



## **Thematic Research Programme**

## Current Trends in Geometric Methods in Natural Sciences

2 September - 20 December 2019 ICMAT, Madrid www.icmat.es/RT/2019/CTIGMINS/

## Minicourse

## HAMILTONIAN FRAMEWORK OF AN IDEAL HYDRODYNAMICS: CASIMIRS AND VORTEX STRUCTURES

**SPEAKER:** Boris Khesin (University of Toronto)

DATE: 2 - 3 October 2019 - 11:00

VENUE: Aula Gris 1, ICMAT

**ABSTRACT:** We start with a classification of simple Morse functions on symplectic surfaces with respect to actions of symplectomorphism groups. This allows us to describe generic coadjoint orbits and a complete list of Casimirs for 2D Euler hydrodynamics on surfaces without boundary, thus resolving one of V. Arnold's problems. For this we introduce a notion of anti-derivatives on a measured Reeb graph and describe their properties.

In the second lecture we describe Hamiltonian dynamics on the spaces of vortex membranes. We show that an approximation of the hydrodynamical Euler equation describes the skew-mean-curvature flow on vortex membranes in any dimension. This generalizes the classical binormal, or vortex filament, equation in 3D. We also discuss the Hasimoto transform and counterexamples to its existence in higher dimensions.

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