Four Dimensional Topology

November 21 – November 23, 2014
Osaka City University

Abstracts

Smooth unknotting of a ribbon surface-knot

Akio Kawauchi (Osaka City University)

It is shown that a ribbon surface-knot is smoothly trivial if the fundamental group is infinite cyclic.

The polynomial invariants of Quasi-Alternating links

(joint work with K. Qazaqzeh)

Nafaa Chbili (United Arab Emirates University)

In this talk, we use the Jones polynomial and the Brandt-Lickorish-Millet polynomial to introduce new obstruction criteria for a link to be Quasi-alternating. As an application, we identify some knots of 12 crossings or less and some links of 9 crossings or less that are not quasi-alternating. In addition, we show that there are only finitely many Kanenobu knots which are quasi-alternating. This supports a conjecture of Greene that states that there are only finitely many quasi-alternating links with a given determinant.

Group actions, regular polyhedra, and quotient families

Shigeru Takamura (Kyoto University)

We introduce quotient families of complex analytic varieties, which involve representations of finite groups. After we explain their basic properties, we describe quotient families associated with regular polyhedra.

Regular polyhedra and complex surfaces

Ryota Hirakawa (Kyoto University)

To each regular polyhedron, we associate non-compact/compact complex surfaces together with fibrations. The singular fibers of these fibrations are described.

Deformation equivalence classes of surfaces with the first Betti number one, and the second Betti number zero

Shota Murakami (Keio University)

In this talk, we ask whether the number of deformation equivalence classes of surfaces homotopy equivalent (or diffemorphic) to a smooth closed 4-manifold M is finite or not. This problem is solved except the case where $b_1(M) = 1$. We will prove that the number of deformation equivalence classes of surfaces homotopy equivalent to M is finite if $b_1(M) = 1$ and $b_2(M) = 0$.

On ribbon-clasp 2-knots

(joint work with Seiichi Kamada)

Kengo Kawamura (Osaka City University)

An ribbon-clasp 2-knot is the boundary of an immersed 3-ball in $\mathbb{R}^4$ whose singular set consists of only ribbon singularities and clasp singularities. In this talk, we will talk about ribbon-clasp 2-knots and their presentations by virtual curves.

Multisections of Lefschetz fibrations and topology of symplectic 4-manifolds

(joint work with Refik Inanc Baykur)

Kenta Hayano (Hokkaido University)

A multisection of a Lefschetz fibration is a 2-dimensional submanifold in the total space on which the restriction of the fibration is a simple branched covering. In this talk we will first explain how to understand topology and configuration of multisections in a combinatorial way via mapping class groups. Multisections are closely related with several problems on topology of symplectic 4-manifolds, such as uniqueness of smooth structures of symplectic Calabi-Yau manifolds, the Stipsicz conjecture on minimality and fiber-sum indecomposability and existence of non-isomorphic Lefschetz fibrations and exotic Lefschetz pencils. We will also explain as many applications of our result to these problems as time permits.

On sections of the Matsumoto-Cadavid-Korkmaz Lefschetz fibration

Noriyuki Hamada (The University of Tokyo)

To investigate (-1)-sections of a given Lefschetz fibration is a fundamental and important problem concerning Lefschetz pencils, hence symplectic topology. On the other hand, Yukio Matsumoto originally constructed a genus-2 Lefschetz fibration with eight singular fibers, and then, Cadavid and Korkmaz independently generalized it to the higher genera. Those Lefschetz fibrations have played a great role in the development of the theory. In this talk, we show explicit monodromies of those fibrations which describe a set of disjoint (-1)-sections. The corresponding Lefschetz pencils are also shown to be minimal.

A genus zero Lefschetz fibration on the Akbulut cork and exotic pairs

Takuya Ukida (Tokyo Institute of Technology)

In this talk, We construct a genus zero positive allowable Lefschetz fibration over the disk (a genus zero PALF) structure on a cork introduced by Akbulut and describe the monodromy as a

positive factorization in the mapping class group of a fiber. We also examine the monodromies of genus zero PALFs on infinitely many exotic pairs of compact Stein surfaces such that one is obtained by applying a cork twist to the other.

Stein fillings of homology spheres and mapping class groups

Takahiro Oba (Tokyo Institute of Technology)

Classification of Stein fillings of a given contact manifold has been discussed as a crucial problem in contact geometry. In particular, it is important to examine which contact manifold admits a unique Stein filling. In this talk, using a correspondence between mapping class groups and Stein fillings, I will present a condition for a Stein fillable homology 3-sphere to admit a unique Stein filling up to diffeomorphism.

Topological 4-manifolds as branched covers of S^4

Daniele Zuddas (Korea Institute for Advanced Study)

It is known that smooth closed oriented 4-manifolds are smooth branched covers of the 4-sphere. In this talk we extend this result to open 4-manifolds, by showing that they are branched covers of suitable open subsets of S^4. This has two main consequences: (1) any exotic R^4 is a smooth branched cover of the standard R^4, and (2) any closed oriented topological 4-manifold is a topological branched cover of S^4 (in the sense of Ralph Fox). Unfortunately, the branching set tends to be very wild at infinity. This is a joint work with Riccardo Piergallini (University of Camerino).

