Abstract of talks

TQFT representation and monodromy

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We will compute the TQFT monodromy in terms of the embedded resolution.

Surface symmetries and equivariant characteristic classes

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By a surface symmetry we mean a pair (G, M), where M is a closed oriented surface and G is a finite group acting on it. In this talk, we will introduce Mackey functors ssociated with surface symmetries. Equivariant characteristic classes such as Mumford-Morita-Miller classes and Newton classes can be regarded as natural transformations of Mackey functors. In addition, we will discuss Riemann-Roch type formulae for these natural transformations.

Extended Zagier reciprocity for Dedekind sum via cyclic quotient singularities

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We extend Zagier's reciprocity for higher-dimensional Dedekind sum in the following sense. Dedekind sum can be expressed as the difference term between orbifold signature and usual signature for an isolated cyclic quotient singularity. By the toric blow up of it via the method of Oka-Danilov subdivision, we obtain cyclic quotient singularities of several types including non-isolated ones. We calculate the orbifold signature and the signature in this relative situation including non-isolated ones. Then we obtain a certain type of "duality" among cyclic quotient singularities, which can be expressed in terms of a certain generalization of Dedekind sum. If all the singularities are isolated after the Oka-Danilov toric blow-up (one-time), our duality coincides with Zagier's reciprocity.

Łojasiewicz inequality on non-compact domains and singularities at infinity

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We give an upgrade of a version of the Łojasiewicz inequality on non-compact domains realized recently by [Dinh-Ha-Thao]. By the way, we give a sufficient condition for the existence of vanishing component at infinity for real polynomials in several variables.

Geometry with density

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A manifold with density is a Riemannian manifold M^n with a positive density function $e^{\varphi(x)}$ used to weight both volume and hypersurface area. The study of the geometry of manifolds with density has increased recently by both mathematicians and undergraduate students. Yet much of the basic geometry of such spaces remains unexplored. This talk introduces some recent results in this trend.

Reidemeister torsions and achirality of knots

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The Reidemeister torsion is a classical invariant of cellular complexes. Its generalization to twisted Reidemeister torsions associated to representations of the fundamental groups of 3-dimensional manifolds have been intensively studied in recent years. We will discuss these invariants and their applications in studying achiral knots (knots which are equivalent to their mirror images).

On the enhancement to the Milnor number of a class of mixed polynomials

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Mixed polynomials are polynomials in complex variables $z_1, \ldots, z_n$ and their conjugates. M. Oka showed that mixed polynomials have Milnor's fibrations under the strong nondegeneracycondition. We study the enhancements to the Milnor numbers defined by W. Neumann and L. Rudolph, which is an invariant of the homotopy classes of fibered links in the sphere andbelongs to integers. We calculate the enhancements to the Milnor numbers of a certain class of stronglynon-degenerate mixed polynomials and show that all integers are realized by such mixed polynomials.

The skew growth function $N(t)$ for the monoid of type Bii and others

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(Joint work with Kyoji Saito)

Let M be a positive homogeneously presented cancellative monoid (e.g. Artin monoids of finite type). We will consider the (spherical) growth function $P(t)$ for the monoid M. Inspired by the author's example and observation, Kyoji Saito has given a combinatorial description of its inversion function $1/P(t)$ by using a structure of common multiples in the monoid M. Namely, he has introduced a concept of a tower of minimal common multiple sets in M and, with respect to the structure on the set of all towers, he has considered the "skew generating function" $N(t)$. And he has shown the inversion formula: $P(t) \cdot EN(t) = 1$. In this talk, we will calculate non-trivial examples of skew growth functions $N(t)$ by studying the structure on the set of all towers.

Jet closures and local isomorphism problem

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Given a morphism of germs inducing isomorphisms of the local jet schemes, then is the morphism isomorphic? This problem is called the local isomorphism problem. We introduce the notion of the jet closure of an ideal and relate it to the local isomorphism problem. By definition the jet closure is intrinsic. Then, we develop a theory on the jet closure, show a relation with integral closure and also give the answer to the local isomorphism problem.

