

Trobada Geomvap — Cardona, 23-24 gener 2019

Horari

dimecres 23

moderador (matí): Jesús Fernández

10:30 - 11:00 *recepció – cafè*

11:00 - 11:30 Alessandro Oneto

11:30 - 12:00 Juan Margalef

12:00 - 12:15 *pausa*

12:15 - 12:45 Eva Miranda

12:45 - 13:00 Cédric Oms

13:00 - 13:30 Josep Álvarez

13:45 - 15:15 *dinar*

15:15 - 16:45 *visita guiada al castell de Cardona*

moderadors (tarda): Juan Margalef / Alessandro Oneto

17:00 - 17:15 Guillem Blanco

17:15 - 17:30 Anastasia Matveeva

17:30 - 17:45 Roisin Braddell

17:45 - 18:00 Robert Cardona

18:00 - 18:15 Arnau Planas

18:15 - 18:45 *pausa cafè*

18:45 - 19:00 Joaquim Brugués

19:00 - 19:15 Franco Coltraro

19:15 - 19:30 Patricio Almirón

19:30 - 19:45 Marina Garrote

19:45 - 20:00 Jordi Roca

21:00 - 22:00 *sopar*

dijous 24

moderadors: Marta Casanellas / Eva Miranda

9:30 - 10:00 Xavier Gràcia

10:00 - 10:30 Maria Alberich

10:30 - 11:00 *pausa cafè*

11:00 - 11:30 Miguel Ángel Barja

11:30 - 12:00 Josep Elgueta

12:00 - 12:15 *pausa*

12:15 - 12:45 Narciso Román-Roy

12:45 - 13:00 Xavier Rivas

13:00 - 13:30 Miguel Muñoz-Lecanda

14:30 - 15:30 *dinar – clausura*

Action of Cremona maps on planar polynomial differential systems

Maria Alberich Carramiñana

The Cremona group of birational transformations of the complex projective plane acts on the space of planar polynomial differential systems. This action is not compatible with the degree of the differential system. When the degree of a differential system is invariant under the action of a plane Cremona map Φ , we say that the differential system is numerically invariant by Φ . We will discuss some implications of this property.

On the tjurina number of plan curve singularities

Patricio Almiron Cuadros

I will present some topics and calculations about the Tjurina number of a plane curve singularity. The principal motivation is a question posed by A. Dimca and G.M. Greuel in 2017 which gives a surprising relation between two of the main invariants of plane curves singularities: Milnor number, of topological nature, and Tjurina number, of analytical nature. I will also present a partial answer to this question in the case of semi-quasihomogeneous singularities (joint work with G. Blanco) which constitute a new hope to achieve a positive answer to Dimca and Greuel's question in the general case.

D-modules over direct summands

Josep Alvarez Montaner

The aim of this talk is to survey some recent results on the structure of modules over the ring of differential operators on a direct summand of a regular ring. In particular, we will present an extension of the theory of V-filtrations and Bernstein-Sato polynomials to this non-regular framework. Time permitting we will also present some applications to multiplier ideals and test ideals.

Clasificación de variedades irregulares y el Teorema Fundamental del Cálculo

Miguel Angel Barja

En esta charla pretendo en primer lugar introducir el problema del estudio y clasificación de las variedades proyectivas complejas. Particularmente quiero hablar de la geografía de ciertos invariantes numéricos asociados a variedades irregulares y explicar la filosofía general que he introducido en diversos trabajos recientes. Esta nueva aproximación permite estudiar variedades irregulares por inducción en su dimensión, a través de una sencilla aplicación del teorema fundamental del cálculo.

Bernstein-Sato polynomials of plane curves

Guillem Blanco

In this talk we will present new results on the structure of the roots of the Bernstein-Sato polynomial of plane curve singularities.

Group symmetries of cosymplectic and b -symplectic manifolds

Roisin Braddell

Cosymplectic manifolds arise naturally in mathematical physics as time-flow of phase spaces. In certain cases the associated symplectic mapping torus can have monodromy. Cosymplectic mapping tori have also become of interest due to the connection to symplectic manifolds with singularities, which are known as b -symplectic manifolds. Due to the structure of these manifolds, they possess very limited symmetries and the existence of symmetries of these objects has interesting local and global consequences. Inspired by similar results from symplectic theory, we give a normal form result for cosymplectic and b -symplectic manifolds equipped with a group action in the neighbourhood of a group orbit and speak a little on the connections with physics. This is a joint work with Anna Kiesenhofer and Eva Miranda.

