Workshop on Geometric Methods in Sympectic Topology

ABSTRACTS

Frédéric Bourgeois (Univ. Paris Sud)

Title – *Bilinearized Legendrian contact homology and equivalence of augmentations*

Abstract Bilinearized Legendrian contact homology is an invariant for isotopy classes of Legendrian submanifolds, which is based on the count of holomorphic curves. It plays a central role in the definition of the augmentation category, an A_∞-category analogous to the Fukaya category for contact manifolds. In this talk, I will explain how bilinearized Legendrian contact homology can decide whether two augmentations are equivalent objects in the augmentation category. Then I will describe all graded vector spaces that can appear in the corresponding homological category. This is a joint work with Damien Galant.

Roger Casals (UC Davis)

Title – *The Reidemeister III Move*

Abstract In this talk I will discuss the Reidemeister III move for Legendrian knots in the standard contact 3-dimensional sphere. In particular, I will explain how to build a faithful modular representation into a subset of the coordinate ring of the Grassmannian associated to the affine exceptional E8-Lie algebra. Then I will explain an application to 3-dimensional contact topology.

Viktor Ginzburg (UC Santa Cruz)

Title – *Spectral Characterization of Besse and Zoll Reeb flows*

Abstract A Reeb flow is Besse when all its orbits are closed, and Zoll when they have the same minimal period. In this talk, based on a joint work with Basak Gurel and Marco Mazzucchelli, we discuss a characterization of Besse and Zoll star-shapped hypersurfaces and Riemannian unit tangent bundles of the sphere in terms of their equivariant spectral invariants, e.g., the Ekeland–Hofer capacities.

This characterization is a part of a much more general phenomenon, which is best understood in the context of (equivariant) Lusternik-Schnirelmann theory.

Ángel Gónzalez Prieto (ICMAT)

Title– *Homotopy groups of spaces of knots with bow, arrows and bordisms*

Abstract The computation of higher homotopy groups of the space of embedded knots in $\mathbb{R}^n$, for $n \geq 4$, is an outstanding open problem. Some of the most advanced and elaborated techniques have being applied to this problem, like functor calculus, with relative success for low degree. However, the power of these tools is in the root of their fail, since the become too involved for allowing precise computations on high dimensional families. In this talk, we will explain a novel low-tech approach to this problem based on the interpretation of the underlying obstruction theory as a decorated bordism class. This will allow us to easily replicate the known results without suffering dimensional curse. Finally, we will show how introducing nuclear weapons like Igusa's theory and h-principle for horizontal knots, we can push this technique much further.

Joint work in progress with F. Cantero, E. Fernández and F. Presas.

Basak Gurel (Florida Central University)

Title – *From pseudo-rotations to holomorphic curves*

Abstract The main theme of the talk is the dynamics of Hamiltonian pseudo-rotations, i.e., Hamiltonian diffeomorphisms of a closed symplectic manifold M having the minimum number of periodic points. This is an interesting and important class of maps and, as has been established recently, there is a strong relation between the symplectic topological properties of M and the dynamics of pseudo-rotations of M, going far beyond periodic orbits. In this talk we discuss new connections between pseudo-rotations and holomorphic curves, recently found in a joint work with Erman Cineli and Viktor Ginzburg.

Emmanuel Giroux (École Normale de Lyon)

Title–

Abstract

Alberto Ibort (Univ. Carlos III)

Title – *Causality and orderability*

Abstract TBA

David Martínez Torres (PUC- Rio de Janeiro)

Title– *Canonical domains for coadjoint orbits*

Abstract I shall discuss how for any coadjoint orbit of a compact Lie group there exists an open dense subset which is symplectomorphic to a domain of a cotangent bundle. If time permits, I shall also present a symplectic duality of sorts between compact and non-compact coadjoint orbits.

Eva Miranda (UPC-ICMAT-Observatoire de Paris)

Title– *Universality of Euler flows and flexibility of Reeb embeddings*

Abstract The dynamics of an inviscid and incompressible fluid flow on a Riemannian manifold are governed by the Euler equations. Recently, Tao launched a programme to address the global existence problem, not only for Euler equations, but also for their viscid counterpart, the Navier-Stokes equations, based on the concept of universality. This notion concerns the Euler equations without fixing neither the ambient manifold nor the metric, and can be defined as the property that any smooth non-autonomous flow on a manifold N may be 'extended' to a solution of the Euler equations for some (M,g) , where the dimension of M is usually much bigger than the dimension of N.

In this talk we will show the universality of the Euler equations using stationary solutions, which model fluid flows in equilibrium. While at first glance it seems that the steady Euler flows are too restrictive to encode aritrarily complicated dynamics, we shall see that the connection between the

Euler equations and contact topology, allows us to import the flexibility principles from the contact realm to show that the stationary solutions exhibit universality features.

