Data Documentation

Time-varying Laminar Non-premixed Jet Flames

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Chapter 1

Experimental details

Burner description [1, 2]:
The burner was equipped with three interchangeable fuel tubes, having inner diameters of 4.0, 5.6 and 8.0 mm. The fuel tubes were surrounded by a concentric 74-mm-diameter co-flow annulus with dry air running through it. The co-flow passage contained two honeycombs with the section between filled with glass beads. A loud-speaker was placed beneath the fuel plenum to impose periodic pressure perturbations to the fuel flow.

1.1 20-Hz and 40-Hz Non-premixed flames

To use the data of these flames, please cite [1].

Nozzle diameter	4.0 mm
Fuel	32% Ethylene/68% Nitrogen
Fuel flow rate	0.264 LPM
Fuel bulk exit velocity	0.35 $m{\cdot}s^{-1}$
Co-flow	Air
Co-flow flow rate	80 LPM
Co-flow bulk exit velocity	0.35 $m{\cdot}s^{-1}$
Forcing frequency	20 and 40 Hz
Forcing amplitude	50%

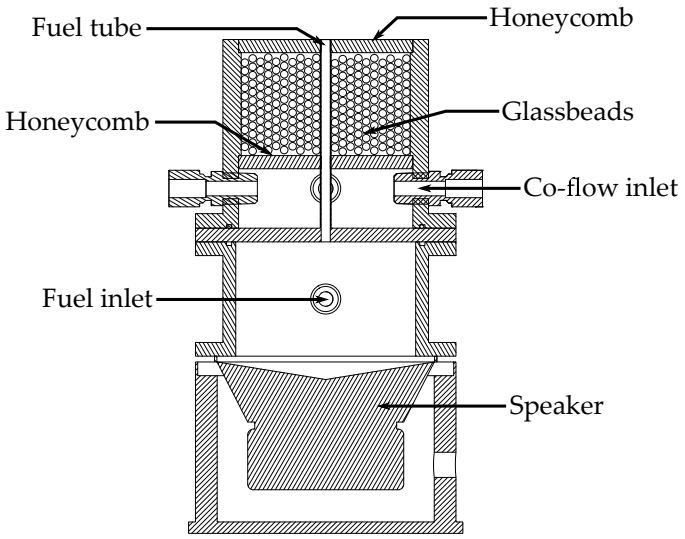

Figure 1.1 Co-flow burner for the investigation of acoustically-forced laminar non-premixed flames.

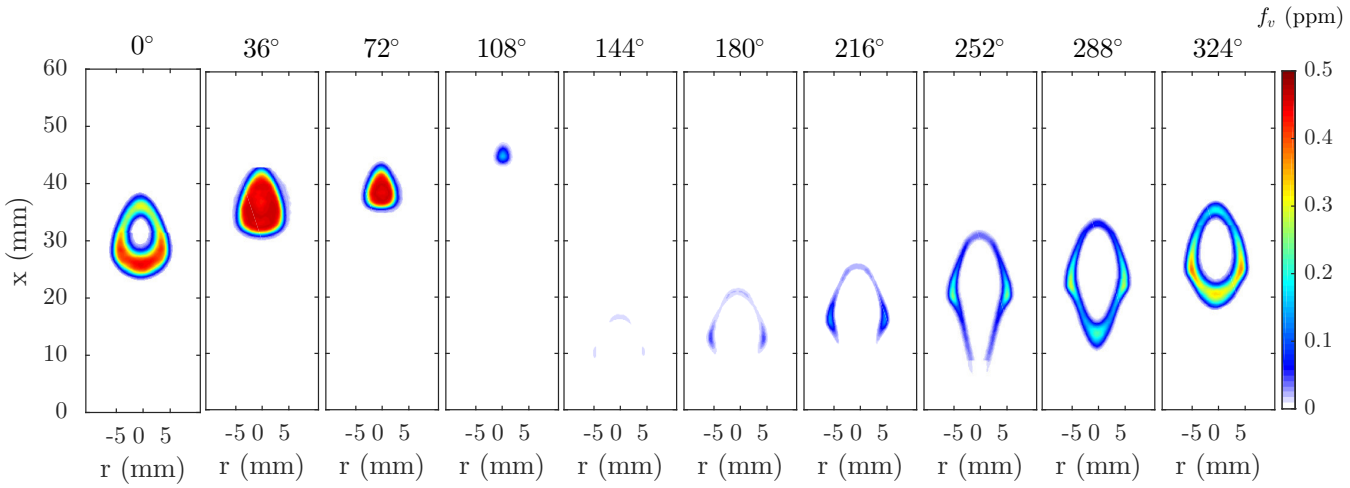

Figure 1.2 Planar measurement of soot volume fraction, f_v, for the laminar flame with 4.0-mm-diameter burner forced at 20-Hz forcing and 50% fuel flow modulation.

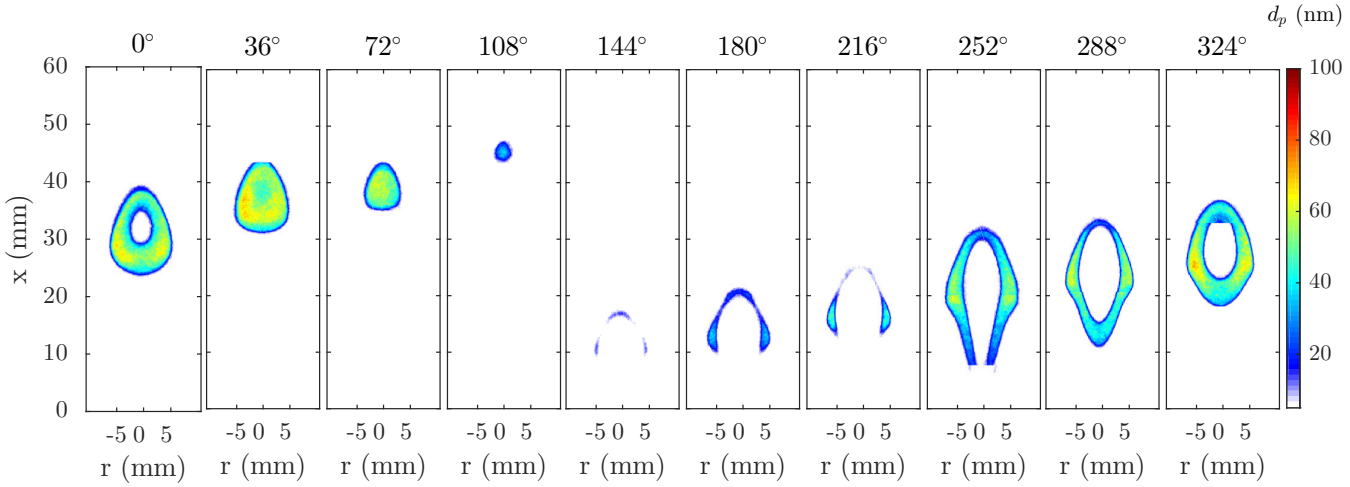

Figure 1.3 Planar measurement of primary particle diameter, d_p, for the laminar flame with 4.0-mm-diameter burner forced at 20-Hz forcing and 50% fuel flow modulation.

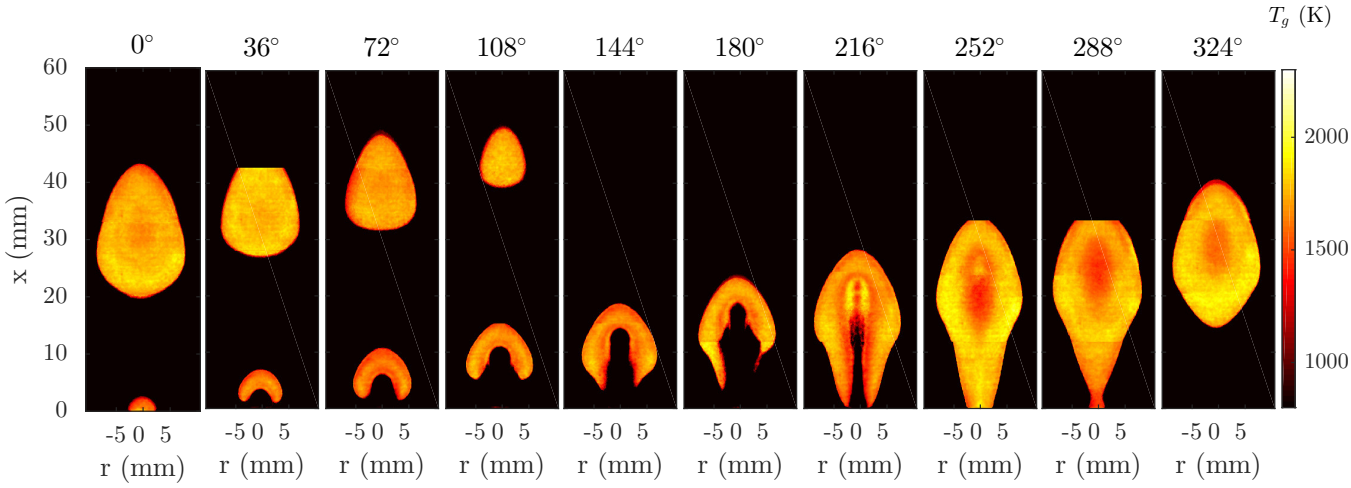

Figure 1.4 Planar measurement of temperature, T_g, for the laminar flame with 4.0-mm-diameter burner forced at 20-Hz forcing and 50% fuel flow modulation.

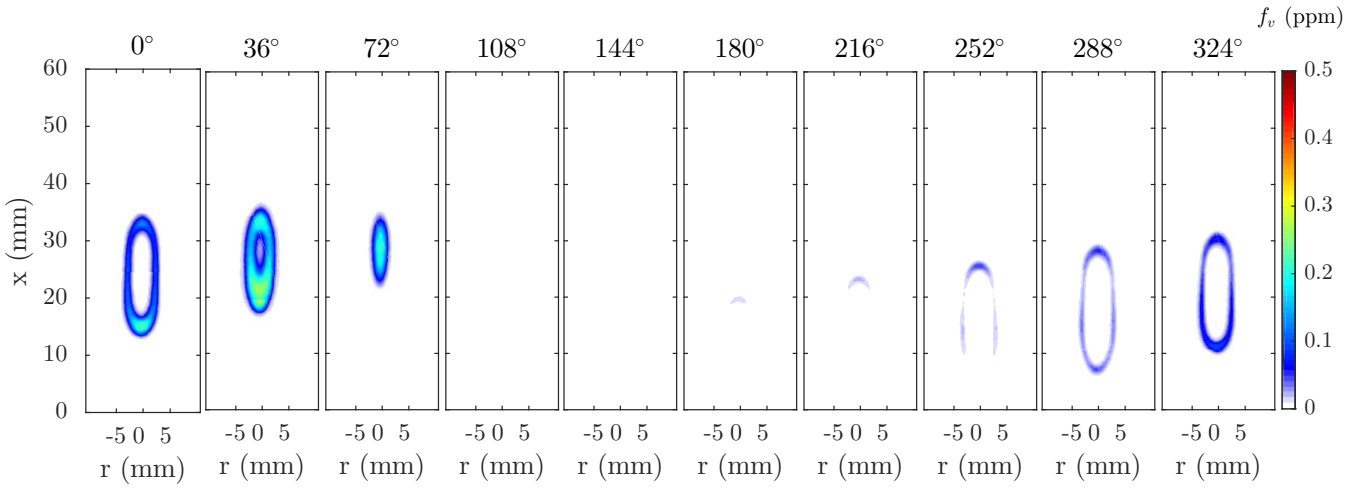

Figure 1.5 Planar measurement of soot volume fraction, f_v, for the laminar flame with 4.0-mm-diameter burner forced at 40-Hz forcing and 50% fuel flow modulation.

