THE FIRST GEOMETRY CONFERENCE FOR FRIENDSHIP OF JAPAN AND GERMANY

Date September 21th – 25th, 2019
Place Chuo University (Korakuen Campus) 6th building, 61125 lecture room
1-13-27 Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan

Invited speakers
- **Bernd Ammann (University of Regensburg, Germany)**
- **Alexander Engel (University of Regensburg, Germany)**
- **Klaus Kröncke (University of Hamburg, Germany)**
- **Michael Wiemeler (University of Münster, Germany)**
- **Burkhard Wilking (University of Münster, Germany)**
- **Rudolf Zeidler (University of Münster, Germany)**

- **Ryushi Goto (Osaka University, Japan)**
- **Kota Hattori (Keio University, Japan)**
- **Shouhei Honda (Tohoku University, Japan)**
- **Hokuto Konno (University of Tokyo, Japan)**
- **Yoshihiko Matsumoto (Osaka Univerity, Japan)**
- **Shin Nayatani (Nagoya University, Japan)**
- **Hirofumi Sasahira (Kyusyu University, Japan)**

Schedule

	10:00–11:00	11:30–12:30	14:00–15:00	15:30–16:30
Sept. 21	B. Ammann-1	B. Ammann-2	A. Engel-1	A. Engel-2
Sept. 22	B. Wilking-1	B. Wilking-2	S. Nayatani	S. Honda
Sept. 23	R. Zeidler-1	R. Zeidler-2	H. Sasahira	H. Konno
Sept. 24	M. Wiemeler-1	M. Wiemeler-2	R. Goto	K. Hattori
Sept. 25	K. Kröncke-1	K. Kröncke-2	Y. Matsumoto	

Organizers and Advisers
- Mikio Furuta (University of Tokyo)
- Shinichiroh Matsuo (Nagoya University)
- Tsuyoshi Kato (Kyoto University)
- Yoshihiko Matsumoto (Osaka University)
- Bernd Ammann (University of Regensburg, Foreign adviser)
- Rafe Mazzeo (Stanford University, Foreign adviser)
- Kazuo Akutagawa (Chuo University)
- Tsukasa Nakagawa (Chuo University, Secretary)

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Titles & Abstracts of Lectures

- **Bernd Ammann (University of Regensburg, Germany)**

Lectures 1 : Parallel spinors on Riemannian and Lorentzian manifolds

Abstract 1 The talk describes results in joint articles with Klaus Kröncke, Olaf Müller, Hartmut Weiß, and Frederik Witt.

We say that a Riemannian metric on M is *structured* if its pullback to the universal cover admits a parallel spinor. All such metrics are Ricci-flat. The holonomy of these metrics is special as these manifolds carry some additional structure, e.g. a Calabi-Yau structure or a G_2-structure. All known compact Ricci-flat manifolds are structured.

The set of structured Ricci-flat metrics on compact manifolds is now well-understood, and we will explain this in the first part of the talk.

The set of structured Ricci-flat metrics is an open and closed subset in the space of all Ricci-flat metrics. The holonomy group is constant along connected components. The dimension of the space of parallel spinors as well. The structured Ricci-flat metrics form a smooth Banach submanifold in the space of all metrics. Furthermore the associated premoduli space is a finite-dimensional smooth manifold, and the parallel spinors form a natural bundle with metric and connection over this premoduli space.

Lorentzian manifolds with a parallel spinor are not necessarily Ricci-flat, however the rank of the Ricci tensor is at most 1, the image of the Ricci-endomorphism is lightlike. Helga Baum, Thomas Leistner and Andree Lischewski showed the well-posedness for an associated Cauchy problem. Here well-posedness means that a (local) solutions exist if and only if the initial conditions satisfy some constraint equations.

We are now able to prove a conjecture by Leistner and Lischewski which states that solutions of the constraint equations on an n-dimensional Cauchy hypersurface can be obtained from curves in the moduli space of structured Ricci-flat metrics on an $(n-1)$-dimensional closed manifold.

Lectures 2 : TBA

Abstract 2 I decide later whether I will extend the first talk into two parts, or whether I will talk about a new subject.

- **Alexander Engel (University of Regensburg, Germany)**

Lectures 1 : Propagation of wave operators

Abstract 1 It is a classical fact that the wave operator associated to a Dirac operator has finite propagation. In this talk we will see how much of this fact can still be salvaged for wave operators associated to elliptic pseudodifferential operators.

Lectures 2 : Topological obstructions and submanifolds

Abstract 2 By the strong Novikov conjecture the higher $\hat{A}$-genera are obstructions to the existence of positive scalar curvature metrics. In this talk we will see how submanifolds can detect non-triviality of these genera.

- **Klaus Kröncke (University of Hamburg, Germany)**

Lectures 1–2 : Ricci flow on singular spaces

Abstract In this talk, I will report on joint work with Boris Verman on the Ricci flow on manifolds with isolated conical singularities. We construct a Ricci de Turck flow which starts sufficiently close to a Ricci-flat metric with isolated conical singularities and converges to a singular Ricci-flat metric under an assumption of integrability, linear and tangential stability. Additionally, we provide a characterization of conical singularities satisfying tangential stability and discuss examples where the integrability condition is satisfied.

In the second part of the talk, we discuss Perelman's Lambda functional as well as the shrinker and the expander entropy on manifolds with isolated conical singularities. We prove that the entropies are monotonous along the singular Ricci de Turck flow. We employ these entropies to show that in this setting, under a curvature condition on the cross section, Ricci solitons are gradient and that steady and expanding Ricci solitons are Einstein.

