The 8th Kagoshima Algebra-Analysis-Geometry Seminar

February 18 (Monday) – 21 (Thursday), 2013
Room 101 (Room 104 only in Feb.18), Faculty of Science, Kagoshima University

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PROGRAM

February 18 (Monday)
10:00～10:50 ：Tatsuya Tate (Nagoya University)
"One-dimensional quantum walks"
11:00～11:50：Takuya Yamauchi (Kagoshima University, Faculty of Education/University of Toronto)
"Arithmetic Calabi-Yau families associated to generalized hypergeometric local systems and its applications"
13:30～14:20 ：Shigeharu Takayama (University of Tokyo)
"On complex geometry of pluricanonical and adjoint bundles"
14:30～15:20 ：Shinnosuke Okawa (Osaka University)
"Semi-orthogonal decompositions of derived category of coherent sheaves"
15:40～16:30 ：Hirofumi Yamada (Okayama University)
"A peripheral combinatorics of partitions"
16:40～17:30 ：Hiraku Nakajima (RIMS)
"Instantons and W-algebras"

February 19 (Tuesday)
10:00～10:50 ：Mutsuo Oka (Tokyo University of Science)

“Intersection theory on mixed curves”

11:00～11:50 ：Jörg Schürmann (University of Münster)

“Generating series for (equivariant) characteristic classes of (external and) symmetric products”

13:30～14:20 ：Masaki Hanamura (Tohoku University)

“Quasi DG categories and the triangulated category of mixed motives over a base”

14:30～15:20 ：Izuru Mori (Shizuoka University)

“Points of a quantum plane”

15:40～16:30 ：Katsuhiko Kuribayashi (Shinshu University)

“Derived string topology”

16:40～17:30 ：Tatsuo Suwa (Hokkaido University)

“Degeneracy loci problem via localization”

18:30～ Dinner Party

February 20 (Wednesday)

10:30～11:20 ：Kaoru Ono (RIMS)

“Non-displaceable Lagrangian submanifolds”

13:30～14:20 ：Hiroshi Tamaru (Hiroshima University)

“Left-invariant metrics on Lie groups and submanifold geometry”

14:30～15:20 ：Satoru Fukasawa (Yamagata University)

“Galois points for a plane curve in arbitrary characteristic”

15:40～16:30 ：Hiroyuki Minamoto (Nagoya University)

“Derived bi-duality via homotopy limit”

16:40～17:30 ：Shinichi Tajima (Tsukuba University)

“Local cohomology, Newton filtrations and Tjurina numbers”

February 21 (Thursday)

9:30～10:20 ：Laurentiu Maxim (University of Wisconsin - Madison)

“Intersection spaces, perverse sheaves and type IIB string theory”

10:30～11:20 ：Shin-ichi Matsumura (Kagoshima University, Faculty of Science)

“Asymptotic cohomology vanishing and a converse to the Andreotti-Grauert vanishing theorem on surfaces”

11:30～12:20 ：Takashi Tsuboi (University of Tokyo)

“Commutator width of diffeomorphism groups”

Abstracts of Talks

- Satoru Fukasawa (Yamagata University)

  Title: Galois points for a plane curve in arbitrary characteristic

  Abstract: I will talk about Galois points for a plane curve, and relations with rational points over finite fields and Coding theory. A Galois point for a plane curve is a point in the projective plane from which the projection induces a Galois extension of function fields. Firstly, we consider a natural question: How many Galois points? I introduce the Theorem answering the question for smooth curves, and explain basic ideas for proofs. (Rendiconti di Padova, to appear) Secondly, we see examples of plane curves whose set of Galois points coincides with the one of rational points. One of them, called "Ballico-Hefez" curve, gives good codes. (Joint work with M. Homma and S. J. Kim, in: Contemp. Math. 574)

- Masaki Hanamura (Tohoku University)

  Title: Quasi DG categories and the triangulated category of mixed motives over a base

  Abstract: We introduce the notion of a quasi DG category, which is a generalization of a DG category; it is closely related to the notion of a Segal category.