On (p, q) torus curves and weak Zariski pairs

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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 $(2, p)$. If p is even, their complements in $\mathbb{P}^2$ have different topologies. Thus they are a weak Zariski pair.

A note on exceptional unimodal singularities and $K3$ surfaces

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(Joint work with M. Mase and K. Ueda)

We study the relation between the graded stable derived categories of 14 exceptional unimodal singularities and the derived categories of $K3$ surfaces obtained as compactifications of the Milnor fibers. As a corollary, we obtain a basis of the numerical Grothendieck group similar to the one given by Ebeling and Ploog.

The nature of singularities for type-I mean curvature flow

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Mean curvature flow is the evolution of a hypersurface moving with normal velocity equal to its mean curvature vector. If the initial hypersurface is compact then the flow will develop singularities in finite time. Type-I flows are flows having comparable upper bound and lower bound on the blow-up rate of the second fundamental form near the first (possible) singularity time. In this talk, we will present some recent results on the nature of singularities of compact Type-I mean curvature flow. We will show that for Type-I flow, the mean curvature controls the flow in the sense that singularities cannot occur if the mean curvature is uniformly bounded. In the case of surfaces, we will show that the mean curvature controls the flow provided that either the Multiplicity One Conjecture of Ilmanen holds or the Gaussian density is less than two. We also give the sharp blow-up rate of the mean curvature of our flow when Type-I singularities occur. Analogies with singularities of Type-I Ricci flow will be also discussed. This talk is based on recent work of the author, some are joint with Natasa Sesum.

Vanishing cycles for hypersurfaces with two singular strata

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In this lecture we shall see that, if we assume that the vanishing cycles are constant on the singular locus of a hypersurface outside a point 0, the general theory of perverse sheaves puts strong restriction on the cohomology of Milnor fiber at the point 0.

On equinormalizablity of families of isolated singularities

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In this talk we shall give a short introduction to equinormalizable theory of families of isolated singularities, which is initiated by B. Teissier (1970's). In particular, we give a criterion for a 1-parametric family of isolated singularities to be equinormalizable, based on the delta invariant of fibers. This is a joint work with G. -M. Greuel.

Families of $K3$ families in certain Q-Fano 3-folds

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The aim is to study families of $K3$ surfaces, which are subvarieties of smooth Fano 3-folds. We discuss the following problem: if the Picard lattices of families of $K3$ surfaces, does there exist birational correspondence between generic members in these families ? We manly study the correspondence of two specific families of $K3$ surfaces in a smooth toric Fano X' and a smooth non-toric Fano 3-fold X, where X' is the blow-up of P^3 along a line and X is the blow-up of P^3 along an irreducible smooth plane cubic. As a conclusion, the moduli spaces of $K3$ surfaces in X' and those in X are isomorphic. This is an expansion of correspondence among 95 families of weighted $K3$ hypersurfaces, which are $K3$ surfaces in toric varieties due to Kobayashi-Mase.

Normalized families and moduli spaces of Galois coverings

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The moduli space of Galois coverings of the comlex projective line is obtained by the quotient space of the parameter space of the complete family, by the automorphism group of the complex projective line. We investigate it through the normalized family. We determine , e.g., its singularity, for some concrete cases.

Rational polynomial and plane Jacobian conjecture

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There does not exist Jacobian pairs $(P(x,y),Q(x,y))$ in which P is a non-trivial rational polynomials.

On the topological complexity and hyperplane arrangements

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We will discuss the topological complexity and its generalization - the higher to pological complexity. Then we present our computations of higher topological complexity for some arrangements.

The method of the calcul of Feynman integrals

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We use the Cauchy integral formula to calcul the singular integral on Riemann surface of Morse function. The Feynman integral is convergent.

For some parametric curves which are complete intersection

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We will present some families of parametric curves in low dimension spaces which are set complete intersection.

Contact structure adapted with Milnor fibration for the link of strongly polar weighted homogeneous face type

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We show that there exists a canonical contact structure adapted to the Milnor fibration for a strongly weighted homogeneous link.

