CORRUGATED FLAMES AND MODERATE TURBULENCE

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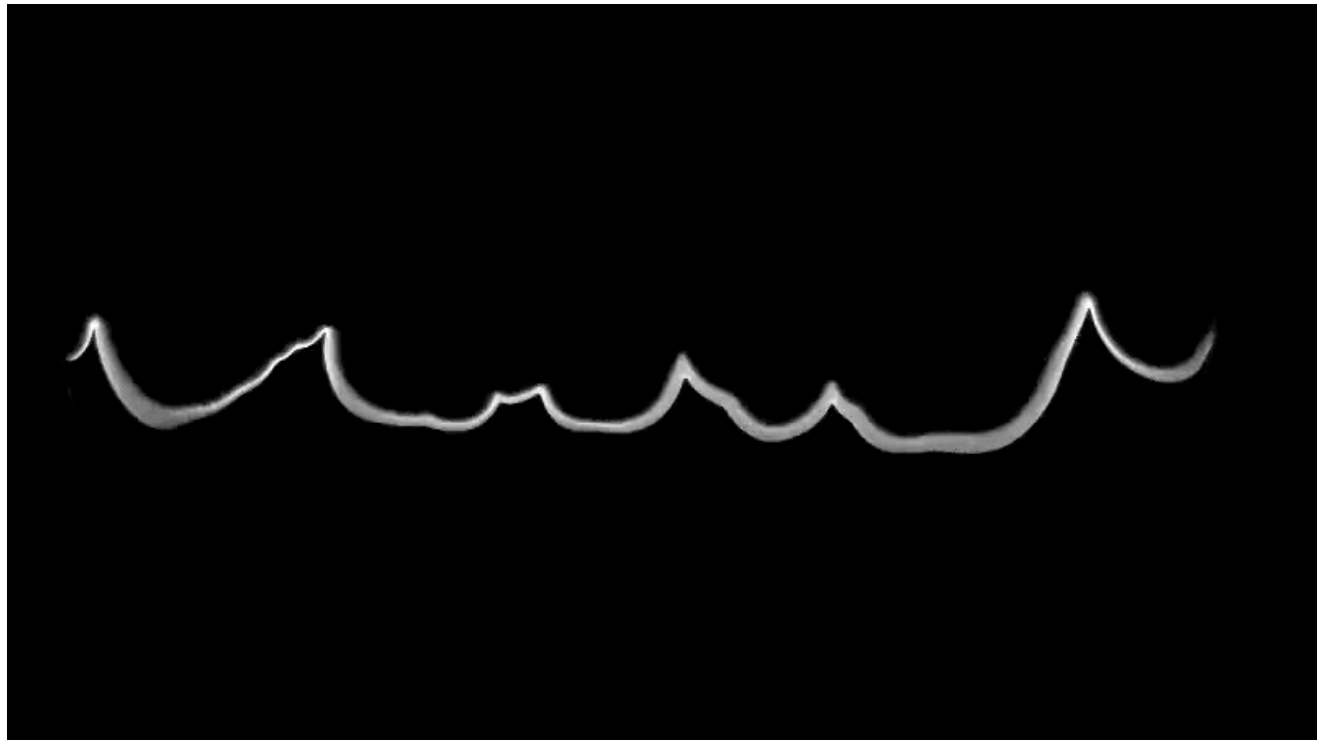
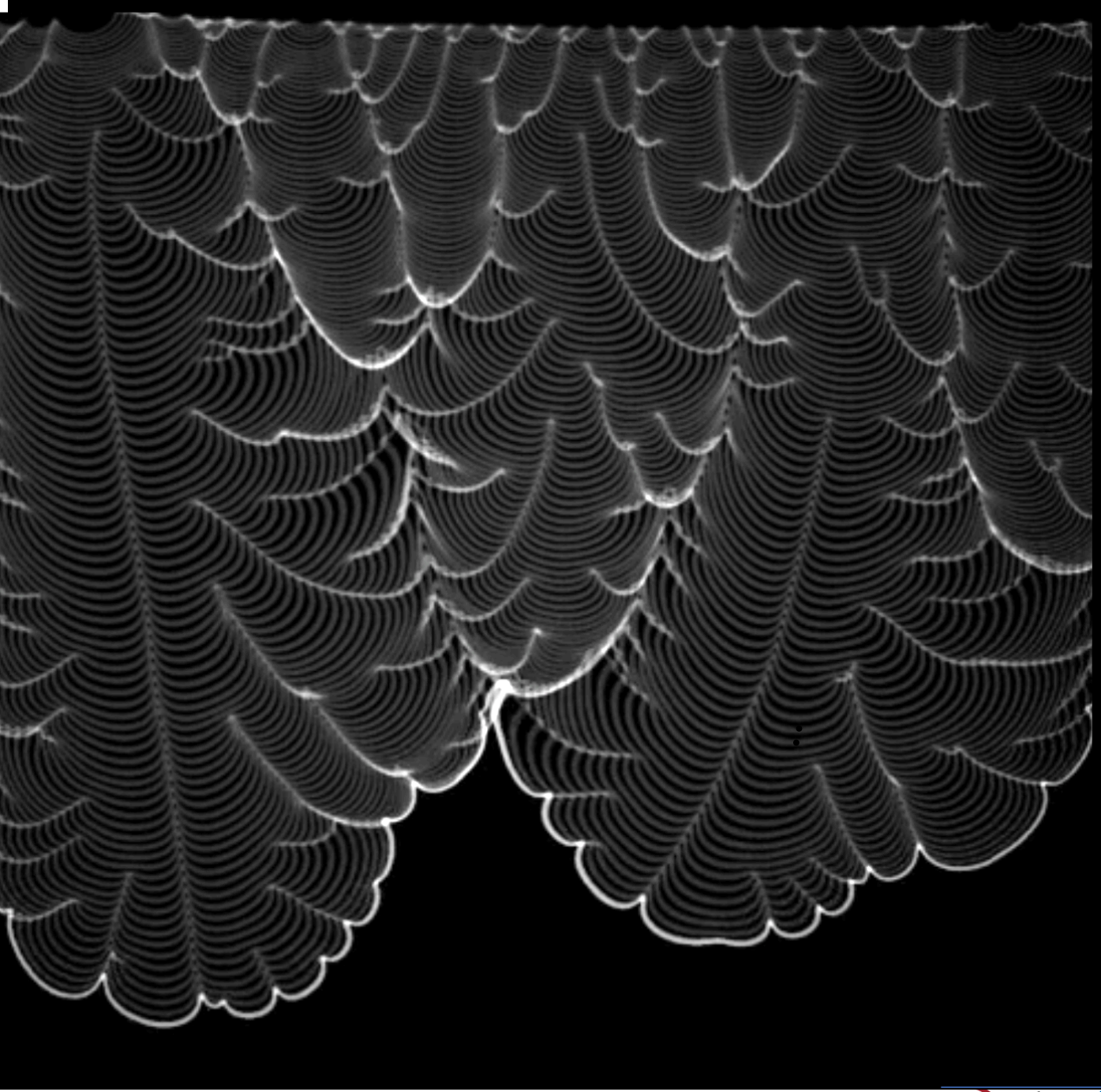
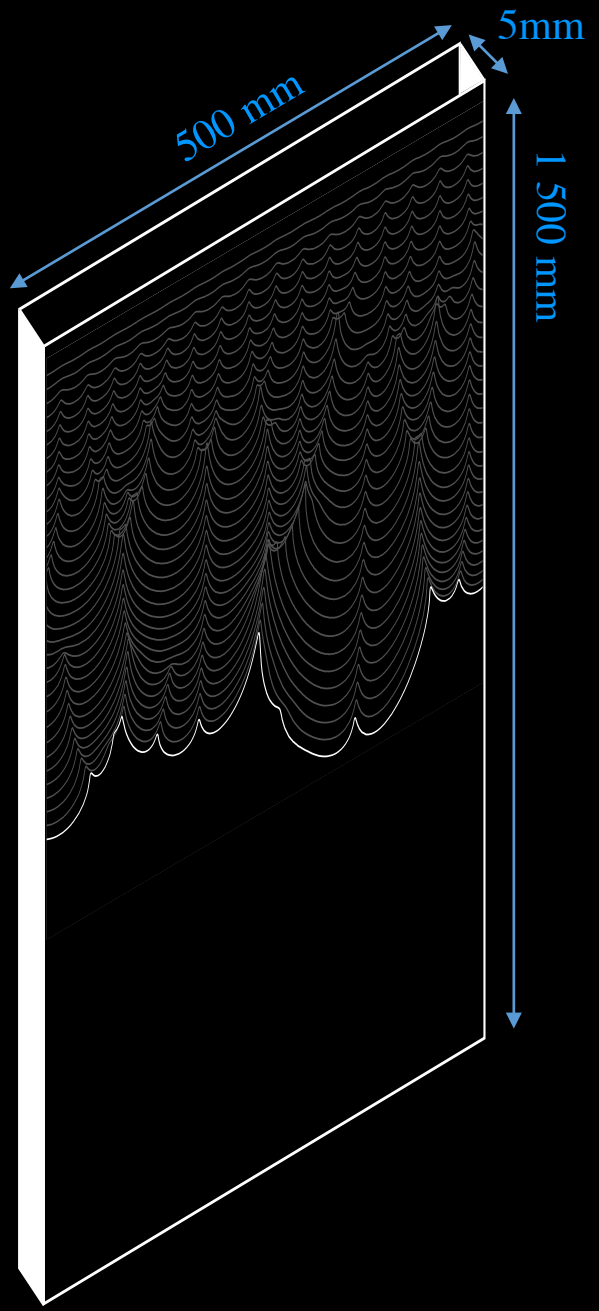
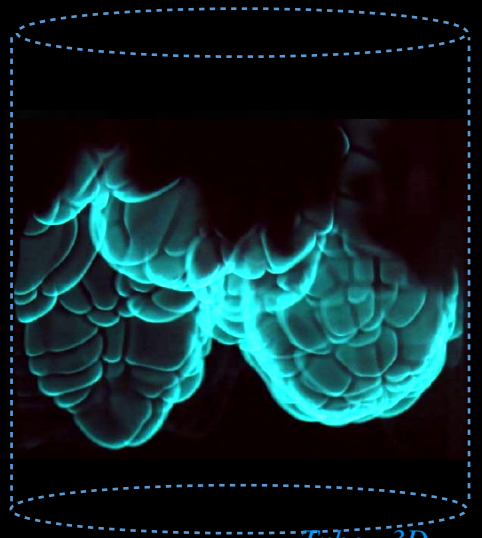
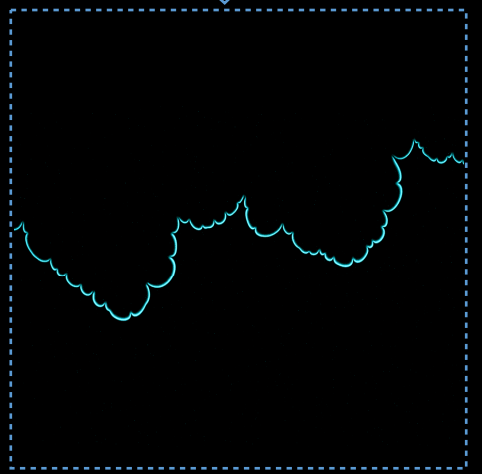








