LadHyX Seminar – May 9, 10:45

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Non-linear dynamics of flame fronts

In many applications where premixed combustion is involved, the flame thickness is weak compared to the scales of the flow. This property allows to describe the flame front evolution as an interface dynamics. In this study some experiments are performed in order to check the validity of such models. The experiments are carried out in a Hele-Shaw burner. This quasi-bidimensional configuration allows for an accurate analysis of the flame front evolution. First, the dynamics of an initially flat flame propagating in a quiescent flow are analyzed. A quantitative comparison of an experimental flame evolution with the one predicted by a Michelson-Sivashinsky type equation is obtained for the first time. Moreover, the analytic pole solutions of this model allows us to predict some statistic properties of the flame front. These predictions are shown to still be valid at large time, where the external noise plays an important role in the observed dynamics. In a second part, flame/burner interactions are investigated. A new vibroacoustic coupling mechanism is identified. Then, harnessing the properties of this vibroacoustic coupling, the flame is submitted to an oscillating flow. It allows us to explore some characteristics of the flame response to a time dependent external forcing. Finally, the flame is submitted to a weakly turbulent flow. The influence of the flow fluctuations intensity on the turbulent flame speed is explored. The flame speed increase is shown to switch from a superlinear regime at small forcing to a sublinear one when the forcing intensity is approaching the laminar flame speed value.