

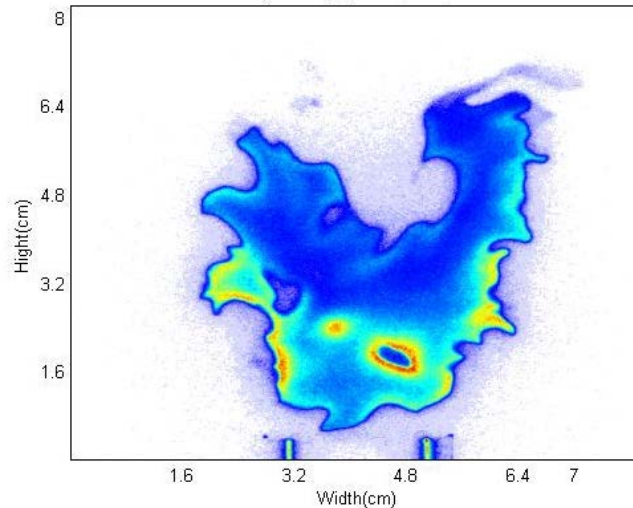


# Flame Dynamics

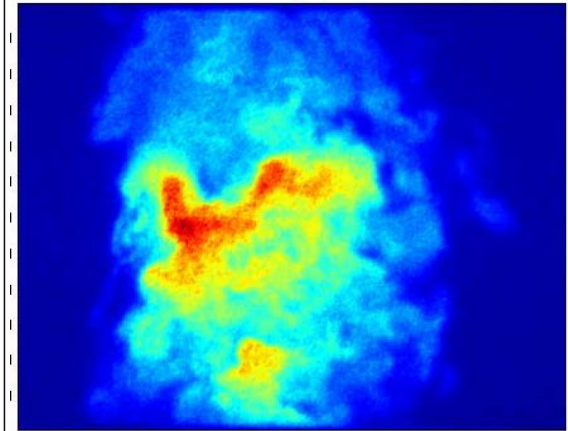
Research in the Combustion and High Speed Fluid Mechanics Lab is focused on unraveling the physics behind complex, time evolving phenomena.



Flame



OH PLIF



Acetone PLIF

One area of interest is the dynamic behavior of flames and how they change in response to changing flow conditions. The interaction of these phenomena, including acoustic waves, fuel mixing, flow vorticity, combustion chemistry, flame stability, and pollutant production, is measured with laser diagnostics and specialized high speed cameras.

Combustion and  
High Speed Fluid  
Mechanics Laboratory



**Albert Ratner**  
Associate Professor

[aratner@engineering.uiowa.edu](mailto:aratner@engineering.uiowa.edu)  
<http://www.engineering.uiowa.edu/~aratner>

Research Summary

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# Combustion Acoustics

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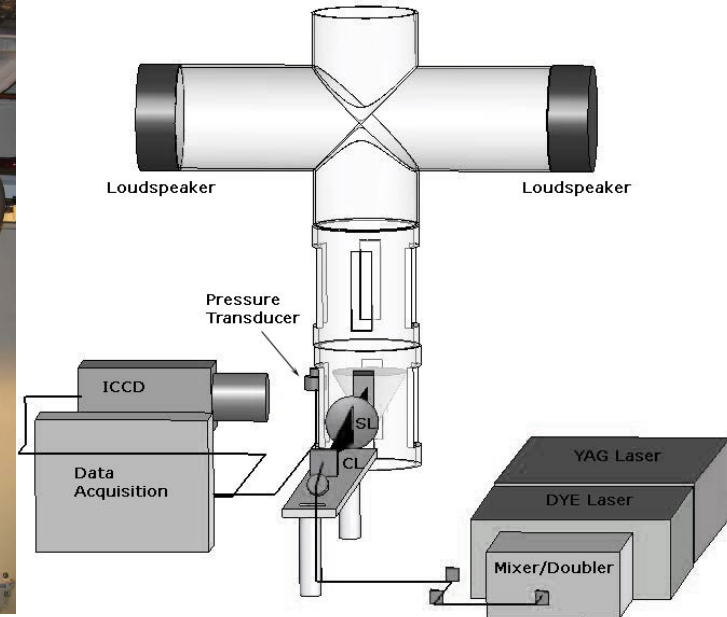
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Research Summary