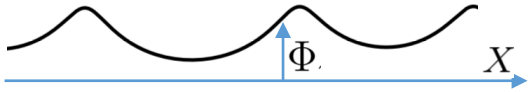
Tube - 3D



HS cell - quasi 2D

$$\Phi_\tau + \frac{1}{2}\Phi_X^2 = \nu\Phi_{XX} + I\left(\Phi, X\right)$$

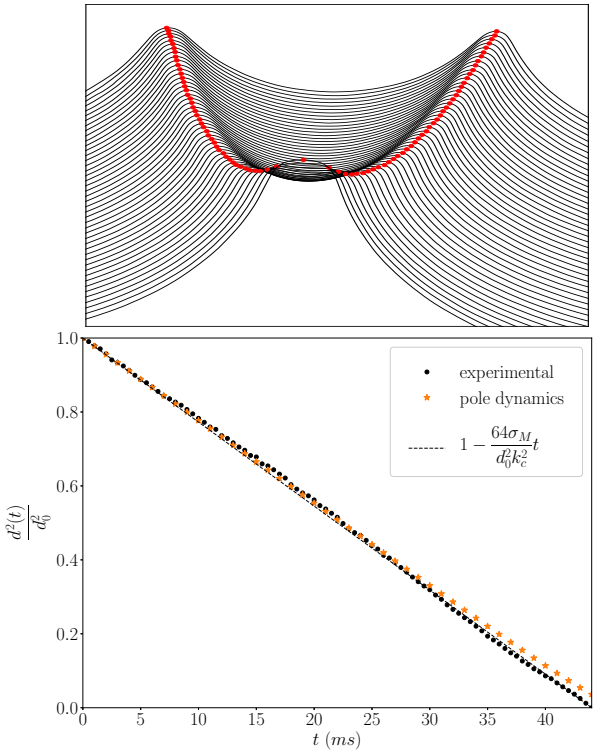
(Sivashinsky 1977)



Analytical solution $$\Phi(X,\tau) = -2\nu \sum_{n=1}^{2N} \ln\left(X - z_n(\tau)\right)$$

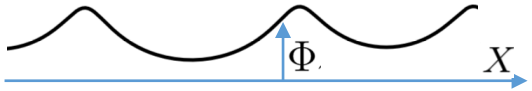
Analytical dynamics $$\dot{z}_\alpha = -2\nu \sum_{\alpha\neq\beta} \frac{1}{z_\alpha - z_\beta} - i\mathrm{sign}\left(Im(z_\alpha)\right)$$

(Thual Frisch Henon 1988)



$$\Phi_\tau + \frac{1}{2}\Phi_X^2 = \nu\Phi_{XX} + I(\Phi, X)$$

(Sivashinsky 1977)



