# Seminaires @ ICARE

# Low-Frequency Unsteadiness in Pressure-Induced Separated Flows

**par**

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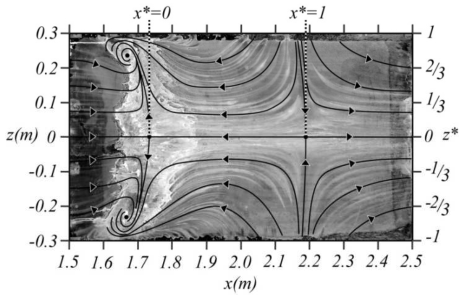
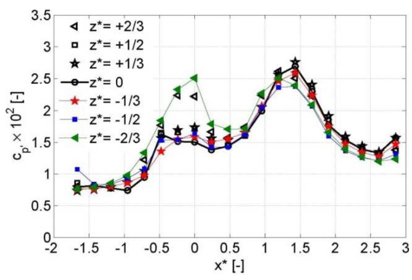
Separation and reattachment of turbulent boundary layers are common in aerodynamic systems and are often detrimental to their performance. Past work on the subject was mostly related to the case of fixed-separation flows, where the boundary layer separates at a singular point on the geometry and reattaches further downstream. In contrast, the work performed at the TFT lab pertains to incompressible, pressure-induced separation bubbles, where the boundary layer separates from a flat surface because of an adverse pressure gradient instead of a geometric singularity. This configuration adds a degree of liberty compared to fixed-separation flows because the position of the separation line is now free to fluctuate on the test surface.




Oil film visualization of separated flow regime




Fluctuating pressure coefficient on test surface

The results from our experimental investigation indicate that such flows are characterized by two separate time-dependent phenomena: a low-frequency mode, which is related to a global ''breathing'' motion (i.e. contraction/expansion) of the separation bubble, and a higher-frequency mode, which is linked to the roll-up of vortical structures in the shear layer above the recirculating region and their shedding downstream of the bubble. These two phenomena are reminiscent of the ''flapping'' and ''shedding'' modes observed in fixed-separation experiments, though their normalized frequencies are different. The breathing mode is also shown to be strikingly similar to the low-frequency unsteadiness observed in shock-induced separated flows at supersonic speeds.