This is joint work with Robert Cardona, Daniel Peralta-Salas and Fran Presas (arXiv:1911.01963)

Ignasi Mundet (UB)

Title– *Jordan property in symplectic and contact geometry*

Abstract A group G is Jordan if there exists some constant C such that any finite subgroup H of G has an abelian subgroup A with the property that the index [H:A] is at most C. There exist many closed manifolds M such that Diff(M) is Jordan, and many other ones for which Diff(M) is not Jordan. After giving some details about the previous statement, I will concentrate on results concerning the Jordan property for Symp(M) and Ham(M), where M is a closed symplectic manifold. For example, I will talk about the statement that Ham(M) is Jordan for every closed symplectic manifold, while there exist many such M for which Diff(M) is not Jordan. If time permits, I will also talk about the Jordan property for automorphism groups of contact manifolds.

Vicente Muñoz (Universidad de Málaga)

Title *On K-contact and Sasakian manifolds of dimension 5*

Abstract Sasakian manifolds are odd-dimensional counterparts of Kahler manifolds in even dimensions, with K-contact manifolds corresponding to symplectic manifolds. It is an interesting problem to find obstructions for a compact manifold to admit such types of structures and in particular, to construct K-contact manifolds which do not admit Sasakian structures.

In dimension 5, we translate the question about K-contact 5-manifolds to constructing symplectic 4-manifolds containing disjoint symplectic surfaces of positive genus spanning the homology. We give a new construction that produces a simply connected K-contact 5-manifold. The question on Sasakian 5-manifolds translates to the existence of algebraic surfaces containig disjoint complex curves of positive genus spanning the homology. We conjecture that this is not possible for $b_1 = 0, b_2 > 1$. We prove this conjecture for some cases where the curves have small genus.

(This is joint work with A. Cañas, J.A. Rojo and A. Viruel)

Emmy Murphy (Northwestern University)

Title – *Obstructions to immersed Lagrangian fillings*

Abstract If L is an immersed Lagrangian surface with only transverse double points, we can perform surgery on those double points to produce a Lagrangian which is embedded, but has higher genus. This talk will discuss the converse statement, whether a Lagrangian with genus comes from such a surgery, in the context of Lagrangian fillings of Legendrian knots. A difficulty is that an immersed filling is often categorically isomorphic to an embedded filling, and so it is not clear how standard tools would detect this. The main result constructs, for every g, k, a Legendrian knot with a genus g immersed filling with k double points, but no genus g-1 filling with k+1 double points. This is joint work with O. Capovilla-Searle, N. Legout, M. Limouzineau, Y. Pan, and L. Traynor.

Klaus Niederkrüger (Univ. Lyon 1)

Title – *Hamiltonian group actions on symplectic manifolds with contact boundary*

Abstract In this talk, I'll sketch some of the basic properties of hamiltonian group actions for symplectic manifolds with contact boundary.

(joint work in progress with Aleksandra Marinkovic)

Cédric Oms (UPC)

Title – *Singular contact structures and periodic Reeb orbits*

Abstract We investigate contact forms admitting singularities and analyze the dynamics of its associated Reeb vector field. A motivation to study differential forms that are singular on a hypersurface comes from celestial mechanics, where classical coordinate changes incude singularities in the symplectic form. Another source of example is coming from fluid dynamics when considering manifolds with boundary. We discuss the Weinstein conjecture on the existence of periodic Reeb orbits in this setting. This is joint work with Eva Miranda.

Time permitting, we will discuss Beltrami fields with isolated singularities. Those can be described as Reeb vector fields associated to contact forms with isolated singularities. We will explain how Hofer's machinery can be possibly applied in this setting to prove existence of periodic Reeb orbits away from the singular set. This is work in progress together with Eva Miranda and Fran Presas.

Álvaro del Pino (Universiteit Utrecht)

Title – *Integral submanifolds of jet spaces*

Abstract Y. Eliashberg and N. Mishachev introduced wrinkled embeddings to show that a tangential homotopy can be approximated by a homotopy of embeddings with simple singularities. Several results in Contact Topology (namely, E. Murphy's h-principle for loose legendrians and D. Álvarez-Gavela's simplification of front singularities of legendrians) rely on this theorem.

In this talk I will explain a higher order analogue of this result, in which instead of tangential homotopies we look at homotopies of the r-jet of a submanifold. I will then discuss some consequences of this in the study of submanifolds tangent to the tautological distribution in jet space (which generalise legendrians). This is joint work with L.E. Toussaint.

Leonid Polterovich (Tel Aviv University)

Title – *Geometry of Quantum Uncertainty*

Abstract I will discuss some geometric facets of uncertainty principles in quantum mechanics.

Romero Solha (PUC-Rio de Janeiro)

Title– *Real geometric quantisation of K3 surfaces*

Abstract The aim of this talk is to illustrate through an example how geometric quantisation behaves when the real polarisations have nodal singularities. I am going to present a construction of singular lagrangian fibrations over a K3 surface and to compute their real geometric quantisation. The

Hilbert spaces obtained are in general finite dimensional (although different from the Kähler quantisation); however, they can be infinite dimensional if the nodal fibres satisfy the Bohr–Sommerfeld condition.