Master M2 i-PCS

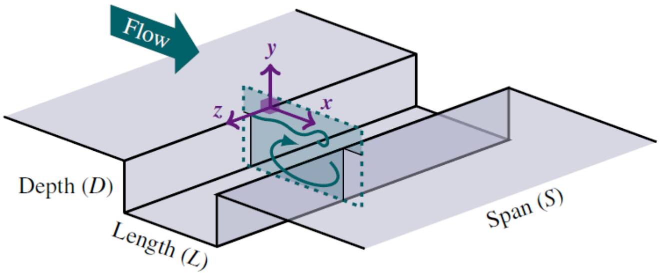
# ***INTERNSHIP PROPOSAL***


Laboratory name: LIMSI, Bât 508, Université Paris Sud, Orsay
CNRS identification code: UPR3251
Internship director'surname: François Lusseyran & Luc Pastur
e-mail: lussey@limsi.fr Phone number: 0169158131/ 0682000287
Web page: https://perso.limsi.fr/**lussey**/ , https://perso.limsi.fr/pastur/

Internship location: LIMSI, Orsay
Thesis possibility after internship: YES
Funding: YES

## Space-time chaos in a centrifugally unstable flow

Impinging shear-layers exhibit powerful self-sustained oscillations, at pure tones, when the Reynolds number is increased beyond a critical value. Those oscillations are the source of noise, for instance in high-velocity trains, or produce music, as in wind instruments. In a cavity flow driven by a shear-layer, however, the first instability is centrifugal and develops on the inner-flow, at Reynolds numbers much lower than the onset of self-sustained oscillations, in contradiction to the Squire theorem famous statement that the primary bifurcation should be two-dimensional in parallel flows [1].




The growth of the instability gives rise to an alley of donuts of vortices, which wind around the main inner recirculation flow. The mode selection at onset depends on the stream-wise aspect ratio of the cavity, and rectangular cavities typically promote a family of left and right traveling waves [2]. At much higher Reynolds numbers, the dynamics of the wave-packet get increasingly complex and eventually ends up into a spatio-temporal chaotic regime. In this regime, the wave field exhibits phase singularities and non trivial front dynamics, and the coupling between the inner-flow dynamics and the shear-layer oscillations may be critical.

The study will be tackled from both the experimental and numerical sides. The PhD will be shaped as a co-tutelle project between two labs, LIMSI and DynFluid (ENSAM Paris). Experimentally, PIV and LDV technologies will be used to get access to the velocity field, in a wind-tunnel settled down at LIMSI. Numerically, we are interested in the stability analysis of the secondary (slowly) drifting state. A Floquet analysis will be conducted under the Nek5000 spectral code for this purpose.


[1] Basley J., Pastur L., Lusseyran F., Soria J., Delprat N. (2014). On the modulating effect of 3-dimensional instabilities in open cavity flows. Journal of Fluid Mechanics 759, 546-578.
[2] Douay, C. L., Pastur, L. R., Lusseyran, F. (2016). Centrifugal instabilities in an experimental open cavity flow. Journal of Fluid Mechanics, 788, 670-694.
[3] Alizard, F., Robinet, J.-CH., Gloerfelt, X. (2012). A domain decomposition matrix-free method for global linear stability. Comput. Fluids 66, 63-84.