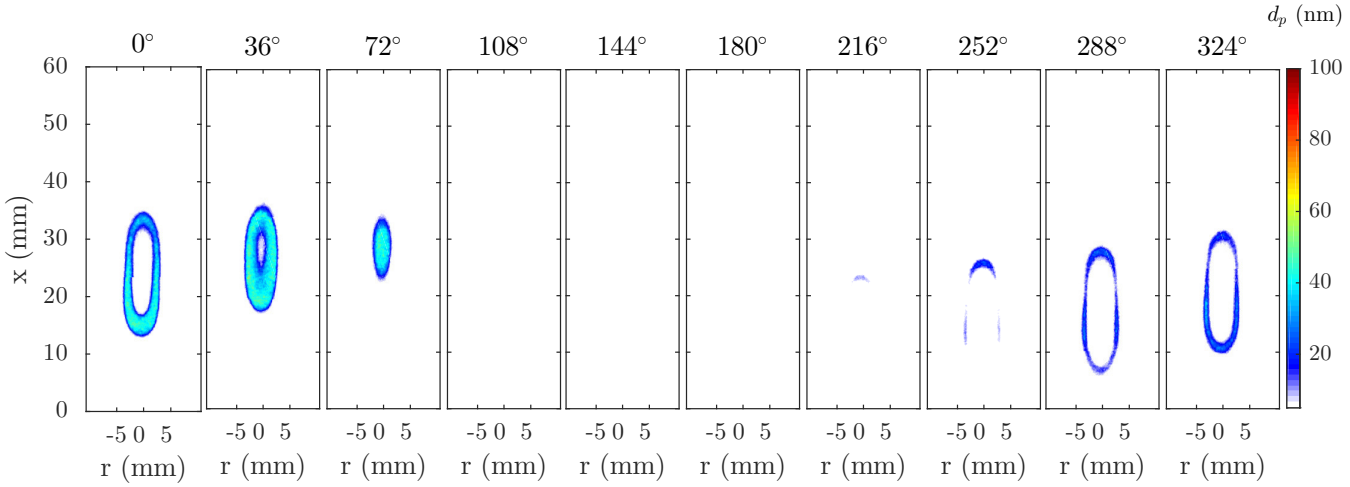

Figure 1.6 Planar measurement of primary particle diameter, d_p, for the laminar flame with 4.0-mm-diameter burner forced at 40-Hz forcing and 50% fuel flow modulation.

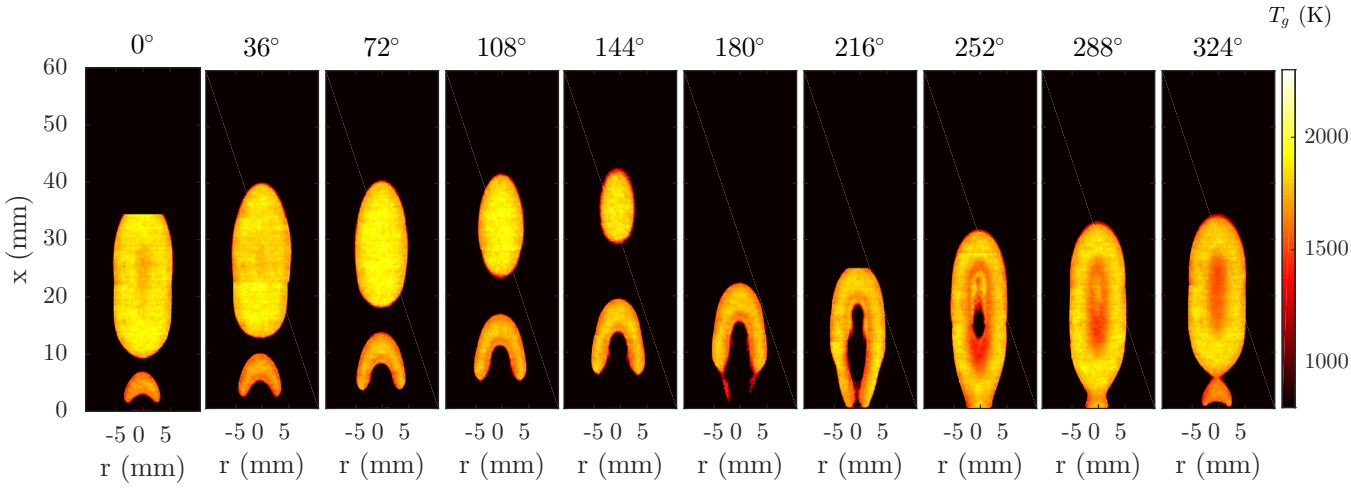

Figure 1.7 Planar measurement of temperature, T_g, for the laminar flame with 4.0-mm-diameter burner forced at 40-Hz forcing and 50% fuel flow modulation.

1.2 10-Hz forcing

To use the data of these flames, please cite [2].

Nozzle diameter	4.0, 5.6 and 8.0 mm
Fuel	41.7% Ethylene/58.3% Nitrogen
Fuel flow rate	0.310 SLPM[1]
Co-flow	Air
Co-flow flow rate	60 LPM
Forcing frequency	10 Hz
Forcing amplitude	25 & 50% (4.0- & 8.0-mm-diameter) 50 & 75% (5.6-mm-diameter)

4.0-mm-diameter burner

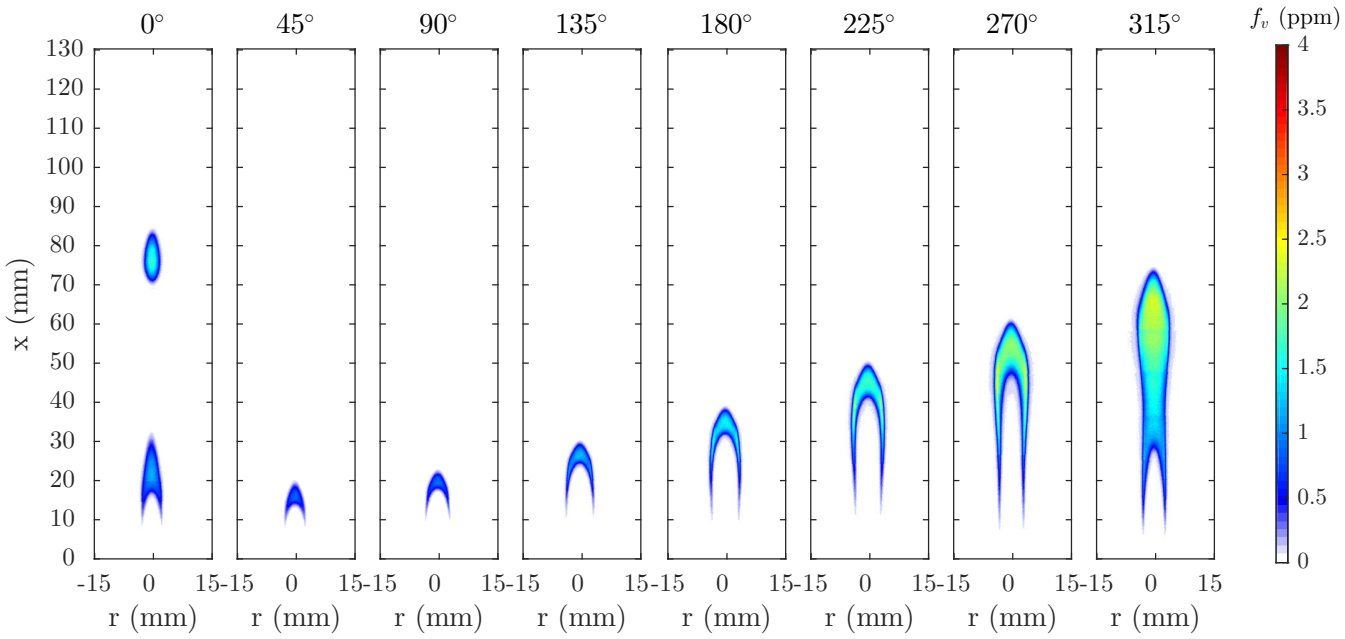

Figure 1.8 Planar measurement of soot volume fraction, f_v, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

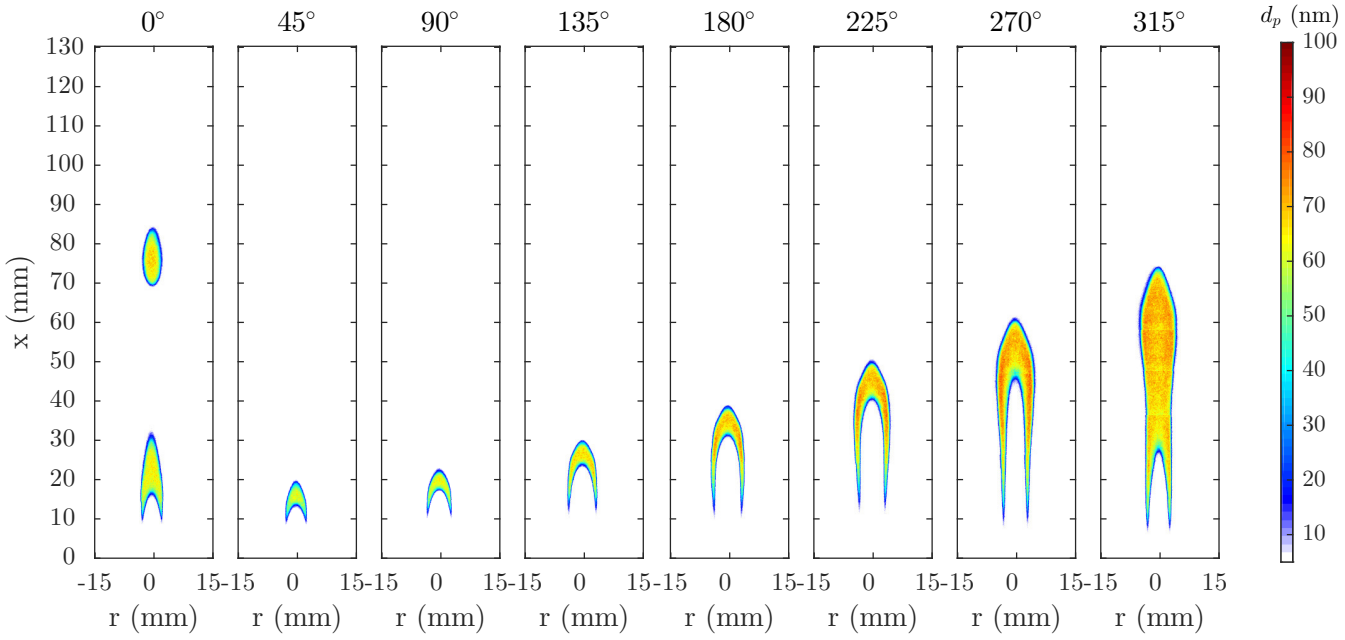

Figure 1.9 Planar measurement of primary particle diameter, d_p, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

