# Four Dimensional Topology

January 29 – January 31, 2007
Faculty Club
Hiroshima University

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**January 29 (Mon)**

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Osamu Saeki (Kyushu University)
Title: On 2-knots with total width 8
Abstract: For a surface knot in 4-space, its total width, which is a positive even integer, is defined by using its planar projections. For a 2-sphere knot, it has been known that its total width is less than or equal to 6 if and only if it is trivial. In this talk, we show that the total width of a 2-sphere knot is equal to 8 if and only if it is a non-trivial (twist) spun 2-bridge knot. For the proof, we use the theory of braided diagrams which have been developed for recovering a surface knot from its planar projection.

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Shin Satoh (Kobe University)
Title: Braid index of connected sum of surface-knots II
Abstract: Any orientable surface-knot $F$ has the braid index $\mathrm{Braid}(F)$. In the previous work with Kamada and Takabayashi, we show that if a surface-knot $F_i$ $(i = 1, 2)$ is not a trivial $S^2$-knot, then it holds that
$\mathrm{Braid}(F_1 \# F_2) \leq \mathrm{Braid}(F_1) + \mathrm{Braid}(F_2) - 2$. In this talk, we give an alternative proof of this theorem and as an application, we give several examples of pairs $\{F_1, F_2\}$ which do not satisfy the equality.

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Akiko Shima (Tokai University)
Title: Separation of Charts (joint work with Teruo Nagase)
Abstract: Let $\Gamma$ be a chart. For each label $i$ we denote by $\Gamma_i$ the subgraph $\Gamma$ consisting of edges of label $i$ and their vertices. We show that if for some label $k$, $\Gamma_k \cap \Gamma_{k+1} = \emptyset$, then there exist two charts $\Gamma^*$ and $\Gamma^{**}$ in disks $D_1$ and $D_2$ respectively satisfying the following conditions: (1) $D_1 \cap D_2 = \emptyset$. (2) $\Gamma$ and $\Gamma^* \cup \Gamma^{**}$ are C-move equivelent. (3) For $k < i$, $\Gamma^*_i$ does not contain any white vertices. (4) For $i < k + 1$, $\Gamma^{**}_i$ does not contain any white vertices.

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Tetsuhiro Moriyama (The University of Tokyo)
Title: On the vanishing of the Rohlin invariant
Abstract: The vanishing of the Rohlin invariant of an amphicheiral integral homology 3-sphere $M$ (i.e. $M \cong -M$) is a natural consequence of some elementary properties of the Casson invariant. In this talk, we give a new direct proof of this vanishing property, by constructing a certain compact spin 4-manifold $X$ such that $\partial X \cong M \amalg M \amalg (-M)$ and $\operatorname{Sign} X = 0$.

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## January 30 (Tue)

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Zjuñici Iwase (Kanazawa University),
Yukio Matsumoto (University of Tokyo)
Title: Pochette surgery on 4-manifolds II
Abstract: A "pochette" is a 4-manifold diffeomorphic to $S^1 \times D^3 \natural D^2 \times S^2$, embedded in a 4-manifold. We consider a surgery process on 4-manifolds along a pochette, as an analogy of the Dehn surgery on 3-manifolds along $S^1 \times D^2$. As we talked previously, the result of a pochette surgery can be described by the original position of the embedded pochette, a "slope" belonging to $\mathbb{Q} \cup \{\infty\}$ and a $\mathbb{Z}_2$-framing. In this talk, we give some new results related to double branched coverings along ribbon knots in $S^4$.

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Yoshihisa Sato (Yamaguchi University)
Title: Stipsicz's Conjecture for Lefschetz fibrations
Abstract: In the mapping class group $\Gamma_g$ of genus $g$, we call a factorization of the identity via positive Dehn twists a positive relation. Which positive relation can be decomposed as the product of other positive relations ? Geometrically, which Lefschetz fibration over $S^2$ can be decomposed as the fiber sum of non-trivial Lefschetz fibrations ? Stipsicz showed that Lefschetz fibrations with (-1)-sections cannot be decomposed as any non-trivial fiber sum, and he conjectured that the fiber sum of non-trivial Lefschetz fibrations would be minimal. The speaker show that this conjecture for genus-2 Lefschetz fibrations is true and announce it in this talk.

