2020 Taipei-Hsinchu Conference on Geometric Invariance and Partial Differential Equations

January 4 - 5, Academia Sinica, Taipei, Taiwan
January 7 - 9, National Tsing Hua University, Hsinchu, Taiwan

Saturday, January 4, 2020

10:00- 10:50 Sun-Yung Alice Chang (Princeton University)

Title: TBA

10:50-11:20 Break

11:20-12:10 Jeffrey Case (Pennsylvania State University)

Title: The Frank-Lieb approach to sharp Sobolev inequalities

Abstract: Frank and Lieb gave a new, rearrangement-free, proof of the sharp Hardy–Littlewood–Sobolev inequalities by exploiting their conformal covariance. By duality, they obtain new proofs of sharp Sobolev inequalities for the embeddings $W^{k,2}(\mathbb{R}^n) \hookrightarrow L^{\frac{2n}{n-2k}}(\mathbb{R}^n)$. We show that their argument gives a direct proof of the latter inequalities without passing through Hardy–Littlewood–Sobolev inequalities. Moreover, their argument can also be used to systematically understand sharp fully nonlinear Sobolev inequalities and their trace analogues.

12:10-14:00 Lunch

14:00-14:50 Yi Wang (Johns Hopkins University)

Title: On fully nonlinear Sobolev trace inequalities

Abstract: In this talk, I will present a result on the rigidity of local minimizers of the functional $\int m_2 + \oint H_2$ among all conformally flat metrics in the Euclidean (n + 1)-ball. We prove the metric is flat up to a conformal transformation in some (noncritical) dimensions. We also prove the analogous result in the critical dimension n + 1 = 4. The main method is Frank-Lieb's rearrangement-free argument. If minimizers exist, this implies a fully nonlinear sharp Sobolev trace inequality. I will also discuss a nonsharp Sobolev trace inequality. This is joint work with Jeffrey Case.

14:50-15:20 Break

15:20-16:10 Yueh-Ju Lin (Wichita State University)

Title: Volume Comparison of Q-curvature

Abstract: Classical volume comparison for Ricci curvature is a fundamental result in Riemannian geometry. In general, scalar curvature as the trace of Ricci curvature, is too weak to control the volume. However, with the additional stability assumption on the closed Einstein manifold, one can obtain a volume comparison for scalar curvature. In this talk, we investigate a similar phenomenon for Q-curvature, a fourth-order analogue of scalar curvature. In particular, we prove

a volume comparison result of Q-curvature for metrics near stable Einstein metrics by variational techniques and a Morse lemma for infinite dimensional manifolds. Moreover, with some appropriate assumptions, one can extend this result to the so called J-Einstein metrics, where J-tensor is a canonical symmetric $(0,2)$-tensor associated to Q-curvature. This is a joint work with Wei Yuan.

17:30- Reception

Sunday, January 5, 2020

10:00- 10:50 Paul Yang (Princeton University)

Title: TBA

10:50-11:20 Break

11:20-12:10 Yoshihiko Matsumoto (Osaka University)

Title: A construction of Poincare-Einstein metrics of cohomogeneity one on the ball

Abstract: Poincaré-Einstein metrics and their relationship with conformal structures on the boundary at infinity have attracted much interest since 1980s, but the knowledge on the existence of such metrics is still quite limited. After sketching the current state of the matter, I will discuss yet another explicit construction of a one-parameter family of Poincaré-Einstein metrics given by a method of Page and Pope, which takes place on the unit ball B^{2n} of even dimension, $n \geq 2$. This is a generalization of Pedersen's construction in B^4, and the associated conformal infinities are given by the Berger metrics on the sphere.

The limiting behavior of this family is of particular interest. As the fibers of the boundary S^{2n-1} become large, the Einstein metric tends to the complex hyperbolic metric on the ball; at the other end of the family, the boundary collapses to the complex projective space $\mathbb{C}P^{n-1}$ and the interior also collapses to a $(2n-1)$-dimensional Einstein space that has one singular point.

12:10-14:00 Lunch

14:00-14:50 Chin-Yu Hsiao (Academia Sinica)

Title: Geometric quantization on CR manifolds

Abstract: Let X be a compact connected orientable CR manifold of dimension greater than five with the action of a connected compact Lie group G. Assuming that the Levi form of X is positive definite near the inverse image Y of 0 by the momentum map and that the tangential Cauchy-Riemann operator has closed range on the reduction Y/G, we prove that there is a canonical Fredholm operator between the space of global G-invariant L^2 CR functions on X and the space of global L^2 CR functions on the reduction Y/G. This is a joint work with Xiaonan Ma and George Marinescu.

14:50-15:20 Break

15:20-16:10 Lan-Hsuan Huang (University of Connecticut)

Title: Mass rigidity for hyperbolic manifolds

Abstract: We will present a variational approach to the rigidity of positive mass theorem for asymptotically hyperbolic manifolds. Namely, if the mass is zero, then the asymptotically hyperbolicmanifold is isometric to hyperbolic space. The result was previously proven for spin manifoldsor under special asymptotics.

16:10-16:40 Break

16:40-17:30 Yuya Takeuchi (Osaka University)

Title: Non-negativity of CR Paneitz operator for embeddable CR manifolds

Abstract: The CR Paneitz operator, which is a fourth-order CR invariant differential operator, plays a crucial role in three-dimensional CR geometry; it is closely related to global embeddability, the CR positive mass theorem, and the logarithmic singularity of the Szeg kernel. In this talk, I will show that,s for embeddable CR manifolds, the CR Paneitz operator is non-negative, and its kernel consists of CR pluriharmonic functions. I will also give some applications of this result to CR geometry. This talk is based on the preprint `arXiv:1908.07672`.

