7 TH PACIFIC RIM COMPLEX GEOMETRY CONFERENCE

SCIENCE SEMINAR HOUSE, KYOTO UNIVERSITY

August 6 – 10, 2012

Aug. 6 (Mon.)

9:00 – 10:00 Claude LeBrun (Stony Brook Univ.)

"Hermitian metrics, Einstein manifolds and conformal geometry"

Abstract: This talk will explain existence and uniqueness proofs for Einstein, Hermitian metrics on Del Pezzo surfaces. I will also discuss some related results and open problems regarding Bach-flat 4-manifolds, and emphasize the degree to which many phenomena seen in real dimension four do not seem to have reasonable generalizations to higher dimensions.

10:30 – 11:30 Tamás Kálmán (Tokyo Inst. Technology)

"Relating Jones-type and Ozsvath-Szabo-type knot invariants"

Abstract: In recent years, low-dimensional topology has been dominated by two theories. Heegaard Floer homology, due to Ozsvath and Szabo, is a version of the Floer homology of Lagrangian intersections. From the perspective of knots, it can be viewed as a categorification of the Alexander polynomial. Khovanov-Rozansky homology is a much less geometric theory which categorifies the Jones and Homfly polynomials. I will report on work in progress aimed at finding an Ozsvath-Szabo-type chain complex for Khovanov-Rozansky homology. In the case of alternating knots, I will show how the project boils down to studying (plane) bipartite graphs (dimer models). I will describe a new theory of such graphs and show how it relates to the Alexander and Homfly polynomials and the so-called Fox conjecture. In the non-alternating case, I will speculate how a generalization might occur through a connection to the branched double cover associated with the knot.
Parts of this work are joint with Andras Juhasz, Hitoshi Murakami, Jacob Rasmussen, and Dylan Thurston.

11:30 – 14:00 Lunch

14:00 – 15:00 Li Ma (Henan Normal Univ.)

"2-d Ricci flow in open surfaces"

Abstract: We first discuss the formulations of Ricci flow in open surfaces from both the conformal and Kähler geometric points of view. We recall some estimates based on the maximum principle. Then we discuss the question when a Ricci flow in the plane converges to a flat metric or a cigar metric.

15:30 – 16:30 Jae-Hyouk Lee (Ewha Womans Univ.)

"Polytopes, quasi-minuscule representations and rational Surfaces"

Abstract : In this talk, we describe the relation between quasi-minuscule representations, polytopes and Weyl group orbits in Picard lattices of rational surfaces. Moreover, to each quasi-minuscule representation, we attach a class of rational surfaces, and realize such a representation as an associated vector bundle of a principal bundle over these surfaces. As a result, any quasi-minuscule representation can be defined by rational curves, or their disjoint unions, satisfying certain natural numerical conditions in a rational surface. This talk is from a joint work with Xu, Mang and Zhang, Jiajin.

17:00 – 18:00 Jeff Viaclovsky (Univ. of Wisconsin)

"Index theorems on anti-self-dual orbifolds"

Abstract: I will present various index theorems for the anti-self-dual deformation complex on anti-self-dual spaces with orbifold singularities. Much of this work is joint work with Michael Lock. I will also discuss some related work regarding Einstein metrics and Yamabe invariants of weighted projective spaces.

Aug. 7 (Tue.)

9:00 – 10:00 Junho Lee (Univ. of Central Florida)

"Einstein orbifolds and complex singularities"

Abstract: The Gromov-Witten invariants of a Kähler surface X (with a smooth canonical divisor) can be written in terms of local GW invariants of spin curves. The calculation of those local invariants leads in a natural manner to spin Hurwitz numbers. These were introduced and studied by Eskin, Okounkov and Pandharipande. They calculated the spin Hurwitz numbers for genus one and odd parity spin curve. Recently, Gunningham calculated all spin Hurwitz numbers in terms of combinatorics of Sergeev algebra. In this talk, I will explain how to use a degeneration of spin curves to obtain a recursion formula for spin Hurwitz numbers. This is a joint work with Thomas H. Parker.

10:30 – 11:30 Olivier Biquard (École Normale Supérieure)

"Relating Jones-type and Ozsvath-Szabo-type knot invariants"

Abstract: Kähler-Einstein metrics on surfaces can have orbifold singularities, and the problem of smoothing such singularities is basically well understood. We study the situation for Einstein metrics with such complex singularities, which is very different. In particular we find new obstructions to smoothing such Einstein metrics.

11:30 – 15:30 Lunch

15:30 – 16:30 Kai Zheng (Inst. Fourier)

"Geodesics in the space of Kähler metrics with cone singularities"

Abstract: (This is a joint work with Simone Calamai.) We prove the existence and uniqueness of the weak cone geodesics in the space of Kähler metrics with cone singularities by solving the singular, homogeneous complex Monge-Ampère equation. As an application, we prove the metric space structure of the appropriate subspace of the space of Kähler metrics with cone singularities.

17:00 – 18:00 Knut Smoczyk (Univ. Hannover)

"The strong elliptic maximal principle for vector bundles and applications to minimal maps"

Abstract: Based on works by Hopf, Weinberger, Hamilton and Evans, we state and prove the strong elliptic maximum principle for smooth sections in vector bundles over manifolds and give some applications in Differential Geometry. Moreover, we use this maximum principle to obtain various rigidity theorems and Bernstein type theorems in higher codimension for minimal maps between Riemannian and Kaehlerian manifolds.

Aug. 8 (Wed.)

9:00 – 10:00 Gérard Besson (Inst. Fourier)

"On open 3-manifolds and Ricci flow"

Abstract: We shall describe recent results obtained with L. Bessières and S. Maillot on open 3-manifolds using Ricci flow technique. This is an opportunity to survey a widely open subject and we shall present some of the interesting features concerning open 3-folds.

