

# PLIF Accomplishments of the Hanson Group

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*Principal Investigator: Dr. Ronald K. Hanson*

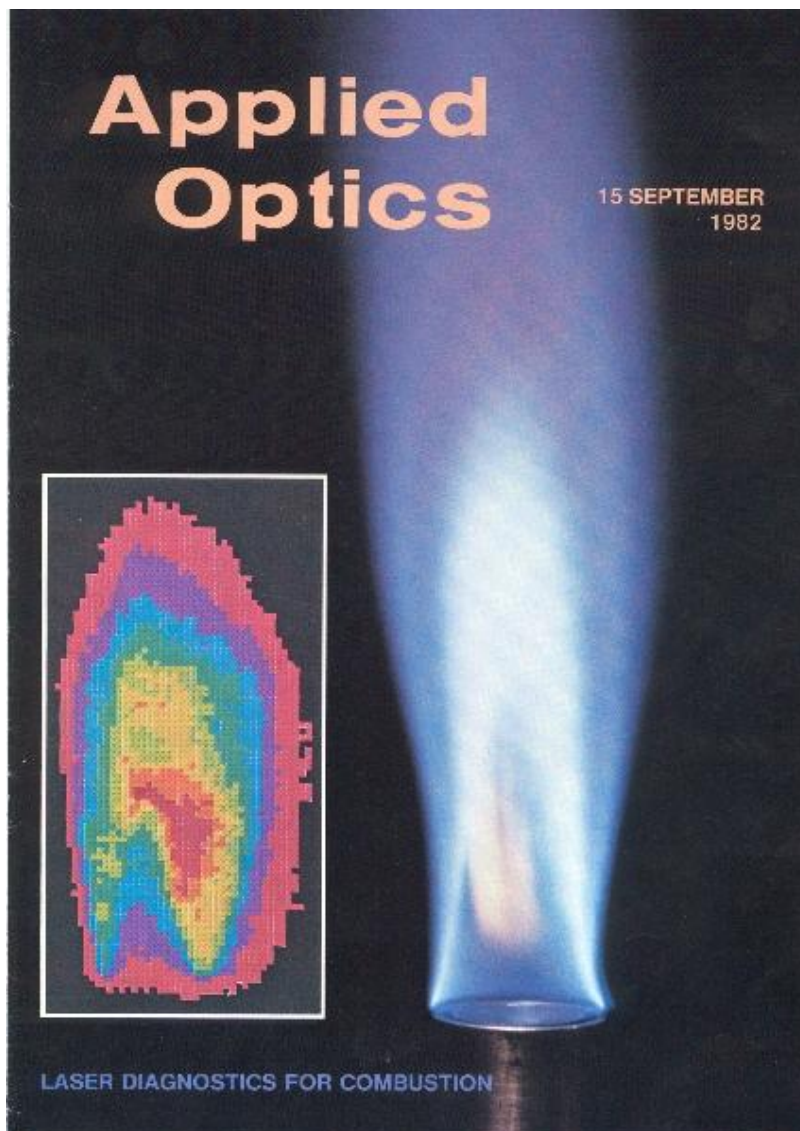
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## **Introduction**

The following is a brief history of the accomplishments of the Hanson Research Group in developing and maturing the Planar Laser-Induced Fluorescence technique.

## **Two-Dimensional Flowfield Imaging (1982)**

The image to the below is among the first PLIF images ever published. Part of one of the seminal works in a field now over 20 years old, this early example represents an image of OH fluorescence in a turbulent, premixed methane/air flame (from Kychakoff, Howe, Hanson, and McDaniel Applied Optics 21 1982).



**Figure 1: Applied Optics Cover, 9/15/1982**

## Turbulent Flame Front Visualization (1984)

Further development of PLIF techniques was motivated, in large part, by its ability to spatially resolve transient properties like the geometries of turbulent flame fronts. The example shown below is part of an OH concentration field in a non-premixed, turbulent ( $Re=8500$ ), hydrogen-air flame (from Kychakoff et al Science 224 1984).