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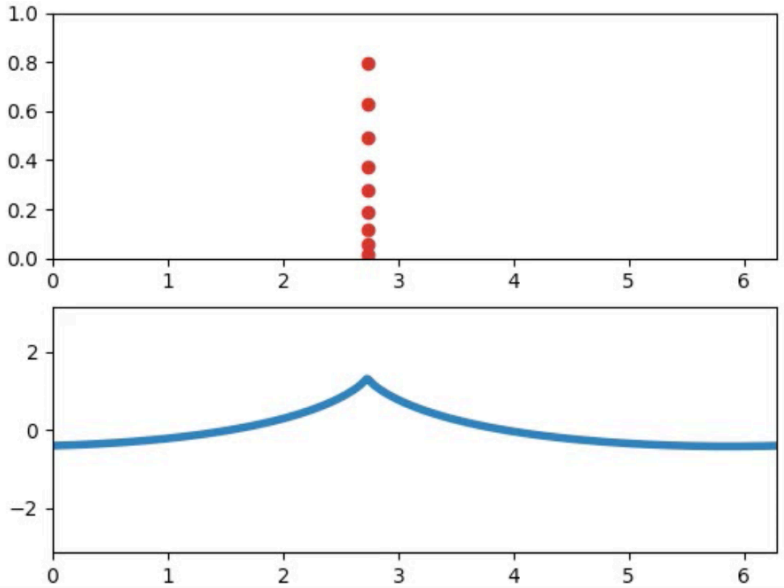
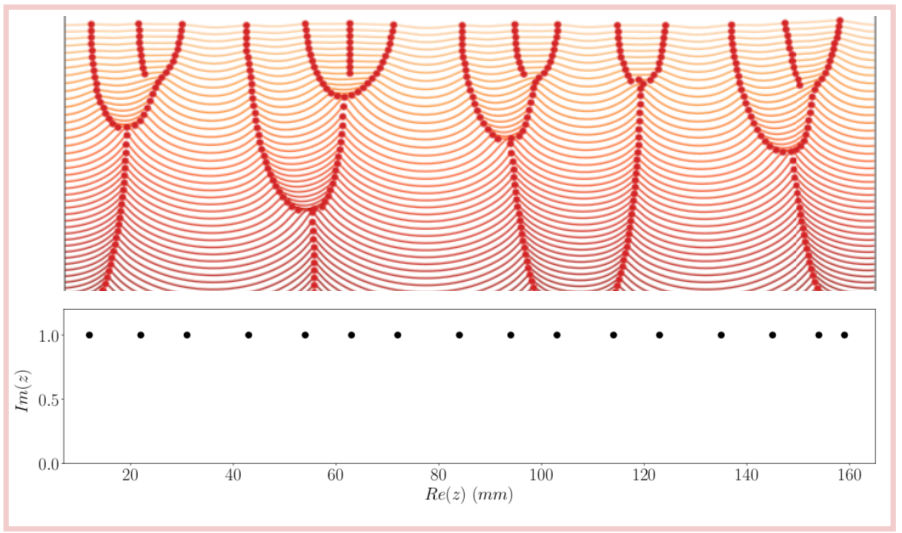
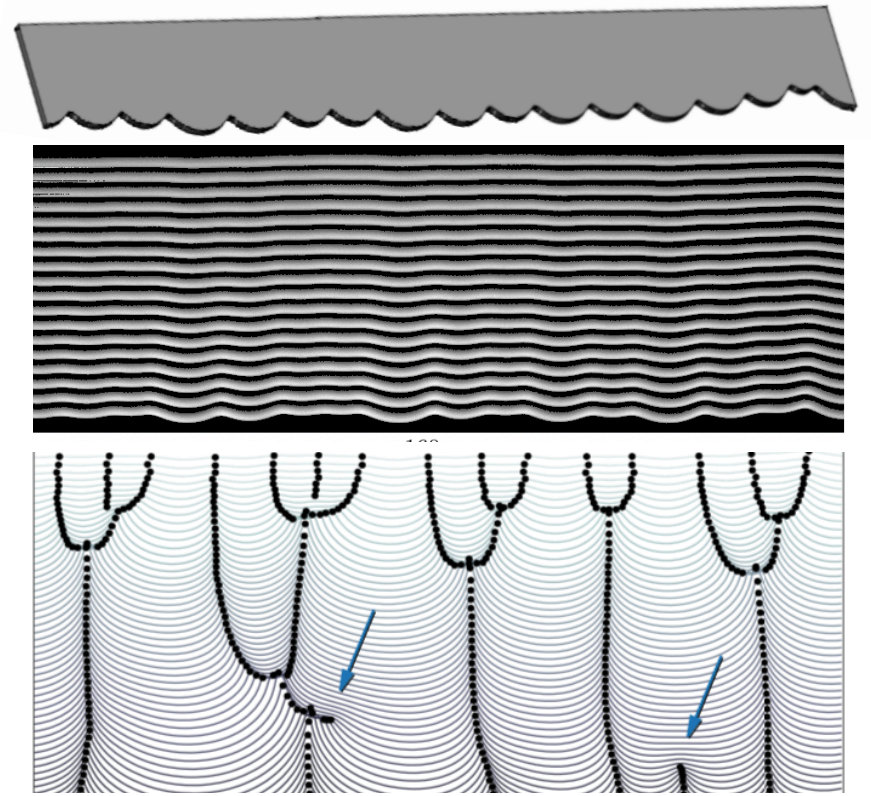
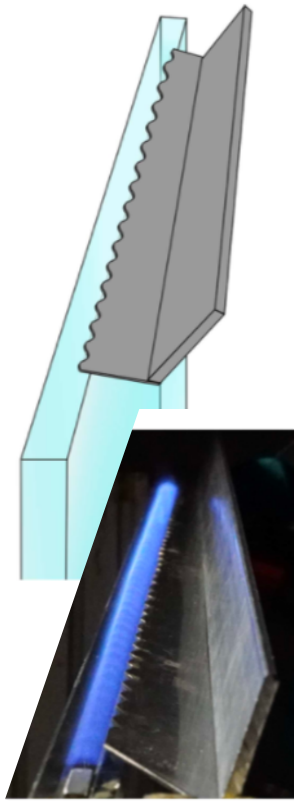


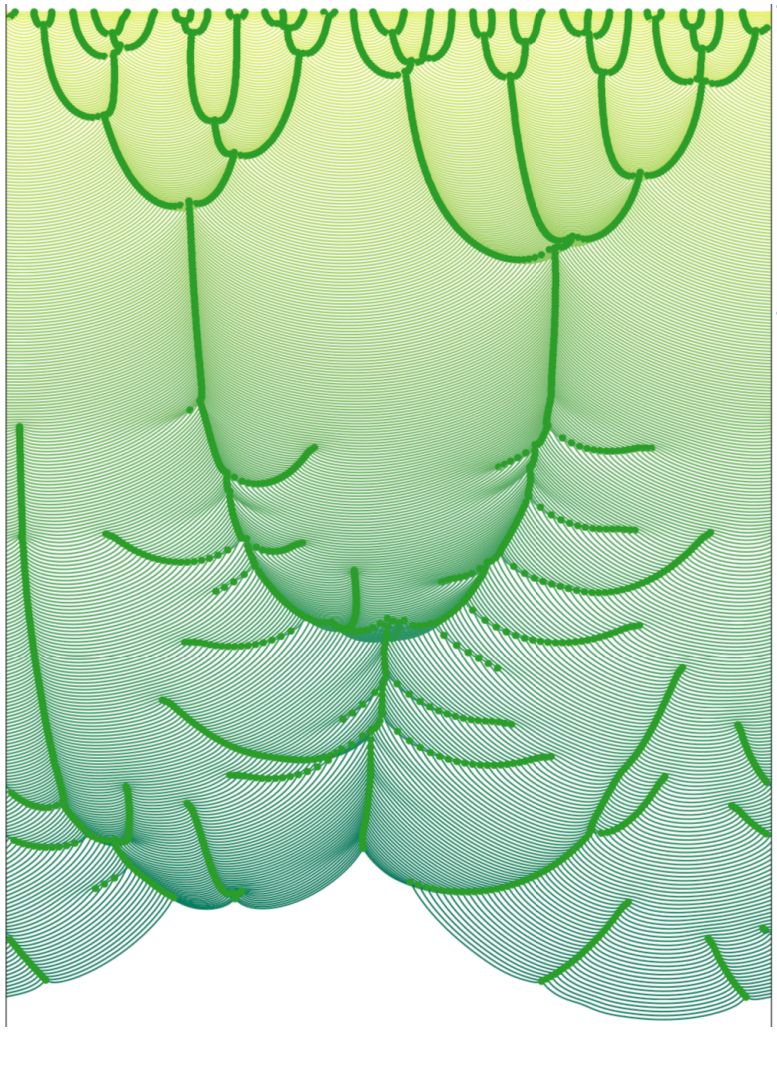






(Al Sarraf et al. 2018)

