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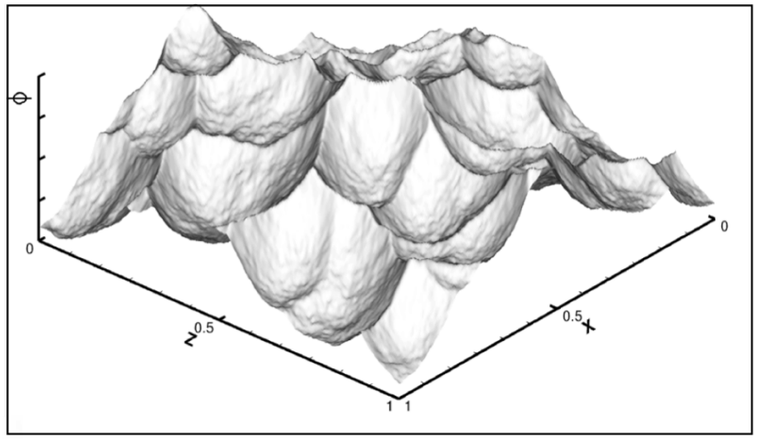
Research activity at a glance

Prof. F. Creta

people: P. E. Lapenna, R. Lamioni

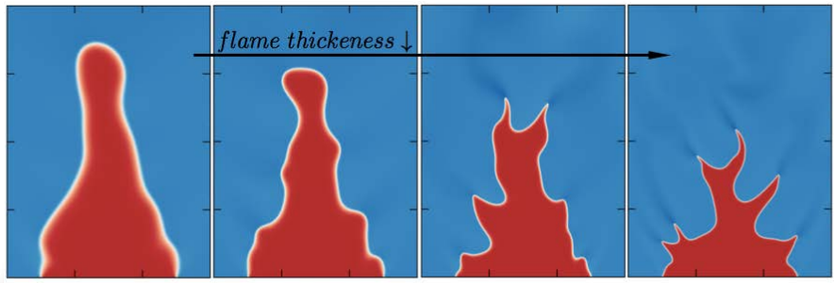
DIMA meeting Area Propulsione
February 6, 2017

Ongoing Research Activities

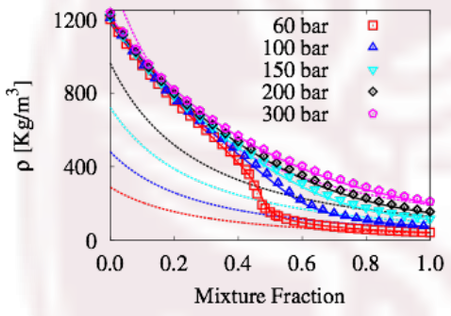


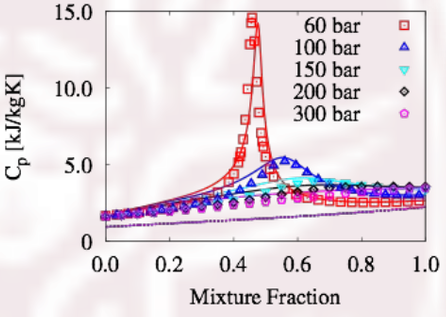
- **Numerical investigation of premixed combustion using a hybrid methodology**
  - » M.Matalon (UIUC-USA), F. Creta

- **Numerical and Experimental characterization of intrinsic instabilities in turbulent premixed flames**
  - » G. Troiani (ENEA), F. Creta, R. Lamioni, P.E. Lapenna



- **The structure of non-premixed flames at supercritical conditions**
  - » F. Creta, P.E. Lapenna, P.P. Ciottoli, M.Pfitzner, H. Muller (UBW-GER)





- **Direct and Large Eddy Simulation of Transcritical flows**
  - » F. Creta, P.E. Lapenna, D. Cecere (ENEA)