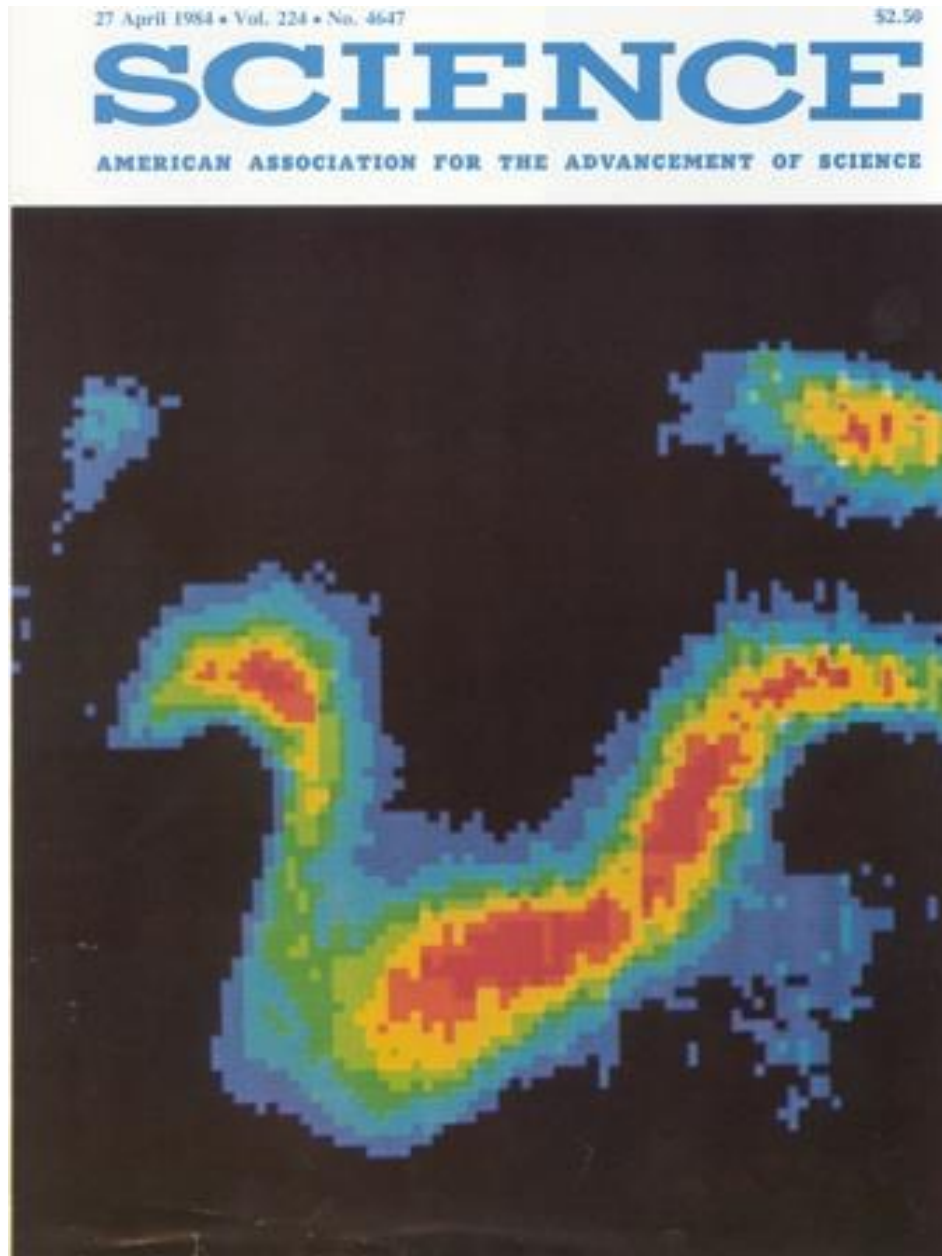


Figure 2: Science Cover, 4/27/1984

## Three-Dimensional Flowfield Imaging (1987)

The image below shows early work on 3-D imaging of biacetyl concentration in an acoustically forced jet (From Kychakoff, Paul, van Cruyningen, and Hanson Applied Optics 26 1987).

