Schedule for Master Lectures

Dec.18-22, 2017

Schedule for Master Lectures - The Legacy of Carl Friedrich Gauss, December 18-22, 2017

Monday (Dec 18)			Tuesday (Dec 19)		Wednesday (Dec 20)	Thursday (Dec 21)	Friday (Dec 22)	
Time	**speaker**	**Time**	**Session1**	**Session2**	**speaker**	**speaker**	**Time**	**speaker**
7:30-8:30	*Breakfast*							
8:30-8:45	*Opening: S. -T. Yau*					*Group Photo*		
Chair	*S. -T. Yau*		*Richard Hind*	----	*Jian Xiao*	*Victoria Hoskins*		*Lizhen Ji*
8:45-9:45	Dusa McDuff		Dusa McDuff		Jean-Pierre Demailly	Frances Kirwan	9:00-9:45	Shinobu Hosono
9:45- 10:00	*Tea Break*							
Chair	*S. -T. Yau*		*Victoria Hoskins*	-----	*Richard Hind*	*Jian Xiao*	10:00-10:45	Huai-Dong Cao
10:00-11:00	Frances Kirwan		Frances Kirwan		Dusa McDuff	Jean-Pierre Demailly		
11:00-11:10	*Short Break*				*Short Break*			
Chair	*S. Y. Cheng*	*Chair*	*Lianfen Qian*		*Yuichiro Taguchi*	*Xiaotao Sun*		
11:10-12:10	Jean-Pierre Demailly **(11:00-12:00)**	11:00-11:45	Angelo Vistoli		Rita Pardini	Yuichiro Taguchi		
12:10-13:30	*Lunch*	11:45-12:30	Youjin Zhang		Yoshinori Namikawa	Hongwei Xu		
		12:30-13:30	*Lunch*					
			Session1	**Session2**				
Chair	*S. Y. Cheng*		*Hongwei Xu*	*Xianghong Gong*		*Rita Pardini*		
13:45-14:30	Feng-Yu Wang		Lianfen Qian	Bo Guan		Maksym Fedorchuk		
11:00-11:10	*Short Break*					*Short Break*		
14:40-15:25	Takeshi Saito		Li-Xin Zhang	Jae-Hyun Yang	*13:30-17:00 free diccussion*	Xiaotao Sun		
15:25-15:50	*Tea Break*					*Tea Break*		
15:50-16:35	Jian Zhou		Gavil Farkas	Naoki Imai		Xianghong Gong		*Departure*
16:35-16:45	*Short Break*					*Short Break*		
16:45-17:30	Alessandro Verra		Jiaxin Hu			Xiaohuan Mo		
17:30-19:00	*Dinner*				*18:00-20:00 Banquet*	*Dinner*		
19:30-21:00	*S. -T. Yau (chaired By Lizhen Ji)*	/	/	/	/	/	/	

Schedule for the Master Lectures Workshop-Embedding questions in Symplectic Topology （Dusa McDuff）Dec. 18-22, 2017

Time&Date	Monday (Dec 18)	Tuesday (Dec 19)	Wednesday (Dec 20)	Thursday (Dec 21)	Friday (Dec 22)
7:30-8:30	*Breakfast*				
8:30-8:45	*Opening: S. -T. Yau*		Group Photo		
Chair	*Yau / Yau / Cheng*	*Hind / Hoskins*	*Xiao / Hind*	*Hoskins / Xiao /Hind*	*Hind*
8:45-9:45	McDuff	McDuff	Demailly	Kirwan	McDuff free slot
9:45- 10:00	*Tea Break*				
10:00-11:00	Kirwan	Kirwan	McDuff	Demailly	
11:00-11:10	*Short Break*				
11:10-11:55	Demailly **(11:10 -12:10)**		Michael Hutchings	Viktor L. Ginzburg	free slot
12:00-13:30	*Lunch*				
Chair	*Hind*	*Cristofaro-Gardiner*	*13:30-17:00 Free discussion*	*Cristofaro-Gardiner*	——
13:45-14:30		Sobhan Seyfaddini		Roger Casals	***Departure***
14:30-14:40	*Short Break*	*Short Break*		*Short Break*	
14:40-15:25	Chris Wendl	Dan Cristofaro-Gardiner		Felix Schlenk	
15:25-15:50	*Tea Break*	*Tea Break*		*Tea Break*	
15:50-16:35	Yi-Jen Lee	Weiwei Wu		Richard Hind	
16:35-16:45	*Short Break*	*Short Break*		*Short Break*	
16:45-17:30	Otto van Koert			Boyu Zhang	
17:30	*Dinner*		*Banquet 18:00-20:00*	*Dinner*	
19:30-21:00	Yau (Charied by Ji)	/	/	/	

Schedule for the Master Lectures-Quotients, Stability and Invariants workshop (Frances Kirwan), Dec. 18-21, 2017

