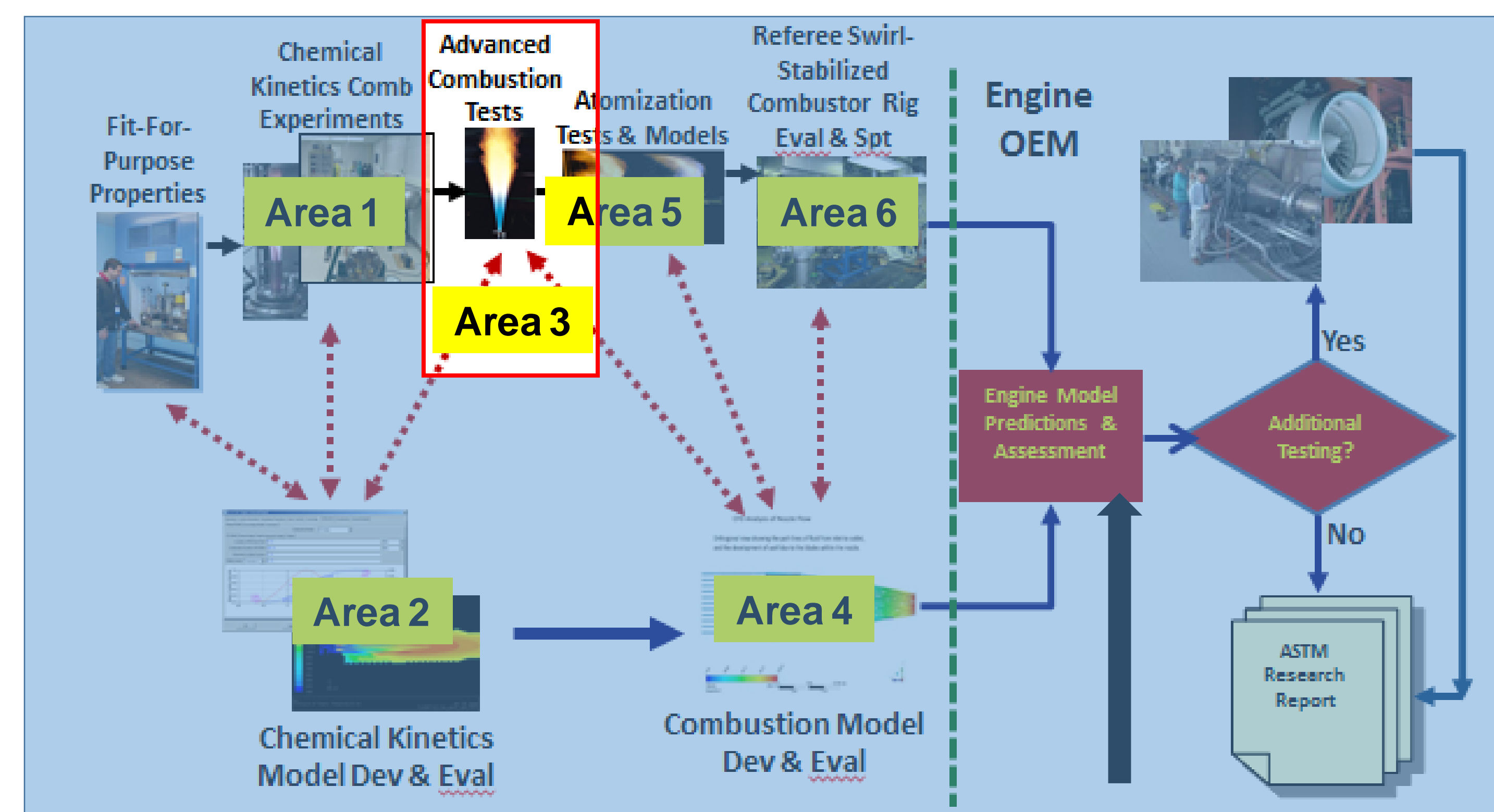


## Motivation and Objectives

### Advanced Combustion Tests

**Screening-** Combustion performance measurements with conventional fuels and fuels with unconventional chemistries determines sensitivities to properties

**Detailed Measurements-** Detailed measurements are used to refine and validate combustion models that can predict and assess fuel sensitivities



## Tasks

### Three Tasks: Sensitive to Fuel Properties

#### 1. High Shear Stabilization & Blowoff

- Important figure of merit for OEMs
- Screen fuels at different operating conditions
- Measure detailed flow field data for model validation and boundary conditions