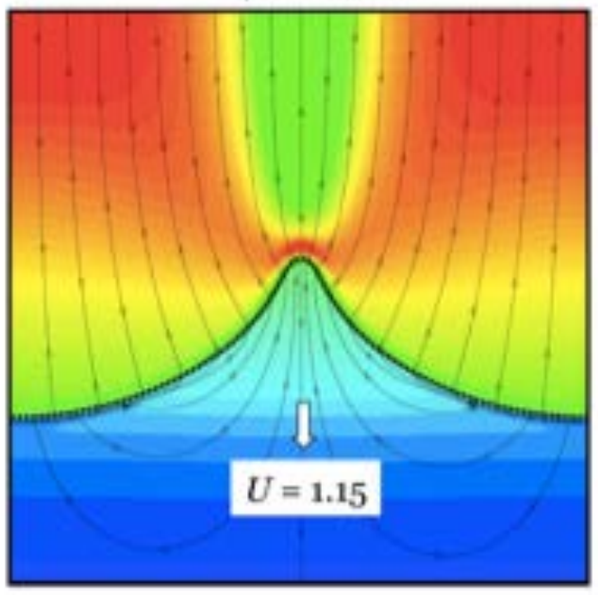
Numerical investigation of premixed combustion using a hybrid methodology

- In this project we implement the "hydrodynamic model" of premixed flames as a hybrid numerical scheme using front tracking, level-set technique embedded in a variable density Navier-Stokes field.

  » Laminar/Turbulent flame propagation

  » Interaction of intrinsic instabilities and turbulence

  » Scaling laws for S_T



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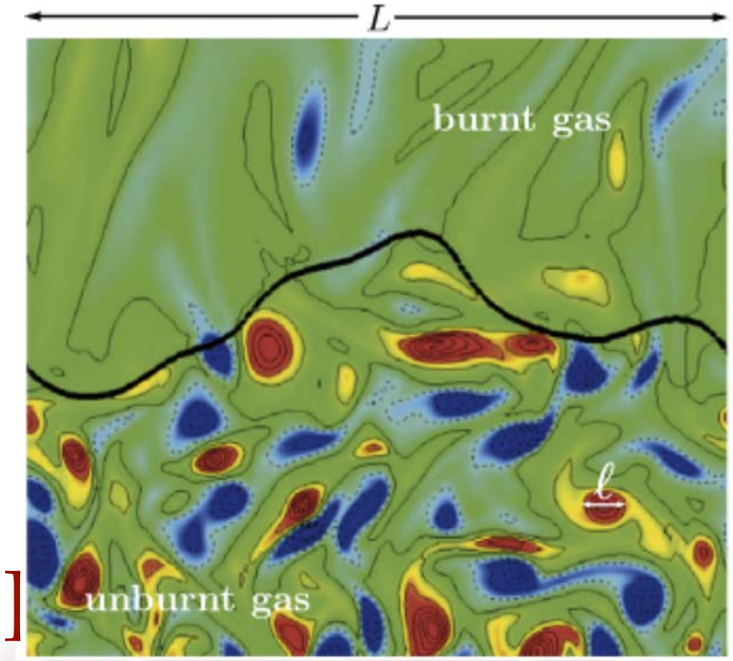

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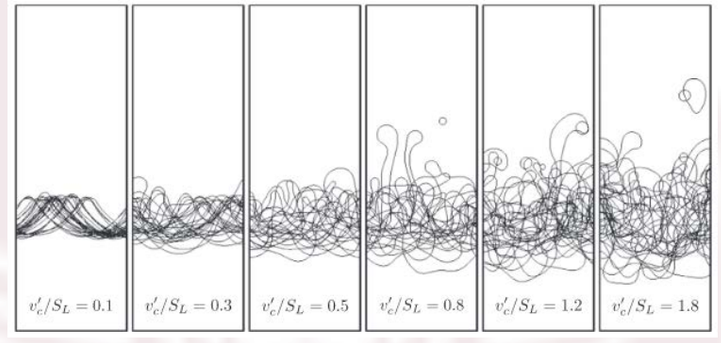

