

Asymptotic limit for the Stokes and Navier–Stokes problems in a planar domain with a vanishing hole

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In this talk, I will show that the eigenvalues of the Stokes operator in a bounded planar domain with a small hole converge to the eigenvalues of the Stokes operator in the whole domain, when the diameter of the hole tends to 0. The convergence of the eigenspaces and the convergence of the Stokes semigroup will also be established. The main ingredients of the analysis are a suitable decomposition of the vorticity space, the formalism elaborated in [1] and some basics of potential theory. I will emphasize in particular how the behavior of the vorticity field is tightly related to the behavior of the harmonic functions. In this idea lies the main originality of this work.

Considering the Navier-Stokes equations, I will show that the method allows recovering some of the main results established in [2] and [3]. It also allows to prove that the vorticity of the solution in the perforated domain converges as the hole shrinks to a point r to the vorticity of the solution in the punctured domain (i.e. the whole domain with the point r removed).

Références

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- [3] J. He and D. Iftimie. A small solid body with large density in a planar fluid is negligible. *Journal of Dynamics and Differential Equations*, 31(3) :1671–1688, Sep 2019.