TRANSPORTATION ENERGY CENTER 8300

SAND2016-4581PE

A Brief Introduction to Engine Combustion Research at Sandia National Labs

Organization 8362 – Engine Combustion

COMBUSTION RESEARCH FACILITY

Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000

Sandia National Laboratories

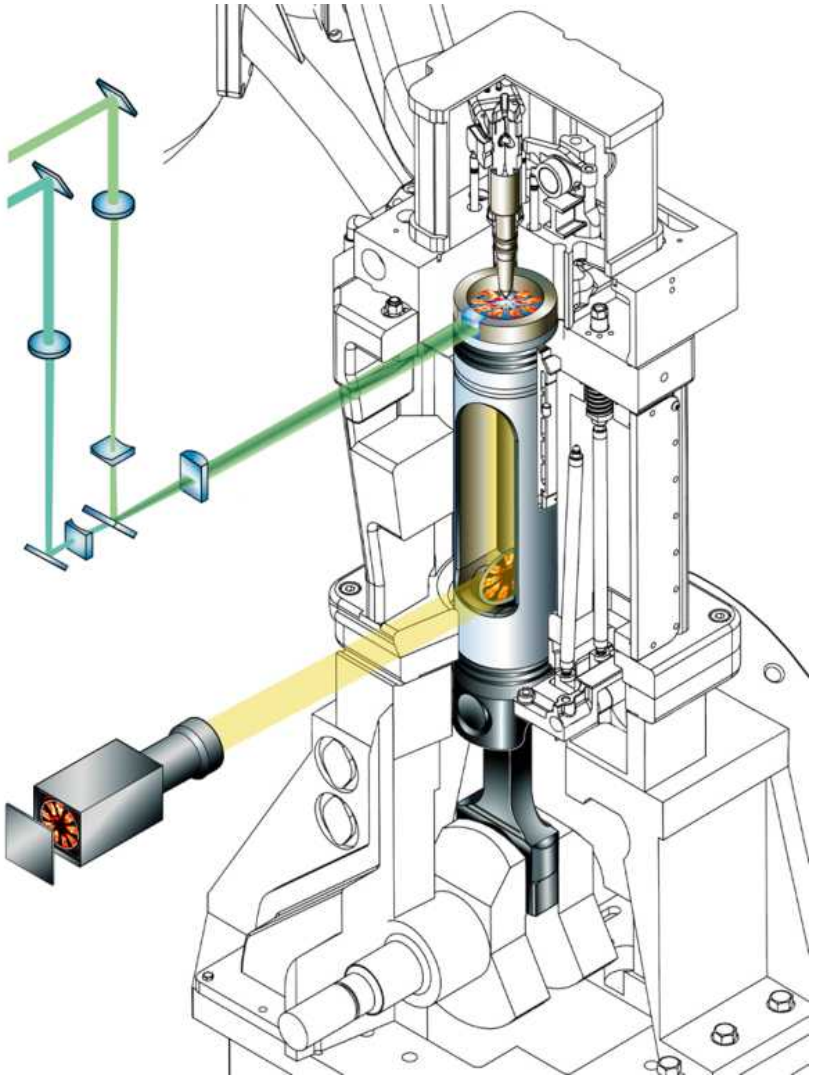
Combustion Research Facility (CRF)

- Sandia National Labs
  - Combustion Research Facility
    - Engine Combustion Group
- Optical and laser-based diagnostics in internal combustion (IC) engines
- Goal: a complete understanding and control of internal combustion dynamics and chemistry
- Meet vehicle efficiency and emissions standards

Sandia National Laboratories

Combustion Research Facility (CRF)

