Week 3 Abstracts

Minicourse: Dylan Cant (University of Montreal)

Abstract: I will present joint work (with Jun Zhang and Eric Kilgore) which establishes the orderability of contact manifolds which are quotients of fillable contact manifolds under finite group actions compatible with the filling (the group action should admit fixed points in the filling). The prototypical example is odd-dimensional real projective space (as the quotient of an odd-dimensional sphere).

Our approach employs an equivariant formulation of the so-called "contact Floer cohomology theory," which has been a topic of recent study by various authors (a notable milestone is a 2019 paper by Uljarevic and Merry), and is related to the Rabinowitz Floer homology developed by Cieliebak, Frauenfelder, Albers, Merry, and others.

I will discuss recent conclusions of the "contact Floer cohomology" theory involving quantitative aspects, such as "spectral geometries" (similar to the spectral metrics for Hamiltonian diffeomorphisms), and unbounded conjugation invariant integer valued measurements (such integer valued measurements have long been a slightly mysterious recurring theme in contact geometry, and go back to work of Givental and Sandon).

A key idea is that mapping cones of continuation maps detect crossings with the *discriminant* (a special codimension-1 subset in the contactomorphism group). To handle the inherent non-canonicity in defining such chain level mapping cones, we lift the structure of contact Floer cohomology to chain level by defining it as an ∞-functor on a suitable ∞-categorification of the Eliashberg–Polterovich orderability relation on the universal cover of the contactomorphism group.

Speaker: David Sloan, Lancaster University

Abstract: Much of physics is described in terms of Lagrangian or Hamiltonian systems defined upon symplectic manifolds. In many of these systems there is a "hidden" symmetry corresponding to the choice of scale within the system. I will briefly recap how the removal of this scale degree of freedom reveals a contact system. This will then be applied to physically interesting systems, including the case of homogeneous cosmology in which the scale factor will be shown to be "superfluous structure" in the terminology of van Fraassen and Ismael. I will end with some remarks on current

research applying these results to general relativity, and some open avenues for further work.

Minicourse: Vladimir Chernov (Dartmouth College)

Abstract: Low and Penrose introduced contact structure on the space of light rays in a spacetime. The sphere S_p of all the light rays through the point p is called the sky of p and is Legendrian. Rudyak and myself started the work on generalized linking number and causality. Jointly with Nemirovski we proved that for almost all globally hyperbolic spacetimes two points p,q are causally related if and only if the Legendrian link S_p, S_q is nontrivial. This holds UNLESS the universal cover of the Cauchy surface S is compact AND has the same homology as a CROSS Compact Rank One Symmetric Spacetime. In particular this solved Low, Natario-Tod Conjectures and answered Penrose question on Arnold Problem list. Jointly with Rudyak, Nemrirovski and in a later work by Bauermeister it was proved that UNLESS both of these conditions hold the spacetime also has no strict refocusing. This is when all light rays through one of the two points pass through the other.

We also discuss our results with Nemirovski on the uniqueness of smooth structures on globally hyperbolic spacetimes and the conjectural generalizations of this results to all globally hyperbolic spacetimes of all dimensions. Conjecturally this smooth structure might be characterized by the contact manifolds of all the light rays or you might possibly need to add a few Legendrian sky submanifolds.