#### 2. Forced Ignition

- Important figure of merit for OEMs
- Screen fuels at different operating conditions
- Detailed diagnostics for model validation
- Develop reduced order models

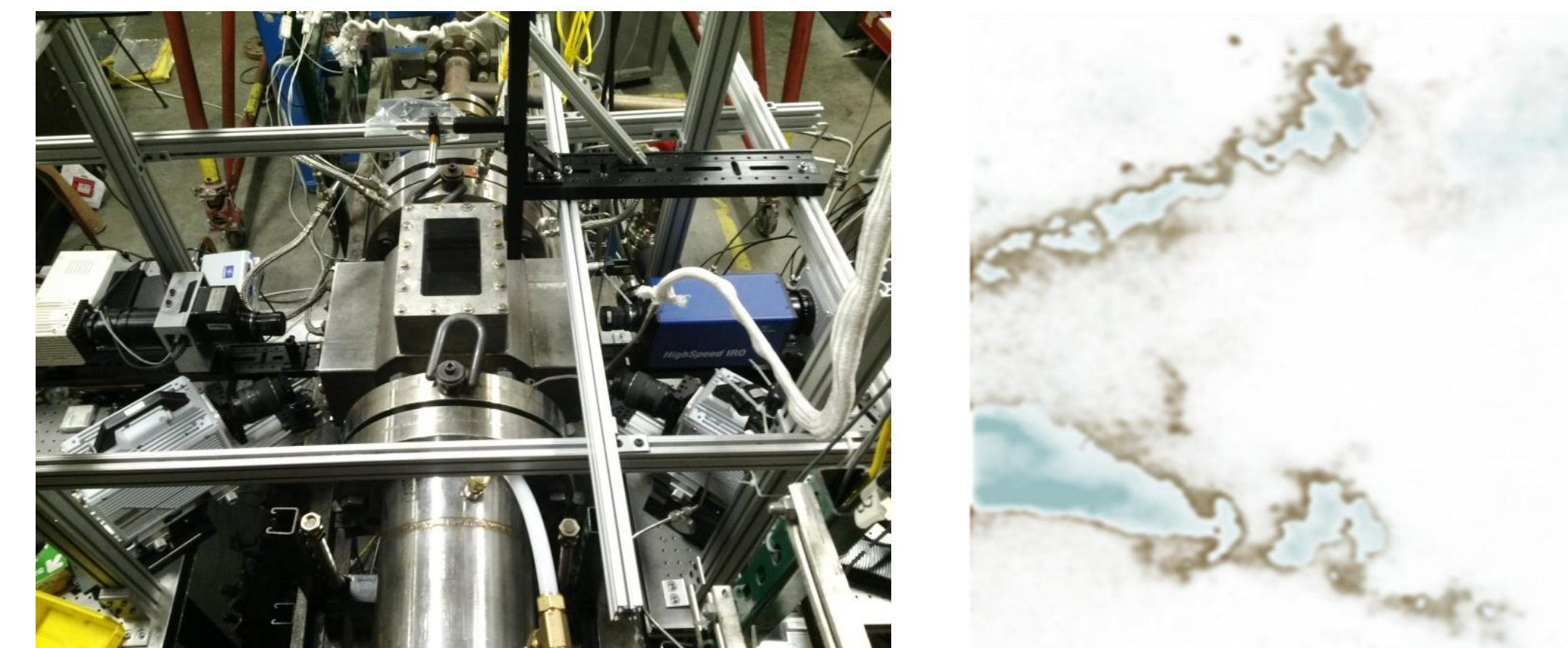
#### 3. Turbulent Flame Speed

- Screen fuels for different flame speeds
- Can evaluate at sub-atmospheric conditions

