



**中国科学技术大学**

University of Science and Technology of China  
School of Mathematical Sciences, Hefei, Anhui, P.R.China 230026

# **The International Conference on Singularity Theory and Applications**

## **Conference Manual**

**July 25-31, 2011**

**Hefei, China**

School of Mathematical Sciences

University of Science and Technology of China

## Program

<b>7/ 24 Sun.</b>	<b>Arrive at Hefei</b>			
<b>7/ 25 Mon.</b>	<b>Opening Ceremony</b>	<b>9: 30-9: 40</b>	Group photo shoot	<b>In front of the building gate</b>
		<b>9 : 40-9 : 50</b>	Vice president's address	<b>Room 1611</b> <b>Host: Jiayu Li (Executive Dean of School of Mathematical Sciences,USTC)</b>
	Time	Title		Speakers
	<b>10 : 00- 10 : 50</b>	Some insights on the Euler local obstruction		Jean-Paul Brasselet (CNRS)
	<b>11 : 00- 11 : 15</b>	<b>Coffee Break</b>		
	<b>11 : 15- 12 : 05</b>	Chern classes of hyperplane arrangements		Paolo Aluffi (Florida State University)
	<b>12 : 10- 14 : 30</b>	<b>Lunch</b>		
	<b>14 : 30- 15 : 20</b>	Residue theory and logarithmic de Rham complex		Alexander Aleksandrov (Russian Academy of Sciences, Institute of Control Sciences)
	<b>15 : 30- 16 : 20</b>	Homotopy Classification of Multiaxial Actions		Min Yan (Hong Kong University of Science and Technology)
	<b>16 : 40- 17 : 30</b>	Degenerations, Singularities and wallcrossings		Ludmil Katzarkov (UCI)
	<b>17 : 40-</b>	<b>Dinner</b>		<b>Banquet Hall of Novotel</b>
	Time	Title		Speakers
<b>7/26 Tue.</b>	<b>9 : 00- 9 : 50</b>	On positivity of Thom polynomials		Piotr Pragacz (Institute of Mathematics Polish Academy of Sciences)
	<b>10 : 00- 10 : 50</b>	Thom series via equivariant localization and iterated residues		Richard Rimanyi (University of North Carolina at Chapel Hill)
	<b>11 : 00- 11 : 15</b>	<b>Coffee Break</b>		
	<b>11 : 15- 12 : 05</b>	Local equivariant Chern classes of Singular varieties		Andrzej Weber (Warsaw University)
	<b>12 : 10- 14 : 30</b>	<b>Lunch</b>		
	<b>14 : 30- 15 : 20</b>	Characteristic classes of Hilbert schemes of points via symmetric products		Joerg Schuermann (University of Muenster)
	<b>15 : 30- 16 : 20</b>	Weights on the cohomology and invariants of singularities		Jaroslav Włodarczyk (Purdue University)
	<b>16 : 40- 17 : 30</b>	Motivic Milnor fibers and Newton polyhedra		Kiyoshi Takeuchi (University of Tsukuba)