LATE TIME DYNAMICS



Deterministic

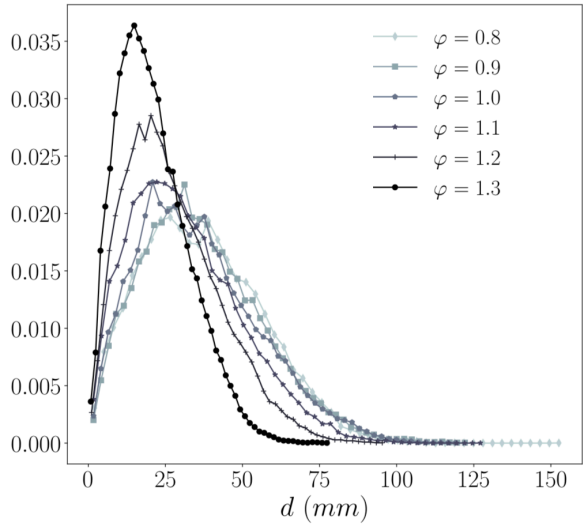
Noise influence

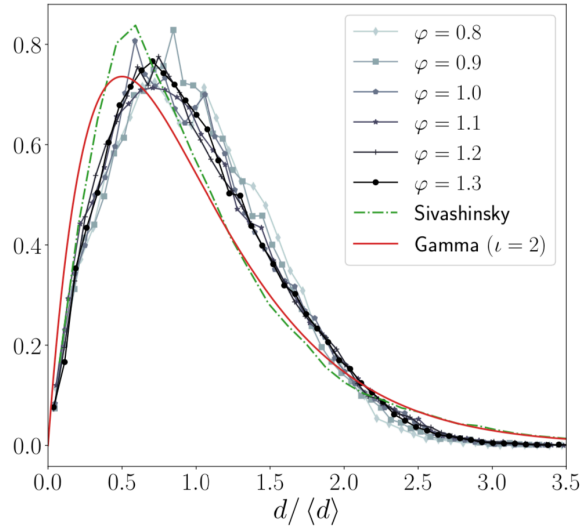
$$\Phi_\tau + \frac{1}{2}\Phi_X^2 = \nu\Phi_{XX} + I\left(\Phi, X\right) + \eta(x,t)$$

Gamma distribution

$$p\left(x = \frac{d}{\langle d \rangle}\right) = \frac{4}{\Gamma(2)} x e^{-2x}$$

