi Nosaka (Kyushu University)

We introduce invariants of Hurwitz equivalence classes with respect to any group G. Our invariants are constructed from any right G-modules M and any G-invariant bilinear function on M, and are of bilinear forms. For instance, when G is the mapping class group of a closed surface, M_g, we get an invariant of Lefschetz fibrations over the 2-sphere. Moreover, the construction is applicable for the quantum representations of level k derived from the Chern-Simons quantum filed theory. In particular, concerning the $U(1)$- or $SU(2)$-gauge groups, our invariant in low fiber-genus case is computable by the help of computers, which we will present in this talk.

Gluing formula for refined Seiberg-Witten invariant along 3-manifolds with $b_1 = 1$

Hirofumi Sasahira (Nagoya University)

I will define Seiberg-Witten-Floer stable homotopy type of 3-manifold with $b_1 = 1$, following the idea of Kronheimer and Manolescu. Using this, I will also construct a gluing formula for refined Seiberg-Witten invariant.

Kirby calculus and singularities of product maps

Kazuto Takao (Hiroshima University)

It is well known that any two Kirby diagrams of diffeomorphic 4-manifolds are related by a finite sequence of creations, cancellations, slides and isotopies. In this talk, we give an upper bound for the minimum number of creations and cancellations in terms of the numbers of handles of the initial diagrams plus a somewhat unexpected number. We also detect the indices of the handles of the creations and cancellations.

On Manolescu's work on the triangulation conjecture

Mikio Furuta (University of Tokyo)

I will explain Manolescu's work on the triangulation conjecture following his paper.

(1) Pin(2) equivariant Seiberg-Witteh Floer homotopy type for spin rational homology 3-spheres.

(2) Pin(2)-equivariant Seiberg-Witten Z/2-cohomolgy for spin rational homology 3-spheres.

(3) Definition of β and the relation $\mu(Y) \cong \beta(Y) \bmod 2$
(4) Relative invariant and homology cobordism invariance of β
(5) Duality and $\beta(-Y) = -\beta(Y)$

Pin(2) equivariant Seiberg-Witten Floer K group as TQFT

Mikio Furuta (University of Tokyo)

We give a K-theory version of Manolescu's construction and, as an application, show a 10/8-type inequality for a compact spin 4-manifold whose boundary is the disjoint union of spin rational homology 3-spheres. This is joint work with Tian-Jun Li. A similar result is obtained by Manolescu.

Splitting a 4-manifold with infinite cyclic fundamental group, revised

Akio Kawauchi (Osaka City University)

In this talk, we concern a revised version of the speaker's earlier paper on a TOP-splitting of a closed connected oriented 4-manifold with infinite cyclic fundamental group. We show that a closed connected oriented 4-manifold with infinite cyclic fundamental group is TOP-split if it is virtually TOP-split. As a consequence, we see that a closed connected oriented 4-manifold with infinite cyclic fundamental group is TOP-split if the intersection form is indefinite, so that every closed connected oriented smooth spin 4-manifold with infinite cyclic fundamental group is TOP-split. By combining this result with an earlier result due to J. A. Hillman and the speaker, the TOP-unknotting conjecture of an orientable surface-knot is solved affirmatively.

Lefschetz fibrations and finitely presented groups

Ryoma Kobayashi (Tokyo University of Science)

It follows from results of Gompf and Donaldson that every finitely presented group is the fundamental group of the total space of a Lefschetz fibration with a (-1)-section. In our work, we constructed Lefschetz fibrations with a (-1)-section whose fundamental groups are a given finitely presented group, by providing genus and monodromy explicitly.

On relationship between seven types of Roseman moves

Kengo Kawamura (Osaka City University)

D. Roseman introduced seven types of local transformations of 2-link diagrams. It is a generalization of Reidemeister moves in classical knot theory. It is known that a particular type can be realized by the other six types. There is another type that can be realized by the other six types. We show that any types except these two types cannot be realized by the other six types.

Ribbon torus-knots with the isomorphic fundamental quandles have the isomorphic fundamental biquandles

Sosuke Ashihara (Hiroshima University)

The fundamental quandles and biquandles are invariants of classical knots and surface knots. It is unknown whether there exist surface knots which have isomorphic fundamental quandles and distinct fundamental biquandles. We give a method of obtaining a presentation of the fundamental biquandle of a ribbon 2-knot/torus-knot from its fundamental quandle. We show that ribbon 2-knots/torus-knots with isomorphic fundamental quandles have isomorphic fundamental biquandles.

Regular-equivalence of 2-knot diagrams and sphere eversions (joint work with Masamichi Takase)

Kokoro Tanaka (Tokyo Gakugei University)

A surface-knot diagram is said to be regular if it has no branch points. In this talk, we construct two regular diagrams of a 2-knot such that any sequence of Roseman moves between them involves branch points.

Nonorientable genus of a knot in punctured CP^2 (joint work with Motoo Tange)

Kouki Sato (Tokyo Gakugei University)

Let K be a knot in $\partial(\mathbb{C}P^2 \setminus IntB^4)$ and $F \subset \mathbb{C}P^2 \setminus B^4$ a smoothly embedded nonorientable surface with boundary K. We prove that if represents zero in $H_2(\mathbb{C}P^2 \setminus IntB^4, \partial(\mathbb{C}P^2 \setminus IntB^4); \mathbb{Z}_2)$, then $b_1(F) \geq -\frac{\sigma(K)}{2} + d(S^3_1(K)) - 1$, where $d(S^3_{-1}(K))$ is the Heegaard Floer d-invariant of the integer homology sphere given by 1 surgery on K. In particular, if K is $\overset{n}{\#}9_{42}$, then the minimal first Betti number of such surfaces is equal to $n-1$.

Immersions of 3-sphere into 4-space associated with Dynkin diagrams of types A and D

Shumi Kinjo (Shinshu University)

In this talk, we introduce the construction of a map from a compact oriented 4-manifold into 4-space, which defined as an extension of some immersion from a compact oriented 3-manifold by using the Kirby calculus. The map from 4-manifold is called a singular Seifert surface. We construct two infinite sequences of immersions of the 3-sphere into 4-space, parameterized by the Dynkin diagrams of types A and D. To determine the regular homotopy classes of the immersions, we use the singular Seifert surfaces.

On the smooth unknotting conjecture in dimension four IX

Takao Matumoto (Kyoto University, Hiroshima University)

A key step to prove the conjecture will be explained. In fact, any path without self-intersection to cancell the node will be simplified to the trivial one, using the fact that the 2-knot is of genus zero.