Hiroshima Topology Conference

Celebrating Professor Takao Matumoto's 60th birthday
February 17 – February 20, 2006
at Hiroshima University, Hiroshima, Japan

ABSTRACT

February 17 (Friday)

15:00–15:30

Disk presentations of surface-knots

Shin Satoh (Chiba University)

We introduce a new method of presenting surface-knots and -links in S^4, called disk presentation. This enables us to define the disk index $\Delta(F)$ of a surface-knot or -link F. We prove that $\Delta(F) = 2$ if and only if F is a trivial S^2-knot, and $\Delta(F) = 3$ if and only if F is a trivial non-orientable surface-knot with $|e(F)| \leq 3 - \chi(F)$, where $e(F)$ is the normal Euler number of F and $\chi(F)$ is the Euler characteristic of F.

15:30–16:00

Ozsváth-Szabó's correction term and lens surgery

Motoo Tange (Kyoto University)

We will give an explicit formula of Ozsváth-Szabó's correction terms of any lens space. Applying the formula to a restriction studied by Ozsváth and Szabó, we can obtain several constraints of lens spaces which are constructed by a positive Dehn surgery in 3-sphere. Some of the constraints are results which are analogous to results which were given by a joint work of T. Kadokami and Y. Yamada, and a work of T. Saito. This constraints completely determine knots yielding $L(p, p-1)$.

16:20–16:50

Refined Kirby calculus for rational homology 3-spheres of prime orders

Kenichi Fujiwara (Tokyo Institute of Technology)

In the theory of surgery on integral framed links in S^3, Kirby calculus involves all orientable closed 3-manifolds. Such theory fortunately can be restricted to some homology 3-spheres.

16:50–17:20

Lens surgery, blow-ups and 4-dimensional manifolds

Yuichi Yamada (University of Electro-Communications)

Some lens surgery (knots that yield lens spaces by Dehn surgery) are A'Campo's divide knots, and are represented by "L-shaped" plane curve, where an L-shaped plane curve is the curve obtained as the intersection of an L-shaped region (union of two rectangles sharing a corner) and the 45-degree lattice in the plane. A'Campo's theory comes from the singularity of complex curves. Thus such study is in good relation with 4-dimensional topology, for example, blowing-ups. The volume of the L-shaped region is equal to or near the coefficient of the lens surgery. I will also talk about a trial to get more information from the L-shapes on the lens surgeries.

February 18 (Saturday)

9:30–10:10

From low dimensional topology to the triangulation of high dimensional manifolds

Ronald J. Stern (University of California, Irvine (USA))

We will start by discussing what is known about an old, and still unsolved, problem that initiated Takao Matumoto's research: Is every topological n-manifold, $n > 4$, a simplicial complex. We will discuss the early work of Takao Matumoto and Galewski-Stern that reduces this to a problem about homology 3-spheres bounding acyclic 4-manifolds and how this problem leads to many more unsolved problems in the study of smooth 4-manifolds.

10:30–11:10

Actions of profinite groups and equivalent singular homology

Soren Illman (University of Helsinki (Finland))

11:30–12:00

On some computational and combinatorial problems with point configurations

Antonio Hernandez-Barrera (DeVry University (USA))

In this talk we describe some geometric problems involving point configurations. We discuss computational and combinatorial open problems related to point configurations in two and three dimensions and present some partial results.

13:30–14:00

Higher homotopy commutativity of Hopf spaces

Yusuke Kawamoto (National Defense Academy)
Yutaka Hemmi (Kochi University)

We give a combinatorial definition of a higher homotopy commutativity of the multiplication for an H-space. To give the definition, we use polyhedra called the permuto-associahedra which are constructed by Kapranov. We also show that if a connected H-space has the finitely generated mod p cohomology for a prime p and the multiplication of it is homotopy commutative of the p-th order, then it has the mod p homotopy type of a finite product of S^1s, $\mathbb{C}P^\infty$s and $L^\infty(p^i)$s for $i \geq 1$. This is a generalization of results by Slack and Lin-Williams.

14:00–14:30

Lusternik-Schnirelmann π_1-categories

Antonio Regidor-García (Hiroshima University)

We define new proper homotopy invariants, the proper Lusternik-Schnirelmann π_1-categories p$\widetilde{\pi}_1$-cat and p$\widetilde{\pi}_1^\infty$-cat. Then, we prove that, if p$\widetilde{\pi}_1$-cat (resp. p$\widetilde{\pi}_1^\infty$-cat) of a locally path-connected, Hausdorff, locally compact, and paracompact space is equal to or less than n, then there is a proper map to a locally finite polyhedron of dimension $n+1$ that induces an isomorphism of fundamental pro-groups p$\widetilde{\pi}_1$ (resp. p$\widetilde{\pi}_1^\infty$).