CELL SIZE DISTRIBUTION





CORRUGATED FLAMES AND MODERATE TURBULENCE

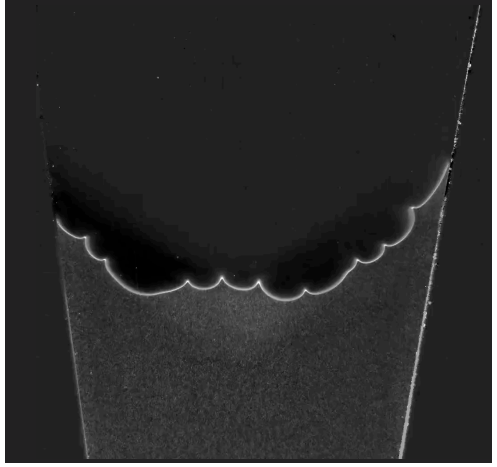
I

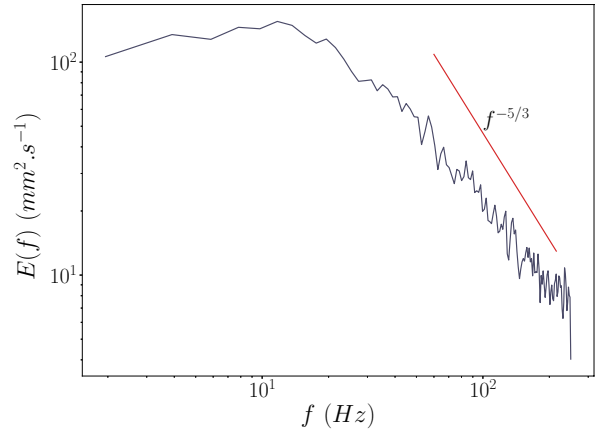
Without Turbulence

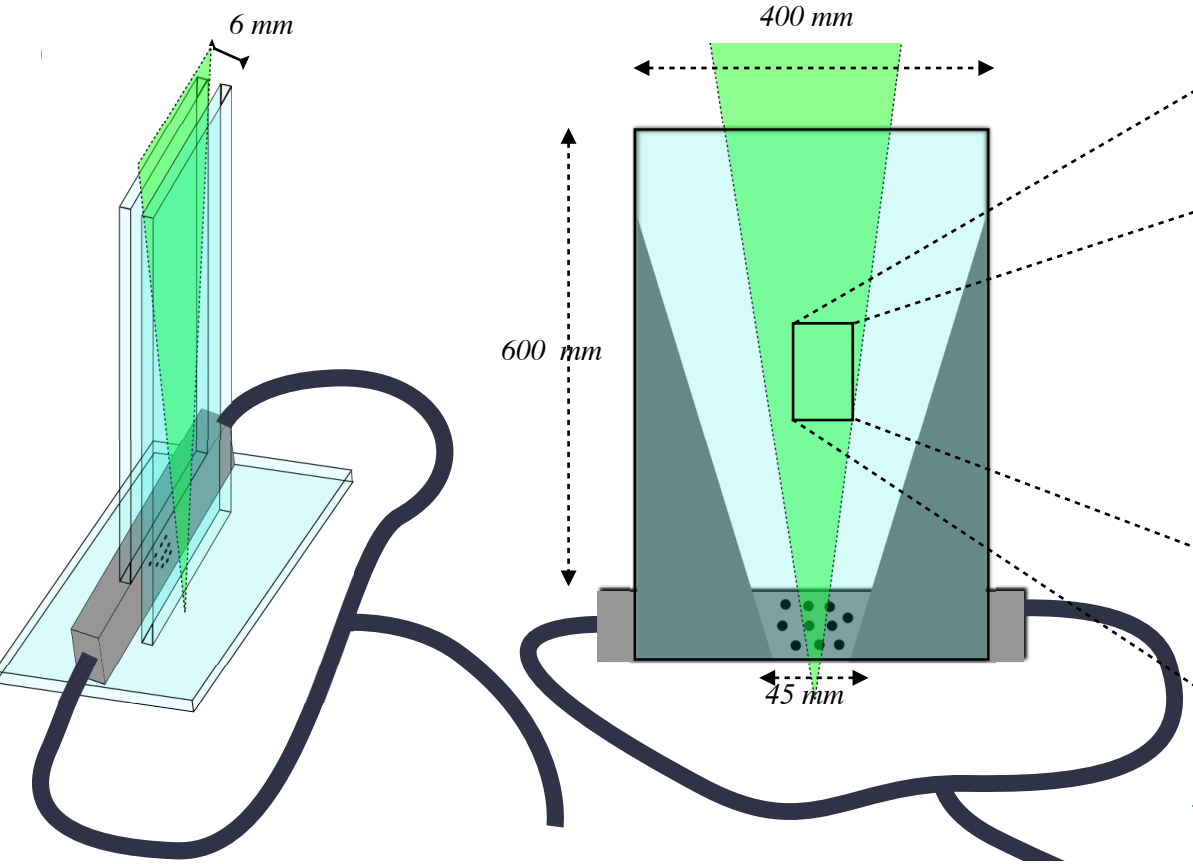
noise

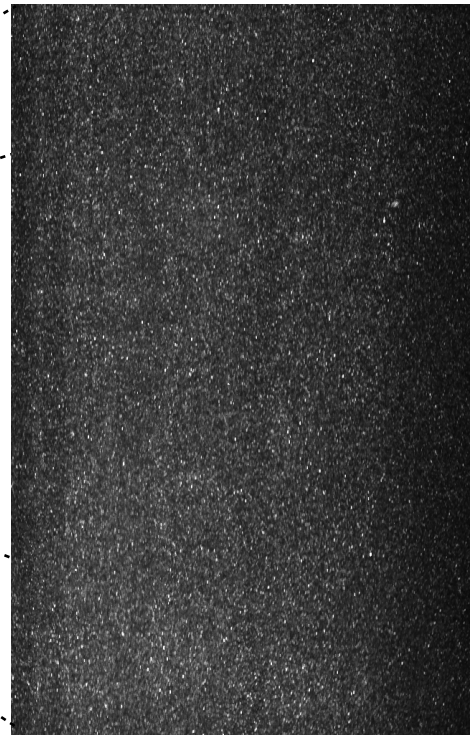
II

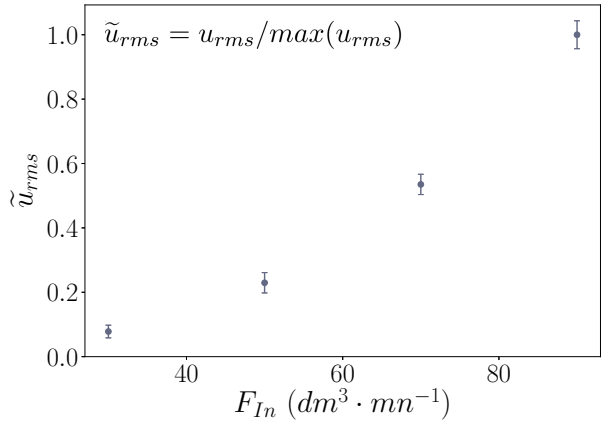
With Turbulence

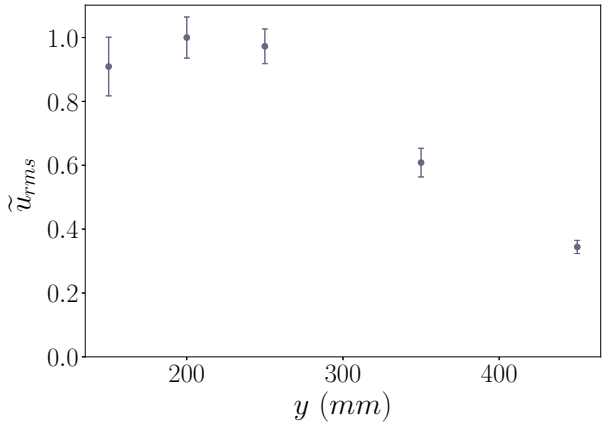


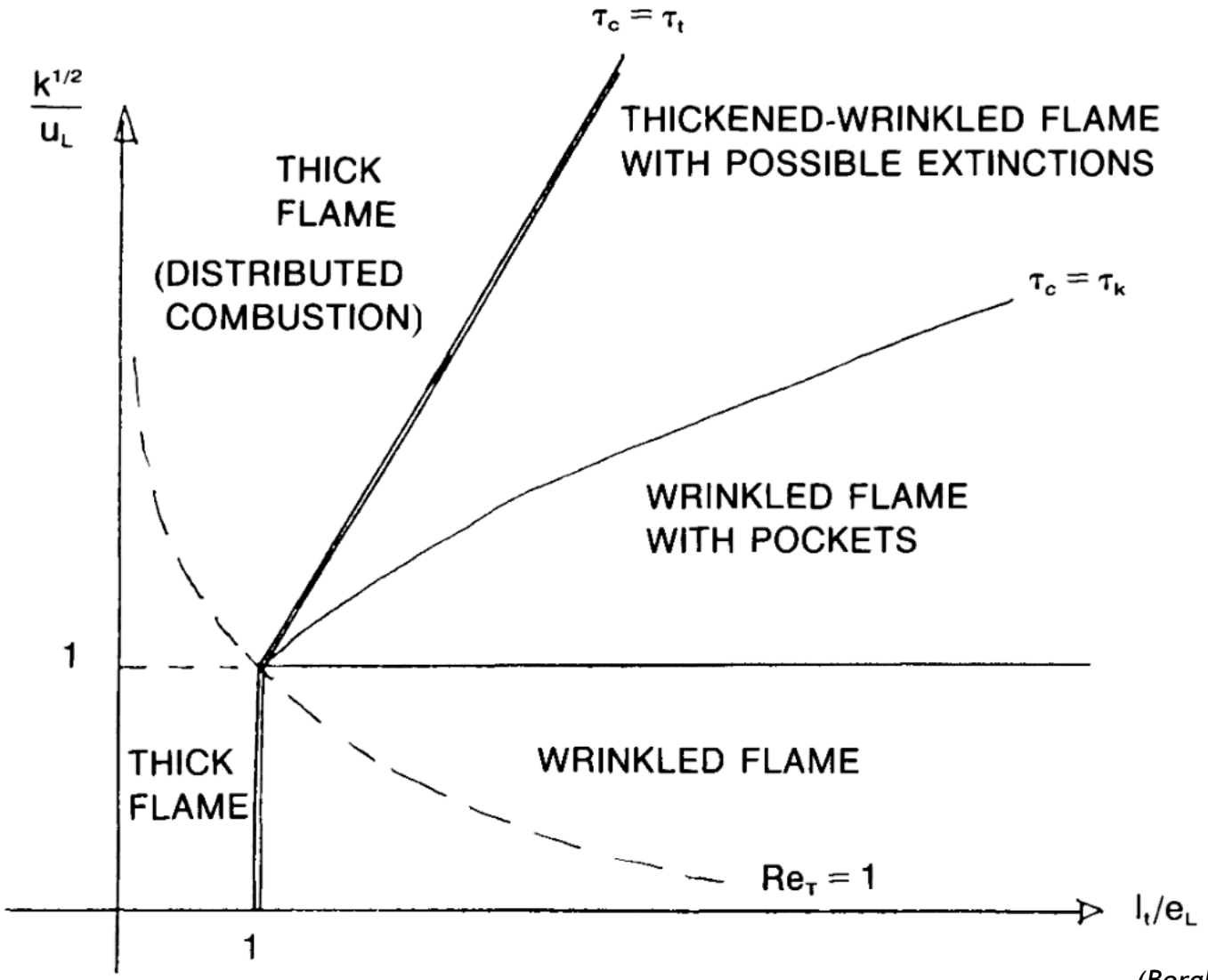

10^2
10^1
$E(f)\ (mm^2.s^{-1})$
$f^{-5/3}$
10^1
10^2
$f\ (Hz)$


6 mm
400 mm
600 mm
45 mm

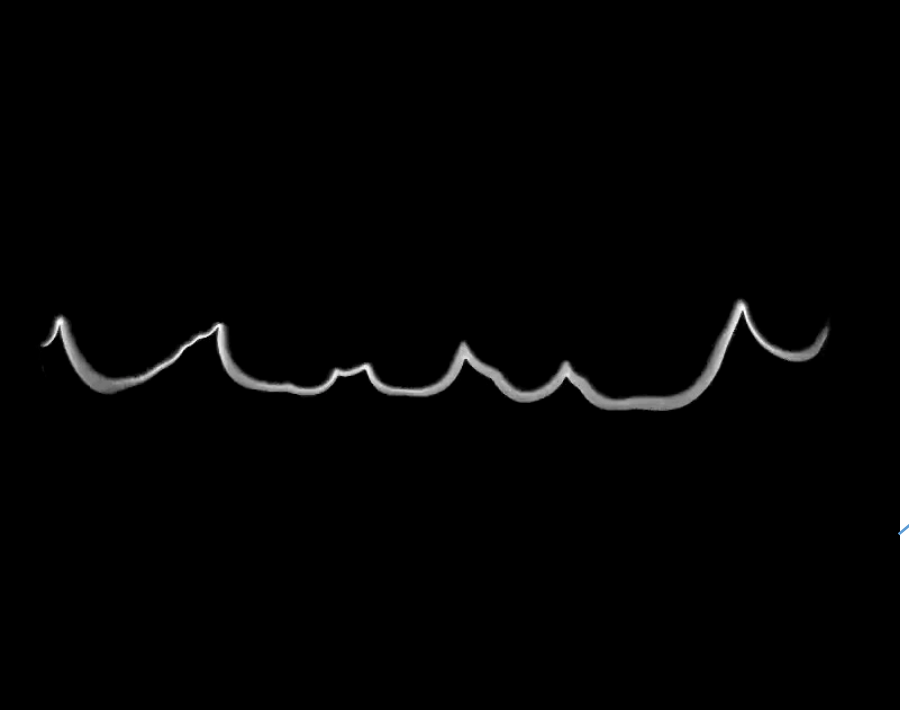



$\tilde{u}_{rms} = u_{rms}/max(u_{rms})$
1.0
0.8
0.6
0.4
0.2
0.0
$\tilde{u}_{rms}$
40
60
80
$F_{In}\ (dm^3 \cdot mn^{-1})$