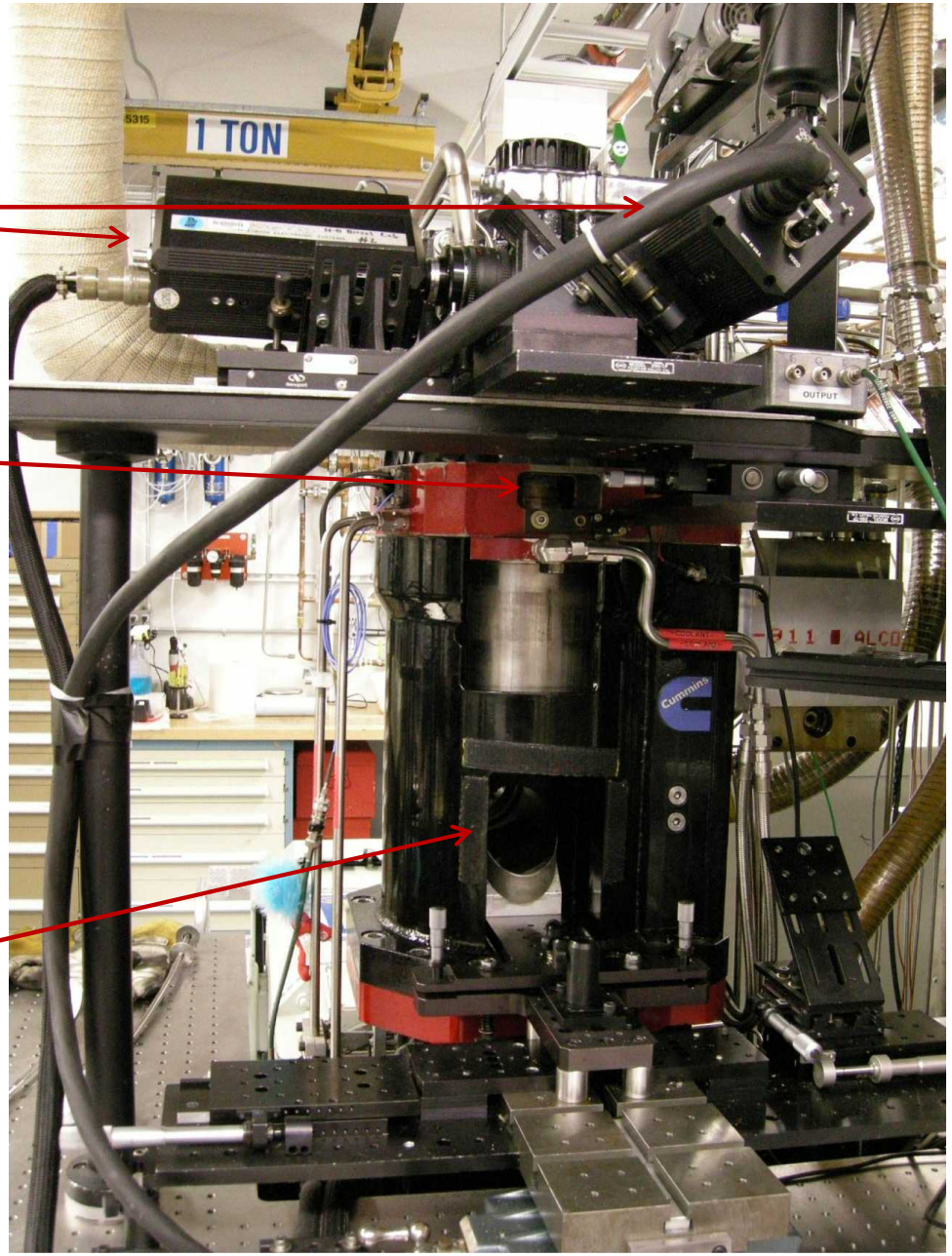
- Laser-based diagnostics
- Selectively image combustion radicals
- Improve CFD and LES models of reacting flows
- Test new fuels, combustion schemes, engine models.
- Work closely with automotive industry



High-Speed Intensified CCD Cameras

Optical Access Ports (aka “windows”)