	17 : 40-	<b>Dinner</b>	
	Time	Title	Speakers
7/27 Wed.	9 : 00- 9 : 50	Minimal Stratifications for Line Arrangements	Masahiko Yoshinaga (Kyoto University)
	10 : 00- 10 : 50	Topological complexity of arrangement complements	Sergey Yuzvinski (University of Oregon)
	11 : 00- 11 : 15	<b>Coffee Break</b>	
	11 : 15- 12 : 05	TBA	Sylvain Cappell (Courant Institute of Mathematical Sciences)
	12 : 10- 14 : 30	<b>Lunch</b>	
	14 : 30- 15 : 20	Monodromy groups of conformal field theory	Toshitake Kohno (The University of Tokyo)
	15 : 30- 16 : 20	Singularities and Intersection Spaces: Theory and Application.	Markus Banagl (Heidelberg University)
	16 : 40- 17 : 30	Fiberwise bordism groups	Shoji Yokura (Kagoshima University)
	17 : 40-	<b>Dinner</b>	
7/ 28 -7/29		<b>Excursion</b>	
	Time	Title	Speakers
7/30 Sat.	9 : 00- 9 : 50	Mixed polynomials and mixed varieties	Mutsuo Oka (Tokyo University of Science)
	10 : 00- 10 : 50	Mordell-Weil groups of elliptic threefolds over $P^2$ , Alexander polynomials, and quasi-toric relations of curves	José Ignacio Cogolludo Agustín (Universidade de Zaragoza)
	11 : 00- 11 : 15	<b>Coffee Break</b>	
	11 : 15- 12 : 05	The Global Invariant of Hyperplane Arrangements	Guangfeng Jiang (Beijing University of Chemical Technology)
	12 : 10- 14 : 30	<b>Lunch</b>	
	14 : 30- 15 : 20	Hodge theory and the fundamental group	Donu Arapura (Purdue University)
	15 : 30- 16 : 20	Obtaining Higher Homotopy Groups from the Fundamental Groups	Jie Wu (National University of Singapore)
	16 : 40- 17 : 30	Motivic zeta functions for quasi-ordinary hypersurface singularities	Manuel Gonzalez Villa (Ruprecht-Karls-Universität Heidelberg)
	17 : 40-	<b>Dinner</b>	

	Time	Title	Speakers
<b>7/31 Sun.</b>	<b>9 : 00- 9 : 50</b>	A differential operator and tom Dieck-Kosniowski-Stong localization theorem	Zhi Lu (Fudan University)
	<b>10 : 00- 10 : 50</b>	Propagation for solutions with moderate growth of D-Modules	Teresa Monteiro Fernandes (University of Lisbon Portugal)
	<b>11 : 00- 11 : 15</b>	<b>Coffee Break</b>	
	<b>11 : 15- 12 : 05</b>	Hodge modules on abelian varieties	Christian Schnell (University of Illinois at Chicago)
	<b>12 : 10- 14 : 30</b>	<b>Lunch</b>	
	<b>14 : 30- 15 : 20</b>	KZ connections and Brauer type algebras	Zhi Chen (University of Science and Technology of China)

★ All talks are held in the **Room 1611**.

★ Coffee Break is in the **Room 1623**.

★ Please go to the **Staff Cafeteria** to have lunch and supper.

★ On **evening of July 25**, there will be a dinner for all participants at the **Banquet Hall of Novotel Qi Yun Hotel**.

★ **Room 1623** is open for all participants during the conference.

## Organizers

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## Titles and Abstracts

- Jean-Paul Brasselet: [Some insights on the Euler local obstruction](#)

The lecture concerns a joint work with N. Grulha and M. Ruas. The local Euler obstruction was introduced by R. MacPherson as a key ingredient for his construction of characteristic classes of singular complex algebraic varieties. Then, an equivalent definition was given by J.-P. Brasselet and M.-H. Schwartz using vector fields and many other definitions and interpretations have been provided. The notion of local Euler obstruction developed mainly in two directions: the first one comes back to MacPherson's definition and concerns with differential forms. That is developed by W. Ebeling and S. Gusein-Zade in a series of papers. The second one relates local Euler obstruction with functions and maps defined on the variety. That approach is useful to relate local Euler obstruction with other indices. Aim of the lecture is to present these new features on the subject.

- Paolo Aluffi: [Chern classes of hyperplane arrangements](#)

We relate invariants such as the Chern-Schwartz-MacPherson class of the class in the Grothendieck group of varieties to combinatorial invariants, for the case of hyperplane arrangements in projective space. We will explain the connection between these algebro-geometric invariants and results of Orlik-Solomon, Mustata-Schenck, and Wakefield-Yoshinaga.

- Alexander Aleksandrov: [Residue theory and logarithmic de Rham complex](#)

The purpose of the talk is to give an elementary introduction to the theory of residue of logarithmic differential forms, and to describe some of the less known applications of this theory, developed by the author in the past few years. In particular, we briefly discuss the notion of residue due to H. Poincare, J. de Rham, J. Leray and K. Saito, and then obtain a nice description of regular meromorphic differential forms in terms of residues of logarithmic differential forms. We also discuss a new method for computing the topological index of complex vector fields on hypersurfaces with arbitrary singularities, some applications to the theory of holonomic D-modules of Fuchsian and logarithmic types, to the theory of Hodge structures on singular varieties, etc.