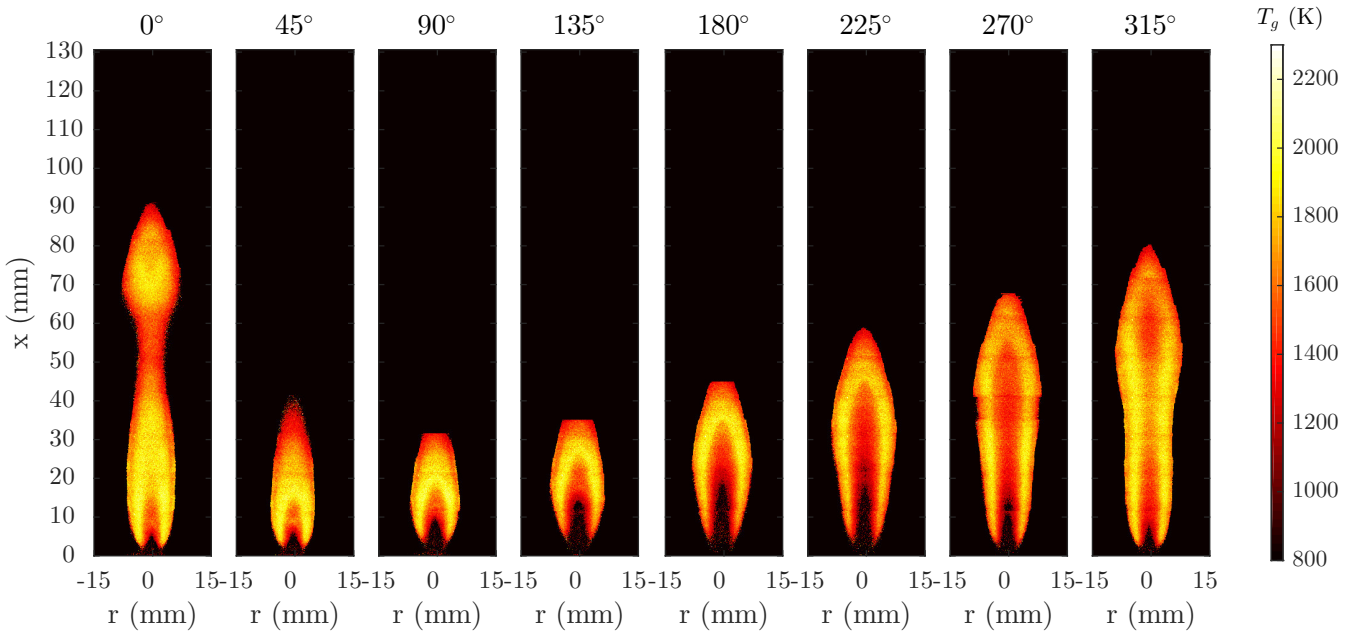

Figure 1.10 Planar measurement of temperature, T_g, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

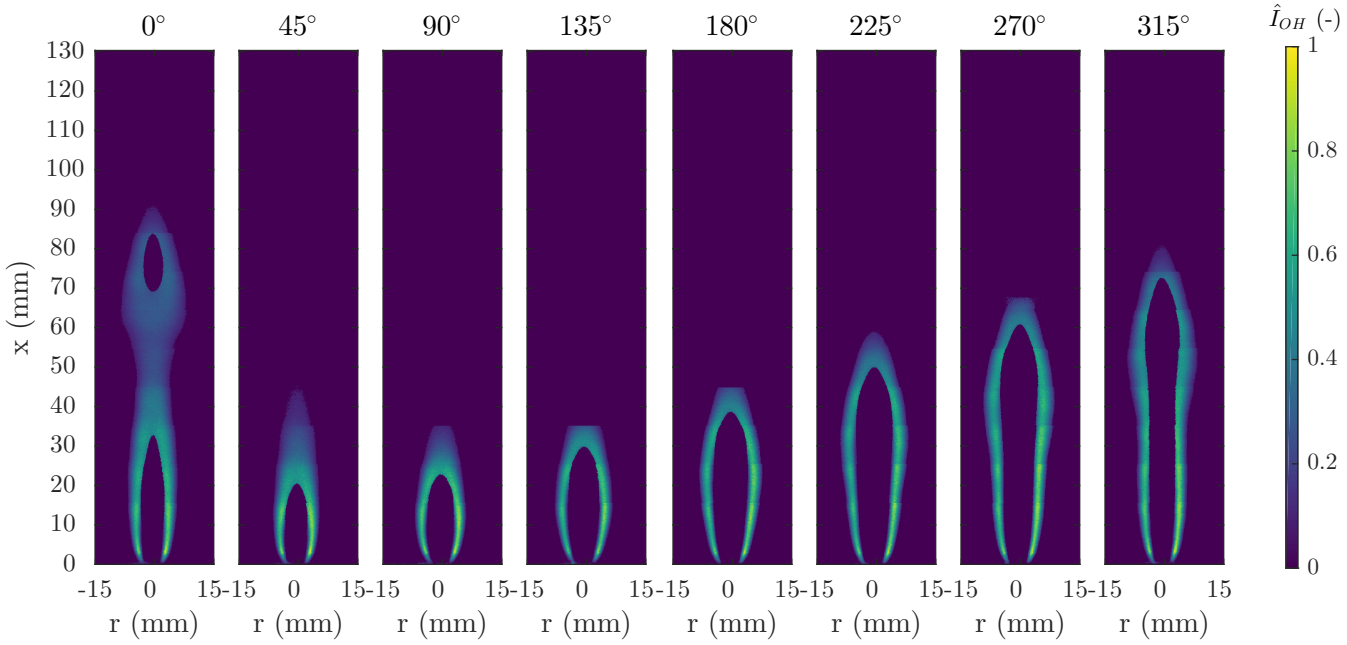

Figure 1.11 Planar measurement of OH-LIF, I_{OH}, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

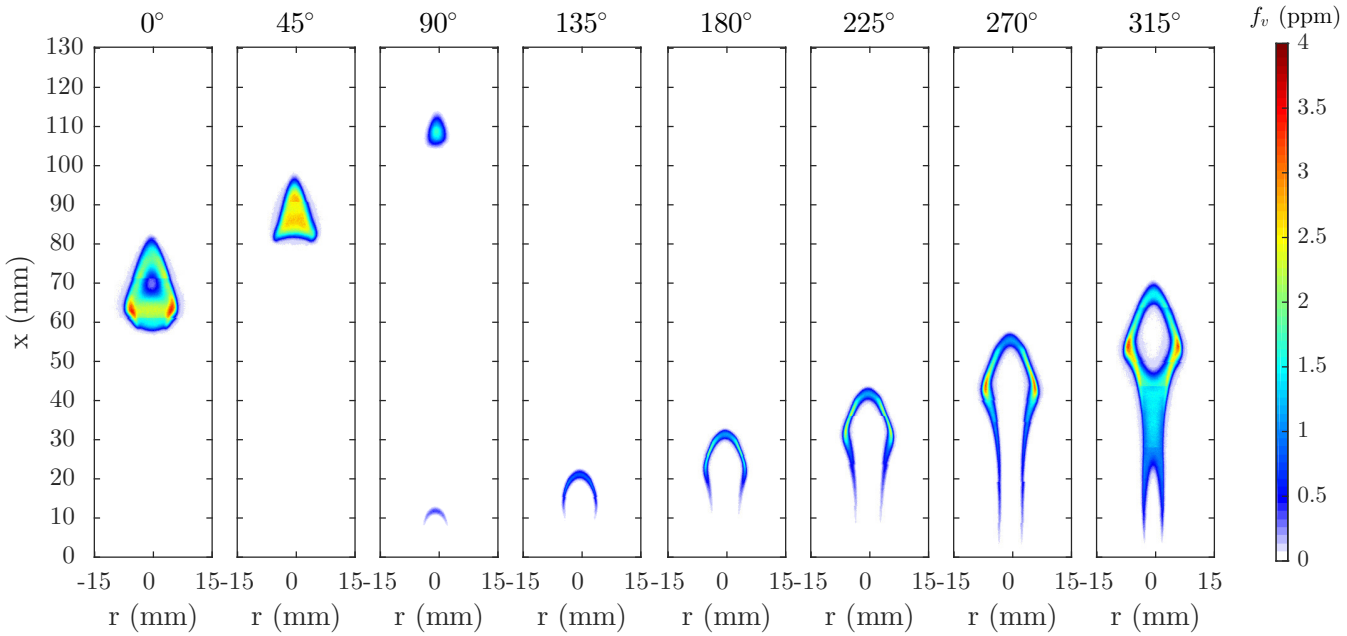

Figure 1.12 Planar measurement of soot volume fraction, f_v, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

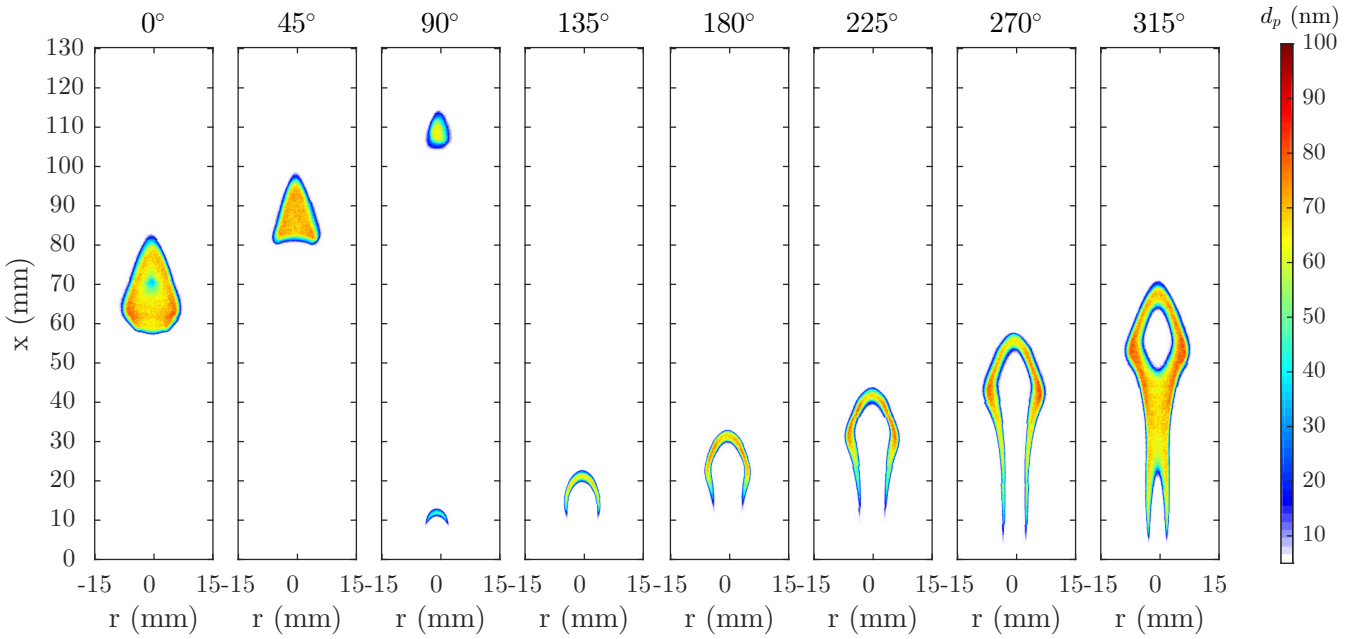

Figure 1.13 Planar measurement of primary particle diameter, d_p, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