Some quantitative results in singularity theory

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(Joint work with Ta Le Loi)

In this talk, we will give some quantitative results in singularity theory: quantitative Lipschitz inverse and implicit function theorems, quantitative rank theorem, quantitative splitting lemma, and quantitative Morse theorem.

On singularities of rational curves

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In this talk, we present how to determine the invariants of the singularities on a rational plane curve defined by a rational parametrization.

Geometry of sections of elliptic surfaces and its application

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We consider Zariski pairs for conic-line, conic arrangement by using geometry of sections of elliptic surfaces and dihedral covers.

Some facts on C^*-equivariant degenerations of curves and normal surface singularities with C^*-action

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We discuss on some relations between C^*-equivariant degenerations of curves and normal surface singulities with C^*-action. Especially, I introduce that any C^*-equivariant degenerations of curves is given as a cyclic quotient of a torsion line bundle on a curve; also introduce any normal surface singularities with C^*-action is given as a cyclic quotient of a quasi-cone singularity.

Bernstein-Sato Polynomials and applications

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By using Bernstein-Sato polynomial, we introduce a way to generalize the Euler's gamma function as well as some related special functions. With a given polynomial in one variable $f(t) \geq 0$, we can associate a function, so-called "gamma function associated with f", defined by $\Gamma_f(s) := \int_0^\infty f^{s-1}e^{-t}dt$. This function has many features similar to the Euler's gamma function. We also present some initial results on the gamma-type functional equation for $\Gamma_f(s)$ in some special cases.

Minimal surface in Gauss Space

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We gave some sufficient conditions for surfaces of revolution, translation and ruled surfaces in Gauss space, that is R^3 with Gaussian density, to be minimal. Then, we proved that in Gauss space there exists only one minimal sphere in the class of spheres and only one minimal cylinder in the class of cylinders, such as only planes passing through the origin O are minimal in the class of translation surfaces of the form $X(u; v) = (u; v; g(u) + h(v))$, where $g(u), h(v)$ are polynomials.

On the local geometry of definably stratified sets

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(Joint work with Guillaume Valette)

We describe some geometric properties of the graph in $\mathbb{R}^3$ of

$$g(x,z) = \exp((x^2+1)\ln(z)) = z^{x^2+1}, z > 0.$$

The function g was used by Pawłucki as a counterexample to a generalisation of his theorem for subanalytic stratied sets with a smooth singular locus of codimension 1: the stratied set is Whitney (b)-regular if and only if it is locally a nite union of C^1 manifolds with boundary. For the graph of g, (b)-regularity holds over the x-axis and the set is homeomorphic to a half-plane, but is not a C^1 manifold with boundary. We show that the graph of g is a counterexample to analogues of several subanalytic results: the graph of g does not satisfy Kuos ratio test and gives the rst denable stratied set, in an o-minimal structure, which is Whitney b-regular while the density, or Lelong number, is not continuous along strata. By Millers dichotomy these examples exist in every o-minimal structure which is not polynomially bounded.

We give theorems indicating for which o-minimal structures the denably stratied sets do satisfy the same geometric properties as subanalytic sets, avoiding the pathologies exhibited by the graph of g.

Mirror symmetry and singularities

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We discuss various aspects of the relation between mirror symmetry and singularity theory. A special emphasis is put on Kontsevich's homological mirror symmetry conjecture.

Log mixed Hodge theory

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(Joint work with K. Kato and C. Nakayama)

Feeling relation with mirror symmetry, we will overview log mixed Hodge theory which is a generalization and a refinement of the classical theory of period maps and intermediate Jacobians. The core of this theory is expressed as Fundamental Diagram consisting of various kind of partial compactifications of a classifying space of mixed Hodge structures and maps among them.

On the Dijkgraaf-Witten invariants

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Turaev gives a formula for the Dijkgraaf-Witten invariants of a 2-manifolds in 2007. In this talk we will discuss a similar formula for the case of a circle bundle over a surface.