- Min Yan: [Homotopy Classification of Multiaxial Actions](#)

A multiaxial action by  $U(n)$  is locally modeled on  $kC^n + C^p$ , where  $U(n)$  acts canonically on  $C^n$  and trivially on  $C^p$ . There are similar multiaxial actions by  $O(n)$  and  $Sp(2n)$ . Mike Davis gave diffeomorphic classification of multiaxial smooth manifolds in case  $k \leq n$ . We describe how to homotopically classify multiaxial topological manifolds without assuming  $k \leq n$ . Moreover, we compute the classification in case of the multiaxial sphere. Such classification is a vast generalization of the classical result on fake complex projective spaces. In fact, up until now, not much is known about the homotopy classifications of actions by positive dimensional Lie groups. This is a joint work with S. Cappell and S.

Weinberger.

- Ludmil Katzarkov: [Degenerations, singularities and wall crossings](#)

In this talk we will introduce new categorical structures from classical prospective of degenerations.

- Piotr Pragacz: [On positivity of Thom polynomials](#)

The pioneering papers of Griffiths and Fulton and Lazarsfeld investigated numerical positivity related to ample vector bundles in differential and algebraic geometry. Their various variants are nowadays widely investigated in algebraic geometry. Among main objects of global singularity theory are the Thom polynomials of singularity classes. We shall consider Thom polynomials of singularities of mappings and Lagrangian and Legendrian Thom polynomials. We shall show that in some bases coming from representation theory, they admit positive expansions. (This is a report on joint work with M. Mikosz and A. Weber.)

- Richard Rimanyi: [Thom series via equivariant localization and iterated residues](#)

Thom polynomials measure how topology forces singularities. Natural infinite sequences of Thom polynomials can be arranged in formal power series, the Thom series. In the talk we will explore different interpretations and computational strategies of Thom series, as well as present some open problems. This is a joint work with L. Feher, and we will also report on recent results of Berczi-Szenes and Kazarian.

- Andrzej Weber: [Local equivariant Chern classes of Singular varieties](#)

Equivariant cohomology is a powerful tool to study of complex manifolds equipped with a torus action. The localization theorem of Atiyah and Bott and the resulting formula of Berline-Vergne allow to compute global invariants of singular subsets in terms of the fixed points of the action. We will concentrate on the Chern(-Schwartz-MacPherson) classes. The global class is determined by the local contributions coming from the fixed points. The local contributions are in a form of a quotients with the local Chern classes in the numerators. On the other hand, as in the "residue theorem" for meromorphic functions, the sum of local Chern classes is equal to zero. Especially for Grassmanians we obtain interesting calculations with nontrivial formulas involving rational functions. We will discuss the issue of positivity: the local Chern class may be presented in a various ways, depending on some choice of a certain graphs. For some choices we find that the coefficients of the presentation are nonnegative. Also the coefficients in an appropriate Schur basis are nonnegative in many examples.

- Jörg Schürmann: [Characteristic classes of Hilbert schemes of points via symmetric products.](#)

We explain a new formula for the generating series of the Hirzebruch characteristic homology classes of the Hilbert schemes of points for a smooth quasi-projective

variety, push-forward to the corresponding symmetric products. This result is based on two facts: (i) a nice interplay between the geometric definition of a motivic power structure and a motivic Pontrjagin ring of the symmetric products, (ii) a formula for the generating series of the Hirzebruch characteristic homology classes of the symmetric products. This is joint work in progress with L. Maxim, S. Cappell, T. Ohmoto and S. Yokura.