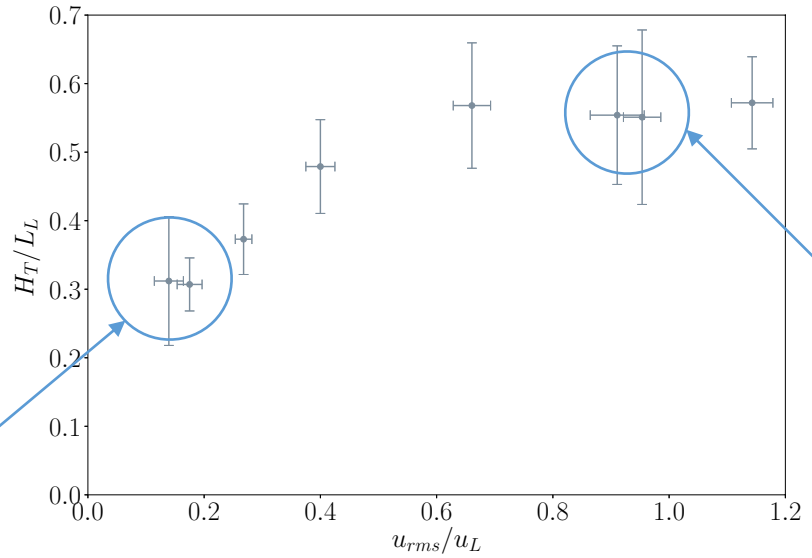

1.0
0.8
0.6
0.4
0.2
0.0
$\tilde{u}_{rms}$
200
300
400
$y\ (mm)$

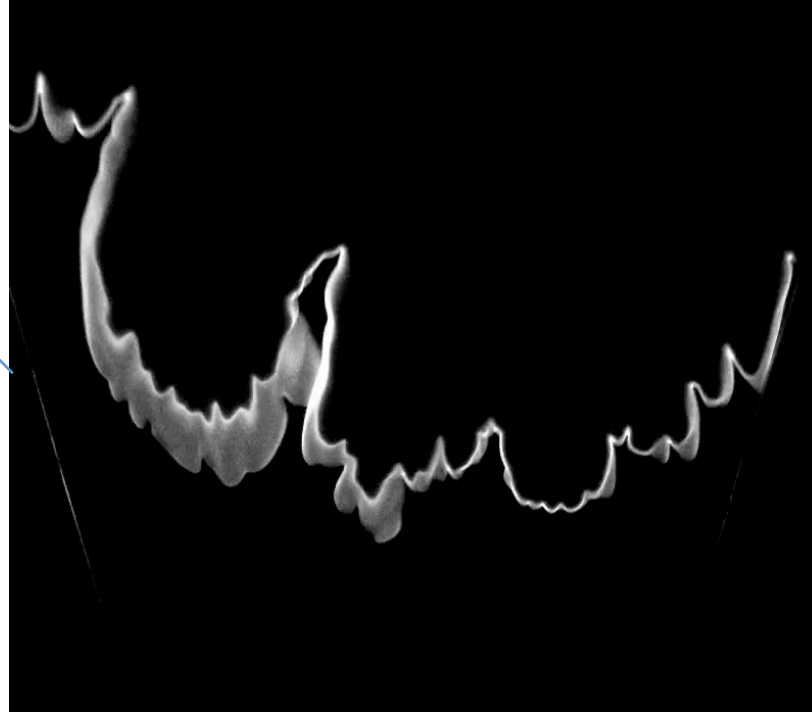

$\tau_c = \tau_t$
$\frac{k^{1/2}}{u_L}$
THICKENED-WRINKLED FLAME
WITH POSSIBLE EXTINCTIONS
THICK
FLAME
(DISTRIBUTED
COMBUSTION)
$\tau_c = \tau_k$
WRINKLED FLAME
WITH POCKETS
1
THICK
FLAME
WRINKLED FLAME
$Re_T = 1$
l_t/e_L
1

(Borghi 1985)