Time&Date	Monday (Dec 18)	Tuesday (Dec 19)	Wednesday (Dec 20)	Thursday (Dec 21)	Friday (Dec 22)
7:30-8:30	*Breakfast*				
8:30-8:45	*Opening: S. -T. Yau*	Group Photo (8:40)			----
Chair	*Yau / Yau / Cheng*	*Hind / Hoskins*	*Xiao / Hind*	*Hoskins / Xiao*	
8:45-9:45	McDuff	McDuff	Demailly	Kirwan	
9:45- 10:00	*Tea Break*				
10:00-11:00	Kirwan	Kirwan	McDuff	Demailly	
11:00-11:10	*Short Break*				
11:10-11:55	Demailly **(11:10 -12:10)**	Lothar Göttsche	----	----	
12:00-13:30	*Lunch*				
Chair	*Hoskins*	*Hoskins*	*13:30-17:00 Free discussion*		*Departure*
13:45-14:30	Yoshinori Namikawa	Jochen Heinloth			
14:30-14:40	*Short Break*				
14:40-15:25	David Hyeon	Young-Hoon Kiem			
15:25-15:50	*Tea Break*				
15:50-16:35	Bohan Fang	Joshua Jackson			
16:35-16:45	*Short Break*				
16:45-17:30	Kirwan free slot	Kirwan free slot			
17:30	*Dinner*		*Banquet 18:00-20:00*	*Dinner*	
19:30-21:00	Yau (Charied by Ji)	/	/	/	

Schedule for the Master Lectures - Global Aspects of projective and Kähler Geometry Workshop (Jean-Pierre Demailly) , Dec. 18-22, 2017

Time&Date	Monday (Dec 18)	Tuesday (Dec 19)	Wednesday (Dec 20)	Thursday (Dec 21)	Friday (Dec 22)
7:30-8:30	*Breakfast*				
8:30-8:45	*Opening: S. -T. Yau*	Group Photo (8:35)			
Chair	*Yau / Yau / Cheng*	*Hind / Hoskins*	*Xiao / Hind*	*Hoskins / Xiao*	*Xiao*
8:45-9:45	McDuff	McDuff	Demailly	Kirwan	
9:45- 10:00	*Tea Break*				
10:00-11:00	Kirwan	Kirwan	McDuff	Demailly	Demailly free slot/problem session
11:00-11:10	*Short Break*				
11:10-11:55	Demailly **(11:10 -12:10)**				free slot
12:00-13:30	*Lunch*				
Chair	*Xiao*	*Xiao*		*Xiao*	——
13:45-14:30	Xiangyu Zhou	Jian Xiao	*13:30-17:00 Free discussion*	Junyan Cao	***Departure***
14:30-14:40	*Short Break*	*Short Break*		*Short Break*	
14:40-15:25	Xiangyu Zhou	Jian Xiao		Junyan Cao	
15:25-15:50	*Tea Break*	*Tea Break*		*Tea Break*	
15:50-16:35	S. -T. Yau	Xiaokui Yang		free slot	
16:35-16:45	*Short Break*	*Short Break*		*Short Break*	
16:45-17:30		Xiaokui Yang		free slot	
17:30	*Dinner*		*Banquet 18:00-20:00*	*Dinner*	
19:30-21:00	Yau (Charied by Ji)	/	/	/	

Title and Abstract for Master Lectures

Dec.18-22, 2017

Title and abstract for The Legacy of Carl Friedrich Gauss

1. Principle Speaker: Shing-Tung Yau, Harvard University, USA

Title: My past experience in mathematics

Abstract: Studying mathematics is like writing a novel where characters and plots needed to remain realistic. The cultivation of emotions is the most important. Excellent mathematics should also touch on various phenomena in nature to be passed down for generations. I will talk about my experience in mathematics since childhood.

2. Huaidong Cao, Lehigh University, USA

Title: Deformations of Fano Manifolds

Abstract: For an analytic family of small deformations of a Fano manifold, Koiso in mid 1980s proved if the central fiber is a Fano K¨ahler-Einstein (KE) manifold which does not admit any nontrivial holomorphic vector fields then each (nearby) fibers also admit a KE metric. In this talk, we shall present a new necessary and sufficient condition on the existence of KE metrics on small deformations of a Fano KE manifold with nontrivial automorphism group. If time permits, we will also describe a canonical extension of pluri-anticanonical forms from a Fano KE manifold to its small deformations which leads to a simultaneous embedding of a family of Fano manifolds into projective spaces with effective control. This is a joint work with Xiaofeng Sun, S.-T. Yau and Yingying Zhang.

3. Gavril Farkas, University of Berlin, Germany

Title: Fundamental Groups, Alexander Invariants and Syzygies of Canonical Curves

Abstract: I will discuss a purely algebraic statement concerning an explicit description of the Chow form of the Grassmannian of lines in projective space. This algebraic statement, which turns out to be equivalent to Mark Green's Conjecture on syzygies of canonical curves (proven by Claire Voisin), has many interesting topological applications of which I will discuss (1) a universal upper bound on the nilpotence index of the fundamental group of any compact Kaehler manifold and (2) a bound on the length of the nilpotence index on the Torelli groups associated to the moduli space of curves. This is joint work with Aprodu, Papadima, Raicu and Weyman.