Elliptical mirror looking up through piston bowl



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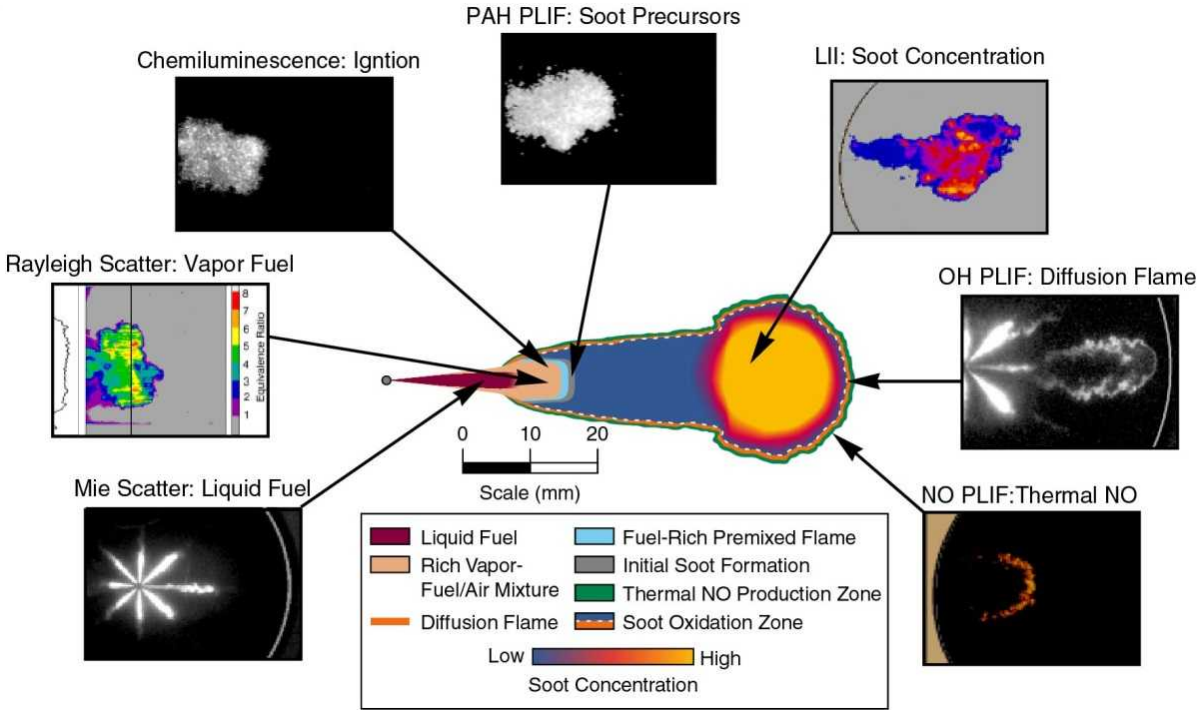
Combustion Research Facility (CRF)

- Optical Diagnostics
  - Optical Scattering
  - Laser-Induced Incandescence (LII)
  - Planar Laser-Induced Fluorescence (PLIF)