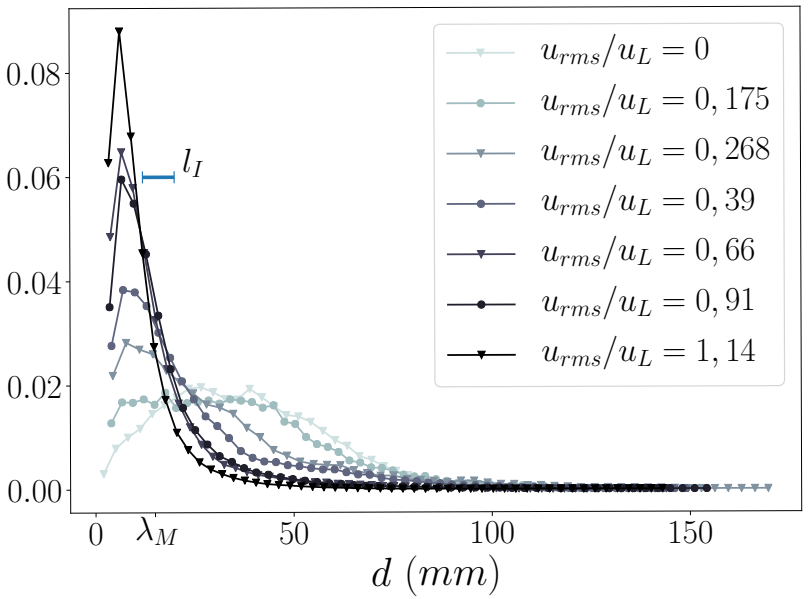
Flame Brush thickness

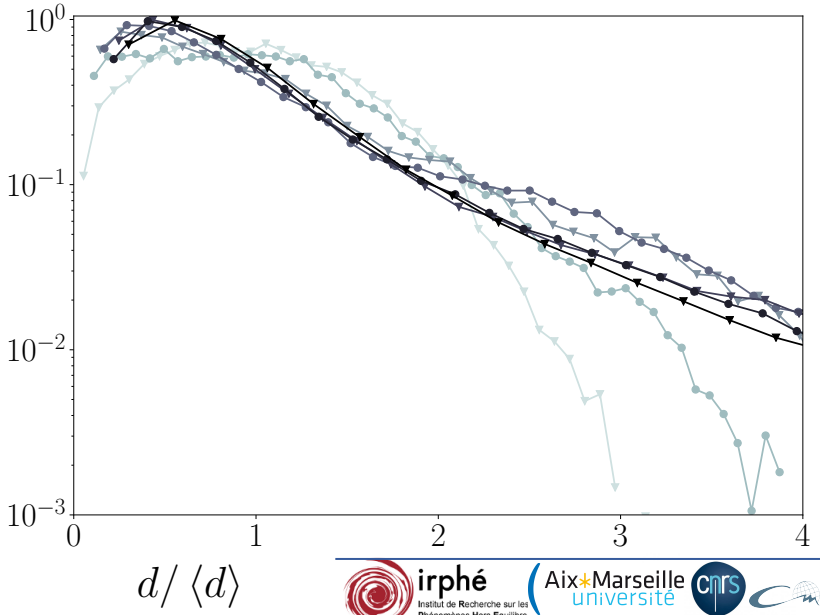




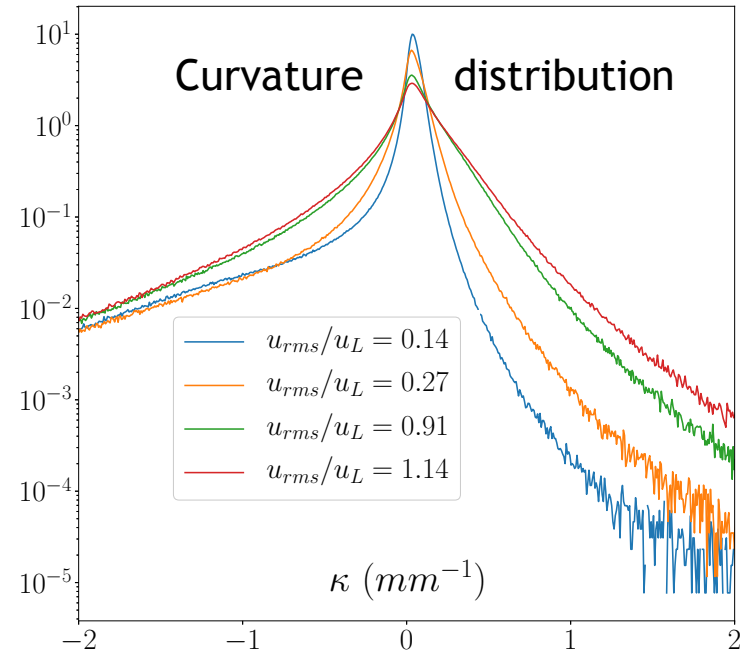
Propane air 0.8

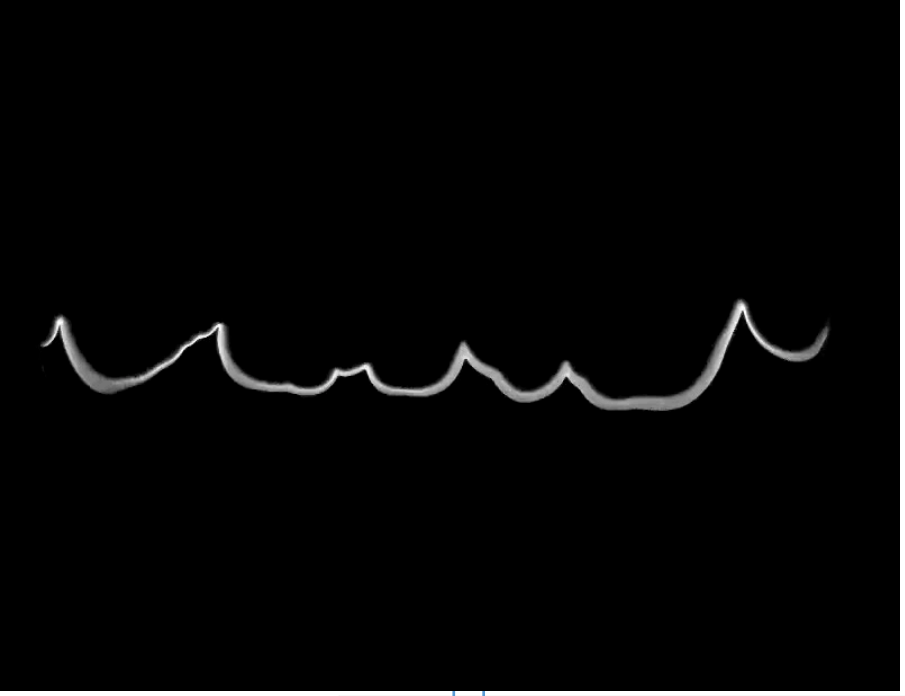
Cell size distribution

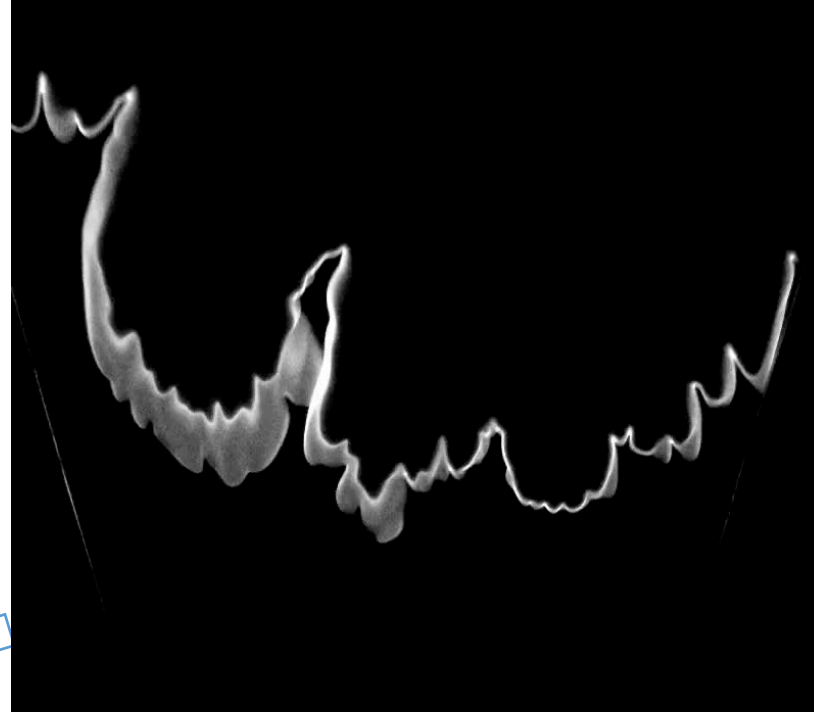




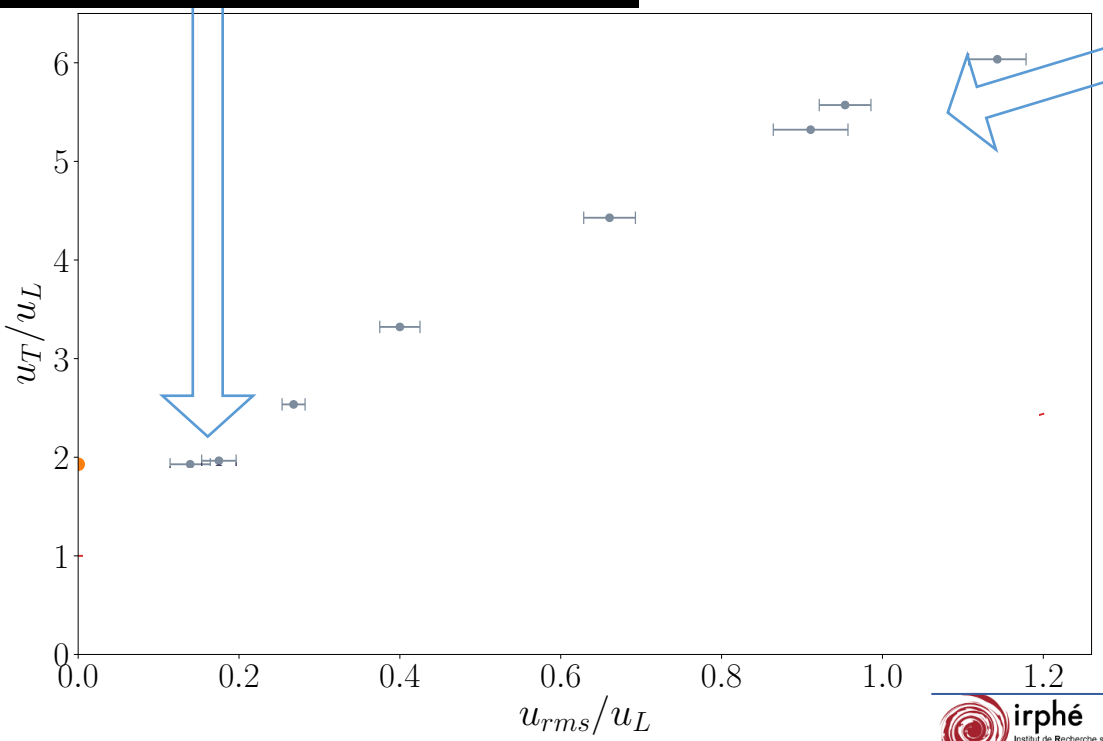
Curvature distribution

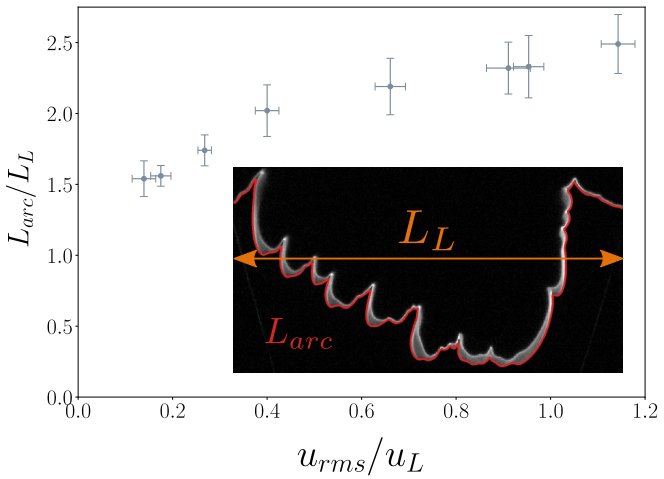


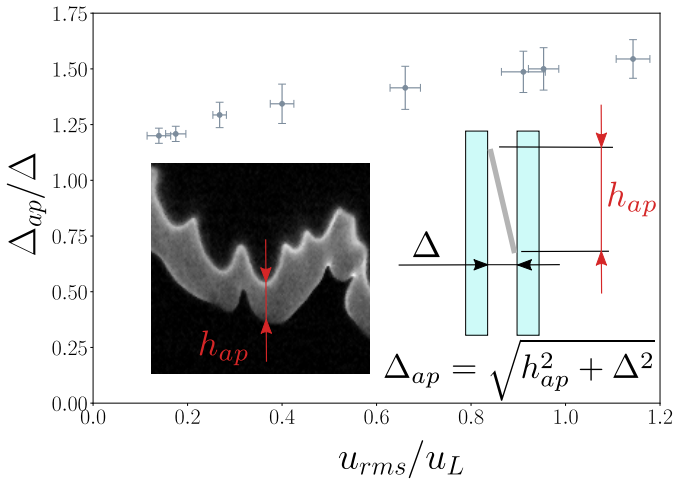


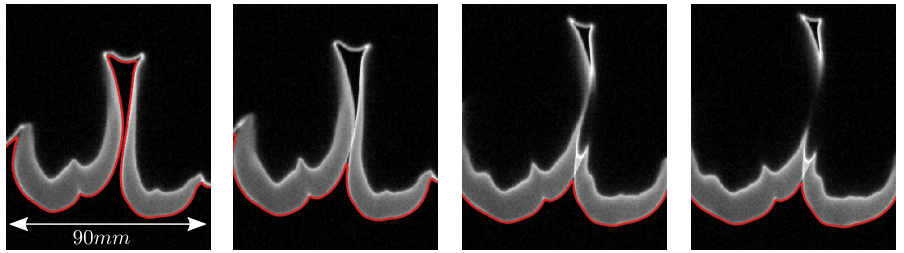


Turbulent velocity from flow rate and position