- Jaroslaw Wlodarczyk: [Weights on the cohomology and invariants of singularities](#)

We study the weight filtration on the cohomology of a proper complex algebraic variety and obtain natural upper bounds on its size, when it is the exceptional divisor of a singularity. The invariants of singularities introduced here gives rather strong information about the topology of rational and related singularities. (based on joint paper with D.Arapura and P.Bakhtary)

- Kiyoshi Takeuchi: [Motivic Milnor fibers and Newton polyhedra](#)

By computing the equivariant mixed Hodge numbers of motivic Milnor fibers introduced by Denef-Loeser etc., we obtain various formulae for the Jordan normal forms of the local and global monodromies of polynomials. Especially we focus our attention on the global ones, i.e., the monodromies at infinity. For polynomials over affine complete intersection varieties the results will be described by the mixed volumes of the faces of their Newton polyhedra. This is a joint work with Y. Matsui and A. Esterov.

- Masahiko Yoshinaga: [Minimal Stratifications for Line Arrangements](#)

The homotopy type of complements of complex hyperplane arrangements have a special property, so called minimality (Dimca-Papadima and Randell, around 2000). In this talk, we introduce the "dual" object to the minimal CW complex for two dimensional real line arrangements, which we call minimal stratification. It is a real semialgebraic stratification which induces a partition into contractible manifolds. We also see associated presentation of the fundamental group. This talk is based on arXiv:1105.1857.

- Sergey Yuzvinski: [Topological complexity of arrangement complements](#)

Topological complexity of (motion planning on) a topological space has been defined by M.Farber as a specialization of Schwartz's genus. Its calculation for hyperplane arrangement complements is important for topological robotics and relates to interesting problems involving the Orlik-Solomon algebras. We will survey old results on the topic and discuss some new ones.

- Sylvain Cappell: TBA  
Abstract: TBA

- Toshitake Kohno: [Monodromy groups of conformal field theory](#)

There is an action of the mapping class groups on the space of the conformal blocks

for Riemann surfaces defined by monodromy. We give a qualitative estimate for the images of such representations of mapping class groups. In particular, we show that the image of any Johnson subgroup contains a non-abelian free group. In the case of braid groups we describe the monodromy group in relation with triangle groups. Based on the estimate of the monodromy groups we give an answer to conjectures by Squier on Burau representations of braid groups. It was shown by P. Gilmer and G. Masbaum that the monodromy groups of conformal field theory for Riemann surfaces are defined over cyclotomic integers. We show that, in general, the monodromy groups are not isomorphic to a higher rank irreducible lattices in semi-simple Lie groups. This is a joint work with Louis Funar.

- Markus Banagl: [Singularities and Intersection Spaces: Theory and Application.](#)

In many situations, it is homotopy theoretically possible to associate to a singular space in a natural way a generalized geometric Poincare complex, called its intersection space, whose cohomology turns out to be a new cohomology theory for singular spaces, not isomorphic in general to intersection cohomology or Cheeger-L2-cohomology. An alternative description of the new theory by a de Rham complex of global differential forms is available. The talk will discuss the properties of the new theory, stressing differences to intersection cohomology, as well as indicate applications of these methods, even outside singularity theory. We will consider the K-theory of intersection spaces. We will see how, as a by-product, one obtains results on equivariant cohomology and flat bundles. The theory also addresses questions in type II string theory and mirror symmetry. While intersection cohomology is stable under small resolutions, the new theory is often stable under deformations of singularities. The latter result is partly joint work with L. Maxim. An analytic description remains to be found, but we shall indicate a partial result based on results of Melrose and Hausel-Hunsicker-Mazzeo.

- Shoji Yokura: [Fiberwise bordism groups](#)

We introduce a notion of fiberwise bordism for certain families of smooth manifolds. We explain motivations for considering this bordism, some connections with other known results, etc. This is a joint work with M. Banagl and J. Schuermann.

- Mutsuo Oka: [Mixed polynomials and mixed varieties](#)

Mixed varieties are a complex analytic technique to study real algebraic variety of codimension 2. I will explain basic properties of mixed varieties and some applications.

