RICCI FLOW AND RELATED TOPICS

27-31 March 2023

University of Warwick

SCHEDULE - TITLES - ABSTRACTS

Version of: March 26, 2023. Subject to small changes.

`https://warwick.ac.uk/fac/sci/maths/research/events/2022-2023/ricciflow`

Location: MS.03 (second floor of Zeeman building on the University of Warwick campus, close to two floors above the main entrance). This is NOT in the Mathematical Sciences Building, which is next door.

Stairwells: The security in Zeeman building was recently adjusted, with the following bizarre consequence: If you enter certain stairwells (where you have to press a green button to get through) then you will not be able to get out without a security card. **Solution:** use the green 'emergency door release' near an external exit by lifting the clear plastic cover. There is no need to break the plastic cover, contrary to what it may say!

All talks 50 minutes + 5 minutes questions.

Beware: UK clocks move forwards 1 hour in the early hours of Sunday 26 March 2023.

Monday

9.00 - 9.50	**Eric Chen (UC Berkeley)**
10.00 - 10.50	**Tristan Ozuch (MIT)**
11.00 - 11.30	Coffee/tea in common room
11.30 - 12.20	**Brett Kotschwar (Arizona)**
12.30 - 14.00	Lunch in common room
14.00 - 14.50	**Ovidiu Munteanu (Connecticut)**
15.00 - 15.30	Coffee/tea in common room
15.30 - 16.20	**Max Stolarski (Warwick)**
17.00 -	Wine/beer reception in common room for all registered participants.
18.00 -	Dinner in common room for all registered participants.

Tuesday

9.00 - 9.50	**Reto Buzano (Torino)**
10.00 - 10.50	**Dan Knopf (UT Austin)**
11.00 - 11.30	Coffee/tea in common room
11.30 - 12.20	**Miles Simon (Magdeburg)**
12.30 - 14.30	Lunch in common room
14.30 - 15.20	**Man Chun Lee (CU Hong Kong)**
15.30 - 16.00	Coffee/tea in common room
16.00 - 16.50	**Hao Yin (USTC)**
Evening :	Arrange your own dinner, in Leamington, Kenilworth or on campus etc.

Wednesday

9.00 - 9.50	**Pak-Yeung Chan (UC San Diego)**
10.00 - 10.50	**Christoph Böhm (Münster)**
11.00 - 11.30	Coffee/tea in common room
11.30 - 12.20	**Guofang Wei (UC Santa Barbara)**
12.30 - 14.00	Lunch in common room
14.00 - 18.30	Free afternoon
18.30 -	**Workshop dinner at Radcliffe private dining room** (on campus) for all registered participants

Thursday

9.00 - 9.50	**Yi Lai (Stanford)**
10.00 - 10.50	**Ronan Conlon (UT Dallas)**
11.00 - 11.30	Coffee/tea in common room
11.30 - 12.20	**Max Hallgren (Rutgers)**
12.30 - 14.00	Lunch in common room
14.00 - 14.50	**Bing Wang (USTC)**
15.00 - 15.30	Coffee/tea in common room
15.30 - 16.20	**Matthias Wink (Münster)**
19.00 -	Dinner at Eleven restaurant for speakers only (sorry)

Friday

9.00 - 9.50	**Markus Wolff (Tübingen)**
10.00 - 10.50	**Lu Wang (Yale)**
11.00 - 11.30	Coffee/tea in common room
11.30 - 12.20	**Felix Schulze (Warwick)**
12.30 -	The end. No lunch provided. Various outlets available on campus.

Christoph Böhm

Homogeneous Einstein metrics

Abstract: We will report on recent progress concerning the classification of homogeneous Einstein manifolds. If the Einstein constant for such a Riemannian metric is negative, then in recent joint work with R. Lafuente we could show that the underlying manifold must be diffeomorphic to a Euclidean space, confirming the famous Alekseevskii conjecture from 1975. In the Ricci flat case it is a classical result that such homogeneous Einstein metrics must be flat. The case when the Einstein constant is positive is wide open, even though there exist general existence and non-existence results.

Reto Buzano

A Local Singularity Analysis for the Ricci flow

Abstract: We will describe a refined local singularity analysis for the Ricci flow developed jointly with Gianmichele Di Matteo. The key idea is to investigate blow-up rates of the curvature tensors locally near a singular point. The theory leads to a localisation of Sesum's result that the Ricci tensor must blow up at a singularity, localisations of the singularity analysis of Type I Ricci flows, as well as some new results about Ricci flows with bounded scalar curvature.