Tuesday, January 7, 2020

10:00- 10:50 Qing Han (University of Notre Dame)

Title: The Loewner-Nirenberg Problem in Cones

Abstract: We study asymptotic behaviors of solutions to the Loewner-Nirenberg problem in finitecones and establish optimal asymptotic expansions in termsof the corresponding solutionsin infinite cones. The spherical domains over which cones areformed are allowed to havesingularities. An elliptic operator on such spherical domains with coefficients singular onboundary play an important role. Due to the singularity of the spherical domains, extra caresare needed for the study of the global regularity of the eigenfunctions and solutions of theassociated Dirichlet problem.

10:50-11:20 Break

11:20-12:10 Yuxin Ge (University of toulouse 3)

Title: Conformally compact Einstein manifolds in high dimensions

Abstract: We discuss some recent progress on compactness result of conformally compact Einstein manifolds in high dimensions under the suitable conformally invariant conditions.

12:10-14:00 Lunch

14:00-14:50 Yongbing Zhang (University of Science and Technology of China)

Title: A CR invariant energy of maps via energy renormalization

Abstract: We will talk about a CR invariant energy of maps from a three-dimensional CR manifold.We obtain the energy by consider the renormalization of the energy of a harmonic map froman asymptotic complex hyperbolic space. The gradient of the energy is the obstruction to theboundary smoothness of the harmonic map from the ACH space.

14:50-15:20 Break

15:20-16:10 Mijia Lai (Shanghai Jiao Tong University)

Title: Some rigidity theorems for manifolds with boundary

Abstract: In this talk, I will present some rigidity theorems for manifolds with boundary. Eventhough they arise in different settings such as conformal deformation of Riemannian metrics,conformally compact Einstein manifolds and eigenvalue estimates, they share two commontechnical tools: the analysis of the Obata equation and the analysis of some nonlinear O.D.Esassociated with equations coming from conformal deformation of Riemannian metrics. In their study of Hamiltonian integrable hierarchies, Feigin and Frenkel showed that the classical principal W algebras are the algebras of regular functions on certain double coset spaces via free field realization. These coset spaces can be viewed as "the formal version of 1 point meromorphic Hitchin system over the Riemannian sphere". In my talk, I explain the generalization of this realization for certain classical W algebras and, as an application, the Hamiltonian integrable hierarchies associated with these algebras. If time permits, I explain my project toward a generalization of W algebras associated with multi- pointed Riemannian surfaces.

18:00- Banquet

Wednesday, January 8, 2020

10:00- 10:50 Jie Qing (University of California Santa Cruz)

Title: TBA

10:50-11:20 Break

11:20-12:10 Fang Wang (Shanghai Jiao Tong University)

Title: Comparison theorems for GJMS Operators

Abstract: In this talk, I will give several comparison theorems for (Fractional) GJMS Operators associated to the Poincare-Einstein manifolds. By characterising equalities, we also some rigidity theorems for the Poincare-Einstein manifolds. This is joint work with D. Chen, X. Zhang / H. Zhou.

12:10-14:00 Lunch

14:00-14:50 Ruobing Zhang (Stony Brook University)

Title: Geometry and analysis of degenerating Calabi-Yau manifolds

Abstract: This talk concerns a naturally occurring family of Calabi-Yau manifolds that degenerates in the sense of metric geometry, algebraic geometry and nonlinear PDE. A primary tool in analyzing their behavior is the recently developed regularity theory and multi-scale singularity analysis in the collapsed setting. We will give a precise description of arising singularities and explain possible generalizations.

14:50-15:20 Break

15:20-16:10 Taiji Marugame (Academia Sinica)

Title: Chains in CR geometry as geodesics of a Kropina metric

Abstract: Chains are natural family of curves on a CR manifold. They satisfy a second order ODE and play a role of geodesics in CR geometry. In this talk, we show that chains can be characterized as geodesics of a certain Kropina metric (a singular Finsler metric). As an application, we reprove and generalize some important facts on chains: (i) Chains determine the CR structure up to conjugate, (ii) Two nearby points can be joined by a chain. This is joint work with Jih-Hsin Cheng, Vladimir S. Matveev, and Richard Montgomery.

16:10-16:40 Break

16:40-17:30 Stephen McKeown (University of Texas at Dallas)

Title: TBA

Thursday, January 9, 2020

10:00- 10:50 Siqi Fu (Rutgers University-Camden)

Title: Spectral stability of the complex Laplacian

Abstract: In this talk, we study how the spectrum of the complex Laplacian behaves when the underlying algebraic, analytic, or geometric structure is slightly perturbed. Our focus is on stability of the variational eigenvalues of the $\bar{\partial}$-Neumann Laplacian on a bounded pseudoconvex domain Ω in $\mathbf{C}^n$ under the perturbation of Ω. This talk is based in part on the joint work with Weixia Zhu.

10:50-11:20 Break

11:20-12:10 Eric Chen (UC Santa Barbara)

Title: L n/2 curvature pinching for the Ricci flow on asymptotically flat manifolds

Abstract: On compact manifolds there are numerous curvature pinching conditions guaranteeing theRicci flows long-time existence and convergence. We will describe a curvature pinching con-dition on asymptotically flat manifolds based on a critical power integral norm of curvaturewhich guarantees the Ricci flows long-time existence and convergence.

12:10-14:00 Lunch