The 7th Kagoshima Algebra–Analysis–Geometry Seminar

February 14 (Tuesday) – 17 (Friday), 2012
Room 101, Faculty of Science, Kagoshima Universiry

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PROGRAM

February 14 (Tuesday)
10:00〜10:50 ：Yuji Sano (Kumamoto University)
"Alpha invariant and K-stability of Fano varieties (joint with Y. Odaka) "
11:00〜11:50 ：Qihong Xie (Fudan University)
"Vanishing theorems on toric varieties in positive characteristic"
13:30〜14:20 ：Masaharu Ishikawa (Tohoku University)
"Tangle sums and factorization of A-polynomials"
14:30〜15:20 ：Shinichiroh Matsuo (Kyoto University)
"Brody curves and mean dimension"
15:40〜16:30 ：Takahiro Yamamoto (Kyushu Sangyo University)
"Topology of the singular value sets of stable maps"
16:40〜17:30 ：Sumio Yamada (Tohoku University)
"On Riemannian and Finsler Geometries of Teichmüller Spaces"

February 15 (Wednesday)
10:00〜10:50 ：Takehiko Yasuda (Kagoshima University)
"Motivic integration and modular representations of a cyclic group of prime order"

11:00〜11:50 ：Go Yamashita (Toyota Central R & D Labs, Inc.)
"Wiles' proof of Fermat's Last Theorem for beginners"
13:30〜14:20 ：Takehiko Morita (Osaka University)
"The thermodynamic formalism approach to Selberg zeta functions for co-finite Fuchsian groups"
14:30〜15:20 ：Alexander Getmanenko (IPMU)
"Microlocal properties of sheaves and complex WKB method"
15:40〜16:30 ：Toru Ohmoto (Hokkaido University)
"Chern class and degree formula (tentative)"
16:40〜17:30 ：Noriyuki Suwa (Chuo University)
"Group algebras and normal bases"
18:30〜 Dinner Party

February 16 (Thursday)
10:00〜10:50 ：Christian Schnell (IPMU)
"Cohomology of holonomic and constructible complexes on abelian varieties"
11:00〜11:50 ：Minoru Itoh (Kagoshima University)
"Invariant Theory for Exterior Algebras"
13:30〜14:20 ：Kentaro Nagao (Nagoya University)
"Hyperbolic 3-manifold and cluster algebras"
14:30〜15:20 ：Masayuki Kawashima (Tokyo Science University)
"On $(2, p)$ quasi torus curves and weak Zariski pairs"
15:40〜16:30 ：Noriyuki Hamada (Kyushu University)
"On the minimal number of singular fibers in a Lefschetz fibration"
16:40〜17:30 ：Osamu Iyama (Nagoya University)
"TBA"

February 17 (Friday)
9:30〜10:20 ：Masato Okado (Osaka University)
"Rigged configuration - a gift from quantum integrable systems"
10:30〜11:20 ：Sho Matsumoto (Nagoya University)
"Moments of matrix elements from the orthogonal group and COE"
11:40〜12:30 ：Nguyen Viet Dung (Vietnam Acad. Sci. & Tech.)
"On the topological complexity and hyperplane arrangements"
14:00〜14:50 ：Taro Fujisawa (Tokyo Denki University)
"Variations of mixed Hodge structure and semi-positivity thorems"
15:10〜16:00 ：Giovanni Morando (RIMS, University of Padua)
"Riemann–Hilbert correspondence and subanalytic sites"
16:10〜17:00 ： Osamu Saeki (Kyushu University)
"Desingularizing special generic maps"

Abstracts of Talks

- Taro Fujisawa (Tokyo Denki University)

  Title: Variations of mixed Hodge structure and semi-positivity thorems

  Abstract:This is a joint work with Osamu Fujino. Mixed Hodge structures on compact support cohomology groups turn out to be important by Fujino's previous works concerning injectivity theorems and vanishing theorems. In this talk, I discuss about variations of mixed Hodge structure on compact support cohomology groups. Moreover, I will talk about the admissibility of the variations of mixed Hodge structure mentioned above. As an application, I will present semi-positivity theorems of Fujita-Kawamata type.

- Alexander Getmanenko

  Title: Microlocal properties of sheaves and complex WKB method

  Abstract: In this joint work with D.Tamarkin, we prove analytic continuability of solutions of the Laplace transformed Schrödinger equation necessary to justify complex WKB asymptotics. Kashiwara–Schapira style sheaf theory is used as the main tool.