Pak-Yeung Chan

Curvature and gap theorems of gradient Ricci solitons

Abstract: Ricci flow deforms the Riemannian structure of a manifold in the direction of its Ricci curvature and tends to regularize the metric. This provides useful information about the underlying space. Ricci solitons are special solutions to the Ricci flow and arise naturally in the singularity analysis of the flow. We shall discuss some curvature and entropy gap theorems of gradient Ricci solitons. This talk is based on a joint work with Yongjia Zhang and Zilu Ma.

Eric Chen

Smoothing cones with nonnegative scalar curvature via Ricci expanders

Abstract: The Ricci flow in dimension four (and higher) can encounter conical singularities. These may potentially be resolved using expanding solitons asymptotic to the singularity's conical structure. I will discuss joint work with Richard Bamler on a degree theory for four-dimensional asymptotically conical gradient expanding solitons, which in particular yields the existence of expanding gradient solitons asymptotic to cones of non-negative scalar curvature over S^3 or its quotients.

Ronan Conlon

Shrinking Kähler-Ricci solitons on complex surfaces

Abstract: Shrinking Kähler-Ricci solitons model finite-time singularities of the Kähler-Ricci flow, hence the need for their classification. I will talk about the classification of such solitons in four real dimensions. This is joint work with Bamler-Cifarelli-Deruelle, Cifarelli-Deruelle, and Deruelle-Sun.

Max Hallgren

Tangent Flows of Kähler Metric Flows

Abstract: In this talk, we will discuss some additional structure in the Kähler setting for Bamler's limit spaces of noncollapsed Ricci flows. We will review various notions of singular set stratification, and then state an improved dimension estimate for odd-dimensional strata of limits of Kähler-Ricci flows. We will also see that tangent flows of Kähler metric flows admit natural isometric actions, which are locally free away from the vertex in the case that the tangent flows are static.

Dan Knopf

Singularity formation of complete Ricci flow solutions

Abstract: We study a class of noncompact Ricci flow solutions that form singularities at spatial infinity. We will discuss methods useful for their analysis and a condition conjecturally sufficient to obtain nontrivial shrinking solitons as singularity model limits of blowup sequences in noncompact solutions.

Brett Kotschwar

Backward propagation of warped-product structures and asymptotically conical shrinking solitons

Abstract: We establish some general sufficient conditions for local warped-products structure to propagate backward in time under the Ricci flow. As an application, we show that if a gradient shrinking soliton is asymptotic to a cone whose cross-section is a product of Einstein manifolds, the soliton must itself be a multiply-warped product over the same manifolds. This implies that certain cones cannot occur as the asymptotic cones of complete shrinking solitons.

Yi Lai

$O(2)$-symmetry of 3D steady gradient Ricci solitons

Abstract: For any 3D steady gradient Ricci soliton with positive curvature, if it is asymptotic to a ray we prove that it must be isometric to the Bryant soliton. Otherwise, it is asymptotic to a sector and called a flying wing. We show that all flying wings are O(2)-symmetric. Hence, all 3D steady gradient Ricci solitons are O(2)-symmetric.

Man Chun Lee

Lipschitz Rigidity on scalar curvature using Ricci flow

Abstract: In this talk, we will discuss how Ricci flow smoothing can be used to study the rigidity of non-smooth metrics related to the scalar curvature. This is based on joint work with L.-F. Tam.

Ovidiu Munteanu

Ends of Ricci solitons

Abstract: This talk will survey several results concerning the topology at infinity of Ricci solitons, including counting the number of ends, as well as structure results.

Tristan Ozuch

4-dimensional specific aspects of Ricci flows

Abstract: Ricci flow has been extensively studied, and most results are either specific to dimension 3 or valid in any dimension. However, given the potential topological applications, a theory specific to the 4-dimensional situation is desirable. In this discussion, I will present tools and techniques that are unique to the dimension 4.

Together with A. Deruelle, we introduce a notion of stability for orbifold singularities. This notion helps to explain the formation of orbifold singularities along Ricci flow and lets us construct large classes of ancient Ricci flows. In collaboration with K. Naff, we utilize self-duality in dimension 4 to simplify the evolution equations of curvature. Among other things, this approach lets us to uncover intriguing links between Ricci flow and Yang-Mills flow.