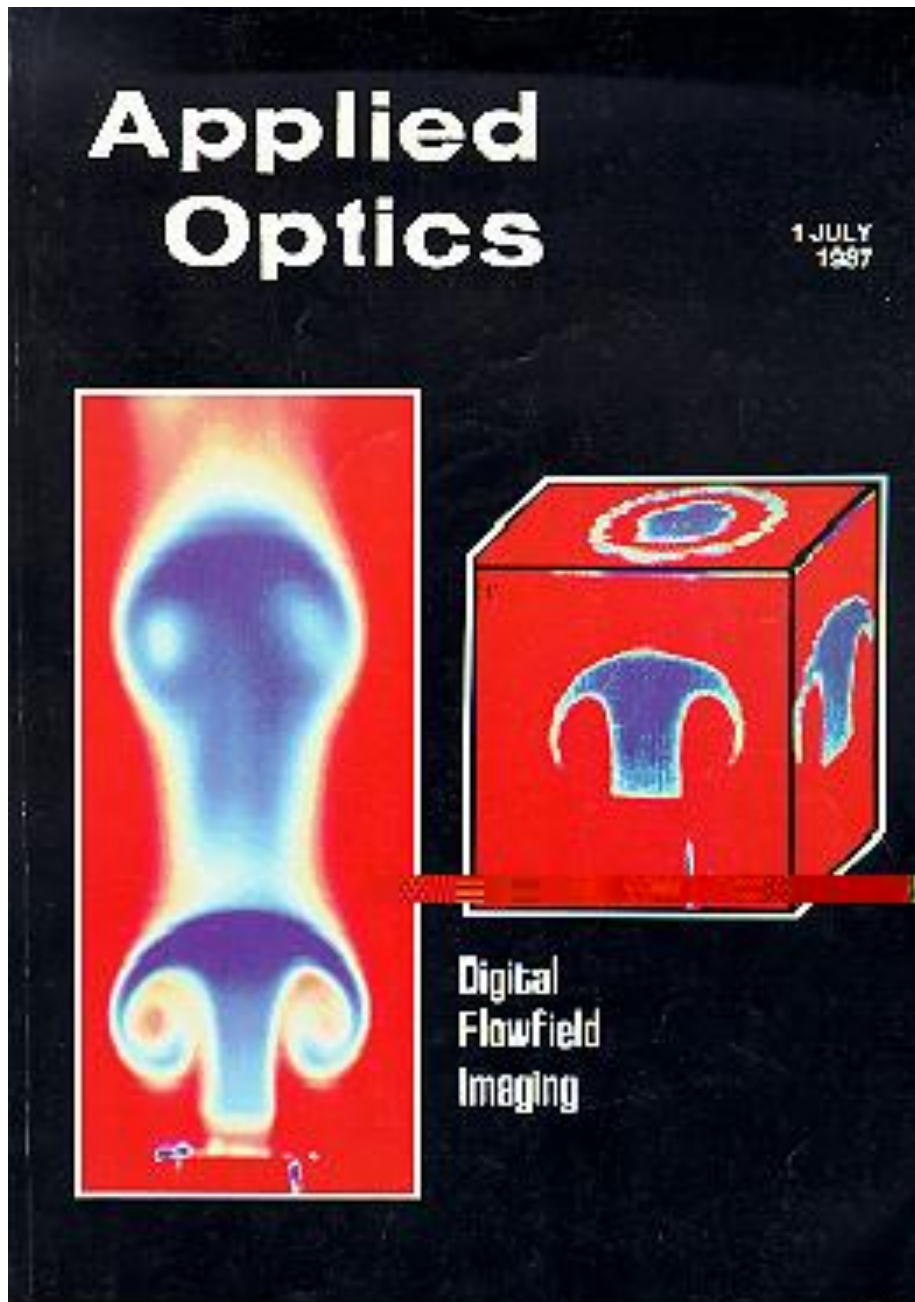


Figure 3: Applied Optics cover, 7/1/1987

## Velocity and Pressure Imaging (1988)

The image at below shows an example image from a line of research into simultaneous PLIF detection of pressure, radial velocity, and axial velocity of an underexpanded Mach 1.5 free jet. The radial velocities are shown, showing the cell-like structure of shock waves and expansion fans (From Hiller and Hanson Applied Optics 27 1988).