## Experimental Facilities

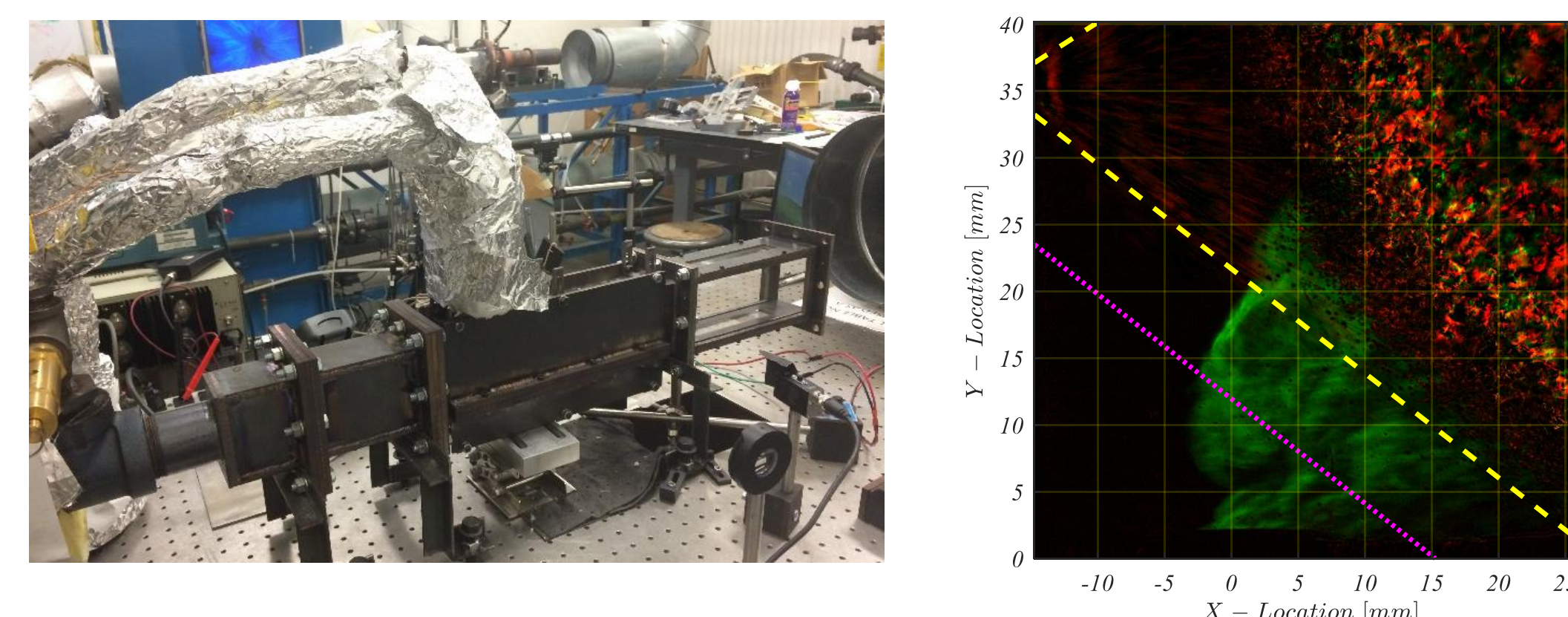
### Task 1. High Shear Rig

Optically accessible, simplified aircraft combustor with high pressure and high preheat capability