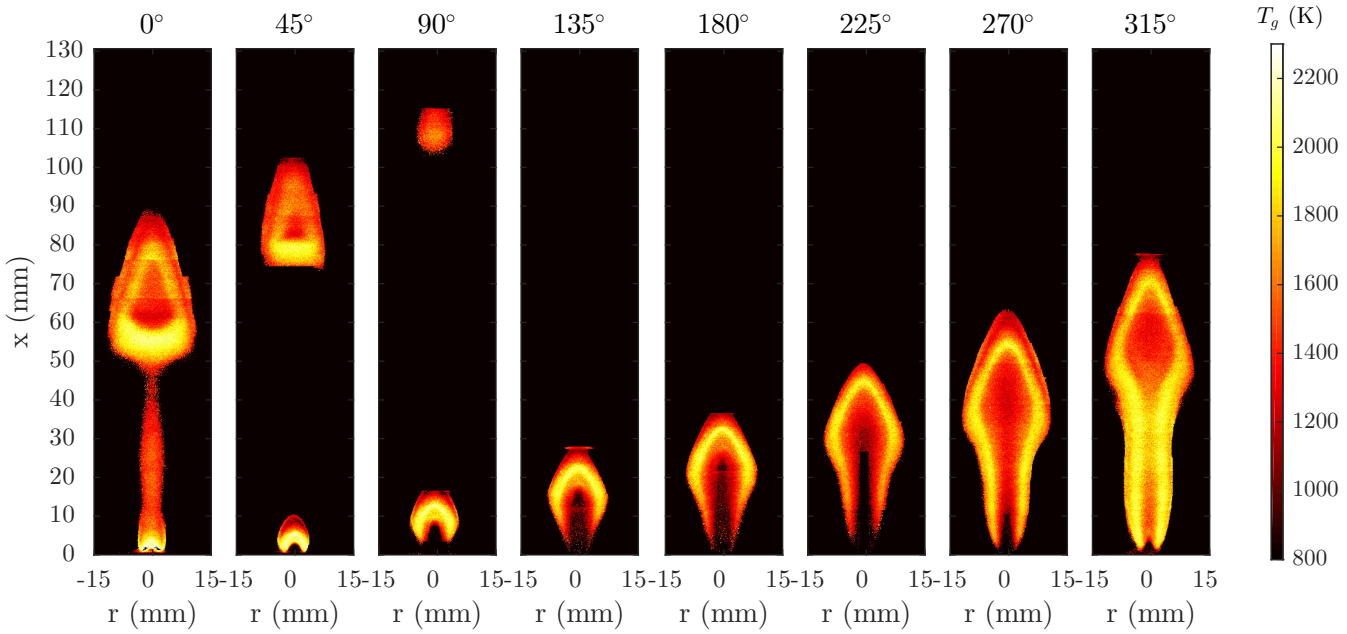

Figure 1.14 Planar measurement of temperature, T_g, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

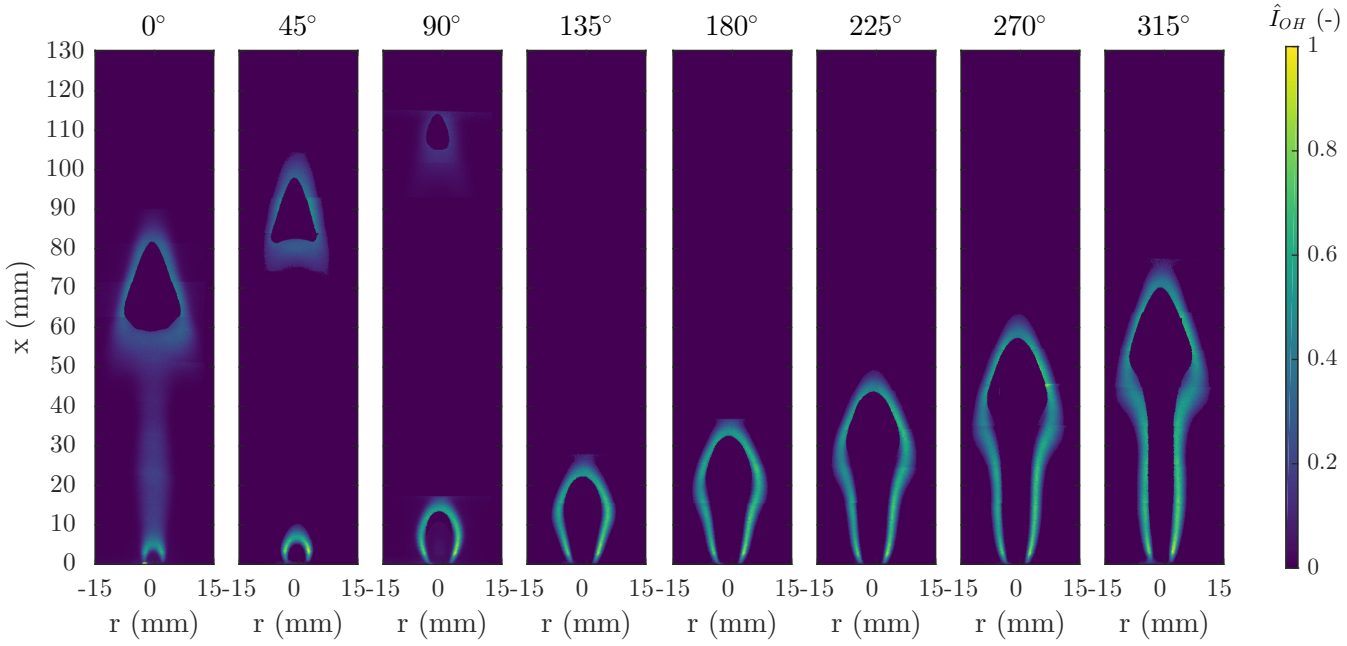

Figure 1.15 Planar measurement of OH-LIF, I_{OH}, for the laminar flame with 4.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

5.6-mm-diameter burner

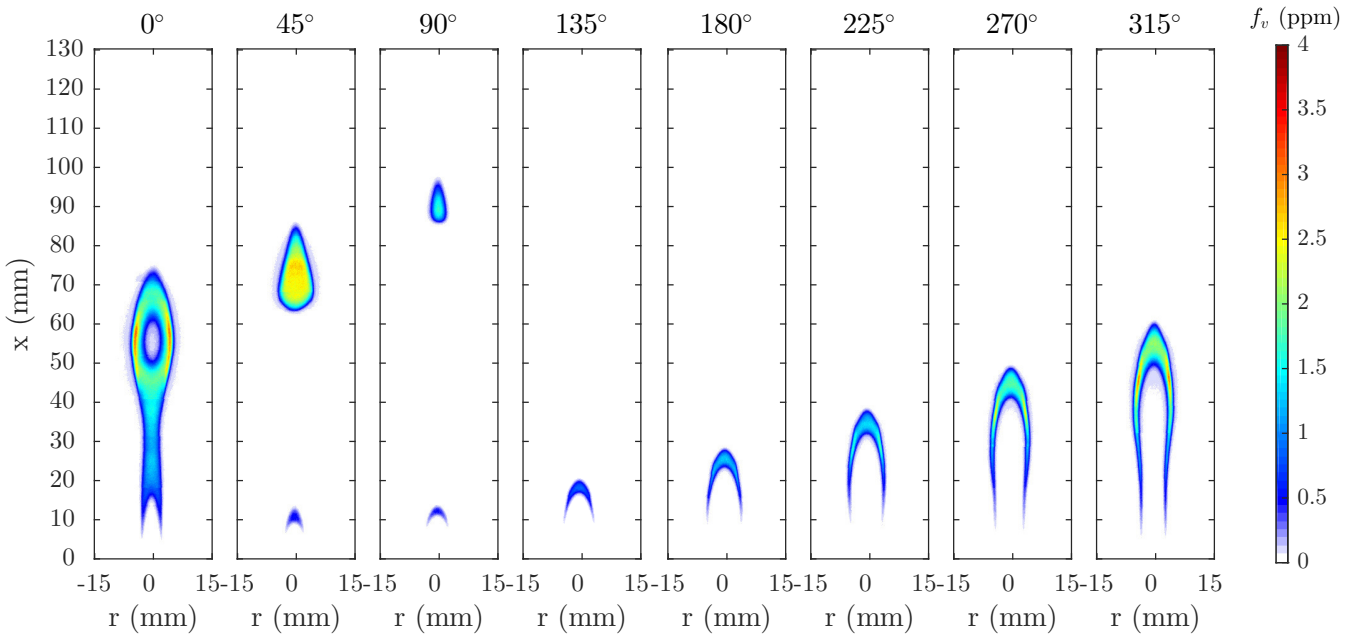

Figure 1.16 Planar measurement of soot volume fraction, f_v, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

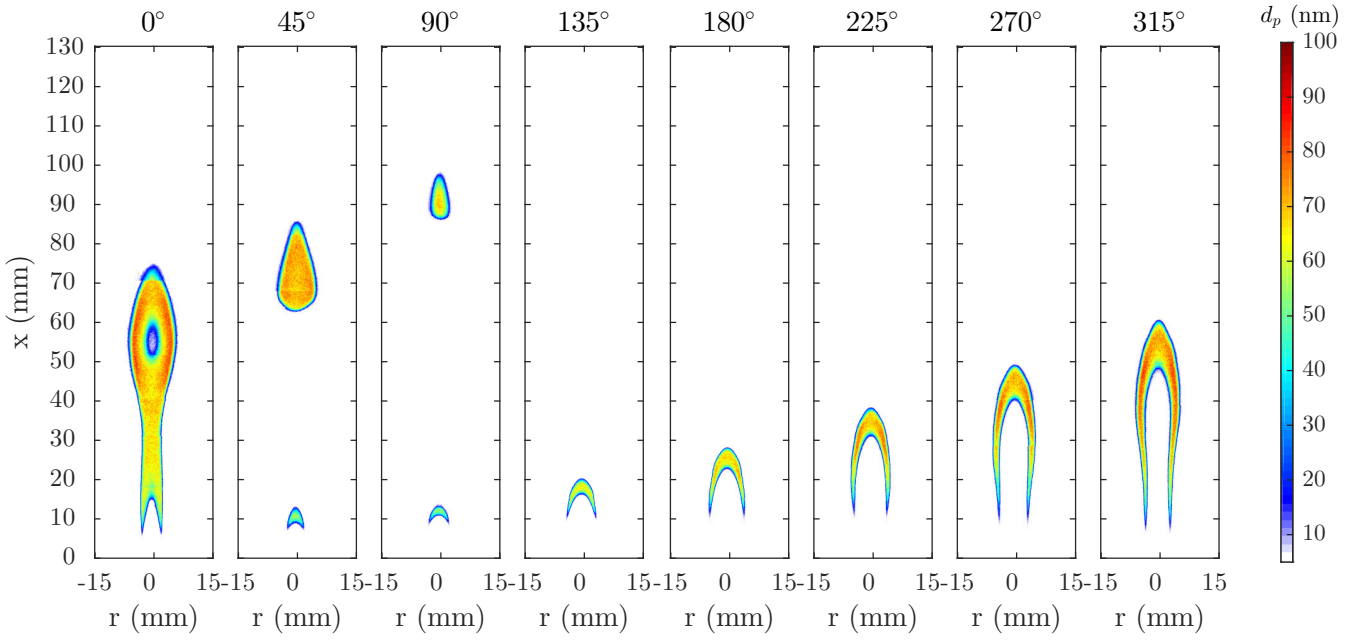

Figure 1.17 Planar measurement of primary particle diameter, d_p, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