4. Maksym Fedorchuk, Boston College, USA

Title: Invariant-theoretic Mather-Yau Theorem, and Applications

Abstract: The famous Mather-Yau theorem says that two isolated hypersurface singularities of the same embedding dimension are biholomorphically equivalent if and only if their moduli algebras are isomorphic. Thus determining whether two given moduli algebras are isomorphic becomes an important problem. In the case of quasi-homogeneous hypersurface singularities, Eastwood and Isaev proposed a purely algebraic approach to this problem, rooted in classical invariant theory. For homogeneous singularities, this approach leads to the associated form morphism that assigns to a singularity the Macaulay inverse system of its moduli algebra. The associated form morphism has several marvelous properties, two of which I will discuss in this talk. In joint work with Isaev, we have shown that the associated form morphism preserves GIT polystability (arXiv:1703.00438). This leads to a purely algebraic invariant-theoretic Mather-Yau theorem for homogeneous hypersurface singularities,

and to interesting new compactifications of the moduli space of smooth hypersurfaces. The associated form morphism also detects whether a homogeneous polynomial with a non-vanishing discriminant is a direct sum (of Sebastiani-Thom type), and so leads to an algorithm for finding direct sum decompositions over the rationals (arXiv:1705.03452).

5. Xianghong Gong, University of Wisconsin-Madison, USA

Title: H¨older estimates for homotopy operators on strictly pseudoconvex domains with C^2 boundary

Abstract: We derive a new homotopy formula for a strictly pseudoconvex domain of C^2 boundary in $\mathbf{C}^n$ by using a method of Lieb and Range and obtain estimates in Lipschitz spaces for the homotopy operators. For $r > 1$ and $q > 0$, we obtain a $\Lambda_{r+1/2}$ solution u to $\bar{\partial} u = f$ for a $\bar{\partial}$-closed $(0, q)$ form f of class Λ_r in the domain. We apply the estimates to obtain boundary regularities of D-solutions for a domain in the Levi-flat Euclidean space.

6. Bo Guan, Ohio State University, USA

Title: Subsolutions and Concavity in Second Order Estimates for Fully Nonlinear PDEs on Real and Complex Manifolds

Abstract: Fully nonlinear elliptic and parabolic equations on manifolds play central roles in some important problems in real and complex geometry. A key ingredient in solving such equations is to establish apriori estimates up to second order. For general Riemannian manifolds, or Ka¨hler/Hermitian manifolds in the complex case, one encounters difficulties caused by the curvature (as well as torsion in the Hermian case) of the manifolds. In this talk we report some results in our effort to overcome these obstacles over the past few years. We shall emphasize on understanding the roles of subsolutions and concavity of the equation based on which our techniques were developed. We are interested both in equations on closed manifolds, and in the Dirichlet problem for equations on manifolds with boundary, without imposing any restrictions to the geometry of the boundary.

7. Shinobu Hosono, Gakushuin University, Japan

Title: GKZ Hypergeometric Systems in Mirror Symmetry of Complete Intersection Calabi-Yau Manifolds

Abstract: Since the discovery of mirror symmetry of Calabi-Yau manifolds in 90's, Gel'fand-Kapranov-Zelevinski (GKZ) hypergeometric systems have been playing a central role to explore, and describe explicitly, mathematical consequences from the mirror symmetry. In this talk, I will focus on some interesting examples of Calabi-Yau threefolds of complete intersections and calculate the global monodromy of the GKZ systems for period integrals. In these examples, I will find that the monodromy nilpotent cones, which are defined locally for each boundary point of some distinguished properties, are naturally glued together by global monodromy relations coming from

boundary divisors. Also I will find nice correspondences between the gluing of nilpotent cones and the movable cones in the birational geometry of mirror Calabi-Yau manifolds.

This talk is based on my recent collaboration with Hiromichi Takagi, *Movable vs monodromy nilpotent cones of Calabi-Yau manifolds*(arXiv:1707.08728), which goes back to my collaborations with A. Klemm, B. Lian, S. Theisen and S.-T. Yau in 90's.

8. Jiaxin Hu, Tsinghua University, China

Title: Heat Kernel Estimates: Gaussian and non-Gaussian

Abstract: I will give a short survey on heat kernel estimates for regular Dirichlet forms on metric measure spaces. For a local Dirichlet from, the heat kernel admits sub-Gaussian or Gaussian estimates, whilst for a nonlocal Dirichlet from, the heat kernel admits stable-like estimates.

9. Naoki Imai, University of Tokyo, Japan

Title: Non-semi-stable Loci in Hecke Stacks and Fargues' Conjecture

Abstract: Recently, a geometrization of the local Langlands correspondence is proposed by Fargues. In this talk, we discuss a non-semi-stable locus in a Hecke stack, which appears in the geometrization of the local Langlands correspondence. We find that a generalization of a diamond of a non-basic Rapoport-Zink space at infinite level covers the non-semi-stable locus, and show the Harris-Viehmann conjecture for this space under some HN-reducibility condition. As an application, we show the Hecke eigensheaf property in Fargues' conjecture for cuspidal Langlands parameters in the $GL(2)$-case. This is a joint work with Ildar Gaisin.