- Jose Ignacio Cogolludo: [Mordell-Weil groups of elliptic threefolds over  \$\mathbb{P}^2\$ , Alexander polynomials, and quasi-toric relations of curves](#)

Given  $C$  a (possibly reducible and non-reduced) projective plane curve, we define the Alexander polynomial  $A(t)$  of  $C$  with respect to the multiplicities of its components. To each root of  $A(t)$  one associates a cyclic covering of  $\mathbb{P}^2$  ramified along  $C$  and an elliptic threefold  $W$  with a natural automorphism. The purpose of this talk will be to



establish a connection between the multiplicity of roots of  $A(t)$ , the rank of the Mordell-Weil group of  $W$ , and the existence of enough "independent" maps onto elliptic orbifold curves (a generalization of pencils) containing  $C$  as fibers. Curves for which such pencils exist are a generalization of torus-type curves and are called here quasi-toric curves. This connection allows one to use the theory of elliptic curves over a function field to find properties of quasi-projective groups and Alexander polynomials. In particular one can find bounds for the degree of Alexander polynomials of curves with only nodes and cusps as singularities. This is a joint work with Anatoly Libgober.

- Guangfeng Jiang: [The Global Invariant of Hyperplane Arrangements](#)

A hyperplane in a complex vector space  $\mathbb{C}^l$  is an  $(l-1)$ -dimensional affine subspace. A hyperplane arrangement  $A$  consists of finite hyperplanes in  $\mathbb{C}^l$ . The complement  $M$  of the union of the hyperplanes in  $A$  is an interesting topological space. The topological structure of  $M$  is one of the central topics in the theory of hyperplane arrangements. For example, the fundamental group  $\pi(M)$  of  $M$  is an interesting and complicated invariant of  $M$ .

The lower central series of  $\pi(M)$  is a chain of normal subgroups  $G_1 = \pi(M), G_{k+1} = [G_k, G_1]$  for  $k \geq 1$ , where  $[A, B]$  denotes the subgroup generated by commutators of elements in  $A$  and  $B$ . The ranks  $\phi_k$  of the finitely generated abelian groups  $G_k/G_{k+1}$  are topological invariants of the arrangement  $A$ . Falk called the third rank  $\phi_3$  *the global invariant* of  $A$ , and posed the following problem. Give a combinatorial interpretation of  $\phi_3$ . Falk also pointed out that this problem remains open, even for graphic matroids.

We solve Falk's problem for graphic hyperplane arrangements by proving the following formula. For graphic hyperplane arrangement  $A(G)$ ,

$$\phi_3 = 2(\#K_3 + \#K_4),$$

where  $\#K_v$  is the number of cliques with  $v$  vertices in the graph  $G$  with which the arrangement  $A(G)$  associated.

By using the global invariant, we classified line arrangements in plane with at most six lines.

- Donu Arapura: [Hodge theory and the fundamental group](#)

I want to discuss some thoughts about Hodge and motivic structures associated to the fundamental group of an algebraic variety using Tannakian methods. I will compare this to other approaches due to Hain, Morgan, Simpson and others.

- Jie Wu: [Obtaining Higher Homotopy Groups from the Fundamental Groups](#)

The braid groups and link groups are the fundamental groups of configurations and link complements, respectively. In this talk, we give an illustration that the general higher homotopy groups of spheres can be obtained as the quotient groups of the intersections of certain canonical subgroups of these groups. The talk will give a philosophical view that the higher homotopy groups may be discovered by systematically studying the subgroups of the fundamental groups of canonical objects.

- Manuel Gonzalez Villa : [Motivic zeta functions for quasi-ordinary hypersurface singularities](#)

Denef and Loeser applied the theory of motivic integration to define new invariants of hypersurface singularities. The motivic Milnor fibre, introduced as a formal limit of the motivic zeta function, encodes much of the geometry of the Milnor fibration. We discuss using toric methods how to compute these invariants for the class of irreducible hypersurface quasi-ordinary singularities. We prove that these invariants are determined by the embedded topological type of the singularity, which is known to be completely characterized by a finite number of characteristic monomials of some fractional power series associated to the hypersurface. This is a joint work with P.D. Gonzalez-Perez.