Felix Schulze

Mean curvature flow with generic initial data

Abstract: We show that the mean curvature flow of a generic closed surface in $\mathbb{R}^3$ avoids multiplicity one tangent flows that are not round spheres/cylinders. In particular, we show that any non-cylindrical self-shrinker with a cylindrical end cannot arise generically. This is joint work with O. Chodosh and K. Choi.

Miles Simon

Initial stability estimates for Ricci flow and three dimensional Ricci-pinched manifolds (Joint work with Alix Deruelle and Felix Schulze)

Abstract: In this talk we examine the Ricci flow of initial metric spaces which are Reifenberg and locally bi-Lipschitz to Euclidean space. We show that any two solutions starting from such an initial metric space, whose Ricci curvatures are uniformly bounded from below and whose curvatures are bounded by $c \cdot t^{-1}$, are exponentially in time close to one another in the appropriate gauge. As an application, we show that smooth three dimensional, complete, uniformly Ricci-pinched Riemannian manifolds with bounded curvature are either compact or flat, thus confirming a conjecture of Hamilton and Lott.

Max Stolarski

Closed Ricci Flows with Singularities Modelled on Asymptotically Conical Shrinkers

Abstract: Finite-time Ricci flow singularities are modelled on gradient shrinking Ricci solitons. We discuss a certain converse question, namely, "Given a complete, noncompact gradient shrinking Ricci soliton, does there exist a Ricci flow on a closed manifold that forms a finite-time singularity modelled on the given soliton." We'll discuss work that shows the answer is yes when the soliton is asymptotically conical. No symmetry or Kähler assumption is required, and so the proof involves an analysis of the Ricci flow as a nonlinear degenerate parabolic PDE system in its full complexity. We'll also discuss applications to the (non-)uniqueness of weak Ricci flows through singularities.

Bing Wang

On Kähler Ricci shrinker surfaces

Abstract: We apply several convergence theories for Ricci shrinkers to demonstrate that any non-compact Kähler Ricci shrinker surface has two distinct canonical neighborhoods outside a compact set. Consequently, we establish that Kähler Ricci shrinker surfaces have uniformly bounded sectional curvature. Combining this curvature estimate with earlier work by many authors, we provide a complete classification of all Kähler Ricci shrinker surfaces. This is joint work with Yu Li.

Lu Wang

A mean curvature flow approach to density of minimal cones

Abstract: Minimal cones are models for singularities in minimal submanifolds, as well as stationary solutions to the mean curvature flow. In this talk, I will explain how

to utilize mean curvature flow to yield near optimal estimates on density of minimal cones.

Guofang Wei

Spaces with Ricci Curvature Lower Bound

Abstract: It is of general interest to study the difference between Ricci and sectional curvature lower bound. A well known difference is their control on Betti numbers. Joint with J. Pan, we constructed manifolds/singular spaces with nonnegative Ricci curvature which give negative answers to two long open questions. One is about the properness of Busemann functions, and the other one regards the singular set of Ricci limit sets. Building on these, joint with X. Dai, S. Honda, J. Pan, we discover two surprising types of Weyl's laws which are fractal-like for some compact singular space with "Ricci lower bound" (Ricci limit spaces). These show dramatic new features for Ricci lower bound.

Matthias Wink

Einstein metrics on the ten-sphere

Abstract: We prove the existence of three non-round, non-isometric Einstein metrics with positive scalar curvature on the sphere S^{10}. Previously, the only even-dimensional spheres known to admit non-round Einstein metrics were S^6 and S^8. This talk is based on joint work with Jan Nienhaus.

Markus Wolff

Ricci-Flow on surfaces along the standard light cone in the 3+1 Minkowski spacetime

Abstract: By identifying the conformal structure of the round 2-sphere with the standard lightcone in the 3+1 Minkowski space we gain a new perspective on 2d-Ricci flow on topological spheres in the context of General Relativity. It turns out that in this setting Ricci flow is equivalent to a null mean curvature flow first proposed by Roesch–Scheuer along null hypersurfaces. Thus, we can fully characterize the singularity models for this proposed flow in the standard Minkowski lightcone, where the metrics of constant scalar curvature (up to scaling) each correspond to a member of the restricted Lorentz group $SO^+(3,1)$. This new viewpoint of conformally round 2d-Ricci flow as an extrinsic flow along the lightcone leads to a new proof of Hamilton's classical result using only the maximum principle.

Hao Yin

Ricci flow on surfaces with rough initial data

Abstract: In this talk, we will discuss Ricci flow on surfaces with Radon measure as initial data. We will outline the proof of existence and give some applications.