  We give the notion of C-diagrams in a quasi DG category; we show the C-diagrams in a given DG category form another quasi DG category. Moreover the associated homotopy category of the latter is a triangulated category.

  We apply this process to the construction of the triangulated category of mixed motivic sheaves over a base variety.

- Katsuhiko Kuribayashi (Shinshu University)

  Title: Derived string topology

  Abstract: We survey derived string topology on Gorenstein spaces including the oriented manifolds, the classifying spaces of Lie groups and Noetherian Hopf spaces. In particular, the (non)triviality of loop products on Gorenstein spaces is discussed. This talk is based on joint work with Luc Menichi and Takahito Naito.

- Shin-ichi Matsumura (Kagoshima University, Faculty of Science)

  Title: Asymptotic cohomology vanishing and a converse to the Andreotti-Grauert vanishing theorem on surfaces

  Abstract: In this talk, we study relations between positivity of the curvature and the asymptotic behavior of the higher cohomology group for tensor powers of a holomorphic line bundle. The Andreotti-Grauert vanishing theorem asserts that partial positivity of the curvature implies asymptotic vanishing of certain higher cohomology groups. We investigate the converse implication of this theorem under various situations. For example, we consider the case where a line bundle is semi-ample or big. Moreover, we show the converse implication holds on a projective surface without any assumptions on a line bundle.

- Laurentiu Maxim (University of Wisconsin - Madison)

  Title: Intersection spaces, perverse sheaves and type IIB string theory

  Abstract: The method of intersection spaces associates rational Poincare complexes to singular stratified spaces. For a complex projective hypersurface with only isolated singularities, we show that the cohomology of the associated intersection space is the hypercohomology of a perverse sheaf, the intersection space complex, on the hypersurface. We will discuss properties of the intersection space complex, such as self-duality, its Betti numbers and mixed Hodge structures on its hypercohomology groups. This is joint work with Banagl and Budur.

- Hiroyuki Minamoto (Nagoya University)

  Title: Derived bi-duality via homotopy limit

  Abstract: We show that a derived bi-duality dg-module is quasi-isomorphic to the homotopy limit of a certain tautological functor. This is a simple observation, which seems to be true in wider context. From the view point of derived Gabriel topology, this is a derived version of results of J. Lambek about localization and completion of ordinary rings. However the important point is that we can obtain a simple formula for the bi-duality modules only when we come to the derived world from the abelian world. We give applications. 1. we give a generalization and an intuitive proof of Efimov-Dwyer-Greenlees-Iyenger Theorem which asserts that the completion of commutative ring satisfying some conditions is obtained as a derived bi-commutator. (We can also prove Koszul duality for dg-algebras with Adams grading satisfying mild conditions. (A part of joint work with A. Takahashi.)) 2. We prove that every smashing localization of dg-category is obtained as a derived bi-commutator of some pure injective module. This is a derived version of the classical results in localization theory of ordinary rings. These applications shows that our formula together with the viewpoint that a derived bi-commutator is a completion in some sense, provide us a fundamental understanding of a derived bi-duality module. Since bi-duality is ubiquity in Mathematics, we can expect that our main result will have a lot of applications. (This talk is based on a preprint available at arXiv math 1210.5582.)

- Izuru Mori (Shizuoka University)

  Title: Points of a quantum plane

  Abstract: The notion of point of a noncommutative scheme has been an issue since the beginning of noncommutative algebraic geometry. Recently, it has been observed that there exist strong interactions between noncommutative algebraic geometry and representation theory of finite dimensional algebras. Due to this new trend, we propose a definition of a point so that it would be useful to parameterize all simple n-regular modules over an n-representation infinite algebra defined by Minamoto, Herschend-Iyama-Oppermann. In this survey talk, I will focus on points of a quantum plane to explain the notion.