9. Xiaohuan Mo, Peking University, China

Title: On Finsler Surfaces of Constant Flag Curvature

Abstract: We discuss Finsler surfaces of constant (flag) curvature. First, we show that the space of those with two dimensional isometric group depends on two arbitrary

constants. We also give a new technique to recover Finsler metrics from the specified two constants. Using this technique we obtain some new Finsler surfaces of constant flag curvature with two dimensional isometric group. Then we show that the space of Finsler metrics with constant flag curvature of which admits a Killing field depends on two arbitrary functions of one variable. Furthermore we find an approach to calculate these functions for spherically symmetric Finsler surfaces of constant flag curvature. In particular, we obtain the normal form of the Funk metric on the unit disk D^2.

10. Yoshinori Namikawa, University of Kyoto, Japan

Title: Towards the Classification of Symplectic Singularities

Abstract: After introducing the finiteness theorem for symplectic singularities, I will give a characterisation of nilpotent orbit closures of a complex semisimple Lie algebra.

11. Rita Pardini, Universita` di Pisa, Italy

Title: Linear systems on irregular varieties

Abstract: I will report on joint work M.A. Barja (UPC, Barcelona) and L. Stoppino (Universit`a dell'Insubria, Como – Italy).

Given a generically finite map $a : X \to A$, where X is a smooth projective variety and A is an abelian variety, and given a line bundle L on X, we study the linear system $|L \otimes P|$, where P is a general element of $\mathrm{Pic}^0(A)$. We prove that up to taking base change with a suitable multiplication map $A \to A$, the map given by $|L \otimes P|$ is independent of P and induces a factorization of the map a. When L is the canonical bundle of X, this factorization is a new geometrical object intrinsically attached to the variety X.

The factorization theorem also allows us to improve, under certain assumptions on the map $a : X \to A$, the known Clifford-Severi and Castelnuovo type numerical inequalities for line bundles on X. A key tool in these proofs is the introduction of a real function, the continuous continuous rank function, that also allows us to simplify considerably the proof of the Clifford-Severi inequalities.

12. Lianfen Qian, Florida Atlantic University, USA

Title: Analysis of Spatial Correlation and Regional Finance in China via Network Analysis

Abstract: Using the data consisting the total of lending and deposit balances, and gross domestic product of 31 provinces in China from 1990 to 2015, this paper utilizes the financial location entropy as a measure of regional financial development indicator to construct the spatial correlation network analyses for China's financial development after Granger causality tests. The paper also studies the influential factors of China's regional financial development based on block models and QAP method. It effectively resolves the difficulty that the traditional spatial method faces when analyzing the financial linkage on the global characteristics of network structure. The empirical

results show that: (1) the spatial correlation of China's regional financial development is complex, but the network is stability and has good accessibility. (2) China's regional financial development is divided into four sectors. The first sector is the main benefit plate in the less developed areas in the west, and the second plate is the agent plate, which plays the role of bridge. The third plate is the net overflow plate in the eastern regions, and the fourth plate is two-way overflow plate, mainly in the more developed provinces in the middle east of China. This indicates that China's regional financial development has clear energy transfer gradient characteristics. (3) Per capita income level, foreign trade index, the index of the third industry development, the influence of the transport ability and the ability of government intervention are important factors, while regional employment situation and the location have little influence on adjacent provinces. Other conclusions and suggestions are also presented.

13 Takeshi Saito, University of Tokyo, Japan

Title: Characteristic Cycle of an l-adic Sheaf

Abstract: The characteristic cycle of an f-adic sheaf on a smooth variety over a perfect field is a $\mathbf{Z}$-linear combination of irreducible components of the singular support, defined by Beilinson as a closed conical subset of the cotangent bundle. It is an algebraic analogue of that studied by Kashiwara and Schapira in a transcendental setting. We discuss its functorial property with respect to proper direct image.

14. Xiaotao Sun, Chinese Academy?of Sciences, China

Title: A Finite Dimensional Proof of Verlinde Formula

Abstract: By degenerating a smooth curve to an curve with one node (irreducible or reducible), we establish two recurrence relations for the dimensions of spaces of generalized theta functions on moduli spaces of semi-stable parabolic bundles on smooth curves of genus g, which imply an explicit formula of dimension (Verlinde formula).

There are two steps to establish such recurrence relations: (1) factorizations of generalized theta functions over nodal curves;(2) invariance of dimensions during degeneration, which are implied by vanishing theorem of cohomolgy on moduli spaces. The step (1) and step (2) for $g > 2$ were done by myself around 2000. However vanishing theorem for $g < 3$ remains open. Recently, we prove that moduli spaces of semi-stable parabolic bundles and generalized parabolic sheaves with fixed determinants are of globally Frobenius regular type, which imply the vanishing theorem for any genus.

15. Yuichiro Taguchi, Tokyo Institute of Technology, Japan

Title: On the Moduli of Galois Representations

Abstract: We explain the construction of a certain moduli space of Galois representations. More generally, for an object in a rather general class A of non-commutative

topological rings, we construct a moduli space of its absolutely irreducible representations of a fixed degree as a (so we call) "f-A scheme". Various problems on Galois representations can be reformulated in terms of such moduli schemes. As an application, we show that the "difference" between the strong and weak versions of the finiteness conjecture of Fontaine-Mazur is filled in by the finiteness conjecture of Khare-Moon.