- Noriyuki Hamada (Kyushu University)

  Title: On the minimal number of singular fibers in a Lefschetz fibration

  Abstract:A Lefschetz fibration is a topological structure on a 4-dimentional smooth manifold, which resembles a surface bundle over a surface, but which allows finitely many singularities, called Lefschetz type critical points. The number of singular fibers of a Lefschetz fibration cannot be arbitrarily, several non-trivial constraints have been known. In this talk, we will discuss the minimal number of singular fibers in a Lefschetz fibration, especially in the case of Lefschetz fibrations over the torus.

- Masaharu Ishikawa (Tohoku University)

  Title: Tangle sums and factorization of A-polynomials

  Abstract:An A-polynomial is a knot invariant derived from the $SL(2,\mathbb{C})$-representations of the fundamental group of the knot 's complement. This polynomial is important since we can obtain a lot of geometric information of the knot including the boundary slopes of incompressible surfaces and cyclic/finite Dehn surgeries. Factorization of A-polynomials via epimorphisms were first mentioned by Silver and Whitten and then studied by Hoste and Shanahan in detail. They proved that if there exists an epimorphism $\pi_1(S^3 \setminus K_1) \to \pi_1(S^3 \setminus K_2)$, preserving peripheral structures, then their A-polynomials have the factorization $A_{K_2}(L, M) \mid (L^d - 1)A_{K_1}(L^d, M)$.

  In this talk, we show that there exists infinitely many examples of pairs of knots K_1 and K_2 that have no epimorphism $\pi_1(S^3 \setminus K_1) \to \pi_1(S^3 \setminus K_2)$ preserving peripheral structures although their A-polynomials have the factorization $A_{K_2}(L, M) \mid A_{K_1}(L, M)$. This is a joint work with T.W.Mattman and K.Shimokawa.

- Minoru Itoh (Kagoshima University)

  Title: Invariant Theory for Exterior Algebras

Abstract:I will give some results in anticommutative invariant theory, namely the invariant theory for exterior algebras. These results are parallel with results in classical invariant theory for polynomial algebras, but this similarity is not so trivial. These results are also related to the Amitsur–Levitzki identity and its analogues in the theory of polynomial identities.

- M. Kawashima (Tokyo Science University):

  Title: On $(2, p)$ quasi torus curves and weak Zariski pairs

  Abstract:In this talk, we construct a pair of plane curves such that they have the same degree and the same singularities. One is a quasi torus curve of type $(2, p)$ and another is a torus curve of type $(2, p)$. For the construction, we use Nagata transformations. If p is even, their complements in $\mathbb{P}^2$ have different topologies. Thus they are a weak Zariski pair. We also show that they are an Alexander equivalent weak Zariski pair for the case $p = 4$.

- Sho Matsumoto (Nagoya University)

  Title: Moments of matrix elements from the orthogonal group and COE

  Abstract: We establish a systematic method for computing averages of monomials in matrix elements from some classes of random matrix ensembles. We here deal with two classes of random matrices: the real orthogonal group with its Haar measure and circular orthogonal ensemble (COE). In both cases, a function on symmetric groups, called the orthogonal Weingarten function, plays a key role.

- Shinichiroh Matsuo (Kyoto University)

  Title: Brody curves and mean dimension

  Abstract:This talk is based on a joint work with Masaki Tsukamoto.

  A BRODY CURVE is studied in Nevanlinna theory. An entire holomorphic map is a Brody curve if its sup norm of the derivative is uniformly bounded. The moduli space of Brody curves is infinite dimensional. Gromov introduced MEAN DIMENSION as "dimension of such infinite dimensional spaces".

  We have studied the mean dimensions of the moduli spaces of Brody curves. In particular, we give the exact formula of the mean dimension of the moduli space of Brody curves to the Riemann sphere. This formula is an infinite dimensional analogue of the Rieman-Roch formula.

- Giovanni Morando (RIMS, University of Padua)

  Title: Riemann–Hilbert correspondence and subanalytic sites

  Abstract: We will start by recalling the Riemann–Hilbert correspondence. Such a correspondence generalizes the 21st Hilbert problem and the well known equivalence between the flat holomorphic connections (whose nature is analytical) on an analytic manifold and the locally constant sheaves of finite rank on it (whose nature is topological). A fundamental point in this correspondence is the difference between the regular and the irregular case. The former deals with connections whose solutions have moderate growth. It has been solved in any dimension through an equivalence involving constructible sheaves, ie sheaves locally constant on the strata of an analytic stratification. The latter being much more complicated and having being fully achieved only locally on curves. We will recall such correspondences introducing the main classical tools used to achieve them such as constructible sheaves, formal decomposition and

asymptotic lifts. We we also introduce the recent and fundamental results of C. Sabbah, T. Mochizuki and K. Kedlaya in the irregular higher dimensional case.

