The 14th "Kagoshima Algebra-Analysis-Geometry Seminars"
— On the occasion of Prof. Yokura's retirement —

February 11th 13:00 - 15th 12:00, 2019
Room 101, Bldg. 1, Faculty of Science, Kagoshima University

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PROGRAM

February 11 (Monday)

13:00-13:50 : Kyoji Saito (IPMU)
Primitive forms *without metric structure* (j.w. K. Aleshkin)

14:00-14:50 : Shin-ichi Matsumura (Tohoku University)
On projective manifolds with semi-positive holomorphic sectional curvature

15:10-16:00 : Timo Essig (Hokkaido University)
Intersection Space Cohomology on Three Strata Spaces

16:10-17:00 : Masaki Hanamura (Tohoku University)
Hodge complexes of smooth varieties and Deligne homology

February 12 (Tuesday)

10:00-10:50 : Yusuke Arike (Kagoshima University)
Vertex operator algebras and modular linear differential equations

11:00-11:50 : Xia Liao (Huaqiao University)
The characteristic cycle of the Milnor number constructible function

13:30-14:20 : Paolo Aluffi (Florida State University)
Newton-Okounkov bodies and Segre classes

14:30-15:20 : Kiyoshi Takeuchi (University of Tsukuba)

On irregularities of Fourier transforms of regular holonomic D-modules

15:40-16:30 : Kazuhiko Yamaki (Kyoto University)
Ample divisors on tropical toric varieties

16:40-17:30 : Lê Dũng Tráng (Aix-Marseille Universit)
On the topology of complex polynomials

February 13 (Wednesday)

10:00-10:50 : Jean-Paul Brasselet (Aix-Marseille Universit)
On the Alexander duality morphism for singular varieties, join work in progress with Tatsuo Suwa

11:00-11:50 : Hiroyuki Chihara (University of the Ryukyus)
Geometric analysis of dispersive flows

13:30-14:20 : Jörg Schürmann (Universitt Mnster)
(Degenerate) affine Hecke algebras and (motivic) Chern classes of Schubert cells

14:30-15:20 : Toru Ohmoto (Hokkaido University)
Multiple-point formulas revisited

15:40-16:30 :Mutsuo Oka (Tokyo University of Science)
On the Milnor fibration of $f(\mathbf{z})\bar{g}(\mathbf{z})$

16:40-17:30 : Shoji Yokura (Kagoshima University)
On bicycles

19:00- Conference Dinner

February 14 (Thursday)

10:00-10:50 : Laurentiu Maxim (University of Wisconsin)
Euclidean distance degree of the multiview variety

11:00-11:50 : Toshitake Kohno (University of Tokyo)
Higher category extensions holonomy maps and iterated integrals

13:30-14:20 : Osamu Saeki (Kyushu University)
Unlinking singular locus from regular fibers and its application to submersions

14:30-15:20 : Makoto Enokizono (Osaka University)
Durfee-type inequality for complete intersection surface singularities

15:40-16:30 : Shihoko Ishii (University of Tokyo)
Is a singularity determined by the jet schemes?

16:40-17:30 : Tatsuo Suwa (Hokkaido University)
Relative Dolbeault cohomology and hyperfunctions

February 15 (Friday)

10:00-10:50 : Free discussion

11:00-11:50 : Free discussion

ABSTRACTS

Paolo Aluffi: Newton-Okounkov bodies and Segre classes

We will present a new approach to the computation of the Segre class of a subscheme of projective space, based on the construction of a suitable Newton-Okounkov body. The result may be viewed as a common generalization of results of Kaveh and Khovanskii and of an earlier result on Segre classes of monomial schemes. The construction of the Newton-Okounkov body is modeled on work of Lazarsfeld and Mustata.

Yusuke Arike: Vertex operator algebras and modular linear differential equations

Modular linear differential equations (MLDEs) are linear differential equations whose spaces of solutions are invariant under modular transformations. They have appeared in attempts to classify vertex operator algebras. In this talk I will explain classification of vertex operator algebras whose characters are solutions of 3rd order MLDEs.

Jean-Paul Brasselet: On the Alexander duality morphism for singular varieties, join work in progress with Tatsuo Suwa.

For a submanifold X embedded in an m-dimensional manifold M, the Alexander isomorphisms $H^{m-i}(M, M - X) \to H_i(X)$ are well defined for instance using triangulations or using sheaves. In the case of a singular subvariety, one shows how these isomorphisms can be defined using intersection homology.