Pin(2)-monopole equations and Yamabe invariants

(joint work with Masashi Ishida and Shinichiro Matsuo)

Nobuhiro Nakamura (Gakushuin university)

The Yamabe invariant of a compact smooth n-manifold M ($n \geq 3$) is a diffeomorphism invariant which is naturally defined from the total scalar curvature functional on the space of Riemannian metrics on M. I will explain that the Pin(2)-monopole equations enable us to compute the exact values of the Yamabe invariants of a family of 4-manifolds which have the form of a connected sum of a compact Kähler surface and something.

4-manifolds constructed by pairs of lens space surgeries

(joint work with Motoo Tange)

Yuichi Yamada (The Univ. of Electro-Comm.)

We study pairs of Dehn surgeries along distinct knots whose results are orientation-preservingly or -reversingly homeomorphic lens spaces. In the authors' previous work, we treated with the case both knots are torus knots. In the present talk, we focus the case where one is a torus knot and the other is a "Berge's knot of TypeVII or VIII". We determine the complete list (set) of such pairs of lens space surgeries and study closed 4-manifolds constructed from the

pairs. The list consists of six sequences. All framed links and handle calculus are indexed by integers.

On homology 3-spheres defined by two knots

Masatsuna Tsuchiya (Gakushuin University)

Let $T_{2,3}$ be a left handed trefoil knot, and K be any knot. We define $M_n(T_{2,3}, T_{2,3}\sharp K)$ to be the homology 3-sphere represented by the Kirby diagram which is a simple link of $T_{2,3}$ and $T_{2,3}\sharp K$ with framings 0 and n respectively, and define $S^3_{-1}(D_-(T_{2,3}\sharp K, n))$ to be the -1-surgery along the $D_-(T_{2,3}\sharp K, n)$, where $D_-(T_{2,3}\sharp K, n)$ is the n-twisted negative Whitehead double of $T_{2,3}\sharp K$. We show that $M_n(T_{2,3}, T_{2,3}\sharp K)$ is diffeomorphic to $S^3_{-1}(D_-(T_{2,3}\sharp K, n))$ and if $n > 2g_4(K) - 2$, $S^3_{-1}(D_-(T_{2,3}\sharp K, n))$ does not bound any contractible 4-manifold, where $g_4(K)$ is the 4-ball genus of K.

Non-orientable genus of knots in punctured Spin 4-manifolds

Kouki Sato (Tokyo Gakugei University)

For a closed 4-manifold X and a knot K in the boundary of punctured X, we define $\gamma^0_X(K)$ to be the smallest first Betti number of non-orientable and null-homologous surfaces in punctured X with boundary K. Note that $\gamma^0_{S^4}$ is equal to the non-orientable 4-ball genus and hence γ^0_X is generalization of the non-orientable 4-ball genus. While it is very likely that for given X, γ^0_X has no upper bound, it is difficult to show it. In fact, even in the case of $\gamma^0_{S^4}$, its non-boundedness was shown for the first time by Batson in 2012. In this talk, we prove that for any Spin 4-manifold X, γ^0_X has no upper bound.

Definite even 4-manifolds bounding homology spheres

Motoo Tange (University of Tsukuba)

Ozsvath-Szabo's correction term d can estimate the H_2-rank of negative define spin bounding 4-mnifolds of a 3-manifold. Whether negative-definite spin bounding satisfying the estimate exists or not is the next problem. We construct negative definite spin boundings with rank $8n$ using minimal resolutions, blow-down, and handle-sliding.

Negativity of the third Ohtsuki invariants of the Brieskorn-Hamm homology 3-spheres

Yasuyoshi Tsutsumi (Oshima National College of Maritime Technology)

We calculate the third Ohtsuki invariant of every Brieskorn-Hamm manifold which is a rational homology 3-sphere. By the result, we show that the third Ohtsuki invariants of Brieskorn-hamm homology 3-spheres are nagative.

Splitting of singular fibers in barking families

Takayuki Okuda (Kyushu University)

A singular fiber appearing in holomorphic fibrations of complex surfaces may split into several simpler singular fibers under a certain deformation family — a splitting family. Splitting families constructed by Takamura's method are called barking families. In this talk, we introduce the concept of the topological monodromy for splitting families, which is an analogy of that for degenerations, and give a description of the topological monodromies of barking families.

Annulus twist and diffeomorphic 4-manifolds II

(joint work with In Dae Jong, John Luecke and John Osoinach)

Tetsuya Abe (Tokyo Institute of Technology)

We solve a strong version of Problem 3.6 (D) in Kirby's list, that is, we show that for any integer n, there exist infinitely many mutually distinct knots such that 2-handle additions along them with framing n yield the same 4-manifold.

On the smooth unknotting conjecture in dimension four X

Takao Matumoto (Kyoto University)

We will review how to reduce the conjecture to a chart type problem and discuss the reduced problem in some typical cases.