14:50–15:20

Angle structures and hyperbolic structures on some cusped 3-manifolds

David Futer (Michigan State University (USA))
Francois Gueritaud (University of South California (USA))

Exhibiting a triangulation into geometric tetrahedra provides, in principle, an elementary proof that a given manifold is hyperbolic. Can this be done systematically? We will give a positive answer to that question for some simple infinite families of cusped 3-manifolds (e.g. complements of 2-bridge knots) and derive some geometric consequences.

15:20–15:50

The curve complex, 3-manifolds and some recent developments

Kenneth Shackleton (Osaka University, JSPS)

We quickly outline the role the curve complex has played in the work of Minsky et al on the ending lamination conjecture. Some of the ideas involved open up a few computational questions on the curve complex and mapping class group, and we hint at how to answer these.

16:20–17:00

Chart descriptions of surfaces in 4-space and their deformation

Seiichi Kamada (Hiroshima University)
Takao Matumoto (Hiroshima University)

Every classical knot can be described as a closed braid and such a braid presentation is unique up to Markov equivalence. It is also true that every 2-knot or generically immersed oriented surface in 4-space can be described as a closed 2-dimensional braid, and such a braid description is unique up to certain equivalence. Once it is deformed into a braid form, it can be described by a graphic on a 2-disk, called a chart. We investigate how surfaces in 4-space are deformed when we deform charts.

February 19 (Sunday)

9:30–10:10

The Pontrjagin-Thom construction and gauge theory

Mikio Furuta (University of Tokyo)

A report on a joint work in progress with Tian-Jun Li.

In a nonlinear Fredholm theory, such as the Seiberg-Witten theory, the Donaldson theory or the Gromov-Witten theory, the Pontrjagin-Thom construction can be used to formulate a twisted stable homotopy class of the ambient Banach space as far as the moduli space is compact. We can construct a version of twisted stable homotopy group which deal with quotient singularities and critical points in the moduli space.

A key point is to define "twisted stable framing" of the Kuranishi structure or virtual neighborhood structure of the moduli space.

A special feature of the Seiberg-Witten theory is that the ambient Banach space has the homotopy type of a finite dimensional closed manifold, which is diffeomorphic to the Albanese torus. The a version of S-dual construction implies that the twisted stable homotopy group is isomorphic to a twisted stable cohomotopy group.

In the Seiberg-Witten Floer theory, C. Manolescu proposed the Seiberg-Witten Floer homotopy type, defined as a suspension spectrum (at least for rational homology 3-sphere). In a similar spirit to look at the stable framing of the moduli space, we can refine the notion of the Conley index. The Conley index is a pointed homotopy type of a space. Our refinement is a pointed simple homotopy type of a manifold (with a part of its boundary collapsed to a point).

In this setting, in principle, it would be possible to apply Kiyoshi Igusa's theory to families of rational homology 3-spheres. There is, however, an obstruction, which is an element of K^1 of the parameter space, to carry out this program directly.

10:30–11:10

Surface-link groups

Akio Kawauchi (Osaka City University)

The set of the groups of n-dimensional manifold-links in S^{n+2} for $n > 2$ coincides with the set SLG of the groups of surface-links in S^4. Let $SLG^r_g(A)$ be the subset of SLG consisting of the group of a surface-link whose component number is r, whose total genus is g and whose second group homology is isomorphic to A. Reviewing the duality theorems for the integral homology of an infinite cyclic covering of a manifold, we show that the set $SLG^r_g(A)$ is a non-empty proper subset of $SLG^r_{g+1}(A)$ for every g and every A generated by 2g elements, and determine the set $SLG^r_g(A)$ to which any given classical link group belongs.

11:30–12:00

Singular fibers of differentiable maps and characteristic classes of surface bundles

Osamu Saeki (Kyushu University)

Let $f : M \to N$ be a smooth generic map between smooth manifolds. For a singular value $y \in N$, the singular fiber of f over y is the map germ $f : (M, f^{-1}(y)) \to (N, y)$ along the fiber $f^{-1}(y)$. When M is a closed oriented 4-manifold and N is a 3-manifold, certain classes of singular fibers appear discretely and we show that the number of specific singular fibers (counted with appropriate signs) coincides with the signature of the 4-manifold M.

On the other hand, let $\pi : E \to B$ be an oriented C^∞ surface bundle. For a generic smooth function $h : E \to \mathbf{R}$, we show that the (closure of the) set of points $b \in B$ such that $h|_{\pi^{-1}(b)}$ is a certain degenerate function represents the dual of a characteristic class of the surface bundle. This is derived by applying the above signature formula to the map $(\pi, h) : E \to B \times \mathbf{R}$ when B is an oriented surface.

13:30–14:00

Unsmoothable group actions on elliptic surfaces

Nobuhiro Nakamura (RIMS, Kyoto University)

(This is a joint work with X. Liu.) We construct locally linear pseudofree cyclic group actions on elliptic surfaces which can not be smooth with respect to infinitely many smooth structures. In particular, such actions on $K3$ which is unsmoothable for the standard smooth structure will be given.