We will then introduce the subanalytic site relative to a complex analytic manifold and the sheaf of tempered holomorphic functions recently defined by M. Kashiwara and P. Schapira. We will explain how these objects allow on the one hand to generalize the classical ones and on the other hand to obtain global results much more precise than those obtained until now. We will also introduce the notion of constructible sheaf on the subanalytic site and we will discuss the recent results we obtained on the contructibility of tempered solutions of holonomic D-modules which was conjectured by Kashiwara and Schapira in 2003. If time will allow, we will show the link between the subanalytic site and real spectra or Berkovich spaces.

- Takehiko Morita (Osaka University)

  Title: The thermodynamic formalism approach to Selberg zeta functions for co-finite Fuchsian groups

  Abstract:Let T_G be the so-called continued fraction transformation defined by $T_G : (0,1) \to (0,1), : x \mapsto 1/x - [1/x]$. D. Mayer shows that the Selberg zeta function for $PSL(2,\mathbb{Z})$ has a determinant representation in terms of transfer operators with complex parameter associated to T_G. Inspired by the result, I would like to explain about the idea to obtain the determinant representations of Selberg zeta functions and the prime number type theorem for hyperbolic conjugacy classes for general co-finite Fuchsian groups via thermodynamic formalism.

- Kentaro Nagao (Nagoya University)

  Title: Hyperbolic 3-manifold and cluster algebras

  Abstract:I will talk on explicit constructions of hyperbolic structures on the mapping tori of pseudo-Anosov mapping classes of punctured surfaces. It has been know Teichmüller theory of punctured surface gives an example of a cluster algebra. The construction will be provided in terms of Teichmüller theory cluster algebras. This is a joint work with Yuji Terashima and Masahito Yamazaki.

- Nguyen Viet Dung (Vietnam Acad. Sci. & Tech.)

  Title: On the topological complexity and hyperplane arrangements

  Abstract: In the talk we discuss the topological complexity of a topological space, and its generalization - higher topological complexity. We will present some of our calculations for higher topological complexity for complement of a hyperplane arrangement.

- Toru Ohmoto (Hokkaido University)

  Title: Chern class and degree formula (tentative)

  Abstract:Brasselet–Schürmann–Yokura's Hirzeburch class transformation T_{y*} unifies additive characteristic classes for singular varieties. For example, its specialization to $y = -1$ commutes with Schwartz-MacPherson's Chern class C_* in a canonical way. However it does not mean a new proof of the existence of C_*. Our aim is to fill up this point by an elementary argument.

- Masato Okado (Osaka University)

  Title: Rigged configuration - a gift from quantum integrable systems

Abstract:Rigged configuration is a combinatorial object that arose from Bethe Ansatz analysis of the Heisenberg spin chain - distinguished example of quantum integrable systems. I will explain how it was born, how it is related to representation theory of quantum affine algebras, and how it is applied to the linearization of the box-ball systems.

- Osamu Saeki (Kyushu University)

  Title: Desingularizing special generic maps

  Abstract:Let us consider a singular map of class C^∞ of a smooth manifold into an Euclidean space. An immersion (or an embedding) of the manifold into a higher dimensional Euclidean space whose orthogonal projection gives the original singular map can be regarded as a desingularization. In this talk, we consider special generic maps, i.e., smooth maps with only definite fold as their singularities, and discuss their desingularizations, especially in codimension one.

  This is a joint work with Masamichi Takase (Seikei University).

- Yuji Sano (Kumamoto University)

  Title: Alpha invariant and K-stability of Fano varieties (joint with Y. Odaka)

  Abstract:From the results of Tian, it is proved that the lower bounds of alpha invariant implies K-stability of Fano manifolds via the existence of Kahler-Einstein metrics. In this talk, I will give a direct proof of this relation in algebro-geometric way without using Kahler-Einstein metrics. This is joint work with Yuji Odaka (RIMS).

- Christian Schnell (IPMU)

  Title: Cohomology of holonomic and constructible complexes on abelian varieties

  Abstract:Let A be a complex abelian variety. The Fourier-Mukai transform of Rothstein and Laumon gives an equivalence of categories between the derived category of D-modules on A and the derived category of coherent sheaves on the space A of line bundles with integrable connection. I will describe some results about the structure of Fourier-Mukai transforms of holonomic (and constructible) complexes of D-modules, which have interesting consequences for the study of D-modules on abelian varieties.