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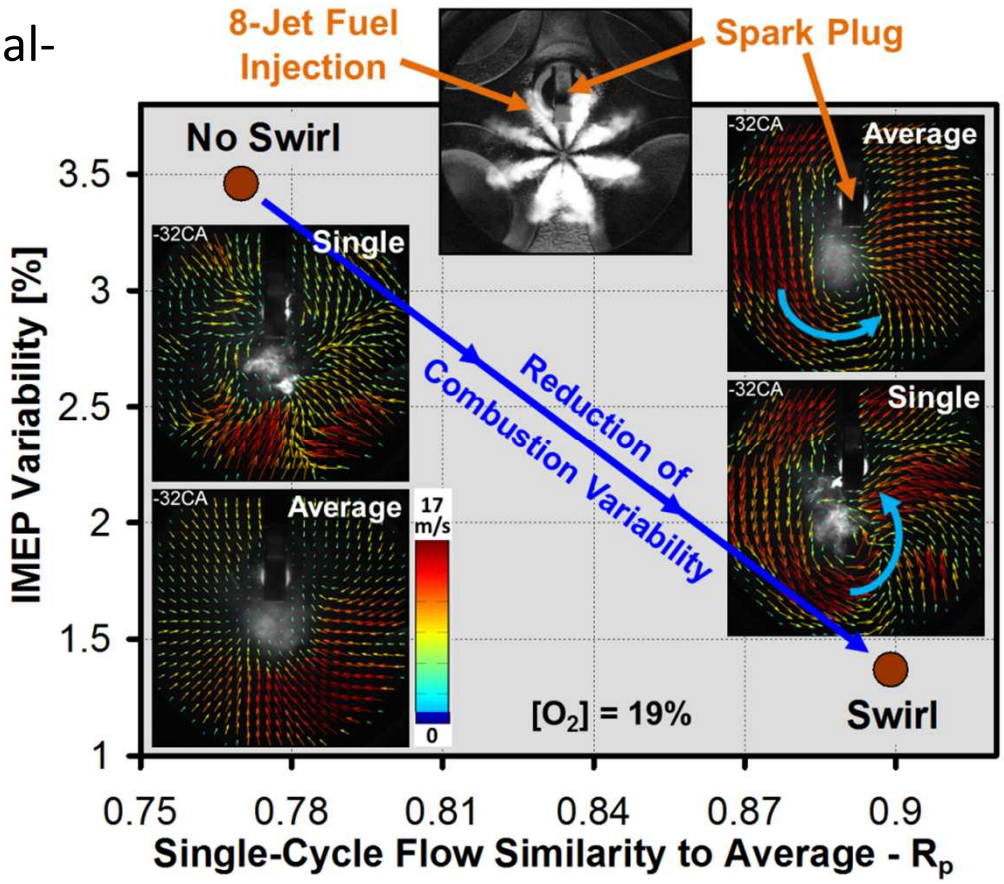
Combustion Research Facility (CRF)

- Particle Image Velocimetry (PIV)
- Quantify gas flow structure in real-time
- Demonstrate effects of flow control on cyclic variability and engine performance



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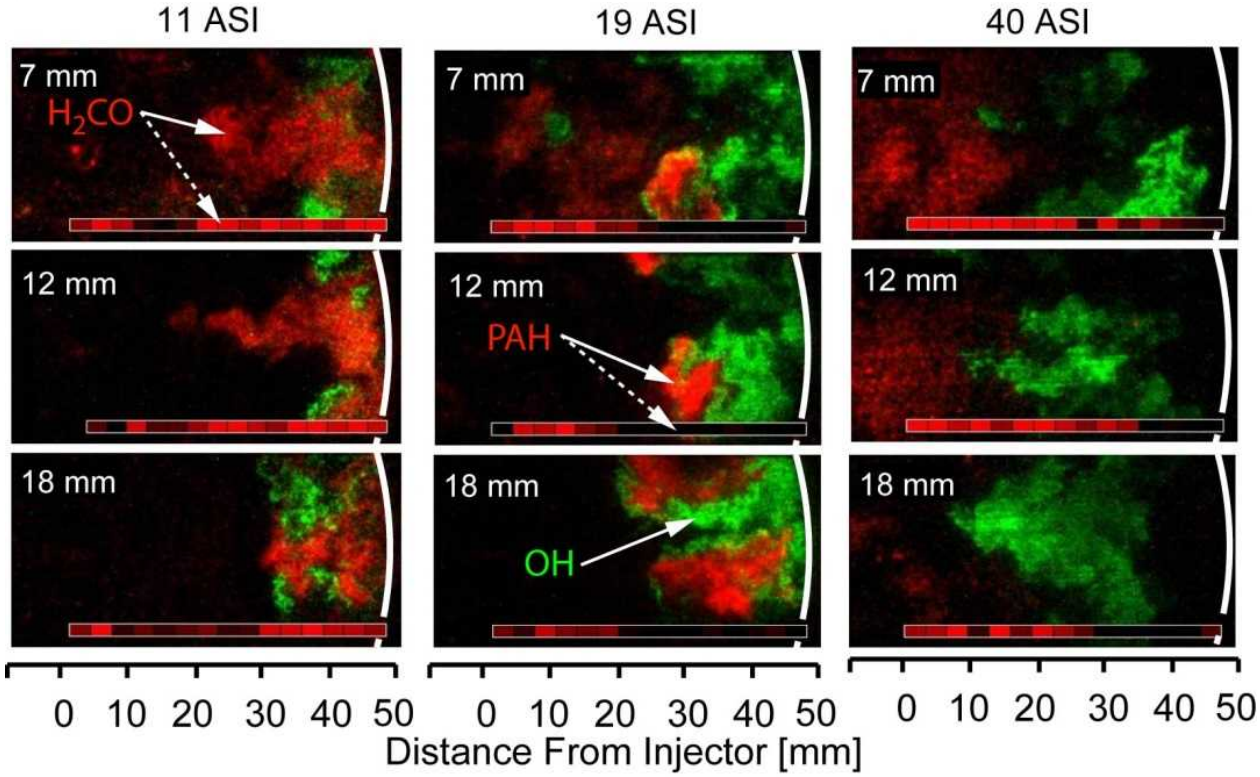
Combustion Research Facility (CRF)