Combustion-Acoustics Chamber



Laser Diagnostics Schematic

Combustion instability and the interaction of sound waves with flames are important issues in modern gas turbine design. The goal of this work is to understand the interplay of effects that lead to combustion instability. This is done through experiments performed in the one-of-a-kind elevated pressure combustion-acoustics chamber (left photograph) installed in the lab. The chamber can produce a user-selectable acoustic bulk modes that simulates the oscillating pressure conditions in a real combustor. Advanced laser diagnostics (right side schematic) are used to measure the resulting changes in flame behavior.



# Spray and Droplet Behavior

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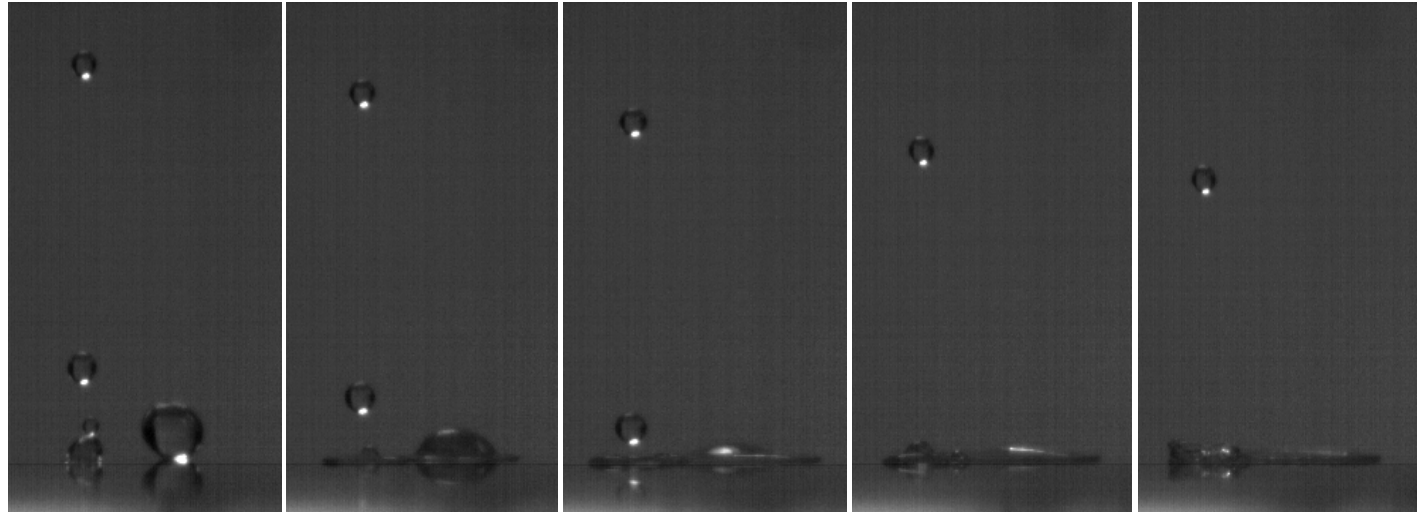


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Research Summary



**Drops Impacting on Surface**  
(Photographed at 2000 Frames per Second)

Research is focused on understanding droplet formation, breakup, and interaction. The image sequence above illustrates the dynamics of the droplet impact process. This research has applications in fuel sprays and combustion, agricultural sprays and deposition, ink-jet sprays for printing devices, paint sprays, and in surface imagery for small scale electronics. Current work includes imaging of fuel and fuel surrogates at pressures of up to 20 bar.