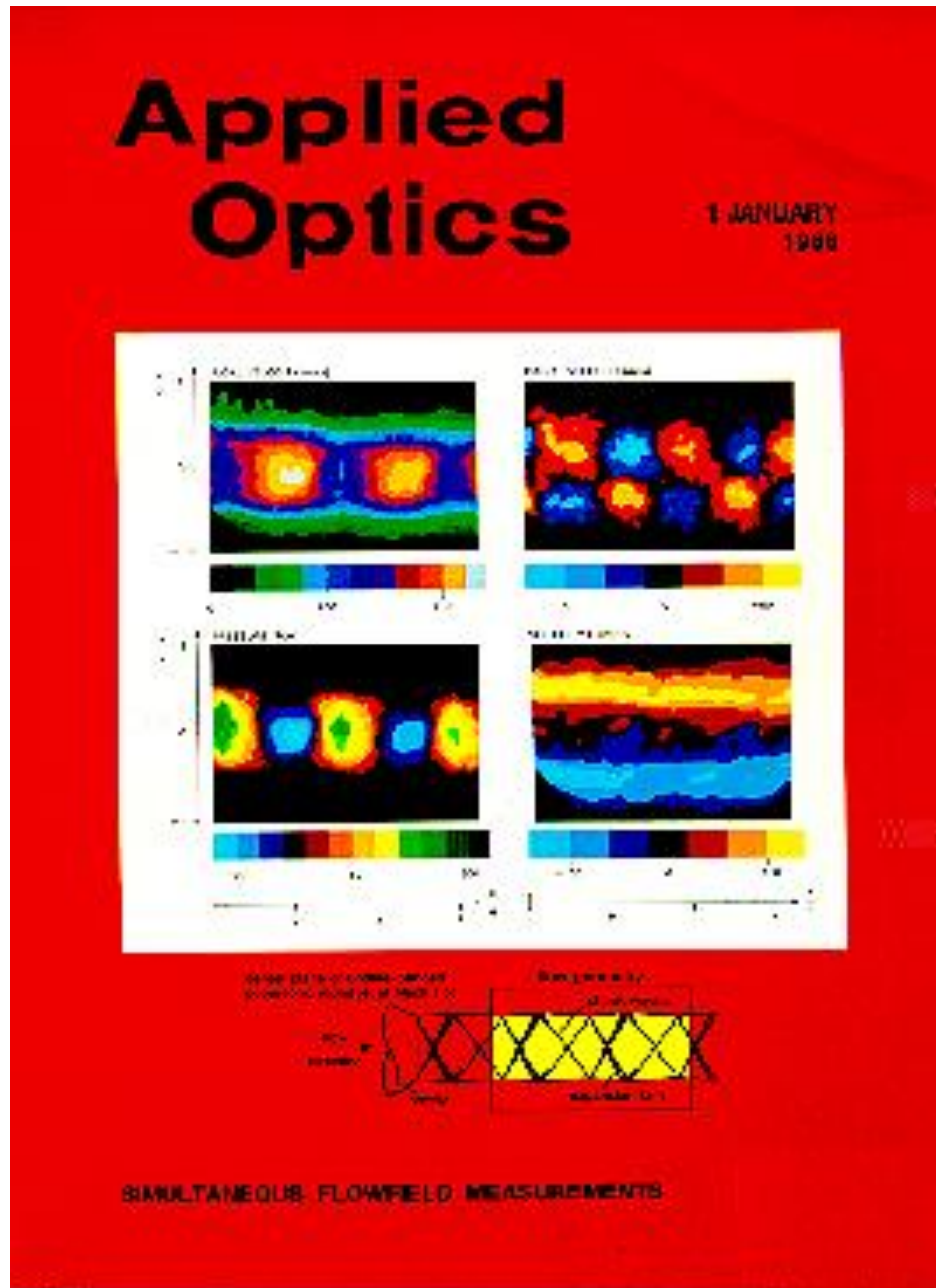


Figure 4: Applied Optics cover, 1/1/1988



## NO Temperature Imaging (1993)

The image below shows the first temporally resolved, two-line NO temperature imaging in a complex, combustion-related flowfield. A fuel jet seeded with NO mixes with a hot, nonoxidizing supersonic crossflow (From McMillin, Palmer, and Hanson Applied Optics 32 1993).

