

Bulletin

de la SOCIÉTÉ MATHÉMATIQUE DE FRANCE

**Tome 154
Fascicule 2**

2026

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DYNAMICS OF HELICAL VORTEX FILAMENTS IN NONVISCOUS INCOMPRESSIBLE FLOWS

BY MARTIN DONATI, CHRISTOPHE LACAVE & EVELYNE MIOT

ABSTRACT. — In this paper, we study concentrated solutions of the three-dimensional Euler equations in helical symmetry without swirl. We prove that any helical vorticity solution initially concentrated around helices of pairwise distinct radii remains concentrated close to filaments. As suggested by the vortex filament conjecture, we prove that those filaments are translating and rotating helices. Similarly to what is obtained in other frameworks, the localization is weak in the direction of the movement but strong in its normal direction and holds on an arbitrary long time interval in the naturally rescaled time scale. In order to prove this result, we derive a new explicit formula for the singular part of the Biot–Savart kernel in a two-dimensional reformulation of the problem. This allows us to obtain an appropriate decomposition of the velocity field to reproduce recent methods used to describe the dynamics of vortex rings or point-vortices for the lake equation.

Texte reçu le 11 mars 2024, modifié le 24 février 2025, accepté le 25 mars 2025.

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Mathematical subject classification (2010). — 35Q31, 76B47.

Key words and phrases. — Euler equations, Green’s function of second-order elliptic equations, vortex filament conjecture, concentrated vorticity.

This work was supported by the BOURGEONS project, grant ANR-23-CE40-0014-01 of the French National Research Agency (ANR). M.D. was funded by the Simons Collaboration of Wave Turbulence and thanks the Institut Fourier for its hospitality. C.L. also benefited of the support of the ANR under France 2030 bearing the reference ANR-23-EXMA-004 (Complexflows project of the PEPR MathsViVEs).