Outline of the Lecture

- Recent Applications of Planar Laser-Induced Fluorescence (PLIF)
PLIF Measurements of Molecular Mixing in Shear Layers


PLIF Measurements of Molecular Mixing in Shear Layers


FIG. 2. Schematic of the jet-in-co-flow facility.
PLIF Measurements of Molecular Mixing in Shear Layers

FIG. 4. Images at various stages of the dual-tracer PLIF data processing. (a) Normalized acetone PLIF or total coflow fluid fraction, $f_{ICF}$. (b) Normalized NO PLIF or pure jet fluid fraction, $f_{pjet}$. (c) Total jet fluid fraction, $f_{jet}$. (d) Molecularly mixed jet fluid fraction, $f_{mjet}$.

FIG. 7. Molecurally mixed jet fluid fraction (upper) and corresponding jet fluid mixing efficiency (lower) for $Re_{jet} = 50,000$. Images in the first column are of the left shear layer and images in the second column are of the right shear layer, but the two images are not correlated in time. Both images span one jet diameter in the radial direction and are taken between $x/d_0 = 1.1-3.6$.

PLIF Measurements of Molecular Mixing in a Driven Shear Layer

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FIG. 8. Instantaneous maps of molecularly mixed jet fluid fraction, $f_{\text{mjet}}$, from 5.8 to 8.6 ms after the acoustic pulse. Each image spans an axial distance of $0.7 < x/D < 5.2$ and the bottom scale is $0 < r/D < 1$. The symbols I–IV refer to different pairing events.

Fig. 5.4  Centerline cross-section of the combustion rig.

Tim Frazier, PhD thesis, UIUC, 2000
Dual-annular counter-rotating swirler fuel injector as viewed from an off-axis downstream reference.
PLIF Measurements of Mixing Premixed Gas Turbine Combustor Facility

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PLIF
Measurements of CH and OH in a Turbulent Flame


Fig. 2. Schematic of the simultaneous CH-OH PLIF diagnostics.
PLIF Measurements of CH and OH in a Turbulent Flame


Re = 18,600 flame

Fuel: 30% CH₄, 70% N₂

Co-Flow: Pure O₂
Simultaneous CH PLIF and PIV Measurements in a Turbulent Flame


**Fig. 1.** CH fluorescence image with overlaid velocity vectors from a $Re = 18\,600$ flame. The respective downstream and radial coordinates are indicated on the ordinate and abscissa. Here, the PIV interrogation region is $1.5\,\text{mm}$ square, and the regions are overlapped by 75%; also, 75% of the mean centerline velocity has been subtracted from all vectors.
**Simultaneous CH PLIF and PIV Measurements in a Turbulent Flame**

**Fig. 2.** Subsection of Fig. 1 from the region \( r = -0.5 \) to 9 mm and \( z = 156 \) to 162 mm

Simultaneous OH PLIF and PIV Measurements at 5 kHz

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Fig. 4 Measurement sequence showing the effect of the precessing vortex core on the mixing of hot gases from the interior recirculation zone with the incoming gases.

Simultaneous OH PLIF and PIV at 5 kHz

**Fig. 4** Measurement sequence showing the effect of the precessing vortex core on the mixing of hot gases from the interior recirculation zone with the incoming gases.

Recent Measurements at DLR Stuttgart

3 kHz simultaneous PIV/OH PLIF in 5 bar methane/air flame in DLR test rig, measurements performed by C. Slabaugh (Purdue) and I. Boxx (DLR)
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Data analysis in process