Hiroyuki Chihara: Geometric analysis of dispersive flows

We study the initial value problems for some dispersive flows for closed curves into compact almost Hermitian manifolds, which are compact almost complex manifolds equipped with Hermitian metric. In other words, we consider the motion of closed curves on manifolds subject to dispersive partial differential equations of order two, three or four. These equations are the geometric generalization of model equations arising in classical mechanics. We show the relationship between the short-time existence theorems and the geometric settings of the target manifolds, e.g., Kaehler condition, curvature condition and etc.

Makoto Enokizono: Durfee-type inequality for complete intersection surface singularities

Durfee's negativity conjecture says that the signature of the Milnor fiber of a 2-dimensional isolated complete intersection singularity is always negative. In this talk, I will explain that this conjecture is true (more precisely, the signature is bounded above the negative number determined by the geometric genus, the embedding dimension and the number of irreducible components of the exceptional set of the minimal resolusion) as an application of a slope inequality for certain fibered surfaces.

Timo Essig: Intersection Space Cohomology on Three Strata Spaces

Banagl's theory of intersection spaces assigns cell complexes to certain stratified topological pseudomanifolds depending on a perversity function in the sense of intersection homology. The main property of the intersection spaces is Poincaré duality over complementary perversities for the reduced singular (co)homology groups with rational coefficients HI. Banagl also gave a de Rham description for the intersection space cohomology theory HI on 2-strata pseudomanifolds with a geometrically flat link bundle. In this talk, I present a way to generalize the intersection space cohomology theory to a class of 3-strata pseudomanifolds with flatness assumptions for the link bundles, using differential forms on manifolds with corners. I present the idea of the proof of a Poincaré duality theorem, which is based on an iteration technique called the method of iterated triangles.

Masaki Hanamura: Hodge complexes of smooth varieties and Deligne homology

Let U be a smooth complex variety and H be a normal crossing divisor on H. We give the construction of an explicit Hodge complex for the cohomology of the pair (U, H). For this purpose we formulate, prove and use the "Cauchy-Stokes formula" which generalizes Cauchy's classical residue formula.

Shihoko Ishii: Is a singularity determined by the jet schemes?

The concept of the jet schemes of a singularity is introduced by J.F.Nash.

The jet schemes reflect the nature of the singularity,for example,these describe some birational invariants of singularities and therefore very useful in birational geometry. In the talk I will show a question posed from another viewpoint: "is a singularity determined by the jet schemes? "

There are several versions of this question: global, local, set theoretic and scheme theoretic. I will talk about the answer for each version.

Toshitake Kohno: Higher category extensions holonomy maps and iterated integrals

We explain a method to construct higher category extensions of holonomy maps of homotopy path groupoids. We use the notion of K.-T. Chen's formal homology connections to construct 2-connections and formulate the 2-flatness condition. We construct a 2-functor from the homotopy 2-groupoid to certain crossed modules. As an application we discuss higher category extensions of Yang-Baxter equations and KZ connections.

Lê Dũng Tráng: On the topology of complex polynomials

In this lecture we shall give some old and new results on the topology of complex polynomials. We shall state some open problems.

Xia Liao: The characteristic cycle of the Milnor number constructible function

Let $f : M \to N$ be a holomorphic map between two complex manifolds. Assume f has no blow up in codimension 0 (e.g. f has finite contact type or N has dimension 1), therefore we can define a Milnor number constructible function μ which to each point of M associates the Milnor number at that point. In this talk, I will present my recent result about the characteristic cycle of μ. In fact, consider MacPherson 's graph construction for the vector bundle morphism $f^*T^*N \to T^*M$, we can show this characteristic cycle appears as a part of the limit cycle of the graph construction. When $\dim N = 1$, this may be used to recover all the known results about characteristic cycles of hypersurfaces.

Shin-ichi Matsumura: On projective manifolds with semi-positive holomorphic sectional curvature

In this talk, I explain the geometry of a projective manifold X (more generally, Kähler manifolds) with semi-positive holomorphic sectional curvature. I first show that, if X has positive holomorphic sectional curvature, then X is rationally connected, that is, arbitrary two points can be connected by a rational curve (the image of $\mathbb{P}^1$ by a holomorphic map), by using MRC fibrations. This result gives an affirmative solution for Yau's conjecture. Moreover I prove the structure theorem for a projective manifold X with semi-positive holomorphic sectional curvature, which can be seen as a generalization of the structure theorem proved by Howard-Smyth-Wu and Mok for holomorphic "bisectional" curvature. Specifically, I show that, if X has semi-positive holomorphic sectional curvature, X admits a locally trivial morphism $X \to Y$ such that the fiber F is rationally connected and the

image Y has a finite etale cover $A \to Y$ by an abelian variety A. Also I show that the universal cover of X is biholomorphic and isometric to the product of $\mathbb{C}^m$ and F. The proof depends on the theory of holomorphic foliations and singular hermitian metrics. This talk is based on the preprints at arXiv:1811.04182v1, arXiv:1809.08859v1, arXiv:1801.09081v1.

