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DYNAMICS OF HELICAL VORTEX FILAMENTS IN NONVISCOUS INCOMPRESSIBLE FLOWS

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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.

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