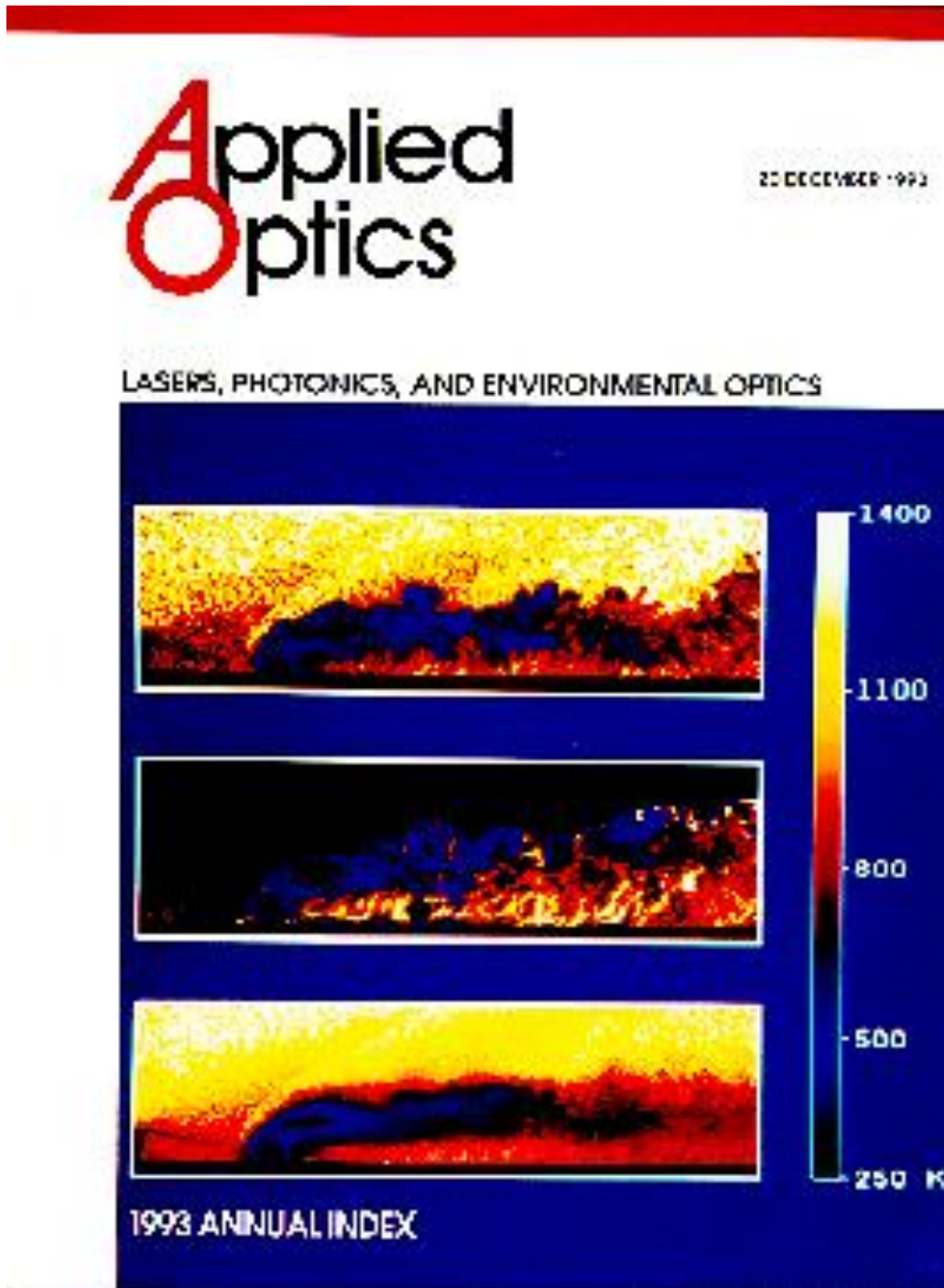


Figure 5: Applied Optics cover, 12/20/1993

## OH Temperature Imaging (1996)

OH temperature images from the first cell of an underexpanded free jet are shown below. Agreement with computation via method of characteristics is quite good (From Palmer and Hanson Applied Optics 35 1996).