16. Alessandro Verra, University of Rome, Italy

Title: K3 Surfaces and Moduli of Étale Cyclic Covers of Curves

Abstract: Complex K3 surfaces S are considered, suitably polarized in genus g by $H \in \mathrm{Pic}\, S$, which are quotients of K3 surfaces $\tilde{S}$ by a symplectic automorphism of order n. Let $P_{g,n}$ be the moduli space of triples (S, H, C), with $C \in |H|$, and let $R_{g,n}$ be the moduli space of degree n, cyclic étale coverings $\tilde{C} \to C$ of curves of genus g. Then (S, H, C) defines a covering $\tilde{C} \to C$, induced by the quotient map $\tilde{S} \to S$.

The assignement $(S, H, C) \to (\tilde{C} \to C)$ defines a map $r_{g,n} : P_{g,n} \to R_{g,n}$. This is a variation of the Mukai map $m_g : P_g \to M_g$ from the moduli of triples (S, H, C), where (S, H) is any polarized K3 surface polarized in genus g, to the moduli of curves of genus g.

In the talk some unexpected and remarkable analogies between the two maps are described. The cases $n = 2, 3$ are considered with more detail. For $n = 3$ the standard irreducible component of $P_{g,n}$ is studied, focusing on the transition case $g = 5$. The unirationality of $R_{5,3}$ is proven via the map $r_{5,3}$. For n = 2 the generic injectivity of $r_{g,2}$, with its exceptions and analogies to m_g, is outlined. (Joint works with A. Garbagnati and with A. Knutsen, M. Lelli Chiesa).

17. Angelo Vistoli, The Advanced Normal School of Pisa, Italy

Title: Chow Rings of Some Moduli Spaces of Smooth Curves

Abstract: There is by now an extensive theory of rational Chow rings of moduli spaces of smooth curves. The integral version of these Chow rings is not as well understood. I will survey what is known, including some recent developments.

18. Fengyu Wang, Center of Applied Mathematics, Tianjin University, China

Title: Coupling by Change of Measures and Applications

Abstract: In order to establish infinite-dimensional Harnack inequality for Markov semigroupswe introduce the method of "Coupling by change of measures". This method is also applied to investigate Bismut type derivative formulas, integration by parts formulas, shift Harnack inequalities and applications. A simple example of SDE is considered to explain the main idea of the method.

19. Hongwei Xu, Zhejiang University, China

Title: Stronger Version of Chern Conjecture for Minimal Hypersurfaces

Abstract: he famous Chern Conjecture for minimal hypersurfaces with constant scalar curvature in a sphere was proposed by S.-S. Chern around 1970, and was listed in the Problem Section by S.-T. Yau in 1982. In this talk, I will talk about recent progress on the stronger version of the Chern Conjecture and its related problems. Based on the previous work due to Peng-Terng [Math. Ann., 1983], Ding-Xin [Adv. Math., 2011] and Xu-Xu [J. Funct. Anal., 2017], we prove that if M is a compact minimal hypersurface in S^{n+1} whose squared length of the second fundamental form satisfying $0 \leq S?n \leq n/18$, then $S = n$ and M is a Clifford torus. This is a joint work with Dr. Li Lei and Dr. Zhiyuan Xu.

20. Jae-Hyun Yang, Inha University, Korea

Title: The Stability of Automorphic Forms and Its Geometric Applications

Abstract: In this talk, I will introduce the notion of the stability of automorphic forms, and apply the stability of automorphic forms to the study of the moduli space of abelian varieties, the moduli space of curves, the moduli space of polarized real tori, the universal family of abelian varieties and the universal family of polarized real tori.

21. Lixin Zhang, Zhejiang University, China

Title: Adaptive Randomization: Efficiency, Selection Bias and Randomization Methods

Abstract: Efrons (1971) biased coin design and Pocock and Simon's (1971) procedure are extensively implemented for balancing treatment allocation and balancing treatment allocation over influential covariates in clinical trials. However, the theoretical properties of the power of the conventional testing hypotheses and its relationship with the selection bias are usually unknown. In the literature, most studies are based on simulations. In this talk, we will consider the asymptotic relative loss of power of hypothesis testing to compare the treatment effects and the asymptotic selection bias under covariate-adaptive randomization procedures. We propose a new framework of covariate-adaptive design and establish the corresponding asymptotic theorems under widely satisfied conditions. A new covariate-adaptive design is defined by choosing suitable allocation function so that the selection bias is asymptotically the same as the complete randomization and the treatment imbalances considered are of the order of $o(n^{1/2})$ in probability for which the loss of power is asymptotically ignorable.

22. Youjin Zhang, Tsinghua University, China

Title: Hodge Integrals and Integrable Systems

Abstract: For an arbitrary semisimple Frobenius manifold we construct an integrable hierarchy of Hamiltonian partial differential equations. In the particular case of quantum cohomology the tau-function of a solution to the hierarchy generates the intersection numbers of the Gromov–Witten classes and their descendents along with the characteristic classes of Hodge bundles on the moduli spaces of stable maps.