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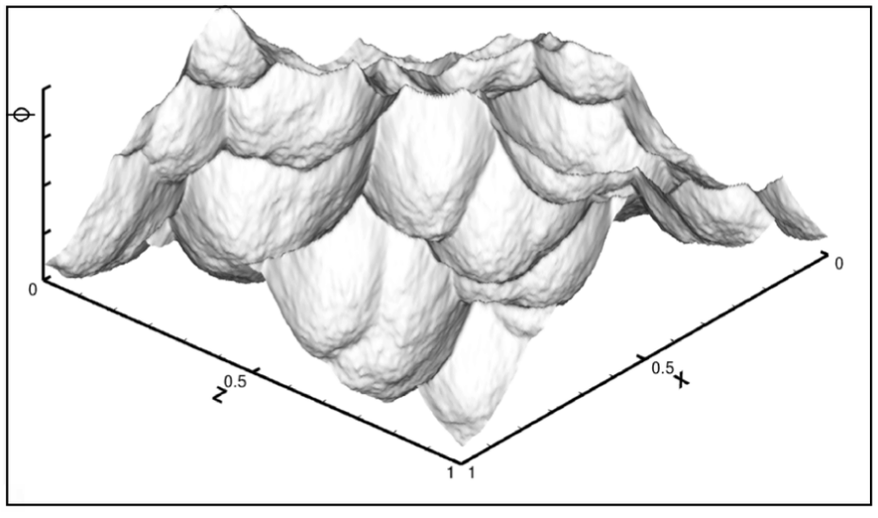

[1]

» **Related Journal Articles**

[1] **F. Creta, N. Fogla** and **M. Matalon**, *Combust. Theory and Model.* (2011)
[2] **F. Creta** and **M. Matalon**, *Proc. of Combustion Institute* (2011)
[3] **F. Creta** and **M. Matalon**, *Jour. of Fluid Mechanics* (2011)
[4] **F. Creta** and **M. Matalon**, *Proc. of Combustion Institute* (2011)
[5] **M. Matalon** and **F. Creta**, *Comptes Rendus Mecanique* (2012)
[6] **N. Fogla, F. Creta** and **M. Matalon** *Proc. of Combustion Institute* (2013)
[7] **N. Fogla, F. Creta** and **M. Matalon** *Combust. and Flame* (2015)
[8] **N. Fogla, F. Creta** and **M. Matalon** *Combust. and Flame* (2017)

Numerical/Experimental study of intrinsic instabilities in turbulent premixed flames

- In this project we investigate, both numerically (DNS) and experimentally (PIV), the interplay between the intrinsic Darrieus-Landau (DL) of a premixed flame and weak turbulence

  » Definition of an unambiguous marker of presence/absence of DL-induced effects

  » Quantification of the DL effects on the flame propagation

  » Assessment of mitigation/suppression of instabilities due to increasing turbulence

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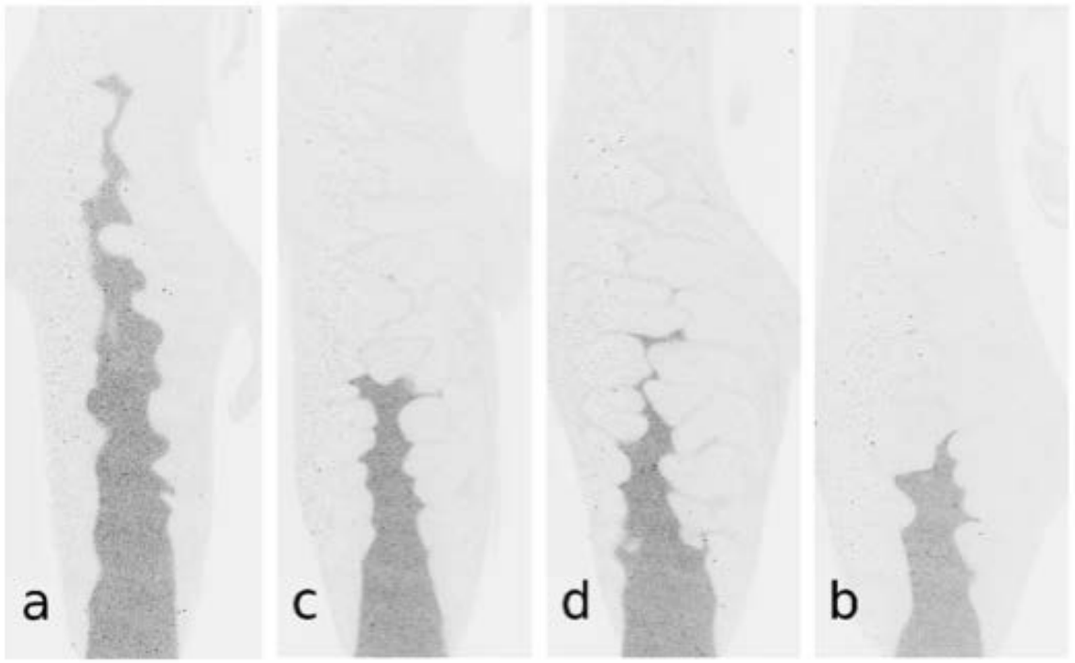