- N. Suwa (Chuo University):

  Title: Group algebras and normal bases

  Abstract: Let k be a field and Γ a finite group. Serre [1, Ch.IV, 8] observes that the unit group of the group algebra $k[\Gamma]$ has a structure of algebraic group over k, which is denoted by $U(\Gamma)_k$, and verifies that any Galois extension of k with group Γ is obtained by a cartesian diagram

$$\begin{array}{ccc} \mathrm{Spec}\ K & \longrightarrow & U(\Gamma)_k \\ \downarrow & & \downarrow \\ \mathrm{Spec}\ k & \longrightarrow & U(\Gamma)_k/\Gamma \end{array}$$

  as a consequence of the normal basis theorem. Moreover Serre verifies the Kummer theory, for example,

constructing a commutative diagram of algebraic groups with exact rows

$$\begin{array}{ccccccccc} 0 & \longrightarrow & \Gamma & \longrightarrow & U(\Gamma)_k & \longrightarrow & U(\Gamma)_k/\Gamma & \longrightarrow & 0 \\ & & \downarrow \wr & & \downarrow & & \downarrow & & \\ 0 & \longrightarrow & \boldsymbol{\mu}_{n,k} & \longrightarrow & \mathbb{G}_{m,K} & \xrightarrow{n} & \mathbb{G}_{m,k} & \longrightarrow & 0. \end{array}$$

It is not so difficult to generalize Serre's argument over a ring in a framework of group schemes. However it is interesting to consider a generalization since the normal basis theorem does not necessarily hold true for a unramified Galois extension of rings. In the first half I give an outline of the argument which is developed in [2]. In the latter half I explain how to generalize the argument from constant finite group schemes to finite falt group schemes.

[1] J. P. Serre, Groupes algébriques et corps de classes, Hermann, Paris, 1959

[2] N. Suwa, Around Kummer theories. RIMS Kôkyûroku Bessatsu B12 (2009) 115–148

- Qihong Xie (Fudan University)

  Title: Vanishing theorems on toric varieties in positive characteristic

  Abstract:We use the liftability of the relative Frobenius morphism of toric varieties and the strong liftability of toric varieties to prove the Bott vanishing theorem, the degeneration of the Hodge to de Rham spectral sequence and the Kawamata–Viehweg vanishing theorem for log pairs on toric varieties in positive characteristic, which generalize those results of Danilov, Buch–Thomsen–Lauritzen–Mehta, Mustata and Fujino to the case where concerned divisors are not necessarily torus invariant.

- Sumio Yamada (Tohoku University)

  Title: On Riemannian and Finsler Geometries of Teichmüller Spaces

  Abstract:Teichmüller space is a set of conformal structures on a given topological surface, where with the genus of the surface larger than one, each conformal structure can be uniquely represented by a hyperbolic metric within the conformal class. There is a canonical Riemannian metric on the space, called Weil–Petersson metric. In the last 10 years, the Weil–Petersson geometry has progressed enough so that the Teichmüller space can be now regarded as an open convex set. Using this viewpoint, we will introduce a set of new Finsler structures on the Teichmüller space, and will discuss its relevance to the Thurston theory of surfaces.

- Takahiro Yamamoto (Kyushu Sangyo University)

  Title: Topology of the singular value sets of stable maps

  Abstract:TTopology of a manifold deeply related to topology of the singular value set of a stable map on the manifold. In this talk, I am going to show some results about stable maps between surfaces.

- Go Yamashita (Toyota Central R D Labs, Inc.)

  Title: Wiles' proof of Fermat's Last Theorem for beginners

  Abstract:I will explain the celebrated Wiles' proof (or a simplification in these decades) of Fermat's Last Theorem for beginners.

- Takehiko Yasuda (Kagoshima University)

  Title: Motivic integration and modular representations of a cyclic group of prime order

  Abstract:The cohomological McKay correspondence proved by Batyrev is the equality of an orbifold invariant and a stringy invariant. The former is an invariant of a smooth variety with a finite group action and the latter is an invariant of its quotient variety. Denef and Loeser gave an alternative proof of it which uses the motivic integration theory developped by themselves. Then I pushed forward with their study by generalizing the motivic integration to Deligne-Mumford stacks and reformulating the cohomological McKay correspondence from the viewpoint of the birational geometry of stacks. However all of these are about tame group actions (the order of a group is not divisible by the characteristic of the base field), and the wild (= not tame) case has remained unexplored. In this talk, I will explain my attempt to examine the simplest situation of the wild case. Namely linear actions of a cyclic group of order equal to the characteristic of the base field are treated. A remarkable new phenomenon is that the space of generalized arcs is a fibration over an infinite dimensional space with infinite dimensional fibers, where the base space is the space of Artin-Schreier extensions of $k((t))$, the field of Laurent series.