# Biomass Combustion

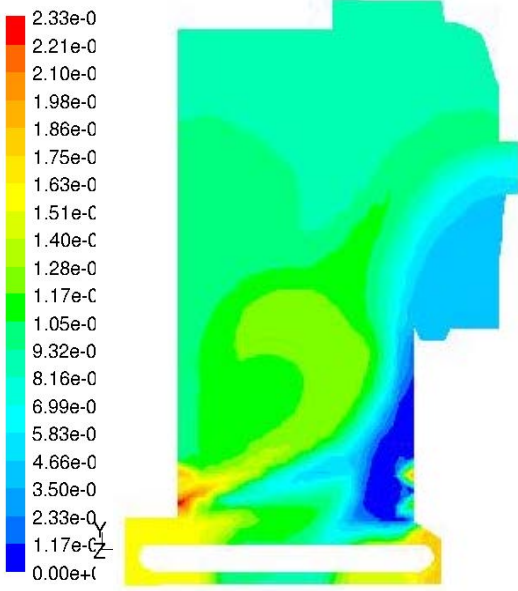
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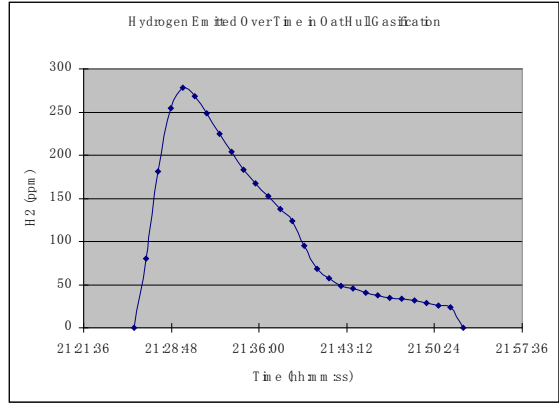
**Albert Ratner**  
Associate Professor

[aratner@engineering.uiowa.edu](mailto:aratner@engineering.uiowa.edu)  
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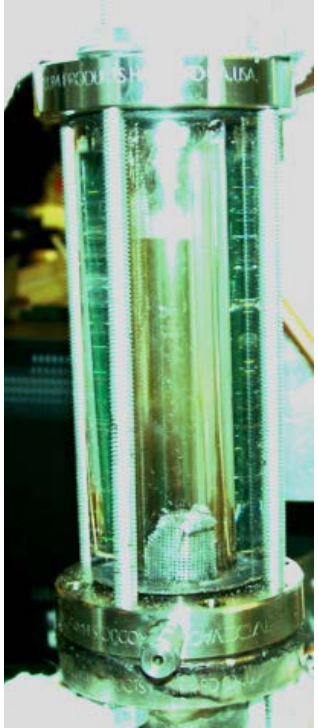
Research Summary



Boiler Simulation



Emitted Hydrogen Gas



Quartz Chamber

This project is focused on understand, measuring, and modeling biomass gasification, pyrolysis, and combustion. The fuel is typically light biomass (oat hulls in this case). Time-evolving gasification measurements are made in a quartz tube gasifier (right image) and resulting chemical species are measured with solid state detectors (Hydrogen out gassing results are the middle figure). This information is then incorporated in computer models of real systems (such as the boiler shown on the left).





# Fuel Fire Safety

Combustion and  
High Speed Fluid  
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**Albert Ratner**  
Associate Professor

[aratner@engineering.uiowa.edu](mailto:aratner@engineering.uiowa.edu)  
<http://www.engineering.uiowa.edu/~aratner>

Research Summary



## Aircraft



Crash  
w/normal jet fuel



Aircraft

## Lab Scale Tests



Normal Jet Fuel



Jet Fuel  
w/Safety Additive

## Large Scale Tests



Normal Jet Fuel



Jet Fuel  
w/Safety Additive

Fuel fire safety research is focused on understanding the breakup and misting behavior of fuels with non-Newtonian polymeric additives. The goal is to create additives that save lives by minimizing crash fires.