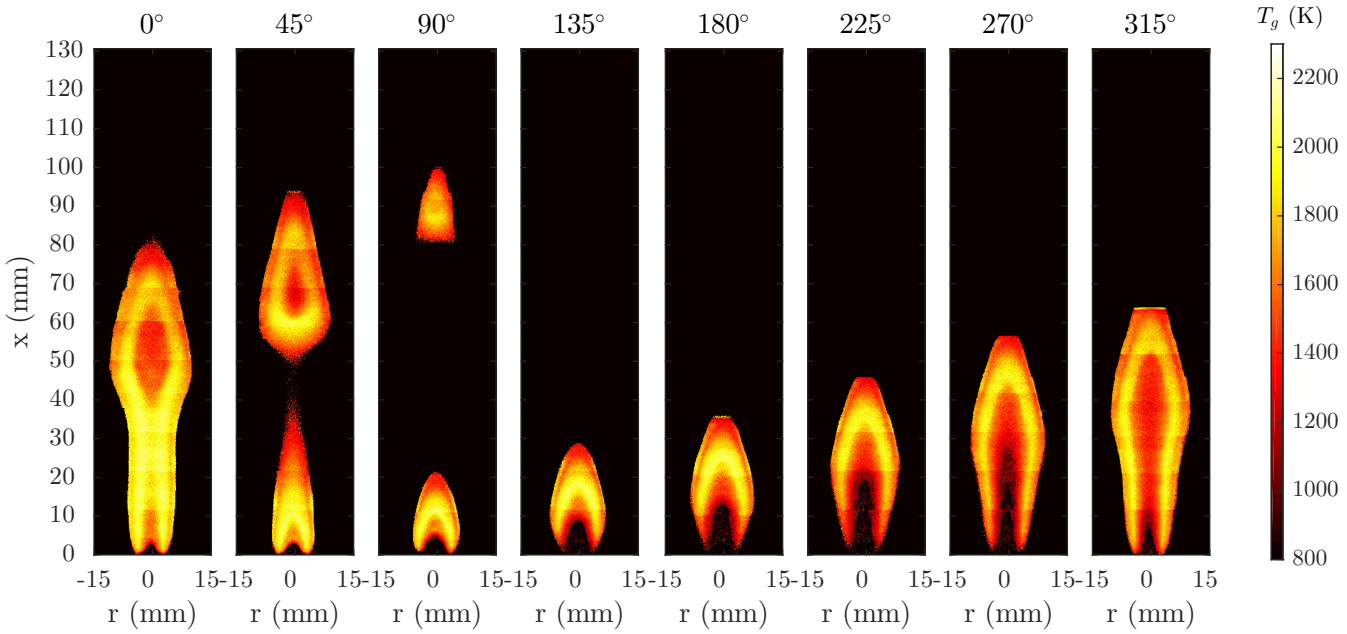

Figure 1.18 Planar measurement of temperature, T_g, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

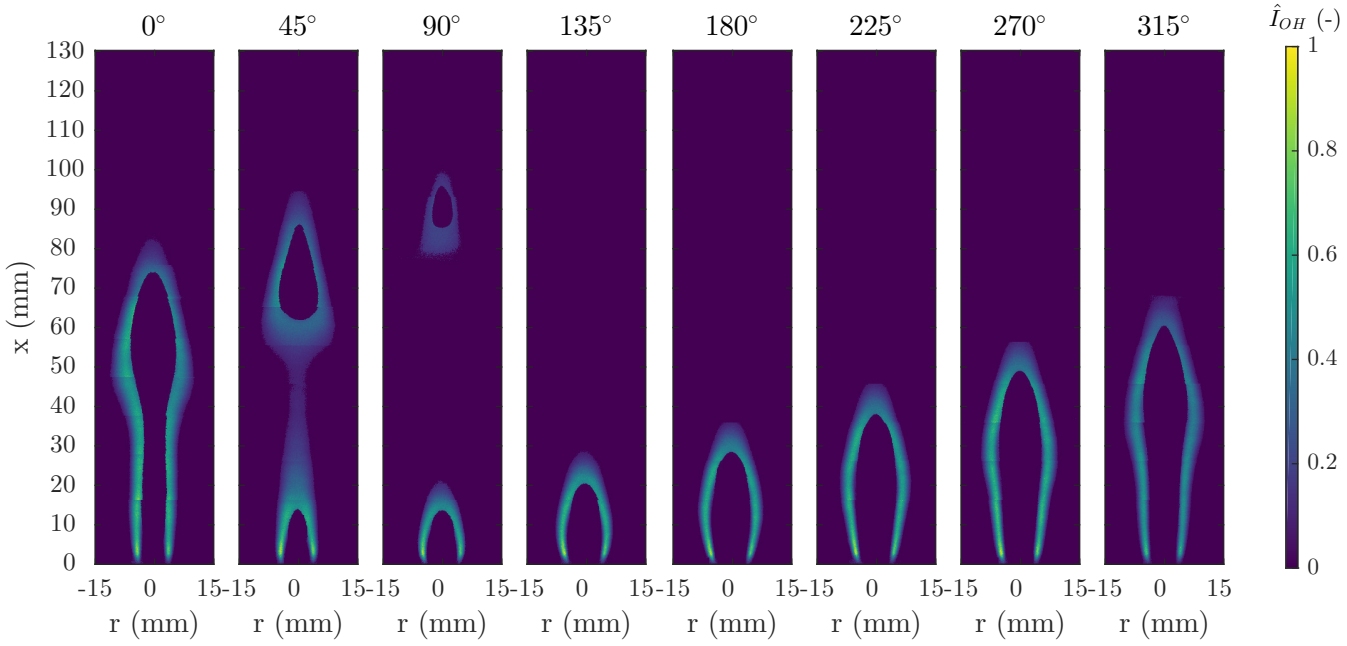

Figure 1.19 Planar measurement of OH-LIF, I_{OH}, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

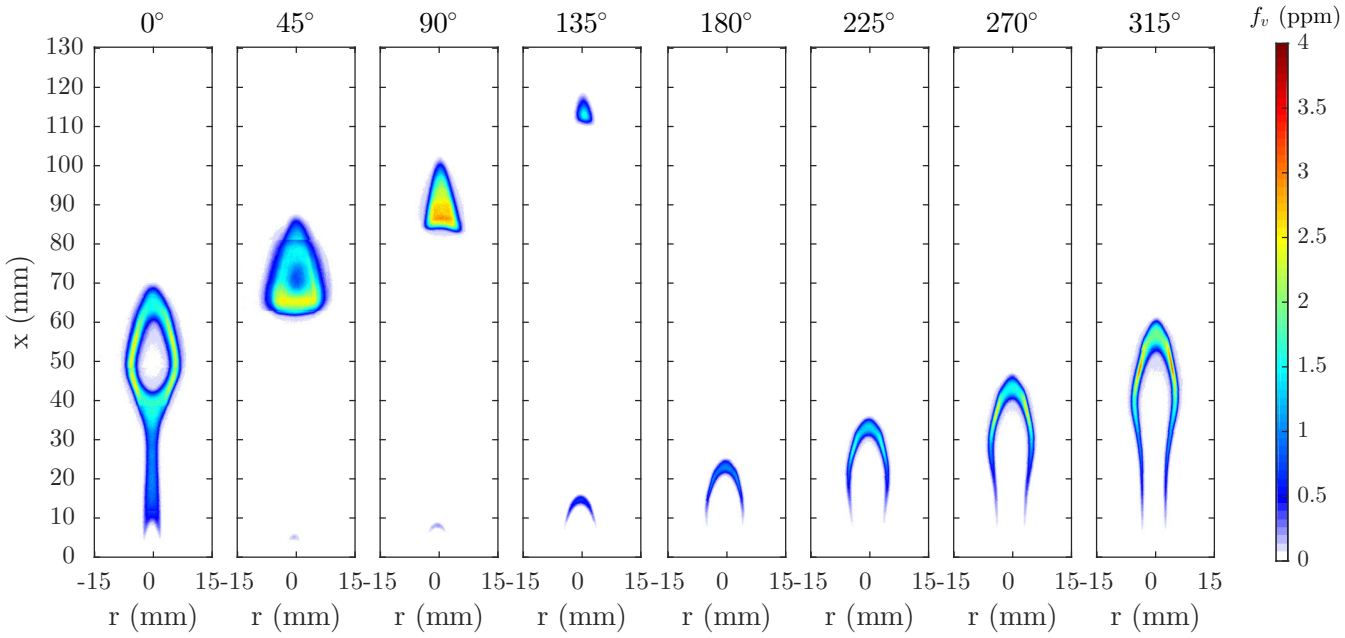

Figure 1.20 Planar measurement of soot volume fraction, f_v, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 75% fuel flow modulation.

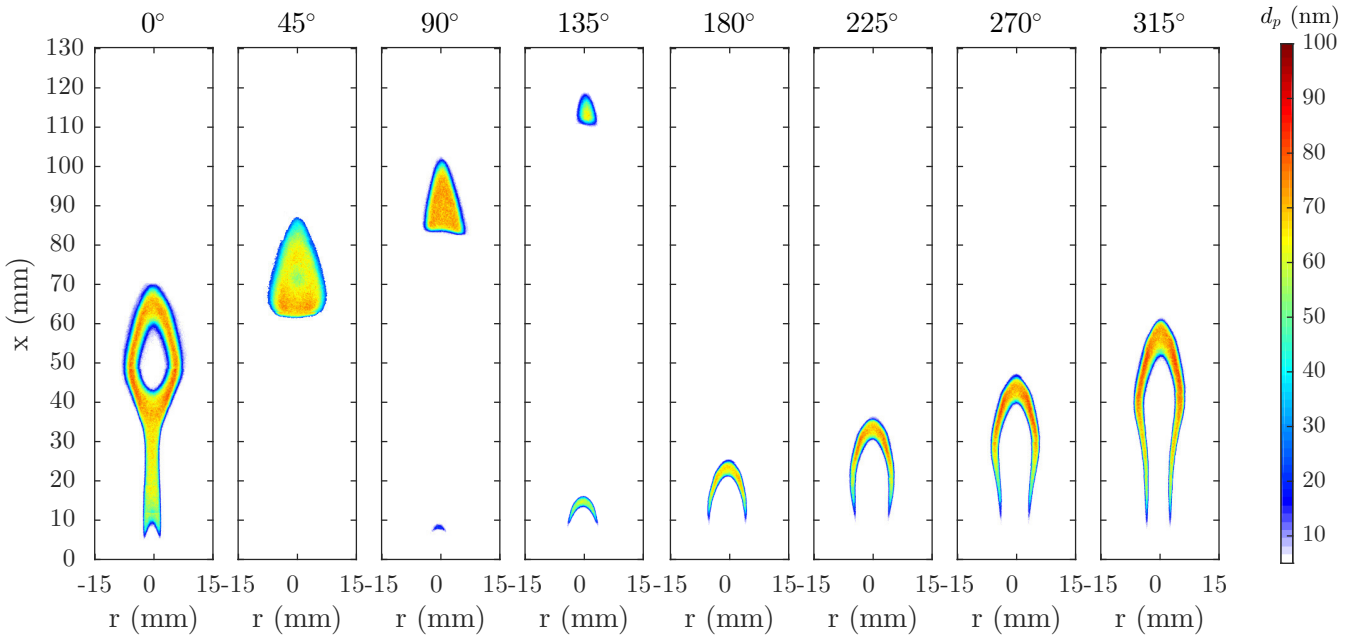

Figure 1.21 Planar measurement of primary particle diameter, d_p, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 75% fuel flow modulation.