- Zhi Lu: [A differential operator and tom Dieck-Kosniowski-Stong localization theorem](#)

In this talk, we define a differential operator on the "dual" algebra of the unoriented  $G$ -representation algebra introduced by Conner and Floyd, where  $G$  is a mod 2 torus group of rank  $n$ . With the help of  $G$ -colored graphs (or mod 2 GKM graphs), we may use this differential operator to give a very simply equivalent description of tom Dieck--Kosniowski--Stong localization theorem in the setting of smooth closed  $n$ -manifolds with effective smooth  $G$ -actions (also called  $n$ -dimensional 2-torus manifolds). Some applications will be considered. This is a joint work with Qiangbo Tan.

- Teresa Monteiro Fernandes: [Propagation for solutions with moderate growth of D-Modules](#)

We obtain a Cauchy Theorem for holomorphic solutions of  $D$ -modules with moderate growth conditions in a space of parameters and obtain an estimate for the obstruction to the propagation (microsupport).

- Christian Schnell: [Hodge modules on abelian varieties](#)

I will explain some results on Hodge modules on abelian varieties, and applications to the study of irregular varieties. (Joint work with Mihnea Popa.)

- Zhi Chen: [KZ connections and Brauer type algebras](#)

We introduce a Brauer type algebra and a BMW type algebra for every Coxeter group and every pseudo reflection group. This is an application of KZ connections on the complementary spaces of hyperplane arrangements.

## Accommodation

### Hotel



#### Hefei Novotel Qi Yun Hotel

**Hotel Class:** ★★★★★

**Address:** No.199 Wuhu Road,  
Hefei, China

**Area:** Baohe, Bell Tower



**Overview:** The Novotel Qi Yun Hotel is situated on Wuhu Road, in the immediate vicinity of the Bao Zheng Memorial Temple.

#### Hotel Description

The Novotel Qi Yun Hotel is situated on Wuhu Road, in the immediate vicinity of the Bao Zheng Memorial Temple, within walking distance to the heart of the city. You can relax by wandering through the side alleys of the Bao River or cycle to the Chao Hu Lake. You're only minutes from Hefei's main department stores and markets.

Dolfi Restaurant - All day dining restaurant featuring International and Asian Favorites East meets west hot and cold buffets are served daily for breakfast and dinner.

The hotel offers 246 tastefully decorated guest rooms and suites, each with individual climate controlled air-conditioning and heating, IDD and DDD telephone service, hair dryer, shower and bath facilities, mini-bar, coffee/tea kettles, remote control TV with extensive international satellite channels, Internet access, personal safe and 7-day laundry cleaning services. Non-smoking rooms are also available.

The Novotel Qiyun Hotel Hefei is located 8kms from the airport, and 3 kilometers from the railway station.

Conference Facility: Conference hall

Restaurant: Chinese restaurant, Western restaurant, Cafe, Bar, Room service

**Hotel Telephone:** 0551-2286688

★ During the conference, spouses are encouraged to visit the vicinity of the hotel, which is within walking distance from downtown.

★ Taxi to the airport/railway station/university campus is available at the hotel.

★ **Chinese addresses:**

Hotel: 合肥市芜湖路 199 号, 诺福特齐云山庄酒店

Campus: 合肥市金寨路 96 号, 中国科学技术大学东区

Airport: 合肥骆岗机场

Railway Station: 合肥火车站

## Meals

★ **breakfast:** at the hotel

★ **lunch & supper:** Staff Cafeteria on Campus

## Map of hotel:





## Map of Campus



## Transportation

- ★ We will arrange two buses to pick up all conference participants from the hotel to the campus every morning and take all back to the hotel after the supper.

### Schedule of the bus

	7/25	7/26	7/27	7/28	7/29	7/30	7/31
Hotel-Math. Building	9:00	8:30	8:30	8:00 (to Yellow Mountain)		8:30	8:30
Math. Building-Hotel	18:00 (to the restaurant)	19:00	19:00			19:00	19:00
The bus will wait at the gates of hotel and the Mathematics Building.							

## Emergency telephones

- 110——Police  
119——fire alarm  
120——ambulance call  
999——emergency medical services of Red Cross  
122——traffic police

- ★ Please ask the conference volunteers for help if you have questions during the conference

- ★ Contact persons:

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