Week 2 Abstracts

Speaker: Karl-Theodor Sturm
Abstract: Super-Ricci flows allows for plenty of nice and powerful characterizations in terms of optimal transport and functional inequalities. To single out Ricci flows among super-Ricci flows, an obvious approach is based on synthetic upper Ricci bounds and their time-dependent counterparts. Here we propose another approach based on the nonpositivity of the negative slope of a certain Gaussian double integral. In the static case, the latter is a synthetic formulation for the integral of the scalar curvature. We will discuss this for both smooth and singular spaces, including cones and doublings.

Speaker: Christina Sormani
Abstract: We will review Ambrosio-Kirchheim Currents on Metric Spaces (Acta 2000) and Sormani-Wenger Intrinsic Flat Convergence of Integral Current Spaces (JDG 2011).

Speaker: Qiaochu Ma
Abstract: Scalar curvature encodes the volume information of small geodesic balls within a Riemannian manifold, making it, to some extent, the weakest curvature invariant. This raises a natural question: what topological constraints does scalar curvature impose on manifolds? In this talk, we shall show that for a manifold with a scalar curvature lower bound, the simplicial norm of certain characteristic classes can be controlled by its volume and isoperimetric constant. This is joint work with Guoliang Yu.

Speaker: Raquel Perales
Abstract: We will survey applications of intrinsic flat convergence to questions arising in mathematical general relativity with a focus on an open conjecture of Lee-Sormani on the Geometric Stability of the Positive Mass Theorem. We will survey progress towards this conjecture in work of Huang, Lee, Stavrov, Allen, Perales, and others.

Speaker: Eric Woolgar
Abstract: The Ricci tensor is not conformally invariant, so nor are singularity theorems. The first thing I learned last week is that one can phrase part of the Penrose theorem in a conformally invariant way. I'll do what I can to reformulate the other part, the energy condition, at least as a statement about representatives within conformal classes. In fact, this reformulation is a special case of the Penrose theorem for weighted spacetimes. With the notion of a weighted spacetime in hand, I will move to a discussion of possible positive mass theorems in the setting of synthetic curvature. Here the main issue is that the strong energy condition now has a synthetic formulation, but positive mass theorems use the dominant energy condition (and its Riemannian cousin, scalar curvature positivity). But there is one formulation of the positive mass theorem which uses Ricci curvature bounds. I will review its proof. The second thing I learned last week is that this formulation should be applicable to Lorentz-Finsler spacetimes, with a weighted Ricci curvature lower bound. Finally, time permitting, I will mention a notion of positive mass that does not rely at all on a spacetime curvature bound, even a synthetic one, and uses only causality relations so it is manifestly conformally invariant and insensitive to weighting.

Speaker: Christina Sormani
Abstract: We will review the Andersson-Galloway-Howard cosmological time, the Sormani-Vega Null Distance, and various notions of convergence defined by Sormani-Sakovich for causally null compactifiable space-times.

Speaker: Yasuaki Fujitani
Abstract: Li-Xia introduced a family of affine connections that connect the substatic condition in general relativity with 1-weighted Ricci curvature. For manifolds with Ricci curvature bounded from below, lower bounds for the first eigenvalue of the Laplacian on minimal hypersurfaces have been established. We extend some of these results to the Laplacian associated with Li-Xia type affine connections.