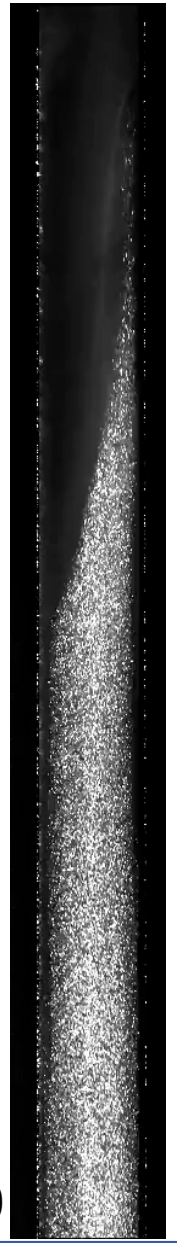




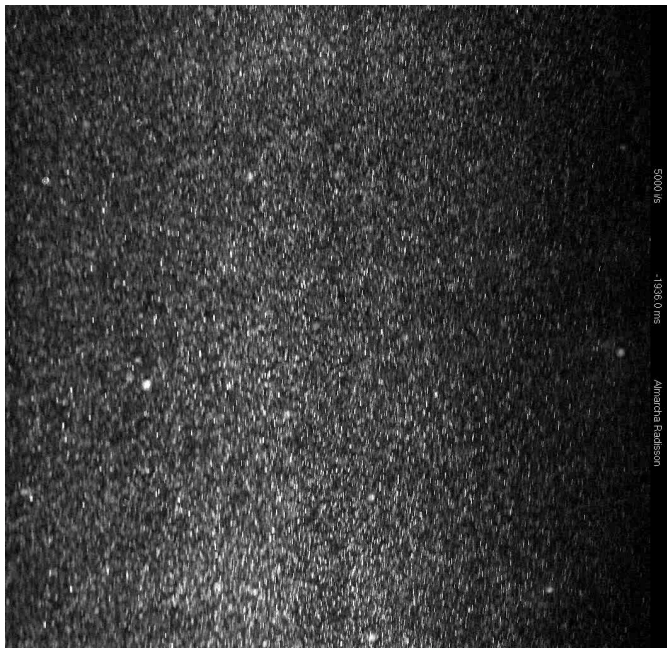




Side view
6 mm

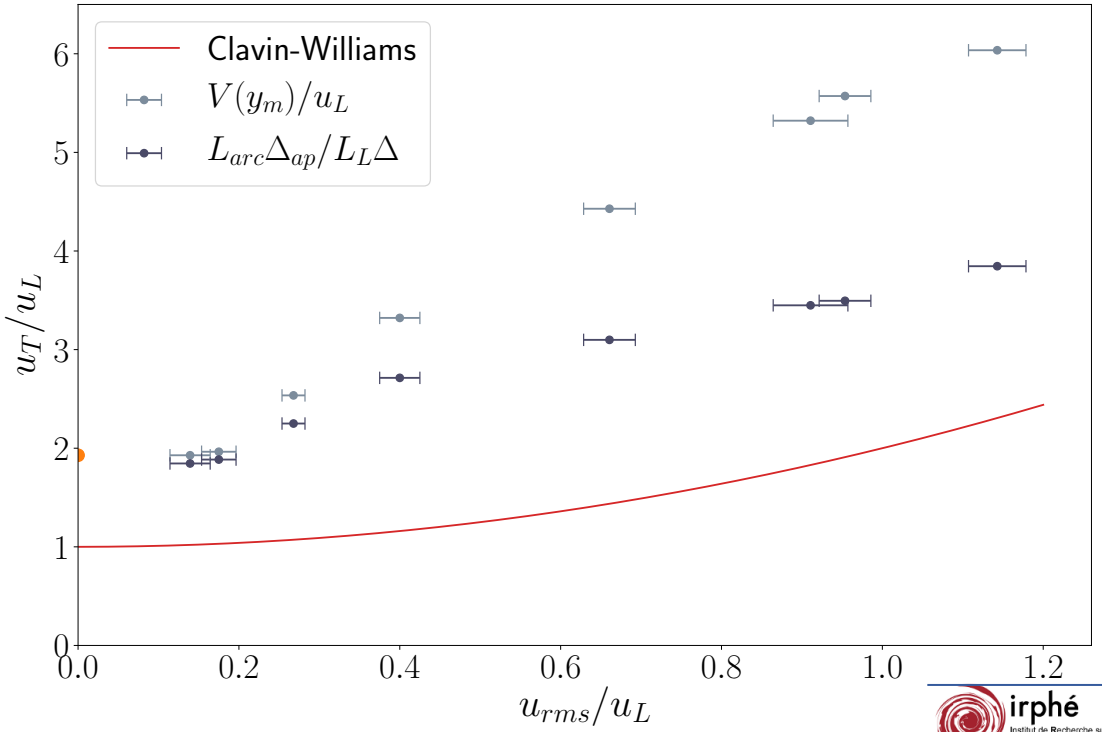


Front view



X100

Turbulent velocity



WEAKLY TURBULENT COMBUSTION IN A HELE-SHAW CELL

Conclusion and perspectives

* Weakly turbulent flames - planar on average - in Hele-Shaw cell

* Leading role of the intrinsic instability for weak turbulence intensities

* Interesting for studying flame-wall interaction, sidewall quenching, and Rich dynamics in the gap.