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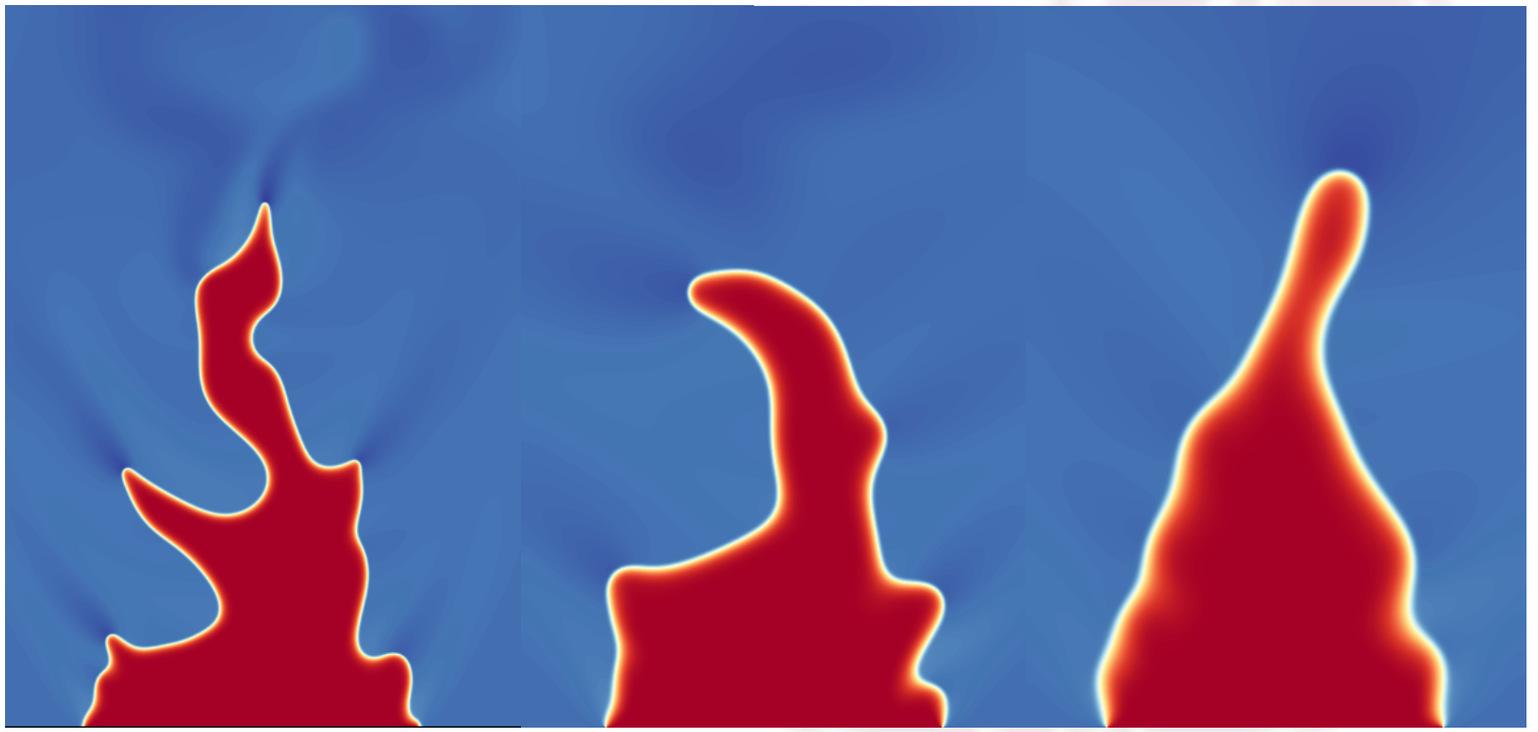


» **Related Journal Articles**

[1] **G. Troiani, F. Creta** and **M. Matalon**, *Proc. of Combustion Institute* (2015)