By considering the integrable hierarchies associated to the one-dimensional Frobenius manifold, we establish a correspondence between a certain class of special cubic Hodge integrals and the so called fractional Volterra hierarchy.

23. Jian Zhou, Tsinghua University, China

Title: Gauss and Elliptic Functions

Abstract: In modern mathematical physics and number theory, elliptic functions and modular forms are widely used. By reading some manuscripts of Gauss, we have found that many results named after other mathematicians were actually first found by Gauss. They include: The notion of elliptic functions, theta functions, Fourier transform and Poisson summation formula, Jacobi triple product identity, modular group, fundamental domain, analogue of Klein J-function, etc. He also discovered the relation to hypergeoemtric equation and defined mirror map widely used in mirror symmetry. In this talk we will give a sampling of such results of Gauss obtained while he was also working on his Disquisitiones Arithmeticae.

Title and Abstract for Dusa McDuff Workshop

1. Principel speaker: Dusa MacDuff, Columbia University, USA

Lecture 1: Introduction to Symplectic Topology
Abstract: An overview of symplectic geometry for nonexperts, giving some perspective to the symplectic embedding question.

Lecture 2: Embeddings of 4-dimensional ellipsoids
Abstract: a discussion of the proof, showing how it is related to symplectic blowing up, how we use toric models, and new results on the set of classes represented by exceptional curves in blow ups of the complex projective plane

Lecture 3: Beyond 4 dimensions
Abstract: We construct some interesting higher dimensional embeddings, discuss the stabilized embedding problem and mention some open questions.

2. Viktor L. Ginzburg, University of California, Santa Cruz, USA

Title: Lagrangian Poincar Recurrence and Pseudo-rotations

Abstract: The Lagrangian Poincar recurrence conjecture, put forth by the speaker and Viterbo around 2010, is a Hamiltonian version of the standard Poincar recurrence theorem. This conjecture asserts that the images of a Lagrangian submanifold under iterations of a compactly supported Hamiltonian diffeomorphism intersect infinitely many times. The conjecture is interesting and non-obvious even for an individual map unless, of course, the map is periodic. In general, the conjecture is wide open. However, one class of maps, of independent interest, for which the conjecture is more accessible is that of pseudo-rotations. These are Hamiltonian diffeomorphisms with finite and minimal possible number of periodic orbits.

In this talk, based on a joint work with Basak Gurel, we discuss a proof of the conjecture for pseudo-rotations of complex projective spaces and a reasonably broad class of Lagrangian submanifolds. We also relate the frequency of intersections with the homological capacity of the Lagrangian.

3. Richard Hind, University of Notre Dame, USA

Title: Embedding and Packing Lagrangian Tori

Abstract: There has been much work recently on embedding and packing problems for symplectic manifolds, especially when the domain is an ellipsoid. I will describe joint work in progress with Ely Kerman and Emmanuel Opshtein considering the case when the domain is a Lagrangian torus. These kinds of questions still make sense provided we put constraints on the area class of the torus. In dimension 4 we can find optimal embeddings but some basic questions remain about maximal packings.

4. Otto van Koert, Seoul National University, Korea

Title: The Three Body Problem and Symplectic Embeddings

Abstract: In this talk I will give an overview of the history of the three-body problem, starting with very old questions and ending with symplectic embedding questions related to this problem. Along the way we will describe the numerous interactions with symplectic geometry, including periodic orbits and global surfaces of section. At the end I will go into work of Junyoung Lee which relates this topic to that of the workshop.

5. Yi-Jen Lee, Chinese University of Hong Kong, China

Title: TBA

Abstract: TBA

6. Chris Wendl, Humboldt-Universita¨t zu Berlin, Germany

Title: Rigid Holomorphic Curves are Generically Super-rigid

Abstract: I will explain the main ideas of a proof that for generic compatible almost complex structures in symplectic manifolds of dimension at least 6, closed embedded J- holomorphic curves of index 0 are always "super-rigid," implying that their multiple covers are never limits of sequences of curves with distinct images. This condition is especially interesting in Calabi-Yau 3-folds, where it follows that the Gromov-Witten invariants can be "localized" and computed in terms of Euler classes of obstruction bundles for a finite set of disjoint embedded curves. By the same techniques, we can also show that unbranched covers of simple J - holomorphic curves are generically regular. These results are based on a decomposition of the space of branched covers into smooth strata on which certain twisted Cauchy-Riemann operators have kernel and cokernel of constant dimension.

7. Weiwei Wu, University of Georgia, USA

Title: Symplectomorphism Groups and Finite Symmetries in Symplectic 4-manifolds

Abstract: We survey some recent progress on symplectomorphism groups and their finite subgroups for certain symplectic four manifolds.

