

## Announcement of the third

# JORNADES D'INTRODUCCIÓ ALS SISTEMES DINÀMICS (JISD2004)

Barcelona, June 28- July 2, 2004

The third edition of the *JORNADES D'INTRODUCCIÓ ALS SISTEMES DINÀMICS (JISD2004)*, will be held from June 28 to July 2, 2004 at the [Universitat Politècnica de Catalunya \(UPC\)](http://www.upc.edu), in Barcelona.

The **JISD2004** will be devoted to the two courses

- Asymptotic Methods In Dynamical Systems (48114), by Prof. [Luigi Chierchia](http://www.dma.uniroma3.it), Università degli Studi "Roma Tre", on the topic *Quasi-periodic solutions for the three-body problem*.
- Seminar of Hamiltonian Systems and Celestial mechanics (48036), by Prof. [Alain Chenciner](http://www.mechanics.jussieu.fr), Institut de Mécanique Céleste, Paris, on the topic *Calculus of variations and introduction to weak KAM theory*.

of the Doctoral Programme in [Applied Mathematics](http://www.upc.edu), inside the [Graduate studies at UPC](http://www.upc.edu), under the supervision of Prof. [Tere M. Seara](http://www.upc.edu), coordinator of the Programme. The courses will be delivered from June 28 to July 2, and will consist on 5 hours lectures every day.

The **JISD2004**, as well as the Doctoral Programme in Applied Mathematics, is supported by a Spanish grant [Mención de calidad en programas de doctorado](http://www.mec.es).

## Contents

Both courses will deal with *K.A.M. theory and its applications*.

- Luigi Chierchia, *Quasi-periodic solutions for the three-body problem*
  1. Hamiltonian formulation for nearly-integrable three-body problems.
  2. KAM theory.
  3. Maximal quasi-periodic solutions and total stability for the restricted, planar, circular three-body problem.
  4. An overview of extensions, perspectives and open problems.
- Alain Chenciner, *Calculus of variations and introduction to weak KAM theory*
  1. In a first part, the study of the variations of an action integral of the form leads to a natural introduction of the basic notions of Classical Mechanics: Legendre transform, Hamiltonian, Poincaré-Cartan integral invariant, symplectic and contact structures, Hamilton-Jacobi theory.
  2. In the second part, one restricts the attention to convex and superlinear Lagrangian, the ones for which exists a good theory of minimization, in particular Tonelli's theorem. In the "weak KAM theory" (Fathi's terminology), one uses minimization to find global weak solutions of the Hamilton-Jacobi equation which arise in many domains of mathematics, for example, Aubry-Mather theory, viscosity solutions, etc.

## Schedule

|                       |               |  |
|-----------------------|---------------|--|
| <b>Monday June 28</b> | 09.00 - 11.00 | Calculus of variations in the convex case (local structures).<br>From Euler-Lagrange equations to the Poincaré-Cartan integral invariant, the Legendre transform and Hamilton's equations.<br>Exercices: Flows, differential forms, symplectic structures. (Alain Chenciner) |
|                       | 11.00 - 11.30 | Cofee break  |
|                       | 11.30 - 13.30 | Delaunay symplectic variables for the two body problem.<br>Formulation of the planar, restricted three-body problem and analyticity properties of the Hamiltonian. Part I. (Luigi Chierchia)   |
|                       |               | The Hamilton-Jacobi equation.  |

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|--------------------------|---------------|---|
| <b>Tuesday June 29</b>   | 09.00 - 11.00 | The solutions of Hamilton's equations as characteristics.<br>Lagrangian submanifolds and geometric solutions of the Hamilton-Jacobi equation.<br>Caustics as an obstruction to the existence of global solutions to the Cauchy problem.<br>Exercices: The geodesic flow on a torus of revolution as an example of a completely integrable system. (Alain Chenciner) |
|                          | 11.00 - 11.30 | Cofee break   |
|                          | 11.30 - 13.30 | Delaunay symplectic variables for the two body problem.<br>Formulation of the planar, restricted three-body problem and analyticity properties of the Hamiltonian. Part II. (Luigi Chierchia)   |
| <b>Wednesday June 30</b> | 08.00 - 10.00 | Minimizers. Weierstrass theory of minimizers. Minimizing KAM tori.<br>Existence of minimizers (Tonelli's theorem) and the Lax-Oleinik semi-group.<br>Exercices: Examples around the pendulum. (Alain Chenciner)   |
|                          | 10.00 - 10.15 | Cofee break   |
|                          | 10.15 - 12.15 | A classical isoenergetic KAM theorem and application to the planar, circular, restricted three-body problem. Part I. (Luigi Chierchia)  |
| <b>Thursday July 1</b>   | 09.00 - 11.00 | Global solutions of the Hamilton-Jacobi equation.<br>Weak KAM solutions as fixed points of the Lax-Oleinik semi-group;<br>convergence of the semi-group in the autonomous case. Conjugate weak KAM solutions.<br>Exercices: Burger's equation and viscosity solutions. (Alain Chenciner)  |
|                          | 11.00 - 11.30 | Cofee break   |
|                          | 11.30 - 13.30 | A classical isoenergetic KAM theorem and application to the planar, circular, restricted three-body problem. Part II. (Luigi Chierchia)   |
| <b>Friday July 2</b>     | 09.00 - 11.00 | Mather's theory.<br>Class A geodesics and minimizing measures.<br>The $a$ and $b$ functions as a kind of integrable skeleton.<br>Exercices: Hedlund's examples.<br>The time-periodic case as a generalization of Aubry-Mather theory.<br>Exercices: classical Aubry-Mather in Birkhoff billiards. (Alain Chenciner)   |
|                          | 11.00 - 11.30 | Cofee break   |
|                          | 11.30 - 13.30 | Extensions (lower dimensional tori, many bodies,...). An overview. (Luigi Chierchia)  |

(\*) All the courses will be held in the room n.005 of the FME building (Facultat de MAtemàtiques i Estadística), at C/ Pau Gargallo, n. 5 Barcelona, 08028.

For more information, please contact Tere.M-Seara-upc.edu

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