DEPARTAMENTO DE ANÁLISIS MATEMÁTICO Y MATEMÁTICA APLICADA

Facultad de Ciencias MATEMÁTICAS

Instituto de Matemática Interdisciplinar

SEMINARIO DE ANÁLISIS MATEMÁTICO Y MATEMÁTICA APLICADA

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Vortex filaments, Polygons and Multifractality

One of the most fascinating phenomena in nature is the formation of vortex filaments such as smoke rings, tornadoes, etc. These real-life examples in a very simplified setting can be compared with a circle, a straight line, respectively, which are also smooth solutions of the Vortex Filament Equation (VFE) that describes the evolution of a vortex filament in an inviscid incompressible fluid. The equation secures a unique place in the literature, thanks to its rich geometric and simple form, and recently, its class of solutions has been extended to regular polygonal curves. In this talk, we introduce VFE and its equivalent forms such as Schr¨odinger map and nonlinear Schr¨odinger equations. Besides discussing their evolution for polygonal initial data, we will see that the path traced by a single point located on the polygonal curve follows a multifractal trajectory which can be compared with the graph of Riemann's non-differentiable function. We will also consider different initial data and geometric settings to claim that this multifractal behaviour indeed appears as a generic phenomenon. A part of the talk is a work in collaboration with Francisco de la Hoz (UPV/EHU) and Luis Vega (BCAM, UPV/EHU).

References [1] F. de la Hoz, S. Kumar and L. Vega. Vortex Filament Equation for a regular l-polygon in the hyperbolic plane. Journal of Nonlinear Science, 32(9), 2022. [2] S. Kumar. On the Schr¨odinger map for regular helical polygons in the hyperbolic space. Nonlinearity, 35(1): 84–109, 2022.

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