[2] **F. Creta, P. Lamioni, P.F. Lapenna, G. Troiani** *Physical Review E* (2016)

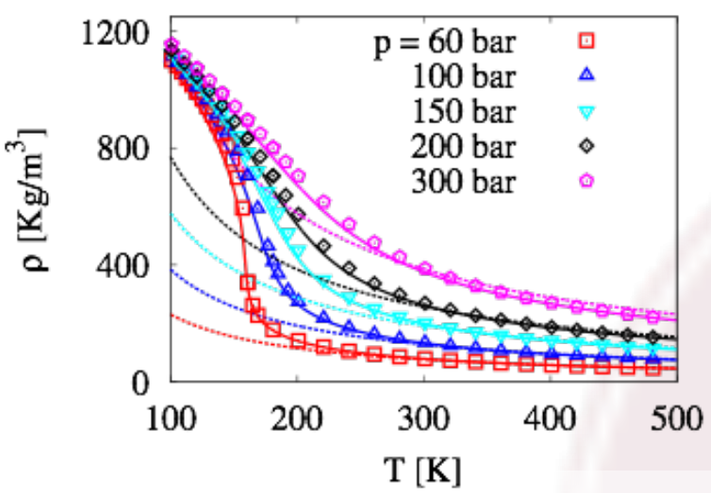
The structure of non-premixed flames at supercritical conditions

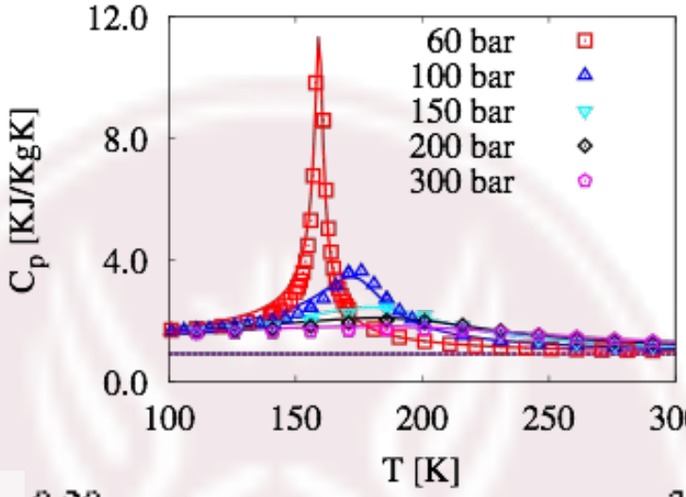
- In this project we develop an efficient multispecies thermodynamic library to account for real gas effects in the context of non-premixed combustion.
- This is used in conjunction with non premixed combustion laminar solvers in the context of flamelet tabulation for high pressure cryogenic LES turbulent combustion solvers.

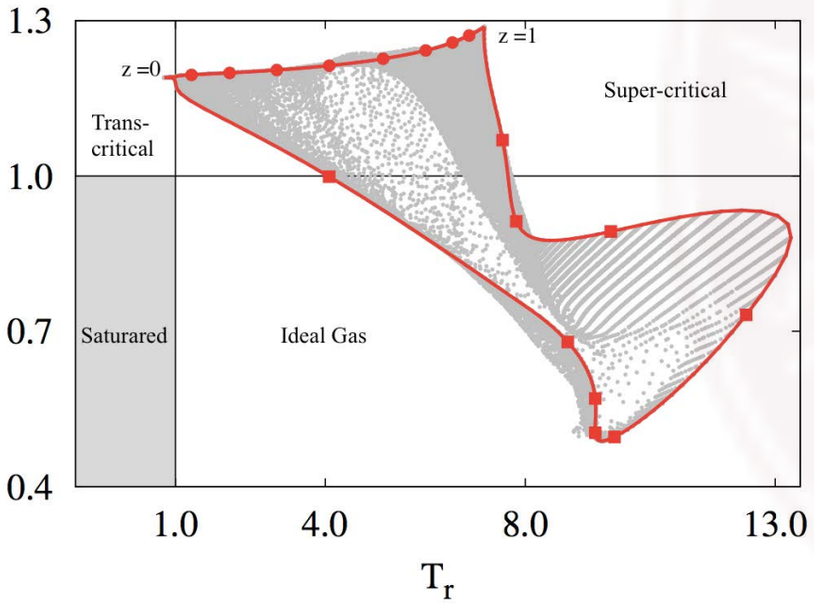
» RGM library based on comprehensive three parameters real fluid EoS