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Selman Akbulut (Michigan State University, USA)
Title: Topology of Manifolds with Exceptional Holonomy
Abstract: We will discuss $G_2$ and Spin(7) manifolds, and the deformations of associative submanifolds in a $G_2$ manifold, and discuss various dualities related to mirror symmetry.

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Sema Salur (University of Rochester, USA)
Title: Calibrated Geometries
Abstract: Calibrated submanifolds are distinguished classes of minimal submanifolds and their moduli spaces are expected to play an important role in geometry, low dimensional topology and theoretical physics.
Examples of these submanifolds are special Lagrangian 3-folds for Calabi-Yau, associative 3-folds and coassociative 4-folds for $G_2$, and Cayley 4-folds for Spin(7) manifolds. In this talk we give an introduction to calibrated geometries and a survey of recent research on the deformation theory of calibrated submanifolds inside Ricci-flat manifolds.

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Kouichi Yasui (Osaka University)
Title: Small exotic rational surfaces without 1- and 3-handles
Abstract: It is not known whether an exotic $\mathbf{CP}^2$ exists. If it exists, then it requires 1- or 3-handles. J.Park etc. constructed exotic $\mathbf{CP}^2 \sharp m \overline{\mathbf{CP}}^2 (5 \leq m \leq 9)$ by using elliptic fibrations, knot surgeries and rational blow-downs. In this talk, we construct exotic $\mathbf{CP}^2 \sharp m \overline{\mathbf{CP}}^2 (5 \leq m \leq 9)$ by using Kirby calculus and rational blow-downs, and prove that our manifolds admit handle decompositions without 1- and 3-handles in the case $7 \leq m \leq 9$.

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Yuki Takahashi(Kobe University)
Title:Surfaces in 3-space with simple fold projection
Abstract:We will consider a fold projection for a surface in the 3-space. If a fold projeciton has the singularity whose image consists of simple closed curves, then it is called a simple fold projection. We will give examples of trivial and non-trivial surfaces in the 3-space with simple fold projections.

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**January 31(Wed)**

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Toshifumi Tanaka (Osaka City University)
Title: On smooth structures on non-compact 4-manifolds
Abstract: When does an oriented smooth 4-manifold admit at least two smooth structures? In this talk, we show that any non-compact, connected smooth

4-submanifold of some closed oriented smooth 4-manifolds can admit at least two smooth structures via gauge theory.

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Hirofumi Sasahira (Tokyo University)
Title:SO(3) torsion Donaldson invariants
Abstract: We construct invariants for 4-manifolds using torsion cohomology classes of SO(3) instanton moduli spaces. Moreover we show that this torsion invariant of $2CP^2\#(-CP^2)$ is non-trivial. Note that any invariants of $2CP^2\#(-CP^2)$ coming from the Seiberg-Witten theory are trivial since $2CP^2\#(-CP^2)$ has a positive scalar curvature metric.

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Yasushi Takeda (Kyushu University)
Title: Virtual surface knots
Abstract: Kauffman introduced the notion of a virtual knot, which is the generalization of a classical knot. In this talk, We introduce a virtual surface knot, which is the genralization of a surface knot, and define an invariant of virtual surface knot. Moreover, we introduce some example of the virtual surface knot.

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Katsuhisa Mimachi (Tokyo Institute of Technology)
Title: Intersection numbers of twisted cycles associated with a Selberg type integral and the Jones polynomial
Abstract: We give an expression of the Jones polynomial by means of intersection numbers of twisted cycles (cycles with coefficients in local system) associated with a Selberg type integral. Representations of the Iwahori-Hecke algebra on such cycles are effectively used.