DOCTORAL INPhINIT FELLOWSHIPS PROGRAMME – INCOMING - CALL 2020

PhD POSITION IN THE GEOMETRY OF DISSIPATIVE DYNAMICS AT THE ICMAT FOR THE INPhINIT PROGRAMME

Job Position title: PhD in the geometry of dissipative dynamics

Research project/ group description

The use of symplectic geometry in hamiltonian mechanics has been a true breakthrough in the area; indeed, it has permitted to obtain new and fundamental results on the integration of the dynamics, via the coisotropic and symplectic reduction theorems, KAM theory, geometric Hamilton-Jacobi theory, among others. However, the symplectic description works for conservative systems, but not for dissipative ones. Recently, we have started to study the use of contact geometry in hamiltonian mechanics, which opens a new way to incorporate geometry to the study of nonconservative systems. The first results are very promising, and we propose to supervise a PhD student in this line of research.

The supervisor for this proposal is Manuel de León (mdeleon@icmat.es), research professor in CSIC and fellow of the Real Academia de Ciencias. His research is focused on symplectic and contact geometry, fields theory, nonholonomic systems, Hamilton-Jacobi theory, mechanics of solids, and continuum theories and materials. Manuel de León is author of almost 300 papers, 4 scientific monographs and has participated in more than 200 conferences. He is founder of the Journal of Geometric Mechanics and has been the president of the International Congress of Mathematicians ICM2006 Madrid; he has been also member of the Executive Committee of the International Mathematical Union (IMU) and the International Council of Science (ICSU).

Manuel de León is a member of the research group Differential Geometry and Geometric Mechanics, composed by 4 graduate students, 2 postdoctoral fellows, an Associated Professor from Universidad Politécnica de Madrid and three group leaders working in several aspects of the above topics. The group has regular seminars and groups meetings, several international visitors every year. The members of the group have different interests and collaborate with different international group leaders (Michigan, EECS-KTH, IMDEA Materiales, Calgary, Oxford, University of California San Diego, and Hebrew University of Jerusalem, among others).

Job position description

The concept of dissipation was introduced in the field of thermodynamics by Lord Kelvin in 1852. Lord Kelvin identified the following dissipation processes: friction, diffusion, conduction of heat and the absorption of light.

The plan here is to consider the two following types of dissipative systems:

- Thermodynamical dissipation
Mechanical (frictional) dissipation

The goal is to identify the geometry behind each kind of dissipation. As far as we know:

- Contact hamiltonian dynamics modelize Thermodynamics and some Rayleigh dissipative systems.
- Symplectic hamiltonian systems modelize conservative systems and dissipative systems with Rayleigh dissipation (by adding an external force).
- Locally conformal systems modelize some particular Rayleigh systems.

At the end, Jacobi geometry and almost Jacobi geometry (the latter in order to include nonholonomic systems) modelize any kind of dissipation.

The PhD candidate is expected to enroll a research training program with researchers who are leaders in the field, participate in the group activities (seminars, courses, conferences, summer schools, young researchers’ workshops, etc.), have regular meetings with his supervisor and the research group, and work in the proposed research topic. In addition, it is expected that the candidate participates in the dissemination and outreach activities of the group.

**Group Leader:** Prof. Manuel de León

Email: mdeleon@icmat.es

**Other relevant websites:**

- Webpage of the group: [https://www.icmat.es/research/national-grants/GEONUMA/](https://www.icmat.es/research/national-grants/GEONUMA/)
- Manuel de Leon’s website: [https://www.icmat.es/mdeleon](https://www.icmat.es/mdeleon)

**Links to the INPhINIT 2020 Incoming Open Call:**

- **Programme description:** [https://obrasociallacaixa.org/en/investigacion-y-becas/becas-de-la-caixa/doctorado-inphinit/incoming](https://obrasociallacaixa.org/en/investigacion-y-becas/becas-de-la-caixa/doctorado-inphinit/incoming)
- **Application website:** [https://www.lacaixafellowships.org/index.aspx](https://www.lacaixafellowships.org/index.aspx)
- **Programme rules** [here.](https://www.lacaixafellowships.org/index.aspx)
- **PhD position finder:** [https://hosts.lacaixafellowships.org/finder](https://hosts.lacaixafellowships.org/finder)