8. Boyu Zhang, Harvard University, USA

Title: Compactness Property of the Beasley-Witten Flow

Abstract: By studying the gradient flows of the Chern-Simons functional on a princi- pal SU(2)-bundle over a three-manifold, one can define the instanton Floer homology groups. Assuming the three-manifold is endowed with a contact structure, Beasley and Witten wrote down a deformed Chern-Simons functional, which reflects the topol-ogy of the contact structure. People have been using methods from theoretical physics to study this functional and obtained interesting results. Brendan McLellan asked if one could establish a rigorous Floer theory using this functional. The first step towards this direction is to establish the compactness property of the moduli space of its gradient flows. In this talk, we will discuss this compactness property.

Title and Abstract for Frances Kirwan Workshop

1. **Principle speaker**: Frances Clare Kirwan, University of Oxford, UK
Lecture 1: Non-reductive Geometric Invariant Theory

Abstract: Geometric invariant theory (GIT) was developed by Mumford in the 1960s in order to construct and studyquotients of algebraic varieties by actions of reductive linear algebraic groups. His main motivation was that many interesting moduli
Spaces in algebraic geometry can be constructed in this way. In general GIT for non- reductive linear algebraic group actions is much less well behaved than for reductive actions. However when the unipotent radical U of a linear algebraic group H is graded, in the sense that a Levi subgroup has a central one-parameter subgroup which acts by conjugation on U with all weights strictly positive, then GIT for a linear action of H on a projective scheme is almost as well behaved as in the reductive setting, provided that we are willing to multiply the linearisation by an appropriate rational character (joint work with Gergely Berczi, Brent Doran and Tom Hawes).

Lecture 2: Generalising symplectic implosion

Abstract: The symplectic reduction of a Hamiltonian action of a Lie group on a symplectic manifold plays the role of a quotient construction in symplectic geometry. It has been understood for several decades that symplectic reduction can be used to describe the quotients for complex reductive group actions in algebraic geometry provided by Mumford's GIT. There is an analogue of this description for GIT quotients by suitable non-reductive actions, which generalises the symplectic implosion construction of Guillemin, Jeffrey and Sjamaar. This involves a version of
a moment map and a Morse stratification provided by its norm-square, with applications including calculating Betti numbers and intersection pairings on non-reductive GIT quotients (joint work with Gergely Berczi).

Lecture 3: Moduli spaces of unstable objects

Abstract: Non-reductive GIT can be applied to the construction of moduli spaces in cases when classical GIT is not applicable. These include moduli spaces of 'unstable' objects of prescribed type, such as sheaves of fixed Harder-Narasimhan type, unstable projective curves or projective schemes of dimension greater than 1 (joint work with Gergely Berczi, Vicky Hoskins and Joshua Jackson).

2. Bohan Fang, BICMR, Peking University, China

Title: Oscillatory Integrals and Gamma II Conjecture

Abstract: The mirror of a complete toric Fano variety is a Landau-Ginzburg model. Oscillatory integrals over these mirror branes will give genus 0 Gromov-Witten descen- dant potentials. By identifying Lefschetz thimbles with T-dual branes, we can show that these integrals have 1) desired asymptotic expansions by stationary phase ex-pansion;
2) correspond to descendant potentials with I ritani's Gamma-classes. Thus this comes to the Gamma I I conjecture f or toric Fano varieties, which asserts f or a Fano variety the asymptotic solutions to the quantum differential equations do have analytic l ifts corresponding to the Gamma-classes of an exceptional collection.

3. Lothar G¨ottsche, International Center for theoretical Physics, Italy

Title: Virtual Refinements of the Vafa-Witten Formula

Abstract: Vafa and Witten made predictions about the Euler numbers of moduli spaces of sheaves on surfaces. They give explicit generating functions in terms of modular forms. These moduli spaces are in general very singular, but they have a perfect obstruction theory, and thus a virtual fundamental class and a virtual Tangent bundle, and thus virtual Chern numbers and in particular a virtual Euler number. We interpret the prediction as being about the virtual Euler numbers. Then a formula of Mochizuki allows to compute the virtual Euler numbers in terms of integrals on Hilbert schemes of points, which we do via reduction to toric surfaces and virtual localization. This allows to check the conjecture in a wide variety of cases up to high expected dimensions of the moduli spaces. We then extend the conjecture first to the χ_y-genus and then to the elliptic genus, where we obtain generating functions similar to that of Dijkgraaf-Moore-Verlinde-Verlinde for Hilbert schemes of points. Finally we extend the conjectures to the virtual cobordism class of the moduli spaces.

4. Jochen Heinloth, University at Duisburg-Essen, Germany

Title: Existence of Moduli Spaces for Algebraic Stacks

Abstract: Recently Alper, Hall and Rydh gave general criteria when a moduli problem can locally be described as a quotient and thereby clarified the local structure of algebraic stacks. We report on a joint project with Jarod Alper and Daniel Halpern-Leistner in which we use these results to show general existence results for good coarse moduli spaces. In the talk we will focus on one aspect that illustrates how the geometry of algebraic stacks gives a new point of view on classical methods, namely we explain how Langton's proof of semistable reduction for coherent sheaves on projective varieties can be reformulated in terms of geometry. This allows to prove semistable reduction for an interesting class of moduli problems.

5. David Hyeon, Marshall University, USA

Title: Toward a GIT Construction for a Moduli Space of Commuting Nilpotents

Abstract: I will describe how a moduli space of commuting nilpotents may be constructed via GIT and how non-reductive GIT can make things much simpler.