10:15 – 11:15 Kazushi Ueda (Osaka Univ.)

"Dimer models and geometry"

Abstract: Dimer models are combinatorial objects which is related to many different subjects of mathematics. In the talk, we first discuss its relation with algebraic geometry and representation theory of finite dimensional algebras, and then the relation with symplectic geometry and mirror symmetry. If the time permits, we will also discuss a very mysterious relation with Sasaki-Einstein metrics.

11:30 – Excursion

18:00 – Reception at New Miyako Hotel

Aug. 9 (Thu.)

9:00 – 10:00 Yanir Rubinstein (Stanford Univ.)

"The geometry of the space of Kähler metrics"

Abstract: The talk will survey some aspects of the geometry of the infinite-dimensional space of Kahler metrics representing a fixed cohomology class. We hope to briefly touch upon some interesting PDEs, Hamiltonian dynamics, the Cauchy problem for the Monge-Ampere equation and lifespan of geodesics, geometric flows, convex geometry, geometric quantization, and metric geometry.

10:30 – 11:30 Yann Rollin (Univ. de Nantes)

"Deformation of singular complex surfaces, extremal metrics and stationary Lagrangians"

Abstract: Given a complex surface X with canonical singularities and an orbifold CSCK metric, we consider a family of complex deformations of X and a simultaneous resolution of the family. Then we answer the problem of existence of CSCK metrics for small deformations of the resolution, under some reasonable assumptions. We also construct some stationary Lagrangian spheres in certain cases via gluing techniques.

11:30 – 15:30 Lunch

15:30 – 16:30 Hans-Joachim Hein (Imperial College)

"Calabi-Yau manifolds modelled on cones"

Abstract: I will mainly present some topics taken from recent and ongoing joint work with Ronan Conlon whose goal is to provide a careful theory of complete, asymptotically conical (AC) Calabi-Yau manifolds. In particular, I will discuss a new gap theorem arising in this context (harmonic functions of less than quadratic growth on AC Kähler manifolds with nonnegative Ricci curvature are pluriharmonic) which would be wrong without the AC condition. Time permitting I will also talk about some observations related to isolated conical singularities of Calabi-Yau manifolds.

17:00 – 18:00 Bing Wang (Stony Brook Univ.)

"The regularity of limit space"

Abstract: We study the structure of the limit space of a sequence of almost Einstein manifolds, which are generalizations of Einstein manifolds. Roughly speaking, such manifolds are the initial manifolds of some normalized Ricci flows whose scalar curvatures are almost constants over space-time in the $L1$-sense, Ricci curvatures are bounded from below at the initial time. Under the non-collapsed condition, we show that the limit space of a sequence of almost Einstein manifolds has most properties which is known for the limit space of Einstein manifolds. As applications, we can apply our structure results to study the properties of Kähler manifolds.

Aug. 10 (Fri.)

9:00 – 10:00 Misha Verbitsky (Moscow State Univ.)

"Global Torelli theorem for hyperkähler manifolds"

Abstract: A mapping class group of an oriented manifold is a quotient of its diffeomorphism group by the isotopies. We compute a mapping class group of a hypekähler manifold M, showing that it is commensurable to an arithmetic subgroup in $\mathrm{SO}(3, b_2-3)$. A Teichmuller space of M is a space of complex structures on M up to isotopies. We define a birational Teichmüller space by identifying certain points corresponding to bimeromorphically equivalent manifolds, and show that the period map gives an isomorphism of the birational Teichmuller space and the corresponding period space $\mathrm{SO}(b_2-3,3)/\mathrm{SO}(2)\times\mathrm{SO}(b_2-3,1)$. We use this result to obtain a Torelli theorem identifying any connected component of birational moduli space with a quotient of a period space by an arithmetic subgroup. When M is a Hilbert scheme of n points on a K3 surface, with $n-1$ a prime power, our Torelli theorem implies the usual Hodge-theoretic birational Torelli theorem (for other examples of hyperkähler manifolds the Hodge-theoretic Torelli theorem is known to be false).

10:30 – 11:30 Ryushi Goto (Osaka Univ.)

"Poisson structures and generalized geometry"

Abstract: I will discuss resent results on generalized Kähler geometry relating with logarithmic Poisson structures. A logarithmic Poisson structure is a holomorphic Poisson structure which preserves the ideal sheaf of a divisor D on a complex manifold. A logarithmic Poisson structure on a compact Kähler manifold gives rise to deformations of generalized Kähler structures such that the divisor D arises as a generalized Kähler submanifold. This is a generalization of the stability theorem of ordinary Kähler manifolds coupled with complex submanifolds, due to Kodaira and Spencer originally. We also obtain the stability theorem of "degenerate" generalized kähler structures which precisely yields unobstructed deformations of Poisson Kähler manifolds. Using the unobstructedness theorem, we show that every compact Poisson Kähler manifold admits bihermitian structures. We describe several examples of logarithmic Poisson structures and higher Poisson structures (i.e., Nambu structures) also. Then we discuss an approach to the extended deformations by higher Poisson structures which go beyond the ones in generalized geometry.

References:

[1] Unobstructed K-deformations of generalized complex structures and bihermitian structures, to appear in Adv. Math.

[2] Deformations of generalized Calabi-Yau and generalized SU(n)-structures, math. DG/0512211, to appear in Osaka J. Math. 49 (2012).

[3] Deformations of generalized complex and generalized Kähler structures, J. Differential Geom. 84 (2010), 525-560.

[4] Poisson structures and generalized Kähler submanifolds, J. Math. Soc. Japan 61 (2009), 107-132.