La construcció de l'homologia de Floer

Joaquim Brugués

L'homologia de Floer fou desenvolupada per donar resposta a la conjectura d'Arnold sobre els punts fixos de simplectomorfismes. Inspirant-se en l'esquema seguit per construir l'homologia de Morse i en els treballs de Gromov sobre les corbes pseudoholomorfes, Floer va construir una homologia que relaciona la topologia d'una varietat simplèctica amb les solucions periòdiques dels sistemes hamiltonians definits sobre la varietat. En aquesta xerrada veurem quins passos són necessaris per definir l'homologia de Floer d'una varietat simplèctica, i quines eines de la geometria simplèctica i l'anàlisi tenen un paper en aquesta construcció.

Estructures geomètriques en hidrodinàmica

Robert Cardona

En aquesta xerrada curta, ens interessem en les equacions d'Euler per a fluids ideals. Aquestes modelen el camp de velocitats d'un fluid incompressible i no viscos. Usant resultats obtinguts amb l'Eva Miranda es pot redemonstrar l'apartat topològic del Teorema estructural d'Arnold per quan la funció de Bernoulli no és constant. En els conjunts singulars de la funció de Bernoulli es troben estructures b -simplèctiques. Quan la funció de Bernoulli és constant, i considerem b -mètriques podem trobar estructures de b -contacte.

Mechanics of inextensible surfaces

Franco Coltraro

In this talk we study the dynamics of surfaces with boundary that are only allowed to deform isometrically through space. We explain how a physical lagrangian model is derived, discretized using finite elements and integrated numerically. Applications to the simulation of cloth are discussed.

Representacions categòriques

Josep Elgueta

La teoria tradicional de representacions de grups és en termes de simetries d'objectes d'alguna categoria adient, com ara espais vectorials. Però també es poden representar en general com a simetries d'objectes d'una 2-categoria; són les anomenades 2-representacions. Explicaré què és una 2-categoria (en les versions estricta i feble) i la corresponent noció de morfisme entre elles en les tres versions (lax, pseudo i estricte), i què és una 2-representació d'un grup. Més en general, explicaré, posant diversos exemples, que és un 2-grup o grup categòric i definiré les corresponents 2-categories de representacions. Comentaré alguns exemples de 2-categories on es poden representar els 2-grups, alguns resultats existents i alguns problemes oberts generals.

Semi-algebraic conditions for phylogenetic varieties

Marina Garrote López

It is well known that there exists a close relationship between Phylogenetics and Algebraic Geometry. It is common to model evolution adopting a parametric statistical model which allows to define a joint probability distribution at the leaves of the trees. When these models are algebraic, one is able to deduce polynomial relationships between these probabilities, and the study of these polynomials and the geometry of the algebraic varieties that arise from them can be used to reconstruct phylogenetic trees. However not every point in this algebraic varieties has biological sense. In this talk we would like to discuss the importance of studying the subset of these varieties with biological sense and explore the extent to which restricting to these subsets can provide insight into existent methods of phylogenetic reconstruction.

Hamilton-Jacobi theory and geometric mechanics

Xavier Gràcia

From the viewpoint of geometric mechanics, any dynamical system should be described in a coordinate-independent way, by means of the tools of differential geometry. Thinking about the geometric structures involved may lead to new interesting questions. In this talk we will consider Hamilton-Jacobi equation, which is in some regards equivalent to Hamilton's equation. In particular, we will give an interpretation of Hamilton-Jacobi equation on a phase space manifold in terms of a family of differential equations on a lower-dimensional manifold, and show how constants of motion may help to solve Hamilton-Jacobi equation.

De la mecánica clásica a la mecánica cuántica

Juan Margalef

El objetivo de esta charla es hacer una introducción a la mecánica cuántica haciendo especial hincapié en los aspectos geométricos. En primer lugar haremos una breve revisión de la mecánica newtoniana, lagrangiana y hamiltoniana, centrándonos en ésta última y en su relación con la geometría simpléctica. A continuación, introduciremos formalmente la mecánica cuántica y su relación con el formalismo hamiltoniano.

Group valued moment maps and equivariant cohomologies

Anastasiia Matveeva

I am going to talk about quasi-Hamiltonian spaces for which the moment map takes values not in the Lie algebra but in the Lie group. I am going to explain the notion of equivariant cohomologies for the Hamiltonian spaces with usual moment maps and say a few words about possible generalization for the group valued case.