» Supercritical pressure influence on unsteady flamelet ignition transient

» Effects of fuel composition on LNG/LOx laminar flame structure







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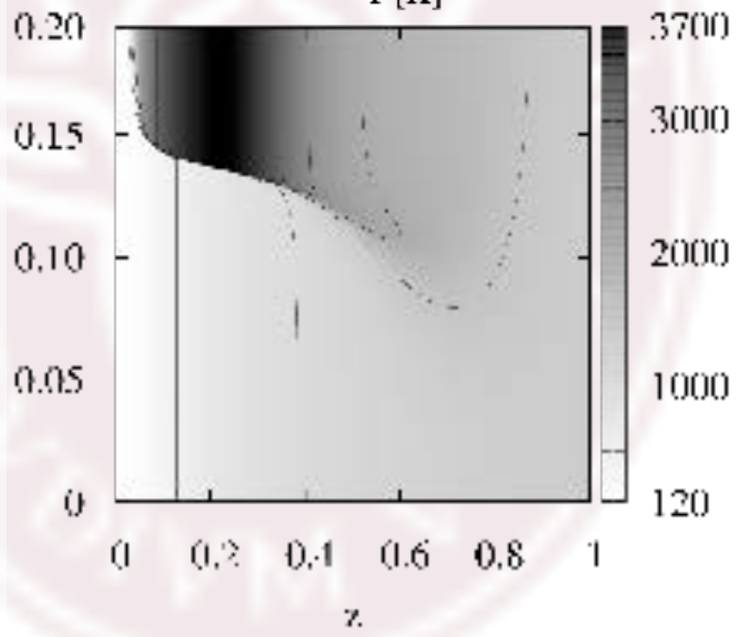


» **Related Journal Articles**

[1] **P.E. Lapenna, P.P. Ciottoli** and **F. Creta,** *Combust. Science and Teeh.* (2017-Under review)

[2] **P.E. Lapenna, P.P. Ciottoli** and **F. Creta,** AIAA-paper 2016-0690, *Jour. of Prop. Power* (2017-In preparation)

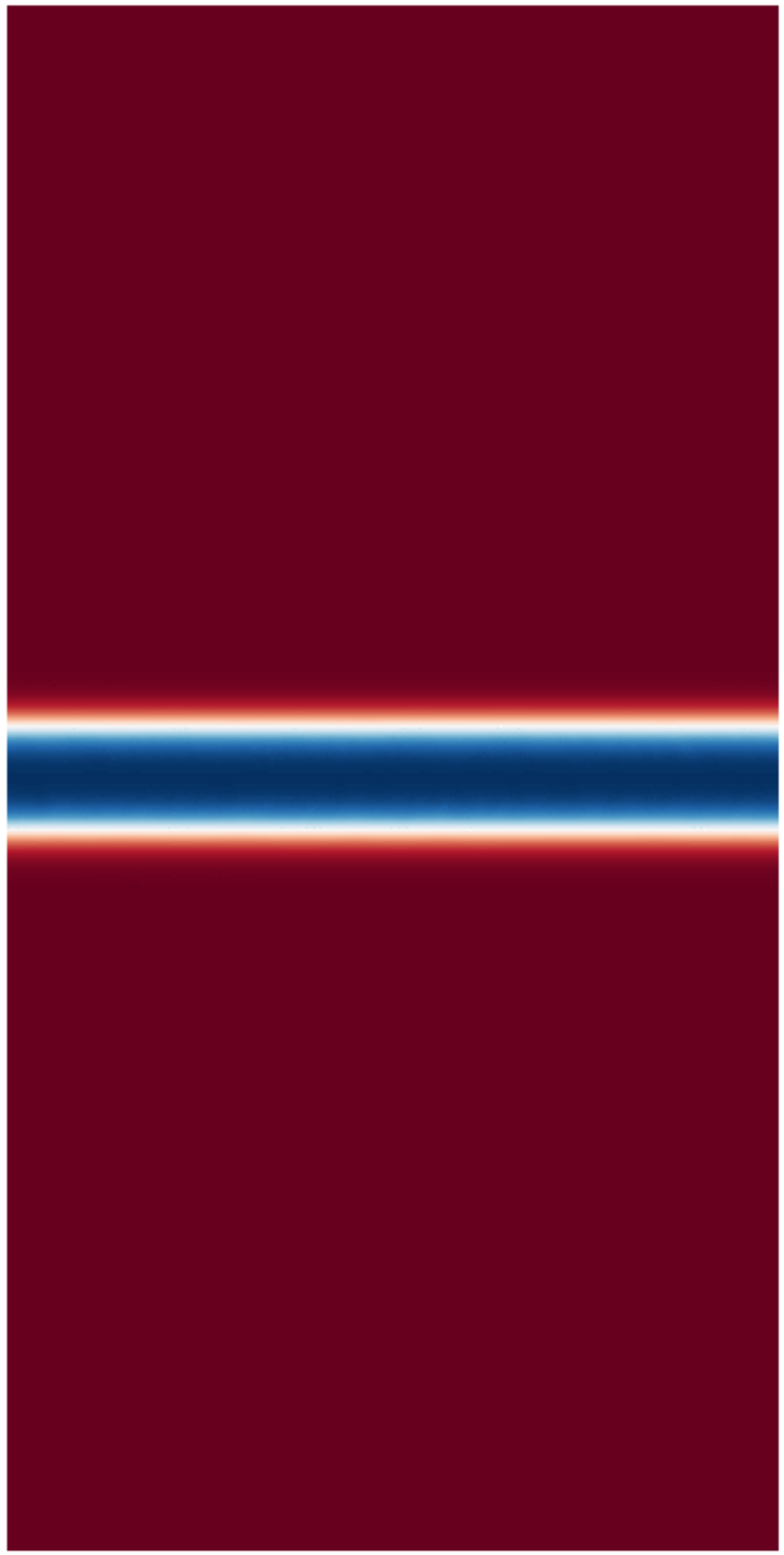
Direct and Large Eddy Simulation of Transcritical flows