- Hiraku Nakajima (RIMS)

  Title: Instantons and W-algebras

  Abstract: More than 10 years ago, I constructed representations of Heisenberg algebras and affine algebras on the homology groups of instanton moduli spaces on certain 4-manifolds. The proof

was mathematically rigorous, but was not conceptually satisfactory. About two years ago, physicists, Alday-Gaiotto-Tachikawa (AGT) proposed a much larger framework, which is conceptually satisfactory, but lacks mathematical footing. I will explain their theory, and a mathematical approach towards a conjecture.

- Mutsuo Oka (Tokyo University of Science)

  Title: Intersection theory on mixed curves

  Abstract: We consider two mixed curve $C, C' \subset \mathbb{C}^2$ which are defined by mixed functions of two variables $\mathbf{z} = (z_1, z_2)$. We have shown in [4], that they have canonical orientations. If C and C' are smooth and intersect transversely at P, the intersection number $I_{top}(C, C'; P)$ is topologically defined. We will generalize this definition to the case when the intersection is not necessarily transversal or either C or C' may be singular at P using the defining mixed polynomials.

- Shinnosuke Okawa (Osaka University)

  Title: Semi-orthogonal decompositions of derived category of coherent sheaves

  Abstract: Semi-orthogonal decomposition (SOD) is a certain decomposition of a triangulated category into smaller pieces. For those triangulated categories which are obtained as the bounded derived category of coherent sheaves on smooth projective varieties, there are many interesting results which are related to the geometry of the varieties. In this talk I will talk about my joint work with Kotaro Kawatani in this direction.

- Kaoru Ono (RIMS)

  Title: Non-displaceable Lagrangian submanifolds

  Abstract: This talk is based on joint works with Fukaya, Oh and Ohta. I will speak on Lagrangian submanifolds, which are not displaced by Hamiltonian diffeomorphisms. I would like to explain non-displaceability using examples such as "balanced Lagrangian torus fibers" in toric manifolds. If time allows, I will present a criterion for generating Fukaya categories based on a joint work with Abouzaid, Fukaya, Oh and Ohta.

- Jörg Schürmann (University of Münster)

  Title: Generating series for (equivariant) characteristic classes of (external and) symmetric products

  Abstract: First we explain different equivariant characteristic classes of Lefschetz type for a singular complex quasi-projective variety X acted on by a finite group G defined for an equivariant constructible or coherent sheaf (complex), mixed Hodge modules or equivariant relative Grothendieck groups of algebraic varieties. For a fixed group element g these are homology classes on the fixed point set X^g, codifying the corresponding trace of the induced action on the cohomology. Putting them together for all group elements, one gets equivariant characteristic classes in delocalized equivariant Borel-Moore homology. These can be used for calculating invariants of the quotient X/G. We apply these for the calculation of generating series of equivariant characteristic classes for external products (of such coefficients) acted on by the permutation action of the symmetric groups S_n. Using the Kuenneth formula, these can be expressed in terms of creation operators

acting on a Fock space given by the delocalized equivariant Borel-Moore homology of all products X^n (even for X singular). Pushing down to the symmetric products $X^{(n)} = X^n/S_n$, the classes live in the homology Pontrjagin ring of the symmetric products, tensorized with the ring of symmetric functions generated by all power-sums p_n. Specializing finally all p_n to 1, one gets the generating series for symmetric products in terms of Adams operations.

- Tatsuo Suwa (Hokkaido University)

  Title: Degeneracy loci problem via localization

  Abstract: Let $\sigma : E \to F$ be a homomorphism of complex vector bundles on a manifold M. The Thom-Porteous formula says that, in the generic situation, the homology class of a degeneracy locus $D_k(\sigma)$ of σ in M is the Poincaré dual of a certain Schur polynomial $\delta_k(F - E)$ of Chern classes of the virtual bundle $F - E$. We give a refined version of this in the sense that the class $\delta_k(F - E)$ is naturally localized at $D_k(\sigma)$ and the localization $\delta_k(F - E, \sigma)$ corresponds to the class of $D_k(\sigma)$ with possibly a non-reduced structure in the homology of $D_k(\sigma)$ via the Alexander duality. This is done by constructing a universal localization for the tautological homomorphism. A prototype of this is the Thom class for the top Chern class and these universal localizations give vast generalizations of the Thom class. This is a joint work with T. Ohmoto.

