

PLIF Measurement of Infrared-Active Combustion Species

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Overview

This project involves extending the PLIF technique to a new spectral region. PLIF measurement has typically utilized electronic transitions, which correspond to UV- or visible-light photons. Unfortunately, the electronic transitions of key species such as CO, CO₂ and H₂O are in the vacuum ultraviolet and therefore can not be excited using single-photon techniques using high-power laser systems under most conditions. One approach, then, is to excite vibrational transitions in these and other molecules. The vibrational transitions interact with infrared radiation and can be excited using both fixed wavelength and tunable infrared lasers.

Conventional wisdom has held that PLIF using vibrational transitions would fail because the less energetic vibrational transitions correspond to less intense radiation. However, the power of current lasers, the high quantum efficiencies offered by current infrared cameras, and the large mole fractions of combustion products make such measurements feasible.

Infrared PLIF (IR PLIF) has the potential for direct measurement of carbon monoxide, water, and carbon dioxide in combusting flows, as well as direct measurement of soot precursors.

Below one can see images of the development of a vortex ring of 50%CO/50%Ar as it interacts with ambient air. This images were generated by using an optical parametric amplifier operating at 2.35 microns to excite the R(7) line of the 1st overtone band of CO. Fluorescence at 4.7 microns was collected on a 256x256 InSb camera.

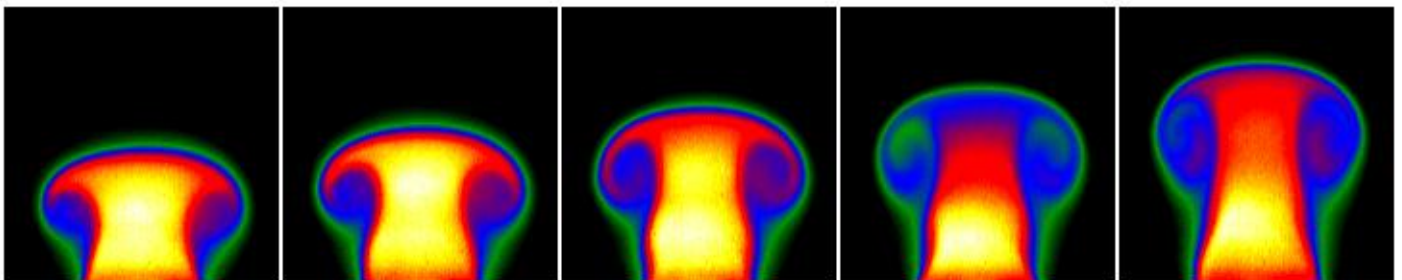


Figure 1: CO Fluorescence image

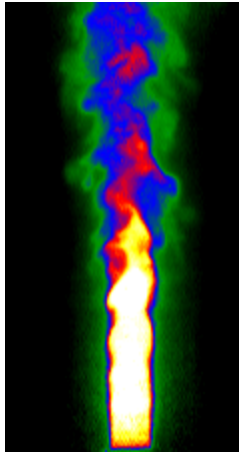


Figure 2: Image of a turbulent ($Re=2800$) CO/Ar jet in coflow, generated using a similar technique

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