• **Michael Wiemeler (University of Münster, Germany)**
Lectures 1–2 : TBA
Abstract ···

• **Burkhard Wilking (University of Münster, Germany)**
Lectures 1–2 : TBA
Abstract ···

• **Rudolf Zeidler (University of Münster, Germany)**
Lectures 1–2 : Positive scalar curvature, band width and index theory
Abstract M. Gromov established the following remarkable result in his recent 2018 GAFA paper: Consider a closed manifold M?such as the torus?for which the existence of a positive scalar curvature metric is obstructed by the Schoen-Yau minimal hypersurface method. Then, if the band $V = M \times [-1, 1]$ is endowed with a Riemannian metric of scalar curvature bounded below by a constant $\sigma > 0$, the distance between the boundary components of V is at most $C/\sqrt{\sigma}$, where C is a universal constant. We prove the analogous statement for manifolds with an index-theoretic obstruction to positive scalar curvature. In particular, this establishes a conjecture of Gromov for simply connected manifolds.

In this series of two talks, we will give an introduction to this circle of ideas, present the index-theoretic result, and draw a connection to largeness properties such as (iso-)enlargeability and notions of infinite width which act as obstructions to positive scalar curvature.

• **Ryushi Goto (Osaka University, Japan)**
Lecture : Scalar curvature as moment map in generalized Kähler geometry
Abstract Fujiki and Donaldson show that the moment map frame work plays a crucial role in Kähler geometry and scalar curvature arises as the moment map for the action of Hamiltonian diffeomorphisms. Generalized Kahler Geometry is a successful generalization of the ordinary Kahler Geometry. In pursuit of this analogy, we show that there exists the moment map on a generalized Kähler manifold under the certain cohomological condition. We prove that the Lie algebra of the reduced automorphisms is reductive if the scalar curvature of a generalized Kahler manifold is a constant, which is an extension of Matsushima-Lichnerowiz theorem. Many typical examples of generalized Kähler manifolds given by Holomorphic poisson structures are discussed.

• **Kota Hattori (Keio University, Japan)**
Lecture : Geometric quantization and the measured Gromov-Hausdorff convergence
Abstract For a closed symplectic manifold X with a prequantum bundle L, we assume that a 1-parameter family of complex structures $\{J_t\}$ compatible with the symplectic structure converges to the real polarization induced by the the Lagrangian torus fibration as t tends to 0. Then it is known that the holomorphic sections of L converge to the delta distributions supported at the Bohr-Sommerfeld fibers in many cases. In this talk we show that the principal frame bundle of L on the neighborhood of the Bohr-Sommerfeld fibers converges to some pointed metric measure spaces in the sense of S^1-equivariant measured Gromov-Hausdorff topology, and the limit space has the eigenfunction which can be regarded as the limit of holomorphic sections of L.

• **Shouhei Honda (Tohoku University, Japan)**
Lecture : Sphere theorem for metric measure space
Abstract In this talk we discuss topological sphere theorems for metric measure spaces with Ricci bounds from below in a synthetic sense, which generalize Colding's and Petersen's sphere theorems to singular spaces. One of the key observation to prove these sphere theorems is to take smoothing of the original Riemannian metric via a geometric flow. This talk is based on a joint work with Mondello.

• **Hokuto Konno (University of Tokyo, Japan)**
Lecture : Positive scalar curvature and gauge-theoretic constraints on 4-manifolds
Abstract Gauge theory, such as Seiberg-Witten theory, gives strong constraints on topology of smooth 4-manifolds. One of most celebrated such constraints is Furuta's 10/8-inequality for spin 4-manifolds. In this talk, I shall give a relation between the existence problem for positive scalar curvature metrics for certain type of closed 4-manifolds and 10/8-type inequalities for certain type of end-periodic 4-manifolds. As an application, I will show the non-existence of positive scalar curvature metrics for infinitely many 4-manifolds for which any known way to show such non-existence cannot be applied. This is joint work with Masaki Taniguchi.

• **Yoshihiko Matsumoto (Osaka Univerity, Japan)**
Lecture : CR structures, ACH-Einstein fillings, and almost complex structures
Abstract I will discuss canonical fillings of CR boundaries with Einstein asymptotically complex hyperbolic (ACH) metrics and some almost complex structures. This is relevant to construction of boundary invariants. A remarkable feature of our setting is that CR structures on the boundary are allowed to be non-integrable; hence the need of discussing *almost* complex structures on the domain inside. An energy functional will be introduced, which allows us to extend boundary CR structures to almost complex structures in a canonical manner in a certain sense, and some global existence result on critical almost complex structures will be given.

• **Shin Nayatani (Nagoya University, Japan)**

Lecture : Riemannian metrics maximizing the first eigenvalue of the Laplacian on a closed surface

Abstract By the classical work of Hersch-Yang-Yau, the first eigenvalue of the Laplacian (under area normalization) on a closed surface has an explicit upper bound in terms of the genus of the surface. In this talk, I will focus on Riemannian metrics that maximize the invariant. I first overview the recent progress on the existence problem for maximizing metrics, including the affirmative resolution of Jacobson-Levitin-Nadirashvili-Nigam-Polterovich's conjecture, which explicitly predicts maximizing metrics in the case of genus two, by Toshihiro Shoda and myself. I then discuss the beautiful relation between maximizing metrics and minimal surfaces in the sphere. I would also touch upon the role of hyperbolic metrics in the problem.

• **Hirofumi Sasahira (Kyusyu University, Japan)**

Lecture : Seiberg-Witten-Floer stable homotopy type for 3-manifolds with positive first Betti number

Abstract Manolescu constructed Seiberg-Witten-Floer stable homotopy type for rational homology 3-spheres. This invariant is a refinement of Seiberg-Witten-Floer homology defined by Kronheimer-Mrowka and has strong applications to topology. I will explain how to generalize the Seiberg-Witten-Floer stable homotopy type to 3-manifolds with positive first Betti number.