From Celestial Mechanics to Fluid Dynamics: contact structures with singularities, part I

Eva Miranda

Taking as starting point several examples from Celestial mechanics where regularization techniques bring singularities in, we will introduce the geometry of contact structures where the regularity of the contact 1-form is relaxed. Contact structures also show up modelling problems in Fluid Dynamics and singularities also appear naturally in this context (ongoing joint work with Robert Cardona and Daniel Peralta-Salas).

Two main geometrical problems will be addressed in this talk: The existence problem of contact structures with singularities on a given manifold and the study of its Reeb Dynamics, in particular, the existence of periodic orbits (Weinstein conjecture). This is joint work with Cédric Oms.

Sobre distribuciones no integrables

Miguel C. Muñoz Lecanda

Es conocido que las nociones de primera y segunda formas fundamentales de una superficie regular en \mathbb{R}^3 se pueden extender al caso de una subvariedad de una variedad riemanniana y también al caso de una distribución regular y a la foliación asociada. En esta charla trataremos de extender esas nociones a una distribución regular no involutiva, se analizarán las ideas asociadas sobre curvatura y se caracterizarán las distribuciones que sean totalmente geodésicas. Los resultados que se obtienen están relacionados con el estudio de los sistemas mecánicos sujetos a ligaduras no holónomas, con problemas de controlabilidad en sistemas mecánicos con controles y con la geometría subriemanniana.

From Celestial Mechanics to Fluid Dynamics: contact structures with singularities, part II

Cédric Oms

In the second part of this talk, we give a plug like-construction for the Reeb flow on singular contact manifolds. This disproves the Weinstein conjecture in this setting and more generally, displays examples of singular symplectic manifolds with smooth proper Hamiltonian without periodic orbits on the level-set of the Hamiltonian.

This is joint work with Eva Miranda

Looking for equations of mixtures of phylogenetic models

Alessandro Oneto

The goal of *Phylogenetic Algebraic Geometry* is to apply the language and the tools of classical algebraic geometry to phylogenetic reconstruction problems. Phylogenetic models describe ancestral relationships among different species and often there are polynomial relations between the observed data and the parameters of the model: in this way, it is natural to associate to the model an algebraic variety. One of the main goals of algebraic geometry is to compute the implicit polynomial equations defining an algebraic varieties: in the case of phylogenetic models, these are called phylogenetic invariants and can be used to infer the topology of the tree. In this talk, after a general introduction, I will focus on an ongoing project with Marta Casanellas and Jesus Fernandez-Sanchez where we are looking for phylogenetic invariants of mixtures of particular phylogenetic models.

A b^m -symplectic KAM theorem

Arnau Planas

KAM is a pretty well known theorem in dynamical systems. It explains how small hamiltonian perturbations affect the periodic orbits of an integrable system. We try to generalize the theorem in the b^m -symplectic setting. We proceed in two ways. The first way is to extend the original construction in a b^m -symplectic manifold. The second way is to apply a desingularization technique to the b^m -symplectic form and to the b^m -integrable system.

Singular Lagrangian field theories and k-cosymplectic geometry

Xavier Rivas Guijarro

Classical field theories described by singular lagrangians are of great importance in modern physics. These theories can be geometrically described within the framework of k-cosymplectic geometry; more precisely, we define the notion of k-precosymplectic structure. When considering singular theories, there arises a problem with the existence and uniqueness of solutions. To overcome this problem, a constraint algorithm is needed in order to find a submanifold where we can ensure the existence of solutions.

On the embedding problem for evolutionary Markov matrices

Jordi Roca-Lacostena

DNA substitution models describe the evolutionary process through nucleotide substitution matrices. Assuming that nucleotide mutations always happen at the same rate through time leads to continuous-time models, which only consider matrices that are the exponential of rate matrices. A different approach appears when one regards the evolutionary process as a whole and considers matrices whose entries are given by the substitution probabilities between nucleotides. The understanding of the connection between these two approaches is fundamental for modeling evolution as it has practical and theoretical consequences, such as the identification of rates from experimental biological data. In this talk, I will give a description of the embedding problem, and see some new results obtained during my Ph.D.

Multisymplectic formulation of Lagrangian models in gravitation (GR)

Narciso Román-Roy

After doing a brief presentation of the multisymplectic formulation of 1st and 2nd order classical field theories, we apply it to describe the Hilbert- Einstein and the Einstein-Palatini (affine metric) Lagrangian models of General Relativity.