For this, we need two things to do: To construct locally linear pseudofree cyclic group actions, we use a remarkable result by Edmonds and Ewing. On the other hand, to obtain constraints on smooth actions, we use a mod p vanishing theorem of Seiberg-Witten invariants, which is originally proved by F.Fang, and generalized by the speaker.

14:00–14:30

On torsion Donaldson invariants

Hirofumi Sasahira (University of Tokyo)

Let X be a closed, oriented 4-manifold. In this talk,I explain that under certain conditions a moduli space of intantons on X have a natural spin structure, and we define an invariant of X by using the natural spin strucuture on moduli space.

14:50–15:20

Survey of charts with 9 white vertices by a computer

Yoshio Matsushita (Tokai University)

Kamada gave a method to represent a surface braid of braid index n by an oriented labeled planar graph, called an *n-chart*, and local modifications of a chart, called *C-moves*. C-moves induce ambient isotopies of the closures of surface braids in $\mathbb{R}^4$. He also defined a *complexity* of charts using the number of white vertices and the number of free edges. A chart Γ is *minimal* if its complexity is minimal among the charts which deform to the chart Γ by a finite sequence of C-moves. M. Ochiai, T. Nagase and A. Shima prove that there exists no minimal n-chart with five white vertices. T. Nagase and A. Shima prove that there exists no minimal n-chart with seven white vertices. We investigate minimal charts with nine white vertices by using a computer.

15:20–15:50

Charts with at most one crossing

Teruo Nagase (Tokai University)
Akiko Shima (Tokai University)

Kamada showed that any 3-chart is a ribbon, and Nagase and Hirota showed that any 4-chart with at most one crossing is a ribbon. Here a ribbon chart means a chart C-move equivalent to a chart without white vertices. We show that any chart with at most one crossing is a ribbon.

16:20–16:50

Surface knots and their generic planar projections

Yasushi Takeda (Kyushu University)

We often study surface knots in 4-space by using their projections into 3-space, or their broken surface diagrams. It is well-known that a broken surface diagram reconstructs the given surface knot. In this paper we study surface knots in 4-space by using their generic planar projections. These projections have fold points and cusps as their singularities in general. We consider the question whether such a generic planar projection can reconstruct the given surface knot. We introduce the notion of braids with a band, and show that a generic planar projection together with braids with a band associated to the segments of the fold curve image can reconstruct the given surface knot. As an application, we give a new proof of the Whitney congruence concerning the normal Euler number.

16:50–17:20

A canonical form for braid systems of surface braids

Kokoro Tanaka (University of Tokyo)

The notion of a surface braid was defined by Viro and extensively studied by Kamada. There exists a one-to-one correspondence between the set of (equivalence classes of) surface braids and each of the following two sets. One is the set of (slide equivalence classes of) braid systems, where a braid system is a sequence of elements of the one-dimensional braid group. The other is the set of (C-move equivalence classes of) charts, where a chart is a graph in a two-dimensional disk.

In this talk, we define a canonical form of braid systems, and prove that any braid system can be deformed into a canonical form up to slide equivalence. Though either of braid systems or charts were used in many of previous studies, we obtain the following as an application by interpreting the canonical form of braid systems in terms of charts: Any surface braid can be deformed into an unknotted one by doing some operations, called crossing changes. (Iwakiri has a different proof of the above application.)

February 20 (Monday)

9:30–10:00

Self delta-equivalence of cobordant links

Akira Yasuhara (Tokyo Gakugei University)
Yasutaka Nakanishi (Kobe University)
Tetsuo Shibuya (Osaka Institute of Technology)

Self Δ-equivalence is a equivalence relation for links, which is stronger than link-homotopy defined by J. Milnor. It is known that cobordant links are link-homotopic and that they are not necessarily self Δ-equivalent. In this paper, we will give a sufficient condition for cobordant links to be self Δ-equivalent.

10:00–10:30

Classification of alternating links with tunnel number one

Hiroaki Kuboi (Saitama University)

Alternating links and tunnel number one links have studied for a long time.The classification of unknotting tunnels for 2-bridge link is done by Adams-Raid and Kuhn, and for 2-bridge knot is done by Kobayashi. In this talk, we will gave a classification of tunnel number one alternating links and their unknotting tunnels. This is an extension for the link case of a Lackenby's theorem. We extend Lackenby's argumets to prove our theorem. Main ideas used here are theories about normal surfaces, Heegaard splittings and Menasco's technique.

10:50–11:20

Various Bennequin inequalities on knot concordance invariants

Tomomi Kawamura (Aoyama Gakuin University)

We estimate certain integer-valued knot concordance invariants using diagram invariants. The obtained result is stronger than the Bennequin inequalities on the Ozsváth-Szabó τ-invariant and the Rasmussen invariant shown by Livingston, Plamenevskaya, and Shumakovitch.

Furthermore, we improve the slice-Bennequin inequality and the Bennequin unknotting inequality.

11:20–11:50

Singularities of manifolds with patterns

Kentaro Saji (Hokkaido University)
