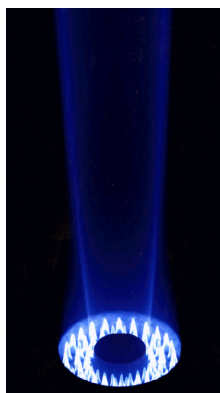




Laser Diagnostics for Combustion

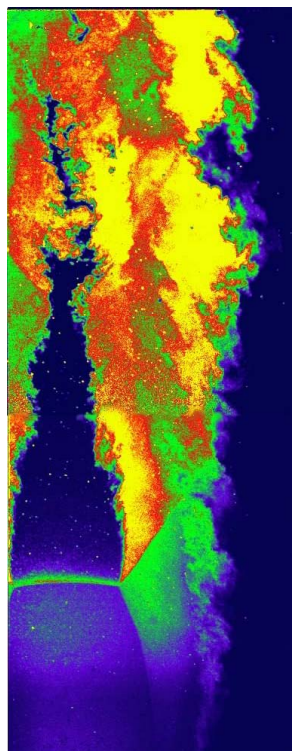
Professor Marshall B. Long
 Department of Mechanical Engineering, Yale University



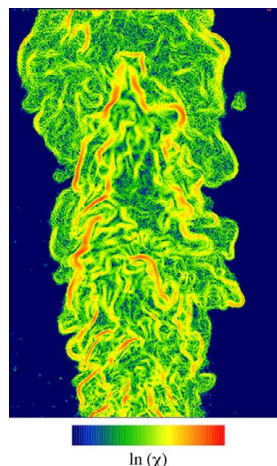
The interplay of turbulence and complex chemistry makes practical combustion systems beyond the realm of problems that can be solved in detail by computation – even with the most advanced computers on the horizon. Experimental measurements are needed to develop appropriate simplifying models. Laser diagnostic techniques can provide quantitative, non-intrusive, highly-resolved measurements of important quantities.

Well-characterized “target flames” are used as a test bed for diagnostics and modeling efforts.

Two-Dimensional Measurements

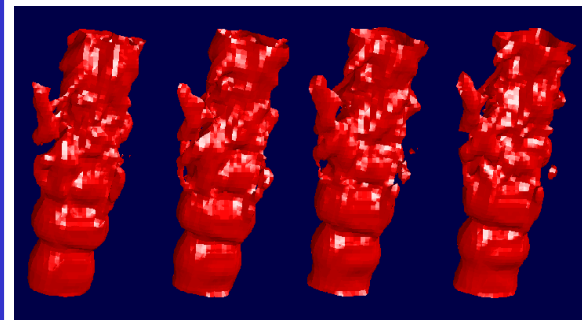


Large-scale structures in a turbulent supersonic jet imaged using Rayleigh scattering. Most turbulent flames require measurement times on the order of 1 μ s.



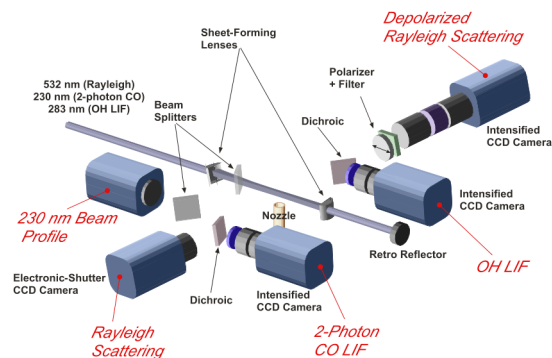
Well-resolved spatial information is critical for obtaining parameters such as the scalar dissipation, which is important in modeling turbulent flames.

Three-Dimensional Information



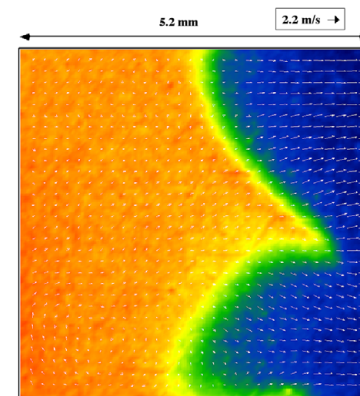
Turbulent flows are inherently three-dimensional and measuring their topology represents a significant challenge. Here the time-development of iso-concentration surfaces in an acoustically forced jet is shown.

Imaging Setup



In order to obtain as much simultaneous information as possible in turbulent systems, it is often necessary to utilize a number of different light-scattering mechanisms, laser wavelengths, and detectors. The experimental configuration shown here utilizes four lasers and five low-light level CCD detectors..

Velocity/Scalar Imaging



Simultaneous measurement of velocity (shown by arrows) and fuel concentration in a turbulent premixed flame.

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