

# WORKING PIZZA SEMINAR ON FLUID MECHANICS

Miércoles, 3 de octubre de 2012

13:30 h., Aula Gris 1 (ICMat, Campus de Cantoblanco)

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ICMAT

## Geometric Structures in Steady Euler Flows: Knotted Vortex Lines and Vortex Tubes

### Resumen:

#### Part 1: Knotted vortex lines

Our goal in the first two lectures is to prove that there are steady solutions to the Euler equations with a set of vortex lines diffeomorphic to any given link. The solutions we construct are of Beltrami type (that is, their vorticity is proportional to the velocity field) and fall off at infinity as  $1/|x|$ .

*Lecture 1* (3rd October - Aula Gris 1):

- Statement of the theorem.
- Heuristics behind the proof: robust local solutions + global approximation.
- Construction of local solutions: a Cauchy-Kowalewski theorem for curl.
- A global approximation theorem for the curl operator.

*Lecture 2* (10th October - Aula Gris 1):

- A crash course on periodic trajectories: Poincaré map, hyperbolicity, hyperbolic permanence theorem.
- Construction of an appropriate Cauchy datum and robustness.
- Conclusion of the proof and remarks.

#### Part 2: Knotted vortex tubes

Our goal in these two lectures is to sketch the proof of the existence of thin knotted vortex tubes in steady solutions to the Euler equation.

*Lecture 3* (17th October - Sala de Audiovisuales):

- Statement of the theorem.
- Heuristics behind the proof: why tubes?
- Construction of local solutions: boundary value problems for curl, harmonic fields and estimates.

*Lecture 4* (24th October - Sala de Audiovisuales):

- Some ideas about KAM theory: invariant tori, heuristics, rotation number, non-degeneracy conditions. A convenient statement.
- Robustness: A KAM theorem for Beltrami fields with small parameter.
- Conclusion of the proof and remarks.

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