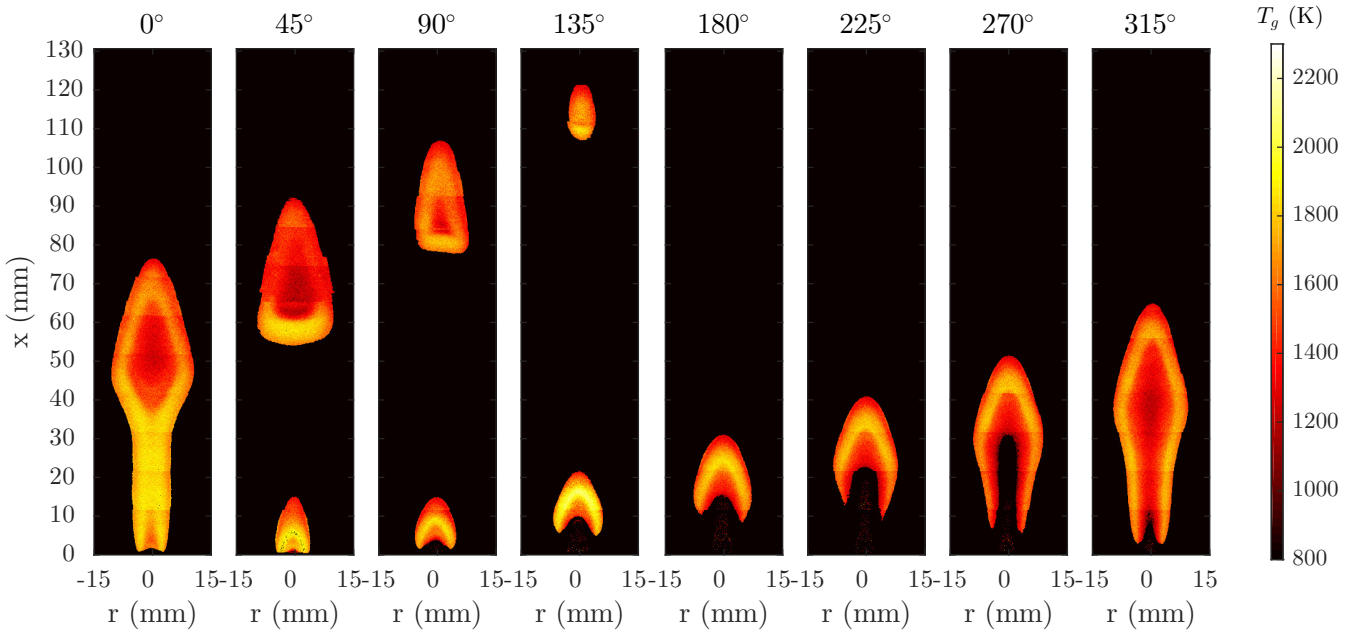

Figure 1.22 Planar measurement of temperature, T_g, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 75% fuel flow modulation.

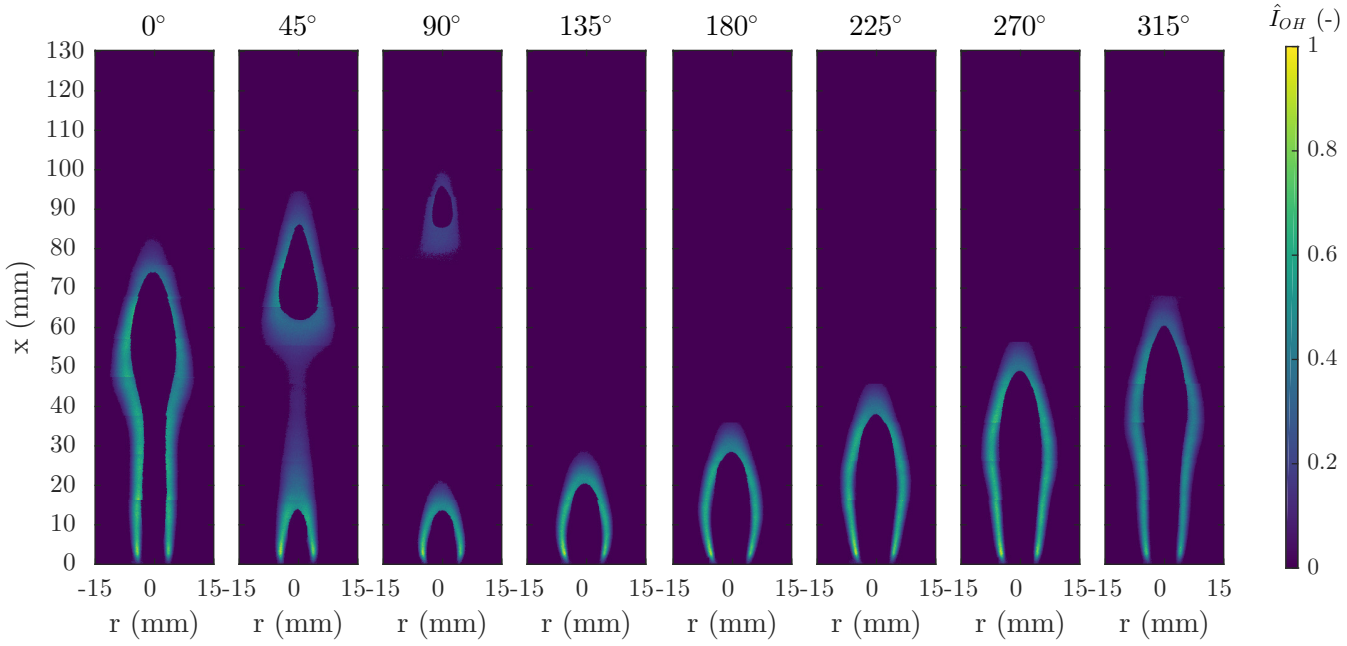

Figure 1.23 Planar measurement of OH-LIF, I_{OH}, for the laminar flame with 5.6-mm-diameter burner forced at 10-Hz forcing and 75% fuel flow modulation.

8.0-mm-diameter burner

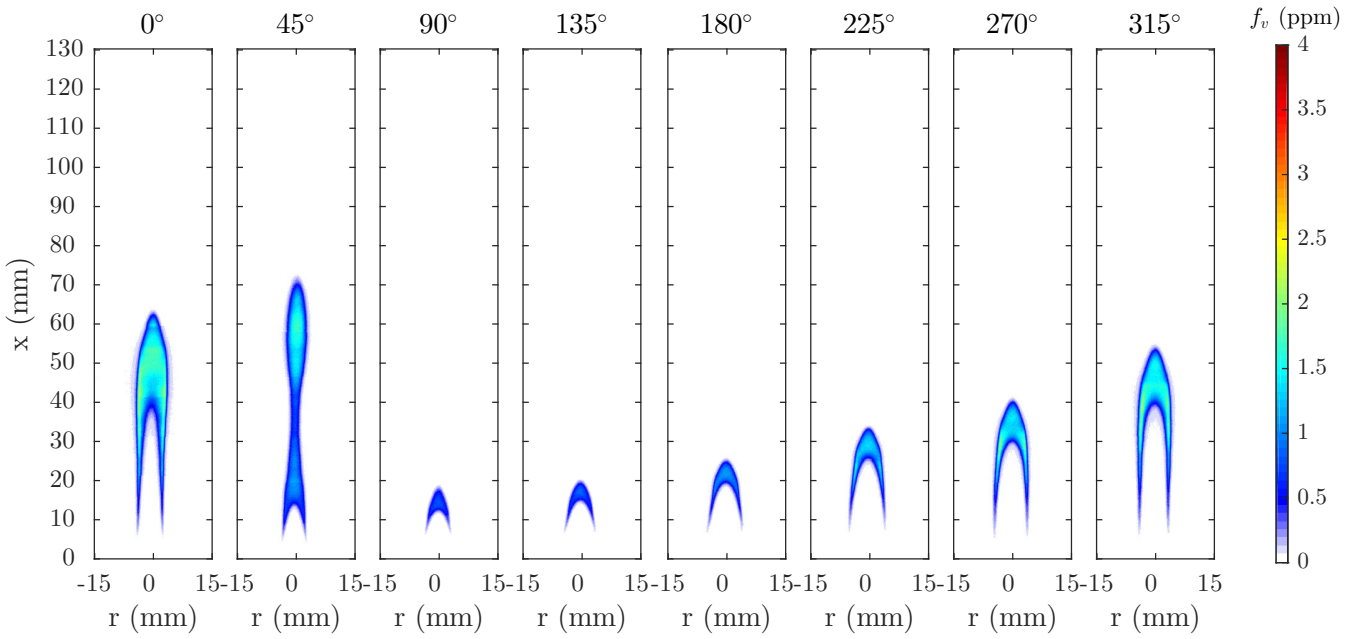

Figure 1.24 Planar measurement of soot volume fraction, f_v, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

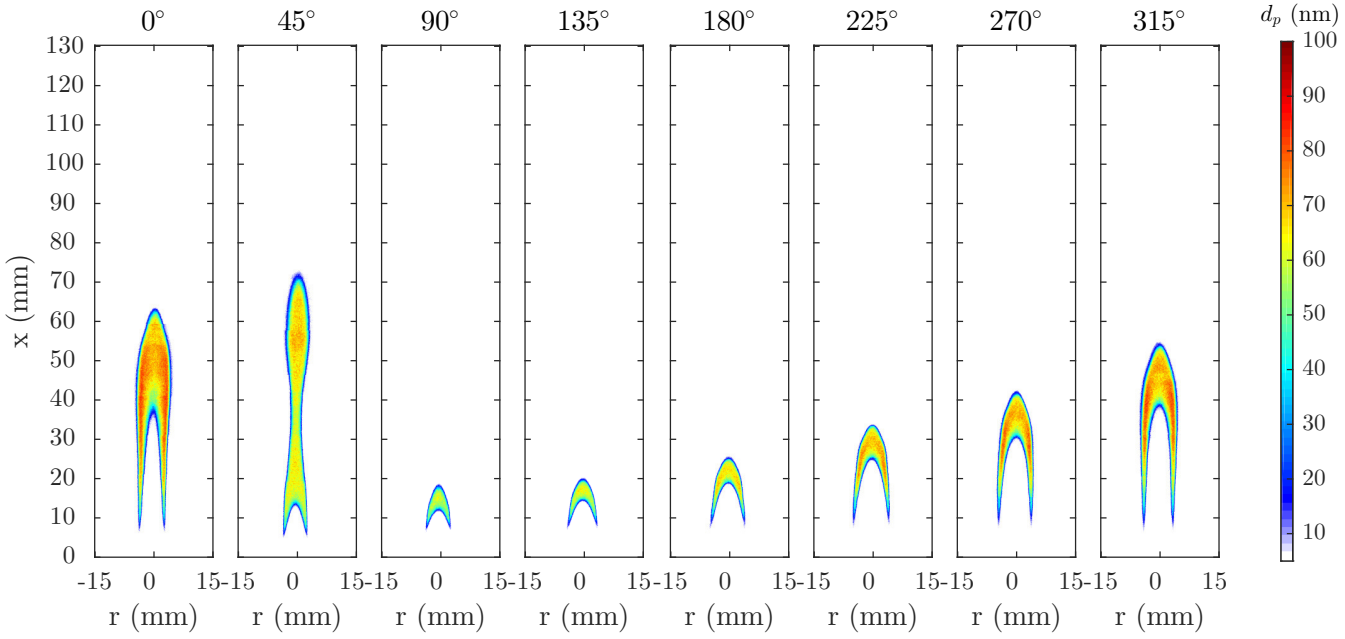

Figure 1.25 Planar measurement of primary particle diameter, d_p, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