6. Young-Hoon Kiem, Seoul National University, Korea

Title: 30 Years of Partial Desingularization

Abstract: Geometric invariant theory (GIT) quotients of smooth projective varieties are often singular. By Luna's slice theorem, the singularities arise from non-trivial stabilizers and often bigger stabilizers result in worse singularities. In 1985, Frances Kirwan invented an algorithm, called the partial desingularization pocess, that systematically resolves all the singularities worse than orbifold singularities by a sequence of blowups. In this talk, I'd like to discuss applications of the partial desingularization process during the past 30 years, in the theory of moduli of vector bundles on curves, in birational geometry of moduli spaces, and in the construction of symplectic varieties. Finally, I'd also like to talk about a recent joint work with Jun Li and Michail Savvas about a theory of generalized Donaldson-Thomas invariant by partial desingularization.

7. Yoshinori Namikawa, University of Kyoto, Japan

Title: Poisson Deformations and Birational Geometry

Abstract: The semiuniversal deformation of a Klein singularity was constructed by Grothendieck, Brieskorn and Slodowy and the Weyl group of a complex Lie algebra naturally appears in its simultnaneous resolution. We generalize these results to conical symplectic varieties by using Poisson deformations. We will also discuss birational geometry related to Poisson deformations.

Title and Abstract for Jean-Pierre Demailly Workshop

1. **Principle Speaker :** Jean-Pierre Demailly, Université Grenoble Alpes, Institut Fourier

Title: Ricci curvature and geometry of compact Kähler varieties

Abstract: The geometric structure of projective and compact Kähler manifolds is governed by the sign of their canonical bundle. We will recall here some fundamental results concerning (semi)positive line bundles and their link with the geometry of compact Kähler varieties. The main goal will be to describe fundamental structure theorems for compact Kähler manifolds with semipositive or nef anticanonical bundles.

Lecture 1: Positivity concepts in Kähler geometry

Abstract: We will first recall the basic definitions and characterizations of the concept of ample, nef, big and pseud oeffective line bundles and (1,1) cohomology classes, in the context of projective, resp. Kähler varieties. The main duality results for positive cones will be described, and as a consequence, a necessary and sufficient criterion for rational connectedness will be established.

Lecture 2: A generalized holonomy principle and the De Rham and Cheeger-Gromoll splitting theorems

Abstract: The concept of holonomy of a euclidean or hermitian vectore bundle will be explained, along with the De Rham splitting theorem and Berger's classification of holonomy groups. We will then introduce our recent result on the holonomy of certain holomorphic vector bundles whose curvature tensor has a trace that is a seminegatie hermit ian endomorphism.

Lecture 3: Structure theorems for compact Kähler manifolds with nefanticanonical bundles

Abstract: The results previously established will be combined to obtain a precise decomposition theorem for compa ct Kähler manifolds with semipositive Ricci curvature (following work of Campana, Peternell and the lecturer), afte r gving a presentation of the main examples. The case when K_X is nef will also be considered, as an introduction to o the work of Junyan Cao and Andreas Höring.

2. **Junyan Cao,** Université Paris VI, Institut de Mathématiques de Jussieu

Title: Structure theorem for projective manifolds with nef anticanonical bundles

Abstract: The goal of our talks is to present joint work with Andreas Höring on the structure of projective manifolds with nef anticanonica bundles. We prove that a simply connected such manifold is a product of a rationally connected manifold and a manifold with trivial canonical bundle. As an application we describe the MRC fibration of any projective manifold with nef anticanonical bundle.

3. **Jian Xiao,** Northwestern University

Title: Local positivity for curves

Abstract: One of the most important invariants measuring the local positivity of a nef line bundle is the local Seshadri function introduced by Demailly. We first give a brief introduction to this invariant. Then using the duality of positive cones, we show that applying the polar transform from convex analysis to local positivity invariants for divisors gives interesting and new local positivity invariants for curves. These new invariants have nice properties similar to those for divisors. In particular, this enables us to obtain a Seshadri type ampleness criterion for movable curves, and give a characterization of the divisorial components of the non-Kähler locus of a big class. (Joint work with N. McCleerey.)

4. **Xiaokui Yang,** Morningside Center of Mathematics, Chinese Academy of Sciences

Title: RC positivity, rational connectedness and Yau's conjecture

Abstract: In this presentation, we will describe the relationship between various positivity notions in differential geometry and algebraic geometry. We shall also introduce a new concept called "RC-positivity" in differential geometry and use it to characterize uniruled and rationally connected projective manifolds. In particular, we confirm a conjecture of Yau that a compact Kähler manifold with positive holomorphic sectional curvature is projective algebraic and rationally connected.

5. **Xiangyu Zhou,** Institute of Mathematics, Chinese Academy of Sciences

Title: Some applications of the optimal L^2 extension and strong openness of multiplier ideal sheaves

Abstract: In this talk, we will first recall our solution of the optimal L^2 extension problem and of Demailly's strong openness conjecture on multiplier ideal sheaves. We will then present some applications and consequences of these results.