- Shinichi Tajima (Tsukuba University)

  Title: Local cohomology, Newton filtrations and Tjurina numbers

  Abstract: We consider Newton non-degenerate hypersurface isolated singularities in the context of Computational Algebraic Analysis. We introduce a notion of Newton filtration on algebraic local cohomology and give a framework to handle algebraic local cohomology classes attached to Jacobi ideals of Newton non-degenerate singularities. We apply the proposed method to study μ-constant deformations and Tjurina numbers.

- Shigeharu Takayama (University of Tokyo)

  Title: On complex geometry of pluricanonical and adjoint bundles

  Abstract: Pluricanonical forms are one of fundamental objects to study compact Kaehleror projective manifolds. Various methods to construct pluricanonical forms, or more generally sections of the so-called adjoint bundles, are introduced for a couple of decades in the classification theory of algebraic varieties. I will try to explain a few of them and their applications.

- Hiroshi Tamaru (Hiroshima University)

  Title: Left-invariant metrics on Lie groups and submanifold geometry

  Abstract: Our theme is the geometry of left-invariant Riemannian metrics on Lie groups, which provide many interesting examples of homogeneous Einstein and Ricci soliton manifolds. In this talk, I will explain our approach from submanifold geometry. In particular, for three-dimensional solvable Lie groups, the existence and the nonexistence of left-invariant Ricci solitons have a nice correspondence with geometry of cohomogeneity one actions on some noncompact symmetric space. I will also mention some higher-dimensional examples and a pseudo-Riemannian version.

- Tatsuya Tate (Nagoya University)

  Title: One-dimensional quantum walks

  Abstract: The notion of quantum walks, or sometimes called discrete time quantum random walks, have been proposed by Aharonov-Davidovich-Zagury in 1993 as a quantum analogue of classical random walks, and they have been re-discovered by, for example, Aharonov-Ambainis-kempe-Vazirani in 2001 in computer science. Since then, it is intensively investigated among computer science, quantum physics and probability theory. Although the definition of quantum walks, at least in one-dimension, are rather easy, their analytical behavior and algebraic aspects had not been well understood. In this talk, various local asymptotic formulas and an algebraic structure of the one-dimensional quantum walks will be given. Problems concerning higher-dimensional cases will be discussed.

- Takashi Tsuboi (University of Tokyo)

  Title: Commutator width of diffeomorphism groups

  Abstract: Many groups of diffeomorphisms have been known to be perfect. That is, any element can be written as a product of commutators. The commutator length of an element of a perfect group is defined to be the minimal number of commutators to write it. The commutator width of the perfect group is defined to be the maximal number of commutator lengths. We will explain that the commutator widths of many groups of diffeomorphisms are bounded. We also discuss certain homeomorphism groups with commutator width one.

- Hirofumi Yamada (Okayama University)

  Title: A peripheral combinatorics of partitions

  Abstract: I will define 3 types of ”weight” for each partition, and show that the products of these weights over partitions coincide. This product turns out to be the Shapovalov determinant for the basic representation of the quantized universal enveloping algebra of affine type A. This is a joint work with M. Ando and T. Suzuki.

- Takuya Yamauchi (Kagoshima University, Faculty of Education/University of Toronto)

  Title: Arithmetic Calabi-Yau families associated to generalized hypergeometric local systems and its applications

  Abstract: In this talk, I will explain how to construct Calabi-Yau families from the local systems related to generalized Gaussian hypergeometric series. Several applications will be explained. This is a joint work with N. Tsuzuki.