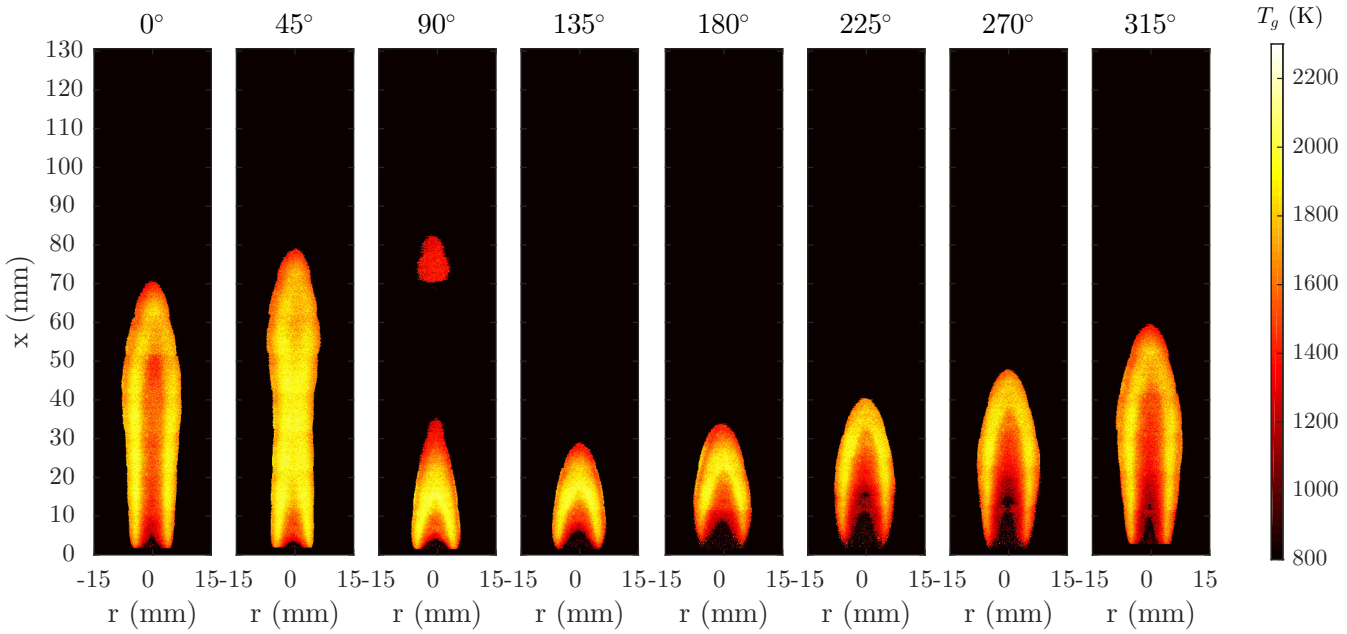

Figure 1.26 Planar measurement of temperature, T_g, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

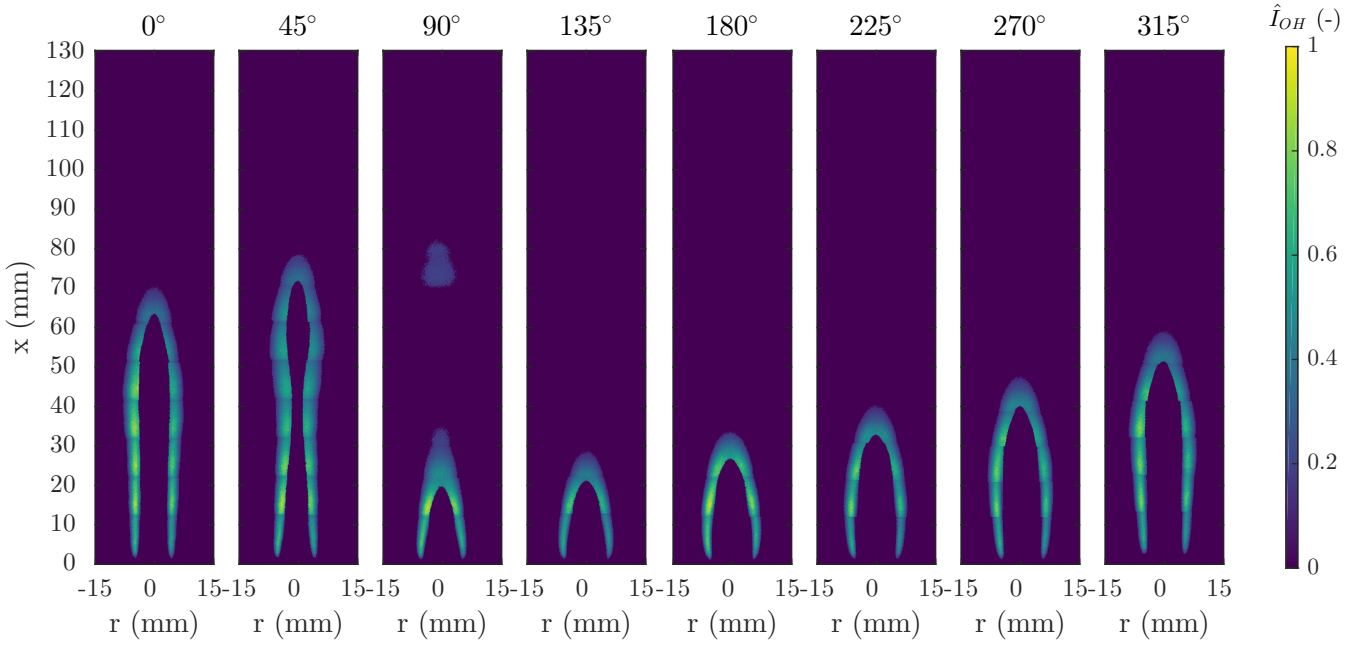

Figure 1.27 Planar measurement of OH-LIF, I_{OH}, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 25% fuel flow modulation.

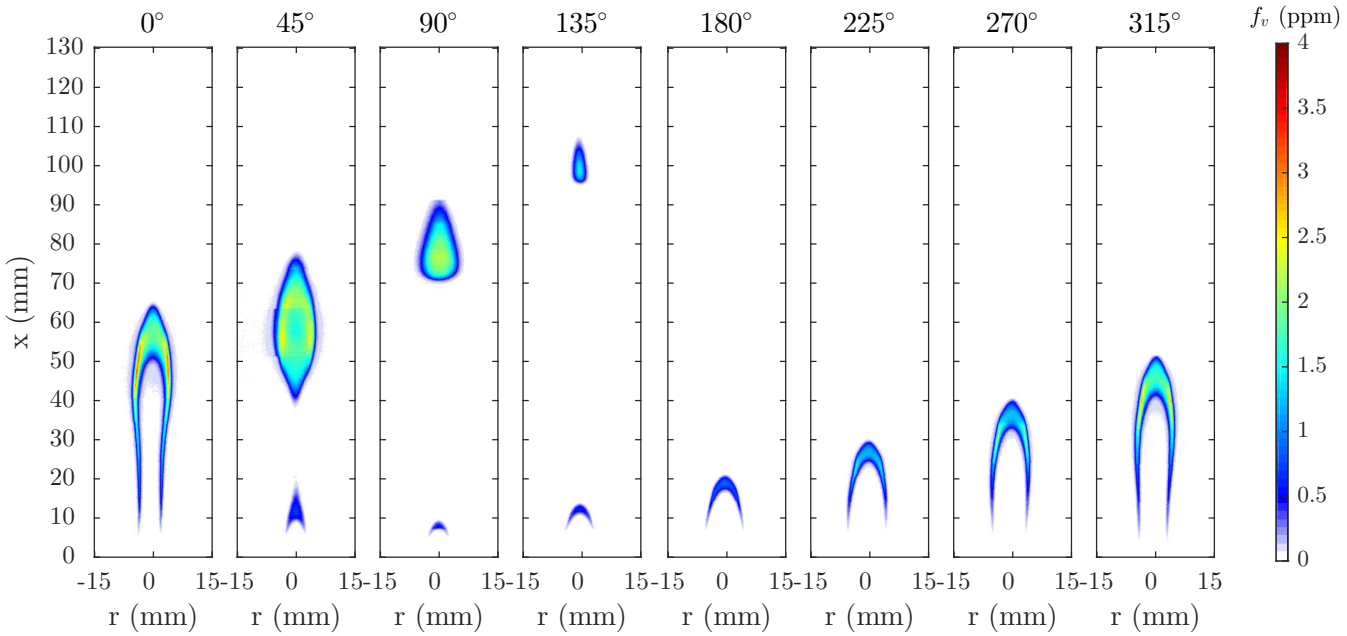

Figure 1.28 Planar measurement of soot volume fraction, f_v, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

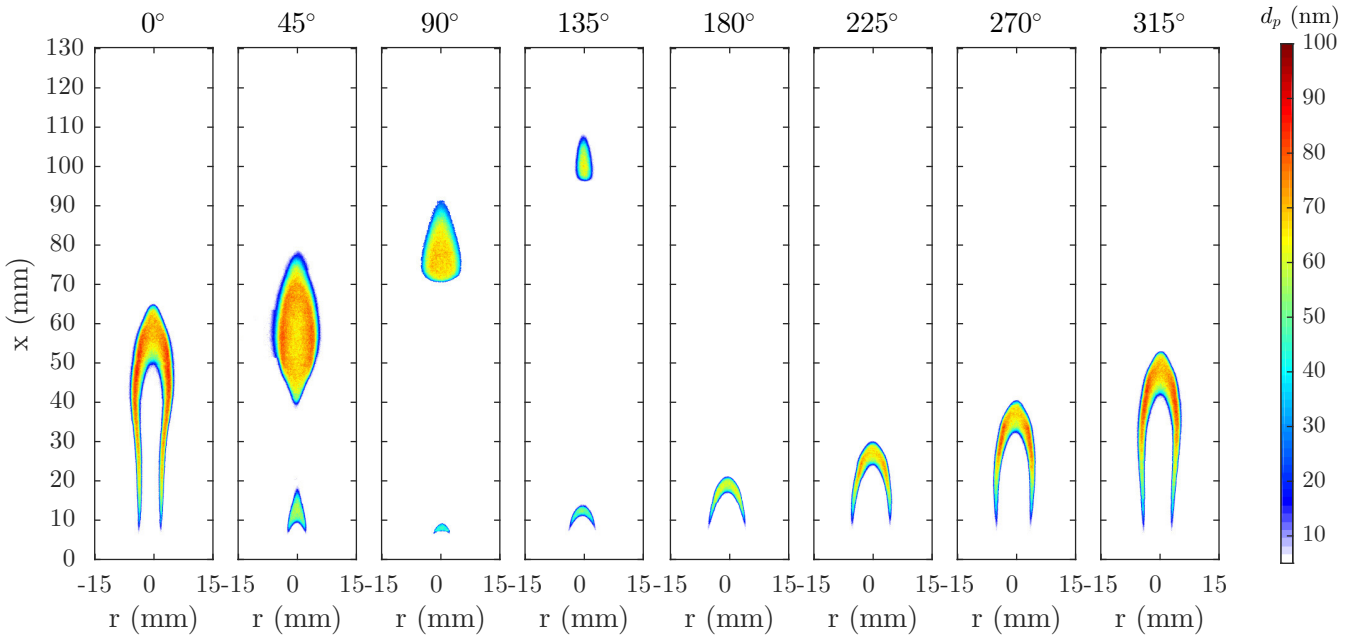

Figure 1.29 Planar measurement of primary particle diameter, d_p, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