- Time-resolved spatial distribution of combustion radicals (aka "pollutants")
  - Allows engine-makers to see where pollutants are hiding and develop schemes to reduce their concentration.

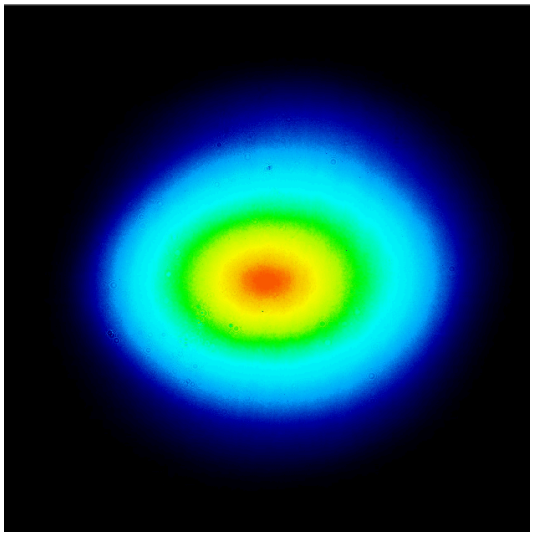


Laser and Optical Technologist

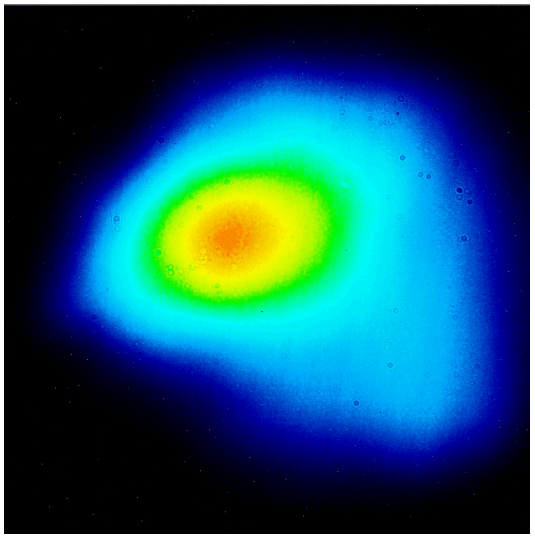
- Hired in 2011 fresh out of CSUEB
- Primarily hired to maintain high-energy lasers in working condition (not as simple as it sounds).
- Supportive environment encourages diversification of skills
- Current projects include:
  - Novel optical parametric oscillator to set standard for PLIF in engines
  - High-speed spatially resolved heat transport quantification through infrared imaging
  - Highly efficient high-speed diffuse background illumination apparatus for quantitative soot attenuation

Laser and Optical Technologist
Common Problems

- “My laser beam used to look like this:”



- “Now it looks like this:”



- “Please fix it.”

Laser and Optical Technologist
Common Problems

- "There's a small anomalous delay in this complicated timing apparatus. Can you fix it?"