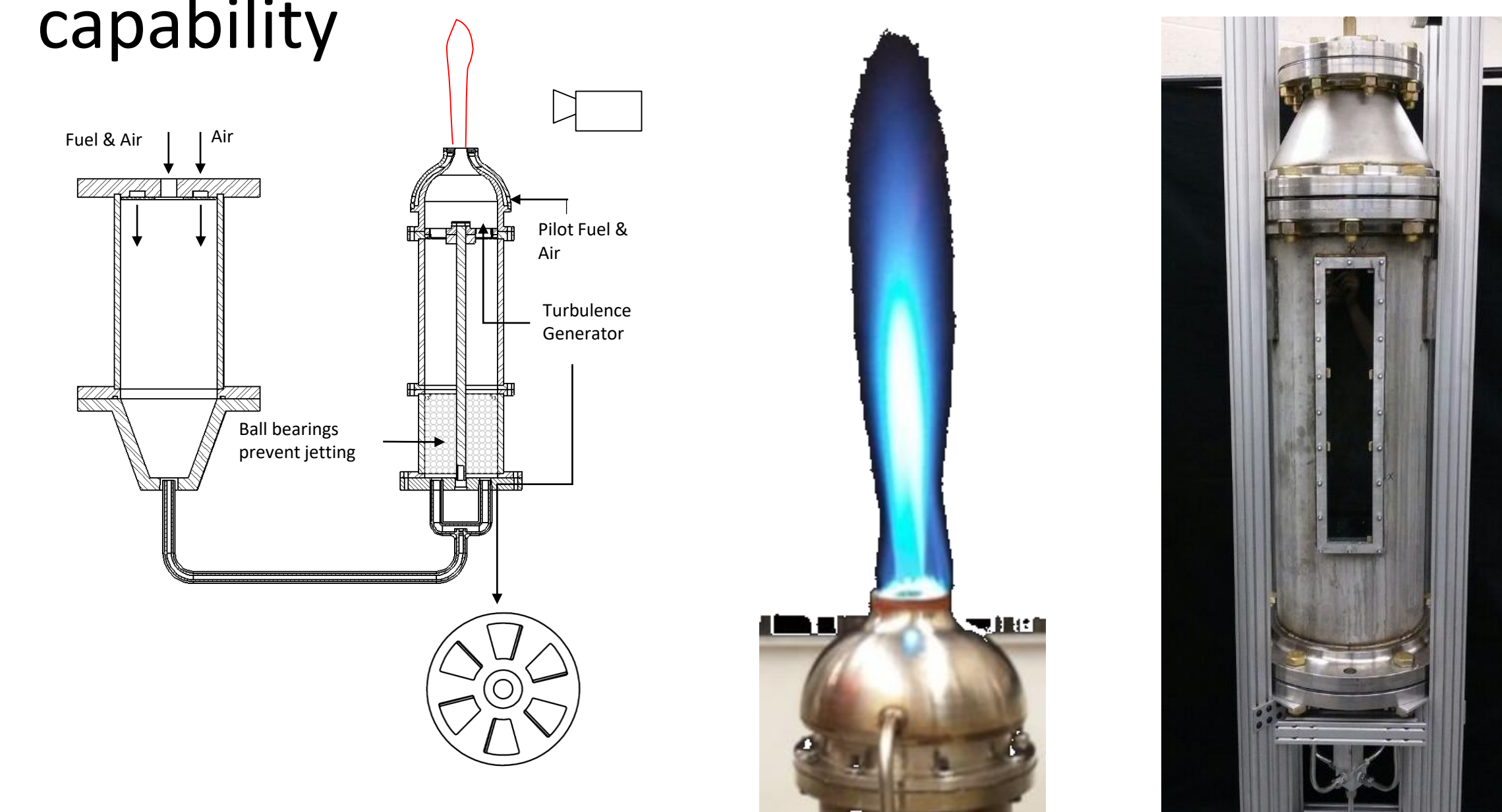
### Task 2. Forced Ignition Rig

Optically accessible, pre-vaporized or spray, chilled fuel and air preheat capabilities



### Task 3. Turbulent Flame Speed Rig

Optically accessible rig with variable turbulence intensity and future sub-atmospheric pressure capability



#### Lead investigators:

Tim Lieuwen, Jerry Seitzman, Wenting Sun (Georgia Institute of Technology)  
David Blunck (Oregon State University)

Tonghun Lee (University of Illinois Urbana-Champaign)

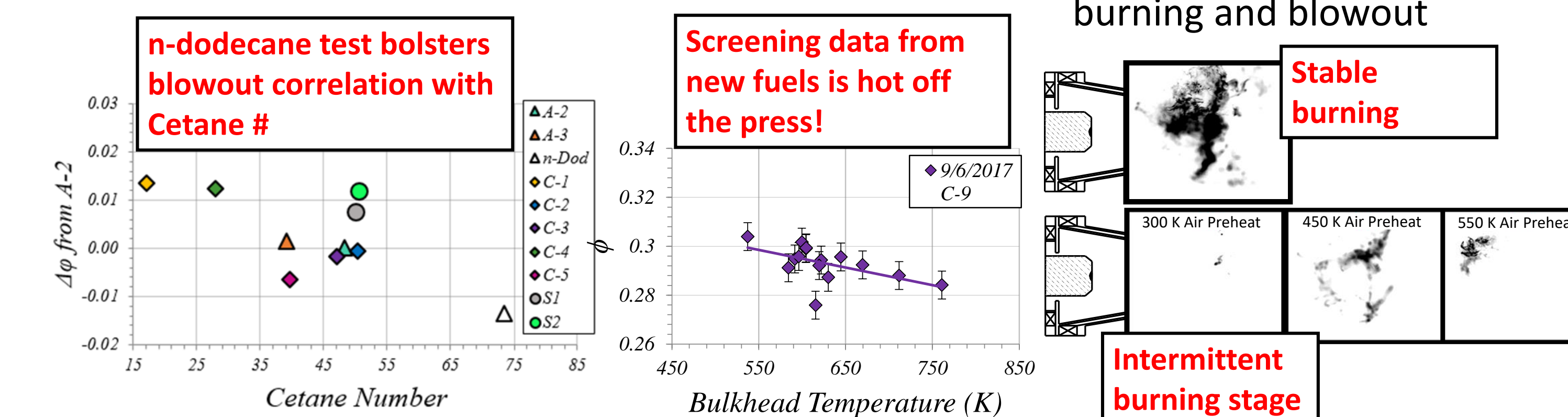
**Project manager:** Cecilia Shaw (FAA)