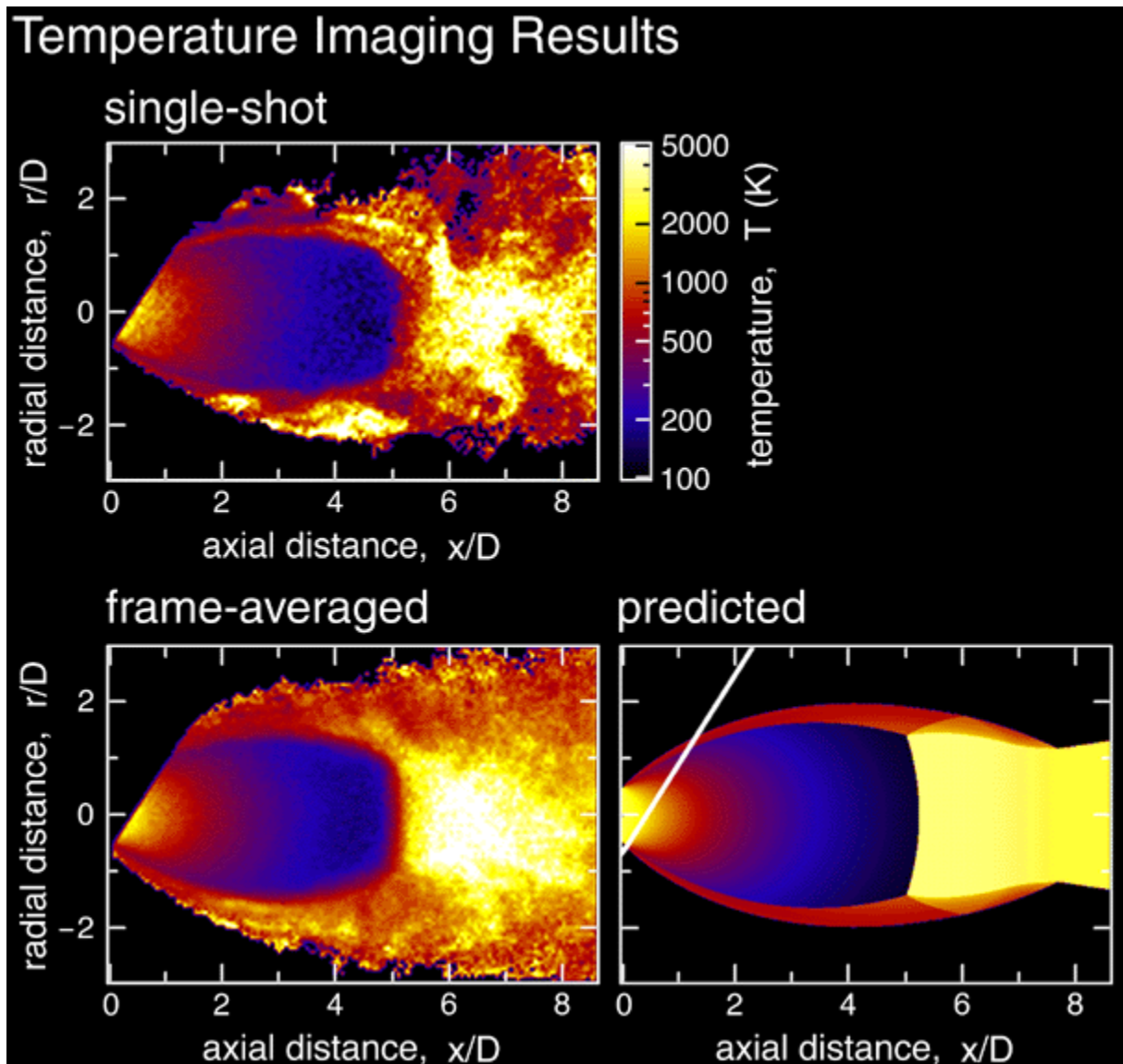


Figure 6: Images from the first cell of of an underexpanded free jet

## References

1. Kychakoff G, Howe R, Hanson R, McDaniel J. "Quantitative Visualization of Combustion Species in a Plane," Applied Optics vol. 21, p. 3225, September 1982.
2. Kychakoff G, Howe R, Hanson R, Drake M, Pitz R, Lapp M, Penney C. "Visualization of Turbulent Flame Fronts with Planar Laser-Induced Fluorescence," Science vol. 224, No. 4647, pp. 382-284, April 1984.