

# 64<sup>th</sup> Texas Geometry & Topology Conference

25-27 February 2022

University of Texas at Dallas

<https://sites.google.com/view/tgtc2022/home>

<b>Friday</b>	
4:30 - 5:30	Paul Yang
5:30 - 6:00	Break
6:00 - 7:00	Vladimir Markovic
7:00	Boxed dinner

<b>Saturday</b>	
8:30 - 9:30	Antoine Song
9:30 - 10:00	Break
10:00 - 11:00	Bruce Kleiner
11:00 - 11:30	Break
11:30 - 12:30	Alice Chang
12:30 - 2:30	Lunch
2:30 - 3:30	David Gabai
3:30 - 4:00	Break
4:00 - 5:00	Bill Minicozzi
5:00 - 5:30	Break
5:30 - 6:30	Andre Neves
7:00	Banquet

<b>Sunday</b>	
8:30 - 9:30	Mark Haskins
9:30 - 10:00	Break
10:00 - 11:00	Kahryn Mann
11:00 - 11:30	Break
11:30 - 12:30	John Etnyre

# Abstracts

**Paul Yang (Princeton)**

## **CR Geometry of 3-manifolds**

I plan to describe the geometric and analytic questions about CR geometry in this dimension. CR manifolds arise typically as the boundary of a strictly pseudoconvex domains in a complex manifold. Closely connected with the embeddability criteria are interesting examples of solvability of the CR version of the Yamabe equation. I also plan to describe global invariants that lead to open problems involving fully-nonlinear PDE.

**Vladimir Markovic (Oxford)**

## **Non-uniqueness of minimal surfaces in higher rank symmetric spaces**

Labourie conjectured that given a Hitchin representation of a surface group in a split real Lie group, there exists a unique equivariant minimal surface in the corresponding symmetric space (extending the work of Schoen who proved this conjecture when  $n = 2$ ). In my recent work, I show that the analogous conjecture for Fuchsian (Hitchin) representations of a surface group into the semi simple Lie group  $\mathrm{PSL}(2, \mathbb{R}) \times \mathrm{PSL}(2, \mathbb{R}) \times \mathrm{PSL}(2, \mathbb{R})$  does not hold. More generally, I find non-unique equivariant minimal surfaces inside every Hermitian symmetric space of rank at least three. I also prove that there is no Riemannian metric on the Teichmüller space for which the energy functional is geodesically convex.

**Antoine Song (Berkeley)**

## **The spherical Plateau problem**

For any closed oriented manifold with fundamental group  $G$ , or more generally any group homology class for a group  $G$ , I will discuss an infinite dimensional Plateau problem in a Hilbert classifying space for  $G$ . For a closed oriented 3-manifold  $M$ , the intrinsic geometry of any Plateau solution is given by the hyperbolic part of  $M$ . I will also talk about the higher dimensional case. For instance, there are CAT(0) Dehn fillings whose corresponding Plateau solutions have a nice asymptotic behavior.

**Bruce Kleiner (NYU-Courant)**

## **Ricci flow, diffeomorphism groups, and contractibility of spaces of metrics.**

In the lecture I will discuss recent joint work with Richard Bamler, which uses Ricci flow through singularities to construct deformations of spaces of metrics on 3-manifolds. As applications we settle longstanding conjectures about diffeomorphism groups of 3-manifolds, and metrics with positive scalar curvature.

## **Alice Chang (Princeton)**

### **Compactness of conformally compact Einstein manifolds**

Given a manifold  $(M^n; [h])$ , when is it the boundary of a conformally compact Einstein manifold  $(X^{n+1}; g^+)$  with  $r^2 g^+|_M = h$  for some defining function  $r$  on  $X^{n+1}$ ? This problem of finding “conformal filling in” is motivated by problems in the AdS/CFT correspondence in quantum gravity (proposed by Maldacena in 1998) and from the geometric considerations to study the structure of non-compact asymptotically hyperbolic Einstein manifolds.

In this talk, instead of addressing the existence problem of a conformal filling in, we will discuss the compactness problem. That is, given a sequence of conformally compact Einstein manifolds with boundary, we will study the compactness of the sequence under assumption of the compactness of their restrictions on the boundary. I will first briefly survey some known results then report recent joint works in progress with Yuxin Ge and others. As applications, we will address the issue of “uniqueness” of the conformal filling in for a class of manifolds.

