

# News Results for the Stokes and Navier-Stokes Equations with Non Standard Boundary Conditions

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We consider the Stokes and Navier-Stokes equations in a bounded domain, eventually multiply connected, whose boundary consists of multi-connected components. We investigate the solvability in  $L^p$  theory, with  $1 < p < \infty$ , under the non standard boundary conditions

$$\mathbf{u} \cdot \mathbf{n} = g, \quad \mathbf{curl} \mathbf{u} \times \mathbf{n} = \mathbf{h} \quad \text{or} \quad \mathbf{u} \times \mathbf{n} = \mathbf{g}, \quad \pi = \pi_* \quad \text{on } \Gamma.$$

The main ingredients for this solvability are given by the Inf-Sup conditions, some Sobolev's inequalities for vector fields and the theory of vector potentials satisfying

$$\boldsymbol{\psi} \cdot \mathbf{n} = 0, \quad \text{or} \quad \boldsymbol{\psi} \times \mathbf{n} = \mathbf{0} \quad \text{on } \Gamma.$$

Those inequalities play a fundamental key and are obtained thanks to Calderon-Zygmund inequalities and integral representations. In the study of elliptical problems, we consider both generalized solutions and strong solutions that very weak solutions.

In a second part, we will consider the nonstationary case for the Stokes equations.