UNIVERSITY OF CAMBRIDGE

Cambridge swirl spray flame: target for TCS

Epaminondas Mastorakos

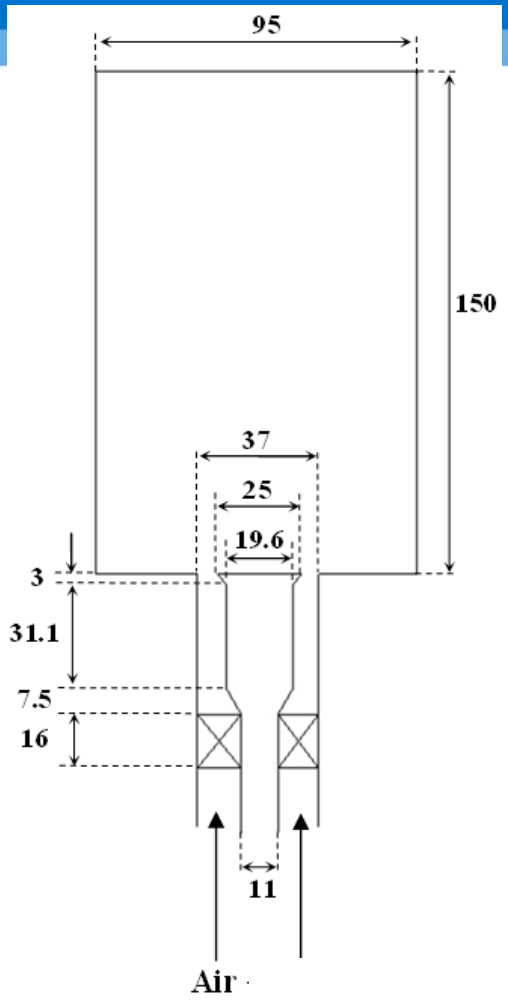
em257@eng.cam.ac.uk

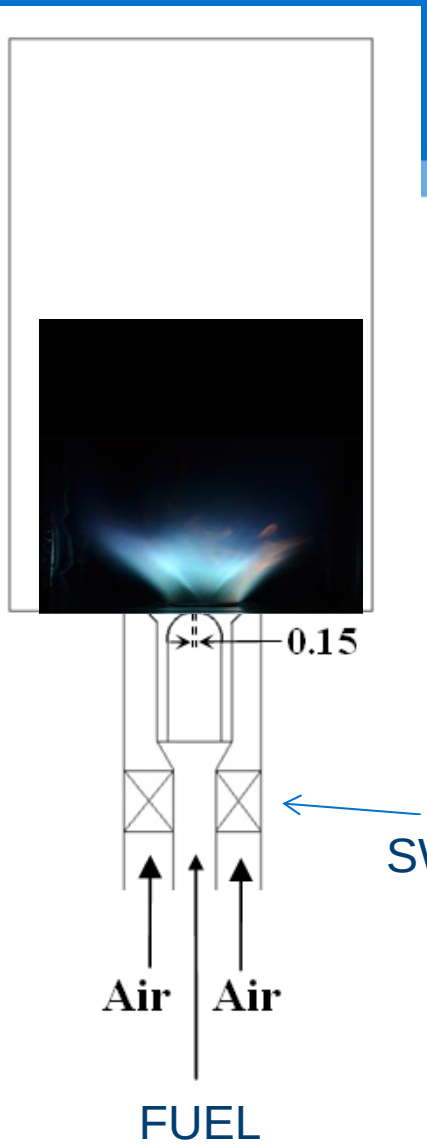
Department of Engineering

Swirl spray flame for TCS inclusion

- The Cambridge Swirl Flame series is meant to study finite-rate kinetic effects in spray combustion, in configurations of direct relevance to gas turbine combustors. Focus of the research is on local and global extinction.
- TCS has so far dealt with jet-type flames, but recirculation is perhaps necessary to include to have bigger impact to industry.
- Geometry files for CFD can be made available.
- Experimental data can be made available electronically (Excel and/or Matlab files).
- See slide 3 for geometry, slide 4 for details. Blow-off curve & photos available for all fuels.
- Slide 5 for references
- Modelled by Cambridge (Giusti) & Darmstadt (A. Sadiki) so far. Heptane with different atomiser, (but similar physics) has been simulated by CERFACS (Riber & Cuenot).
- People at Cambridge: experiments by Drs. J. Sidey & P. Alisson, modelling by Dr. A. Giusti. Looking for a PhD student.

Geometry





SWIRLER

All dimensions in mm.

Available measurements.

FUEL	Mie scattering from spray	OH* (Abel)	OH-PLIF (mean & 10kHz)	CH2O-PLIF (simultan. with OH-PLIF)	PDA (SMD, size distribution , Velocity)	Dynamics of blow-off	Refs	Comments
Cold flow (no fuel)	-	-	-	-	Air flow axial and swirl	-	[1, 2]	Used for grid independence etc
Ethanol	X	X	X	-	X	X	[3,4,5]	CFD at Cambridge completed
Heptane	X	X	X	X	X	X	[3,6]	Plan to simulate at Cambridge
Decane	X	X	X	-	X	X	[3]	
Dodecane	X	X	X	-	X	X	[3]	Currently simulated at Cambridge
Kerosene (A1)	To do	X	X	“Fuel PLIF”	To do	To do	Unpubl. A ppt is available [7]	These kerosenes are standard, part of the USA National Jet Fuel Combustion Programme
Kerosene (C1)	To do	X	X	“Fuel PLIF”	To do	To do	Unpubl. A ppt is available [7]	
Kerosene (C5)								To do

References

1. A. Cavaliere PhD thesis, U of Cambridge. For the physics, but with different atomiser, also see: Cavaliere, D.E., Kariuki, J. & Mastorakos, E. (2013) A comparison of the blow-off behaviour of swirl-stabilised premixed, non-premixed and spray flames. *Flow, Turbulence and Combustion* **91**, 347-372. doi: 10.1007/s10494-013-9470-z

2. Tyliszczak, A., D.E. Cavaliere & Mastorakos, E. (2014) LES/CMC of blow-off in a liquid fuelled swirl burner. *Flow, Turbulence and Combustion* **92**, 237-267. doi: 10.1007/s10494-013-9477-5

3. R. Yuan PhD thesis, U of Cambridge. Draft paper upon request.

4. Giusti, A. & Mastorakos, E. (2016) Detailed chemistry LES/CMC simulation of a swirling ethanol spray flame approaching blow-off. To appear in *Proceedings of the Combustion Institute.* doi: 10.1016/j.proci.2016.06.035

5. Giusti, A., Kotzagianni, M. & Mastorakos, E. (2016) LES/CMC simulations of swirl-stabilised ethanol spray flames approaching blow-off. To appear in *Flow, Turbulence and Combustion*.

6. Yuan, R., Kariuki, J., Dowlut, A., Balachandran, R. & Mastorakos, E. (2015) Reaction zone visualisation in swirling spray n-heptane flames. *Proceedings of the Combustion Institute* **35**, 1649-1656. doi: 10.1016/j.proci.2014.06.012

7. Dr. Jenni Sidey, presentation to NJFCP, June 2016. Please contact Dr. Sidey at jams4@cam.ac.uk