Planar Limits of 3D Helical Flows

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Abstract

We study the limits of three-dimensional helical viscous and inviscid incompressible flows in an infinite circular pipe, with respectively no-slip and no-penetration boundary conditions, as the step approaches infinity. We show that, as the step becomes large, the three-dimensional helical flow approaches a planar flow, which is governed by the so-called "two-and-half D" Navier-Stokes and 2D Euler equations, respectively. The step or pitch is the magnitude of the translation after rotating one full turn around the symmetry axis. For the Euler equations, a "no helical swirl" condition is imposed, which assures global existence. This is joint work with Milton Lopes Filho, Helena Nussenzveig Lopes, Donjuan Niu, and Edriss Titi.