Titles and Abstracts

(1) Christopher Bishop (Stony Brook University)

Title: Weil-Petersson curves, traveling salesman theorems and minimal surfaces

Abstract: Weil-Petersson curves are a class of rectifiable closed curves in the plane, defined as the closure of the smooth curves with respect to the Weil-Petersson metric defined by Takhtajan and Teo in 2006. Their work solved a problem from string theory by making the space of closed loops into a Hilbert manifold, but the same class of curves also arises naturally in complex analysis, geometric measure theory, probability theory, knot theory, computer vision, and other areas. No geometric description of Weil-Petersson curves was known until 2019, but there are now more than twenty equivalent conditions. One involves inscribed polygons and can be explained to a calculus student. Another is a strengthening of Peter Jones's traveling salesman condition characterizing rectifiable curves. A third says a curve is Weil-Petersson iff it bounds a minimal surface in hyperbolic 3-space that has finite total curvature. I will discuss these, and several other characterizations, and sketch why they are all equivalent to each other.

(2) Yuxin Ge (Institut de Mathématiques de Toulouse, Université Paul Sabatier)

Title: Compactness of asymptotically hyperbolic Einstein manifolds in dimension 4 and applications

Abstract: Given a closed riemannian manfiold of dimension 3 $(M^3, [h])$, when will we fill in an asymptotically hyperbolic Einstein manifold of dimension 4 (X^4, g_+) such that $r^2 g+|_{M^3} = h$ on the boundary $M^3 = \partial X^4$ for some defining function r on X^4? This problem is motivated by the correspondance AdS/CFT in quantum gravity proposed by Maldacena in 1998 et comes also from the study of the structure of asymptotically hyperbolic Einstein manifolds.

In this talk, I discuss the compactness issue of asymptotically hyperbolic Einstein manifolds in dimension 4, that is, how the compactness on conformal infinity leads to the compactness of the compactification of such manifolds under the suitable conditions on the topology and on some conformal invariants. As application, I discuss the uniqueness problem and non-existence result. It is based on the works with Alice Chang.

(3) Emmy Murphy (Princeton University)

Title: Flexibility in contact and symplectic geometry

Abstract: There is a notion of flexibility, which acts as a touchstone in a large number of geometric contexts. Originally framed by Gromov as the h-principle, the topic has expanded broadly to influence many fields. The talk will discuss flexibility in symplectic geometry, Stein geometry, and contact geometry, and how the notions of flexibility inter-relate between them. A particular interest here are the flexible/rigid dichotomies we see in these geometries, which has seen rapid progress in recent years. The talk will discuss the general notions and framework, and give a broad tour of recent developments.

(4) Antoine Song (California Institute for Technology)

Title: Stability for the entropy inequality and the positive mass theorem

Abstract: I will discuss two recent stability results. The first one pertains to the volume entropy inequality of Besson-Courtois-Gallot for hyperbolic manifolds. The second one, obtained with Conghan Dong, is about the positive mass theorem of Schoen-Yau in dimension 3 and confirms a conjecture of Huisken-Ilmanen. The proofs of those results are very different, nevertheless I will try to convey some common ideas, including the use of "special" maps from manifolds to a model space.

(5) Gang Tian (Peking University)

Title: Ricci flow on Fano manifolds

Abstract: In this talk, I will discuss a long-standing problem on type II singularity of Ricci flow and Fano manifolds. I will report on some recent progress and related results.

(6) Karen Uhlenbeck (Institute for Advanced Study)

Title: Best Lipschitz Maps, Transverse Measures and Earthquake Flows

Abstract: In a series of three papers, Georgios Daskalopoulos and I have approached analytically parts of Thurston's theory of a Teichmüller space based on best Lipschitz maps between hyperbolic surfaces. I will define best Lipschitz map and outline our results, with emphasis on three key points, one from each paper.

(1) The appearance of transverse measures as Noether currents in the analytic formulation of best Lipschitz maps, or infinity harmonic maps, from a surface to a circle.
(2) The variational problems based on Schatten-von Neumann norms needed to approximate best Lipschitz maps between surfaces by solutions to partial differential equations.
(3) The infinitesimal generators of earthquake flows described in Teichmüller theory by the Lie algebra valued transverse measures which arise as Noether currents.

It is to be hoped that the analytical descriptions we found will prove useful.

(7) Robert Young (Courant Institute, New York University)

Title: Metric differentiation and embeddings of the Heisenberg group

Abstract: The Heisenberg group is the simplest example of a noncommutative nilpotent Lie group. In this talk, we will explore how that noncommutativity affects geometry and analysis in the Heisenberg group. We will describe why good embeddings of $\mathbb{H}$ must be bumpy at many scales, how to study embeddings into L_1 by studying surfaces in $\mathbb{H}$, and how to construct a metric space which embeds into L_1 and L_4 but not in L_2. This talk is joint work with Assaf Naor.

(8) Jonathan Zung (Massachusetts Institute of Technology)

Title: Anosov flows and the pair of pants differential

Abstract: In this talk, I'll explain how to construct a chain complex associated to a transitive Anosov flow on a 3-manifold. This story parallels constructions in contact homology. I'll show computations in simple examples and suggest some conjectures.