## **David Gabai (Princeton)**

### **Knotted 3-Balls in $S^4$ and knotted 3-spheres in $S^1 \times S^3$**

We demonstrate codimension-1 knotting in  $S^4$  and  $S^1 \times S^3$ . That is, there are 3-balls with boundary the standard 2-sphere in  $S^4$ , which are not isotopic rel boundary to the standard 3-ball and there are non-separating 3-spheres in  $S^1 \times S^3$  not isotopic to  $\text{pt.} \times S^3$ . The latter induces diffeomorphisms of  $S^1 \times S^3$  that are homotopic to id but not isotopic to id. (Joint work with Ryan Budney)

## **Bill Minicozzi (MIT)**

### **Singularities of Ricci flow and the gauge problem**

I will talk about joint work with Toby Colding where we prove a strong rigidity theorem for singularities in Ricci flow. The singularities are non-compact which makes the analysis of the gauge group subtle, requiring new analytic ingredients.

## **Andre Neves (Chicago)**

### **Geodesics and minimal surfaces**

There are several properties of closed geodesics which are proven using its Hamiltonian formulation (which has no analogue for minimal surfaces). I will talk about some recent progress in proving some of these properties for minimal surfaces.

## **Mark Haskins (Duke)**

### **Solitons in Bryant's $G_2$ -Laplacian flow**

I will introduce some basic features of  $G_2$ -geometry, a geometry peculiar to 7 dimensions defined in terms of the exceptional compact simple Lie group  $G_2$ . I will then describe a geometric flow on 3-forms, due to Robert Bryant, called Laplacian flow that aims to produce Riemannian 7-manifolds with holonomy group  $G_2$ . The latter are automatically Ricci-flat manifolds.

My talk will concentrate on certain special solutions to Laplacian flow called solitons: in particular, I will describe a recent construction of complete noncompact shrinking, steady and expanding solitons in Laplacian flow. In other better-understood geometric flows (e.g. Ricci flow and mean curvature flow) such solitons have played a key role in understanding singularity formation and hence in understanding the long-time behaviour of these flows. I will try to explain some key similarities and differences between the behaviour of solitons in Laplacian flow compared to Ricci flow or mean curvature flow. This is joint work with Johannes Nordström and also in part with Rowan Juneman (both at University of Bath).

## **Kathryn Mann (Cornell)**

### **Hyperbolic groups acting on their boundaries**

Following Gromov, hyperbolic groups have a natural compactification by a "boundary at infinity", and the group acts on this boundary by homeomorphisms.

This talk will explain a program to show that these boundary actions are rigid or stable in the sense of topological dynamics: any small perturbation of the action is semi-conjugate to the original. While the study of boundary actions and rigidity has roots going back to Selberg and Mostow, this recent project to study hyperbolic groups grew out of joint work with J. Bowden, and now with J. Manning and T. Weisman. I will give some motivation for the problem and the study of groups acting on their boundaries in general, and introduce some key ideas from our work.

## **John Etnyre (Georgia Tech)**

### **New advances in Legendrian knot theory**

The study of Legendrian and transverse knots in contact 3-manifolds, has been a key feature in our understanding of contact geometry in general. In this talk I will survey some of the ways in which Legendrian and transverse knot theory illuminates the nature of contact structures and some of subtle features in their classification. I will particularly focus on current work aimed at classifying Legendrian and transverse torus knots in overtwisted contact structures. This classification exhibits many features not previously seen before and is the start of a project to complete the decades old project to classify tight contact structures on small Seifert fibered spaces. This is joint work with Hyunki Min and Anubhav Mukherjee.

## Demographics

Of the 10 speakers, 8 were male and 2 were female. 2 of the speakers were junior faculty/postdoc, the others were senior faculty.

There were 123 registered participants. Here is a break-down in terms of gender, race/ethnicity, and rank:

### Gender:

Male	98
Female	20
Other	3
No response	2

### Ethnicity:

White	43
Hispanic or Latino	13
Black or African-American	3
Asian	51
Two or more races	2
No response	11

### Rank:

Senior Faculty	13
Junior Faculty/Postdoc	30
Graduate student	79
Special	1