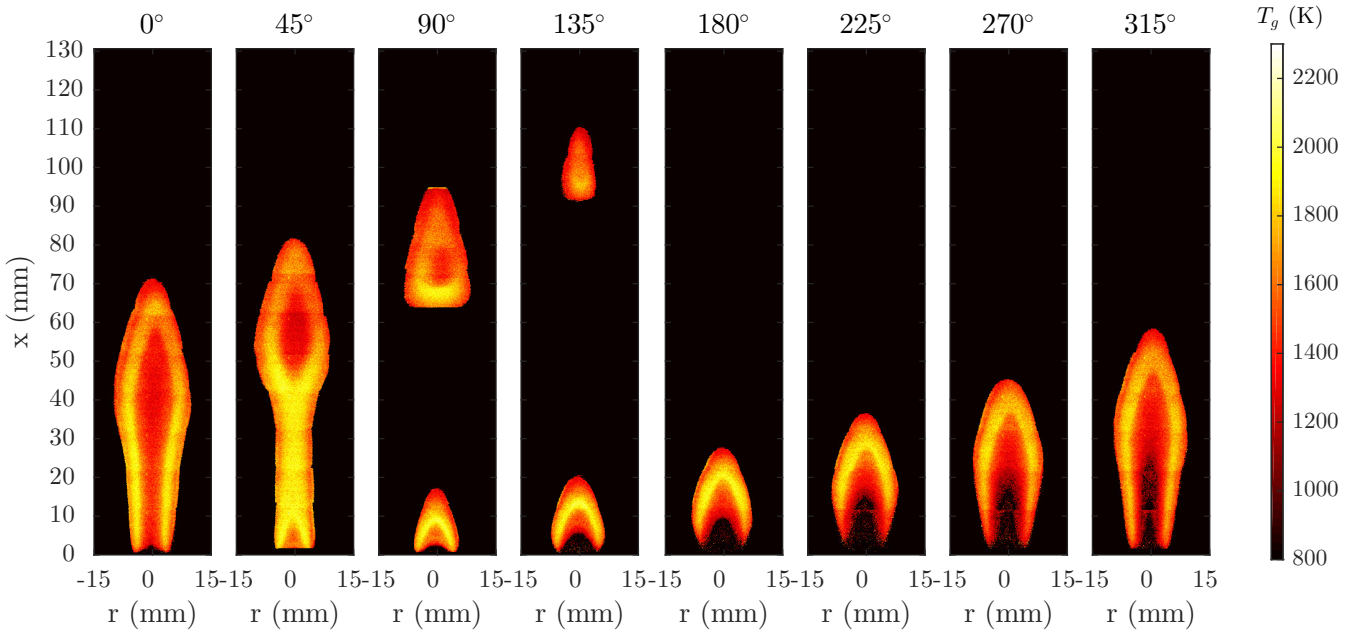

Figure 1.30 Planar measurement of temperature, T_g, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

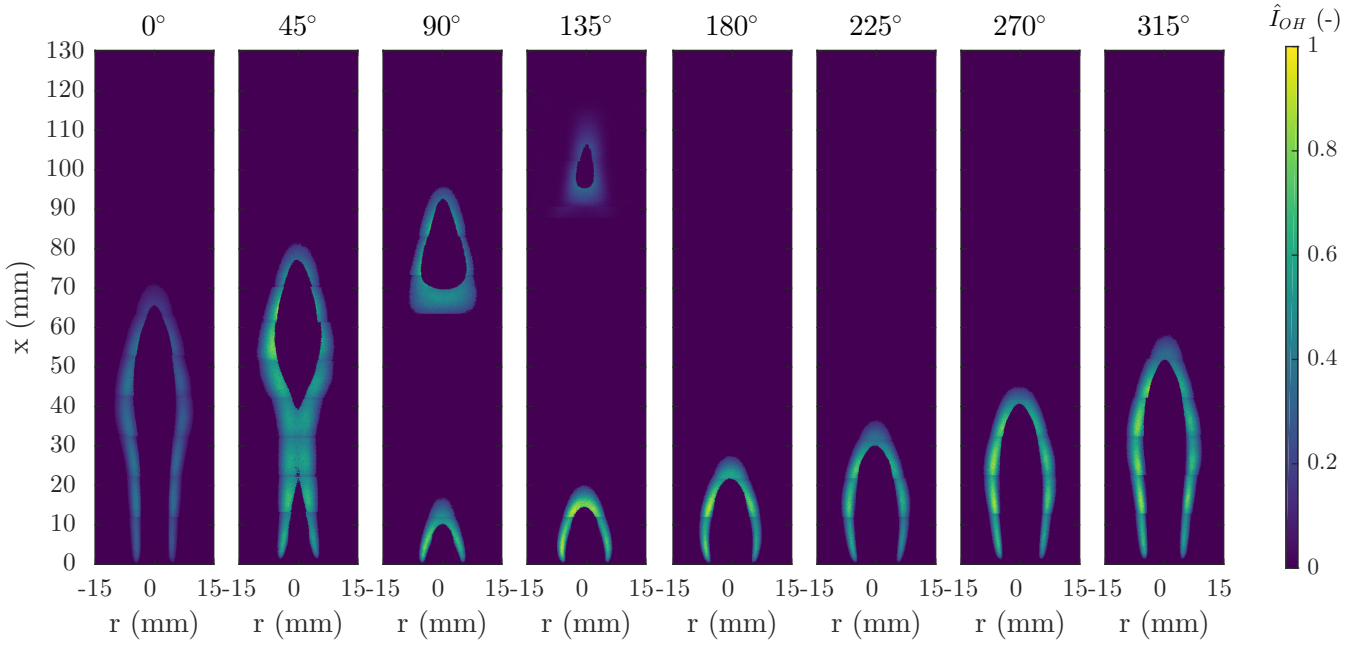

Figure 1.31 Planar measurement of OH-LIF, I_{OH}, for the laminar flame with 8.0-mm-diameter burner forced at 10-Hz forcing and 50% fuel flow modulation.

To acquire the flow exit profiles, please refer to the PIV measurements performed in isothermal conditions

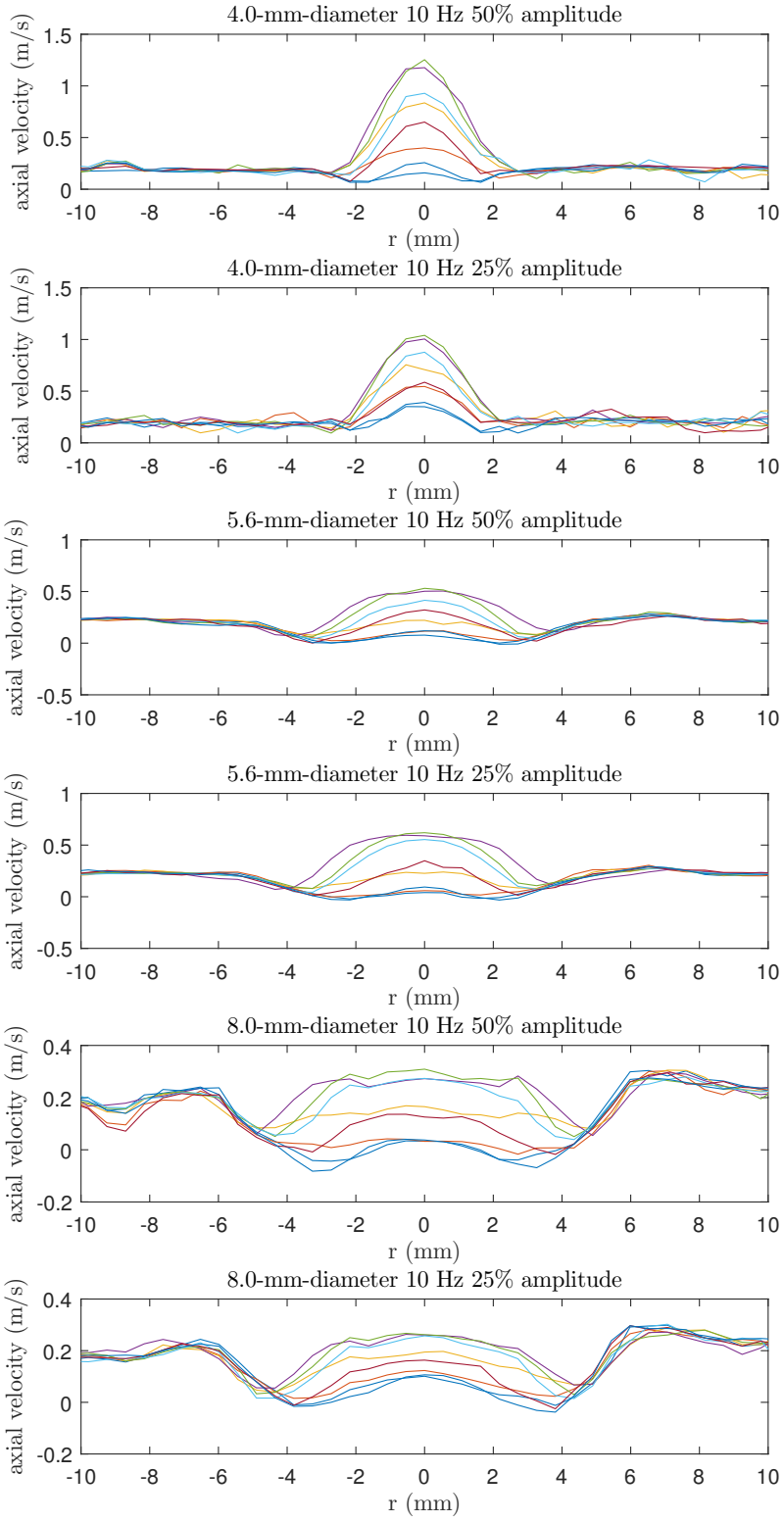

Figure 1.32 Axial velocity profiles near the exit plane, measured in isothermal conditions using PIV.

Bibliography

[1] K. K. Foo, Z. W. Sun, P. R. Medwell, Z. T. Alwahabi, B. B. Dally, and G. J. Nathan, "Experimental investigation of acoustic forcing on temperature, soot volume fraction and primary particle diameter in non-premixed laminar flames", *Combustion and Flame* **181** (2017), pp. 270–282.

[2] K. K. Foo, Z. Sun, P. R. Medwell, Z. T. Alwahabi, G. J. Nathan, and B. B. Dally, "Influence of nozzle diameter on soot evolution in acoustically forced laminar non-premixed flames", *Combustion and Flame* **194** (2018), pp. 376–386.