- In this project we develop we develop a Low-Mach number real fluid version of **`nek5000.`**
- Highly scalable, spectral element, flow solver with state of the art thermo-physical and transport properties

» Investigation of mixing under severe thermodynamical conditions, usually encountered in LRE

» *A-priori* testing, using DNS, of sub-grid presumed pdf methods at supercritical pressures.

» *A-posteriori* analysis, using LES, of sub-grid modeling and simulation of relevant experimental configurations.



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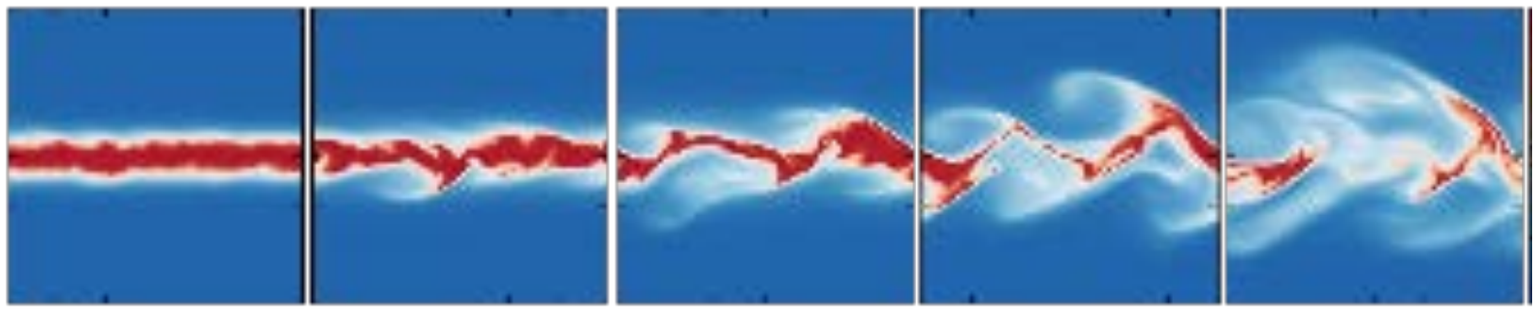

» **Related Journal Articles**

[1] **P.E. Lapenna, F. Creta,** *Jour. of Supercritical Fluids.* (2017-Under review)

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Thank you!

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