Laurentiu Maxim: Euclidean distance degree of the multiview variety

Abstract: The Euclidean distance degree of an algebraic variety is a well-studied topic in applied algebra and geometry. It has direct applications in geometric modeling, computer vision, and statistics. I will describe a new topological interpretation of the Euclidean distance degree of an affine variety in terms of Euler characteristics. As a concrete application, I will present a solution to the open problem in computer vision of determining the Euclidean distance degree of the affine multiview variety. (Joint work with J. Rodriguez and B. Wang.)

Toru Ohmoto: Multiple-point formulas revisited

abstract: From classical to modern enumerative geometry, numerous problems are translated to counting multiple points of singular maps associated to given geometric situations. I will revisit the enumerative theory of singularities of maps from the viewpoint of algebraic cobordism.

Mutsuo Oka: On the Milnor fibration of $f(\mathbf{z})\bar{g}(\mathbf{z})$

We consider a mixed function of type $H(\mathbf{z}, \bar{\mathbf{z}}) = f(\mathbf{z})\bar{g}(\mathbf{z})$ where f and g are convenient holomorphic functions which have isolated critical points at the origin and we assume that the intersection $f = g = 0$ is a complete intersection variety with an isolated singularity at the origin and H satisfies the multiplicity condition .

We will show that H satisfies Hamm-Lê condition. In particular, H has a Milnor fibration at the origin. We give also an example which does not have Milnor fibration if the multiplicity condition is not satisfied.

Osamu Saeki: Unlinking singular locus from regular fibers and its application to submersions

In this talk, we study smooth stable maps of closed 3-manifolds into surfaces and the linking behavior between regular fibers and the singular loci. As an application we give a criterion for a link in an open 3-manifold to be a regular fiber of a submersion.

Kyoji Saito: Primitive forms *without metric structure* (j.w. K. Aleshkin)

Around the end of '70s, the author found the flat structure (i.e. a linear coordinate system with a flat metric and its potential, which is nowadays called also the Frobenius structure by Manin and Duvrobin) on the orbit space of a finite reflection group. Soon after, the flat structure is reconstructed naturally from primitive forms. After 40 years, recently, Kato-Mano-Sekiguchi (cf. also Konishi-Minabe) found the flat structure, which carries neither metric nor potential, on the orbit space of unitary reflection group. This arose a new inpetus to study the flat structure *without metric*. In this talk, we introduce a concept of primitive forms *without metric structure* and show that it induces the flat structure *without metric*. Actually, they are constructed perturbatively using an oscilatory integral factor.

Jörg Schürmann: (Degenerate) affine Hecke algebras and (motivic) Chern classes of Schubert cells

We explain in the context of complete flag varieties $X = G/B$ the relation between (motivic) Chern classes of Schubert cells and convolution actions of (degenerate) affine Hecke-algebras as in the work of Ginzburg and Tanisaki. This is joint work with P. Aluffi, L. Mihalcea and C. Su.

Tatsuo Suwa: Relative Dolbeault cohomology and hyperfunctions

The talk is concerned with the representation of Sato hyperfunctions by relative Dolbeault cohomology classes. It not only simplifies various expressions substantially but also leads to a number of new results. In fact I have already talked about this at several occasions. This time I try to present further developments as time permits. This is a joint work with N. Honda and T. Izawa.

Kiyoshi Takeuchi: On irregularities of Fourier transforms of regular holonomic D-modules

Fourier transforms of regular holonomic D-modules are not regular in general. In this talk, we introduce our recent results on their irregularities. First, by using the irregular Riemann-Hilbert correspondence of D'Agnolo-Kashiwara and the theory of Fourier-Sato transforms for enhanced ind-sheaves of Kashiwara-Schapira etc., we obtain a formula for their enhanced solution complexes. Moreover we show that the irregularities and some parts of the characteristic cycles of the Fourier transforms are expressed by the geometries of the original D-modules. This is a joint work with Yohei Ito.

Kazuhiko Yamaki: Ample divisors on tropical toric varieties

On tropical curves, the divisor theory has been developed. The notion of (very) ample divisors has been defined and such divisors have been deeply studied. On higher dimensional tropical varieties, however, this is not the case. In this talk, we investigate a divisor theory and discuss the notion of (very) ample divisors on tropical toric varieties. This is a joint work in progress with Shu Kawaguchi (Doshisha University).

Shoji Yokura: On bicycles.

I will talk about bicycles and some related topics.