September 26-27, 2017

### Task 1. High Shear Stabilization, Blowoff

- Blowout propensity exhibits **strong correlation with cetane #**
- **Recent screening of new fuels** will stress-test the cetane # correlation

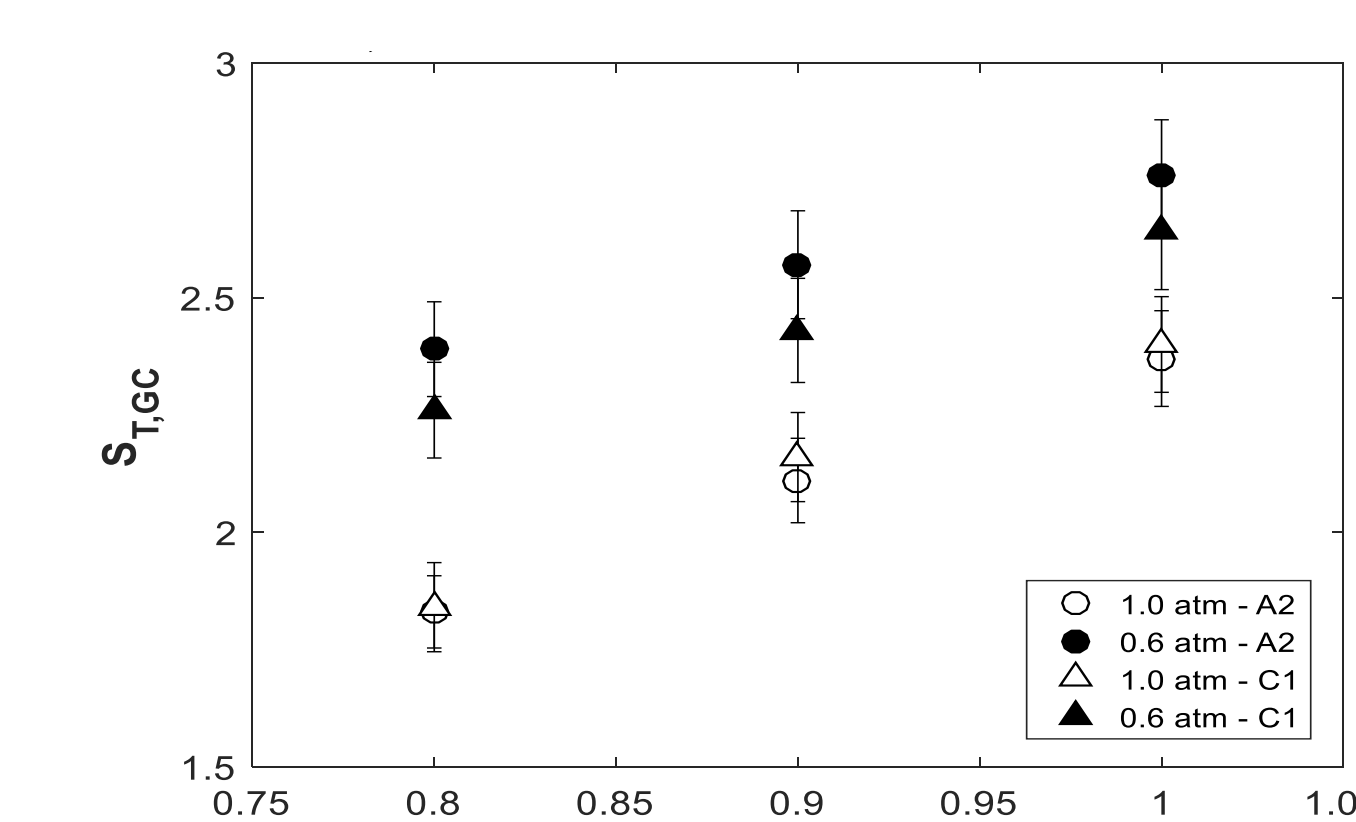
**High-speed chemiluminescence imaging** reveals intermittent burning stage between stable burning and blowout



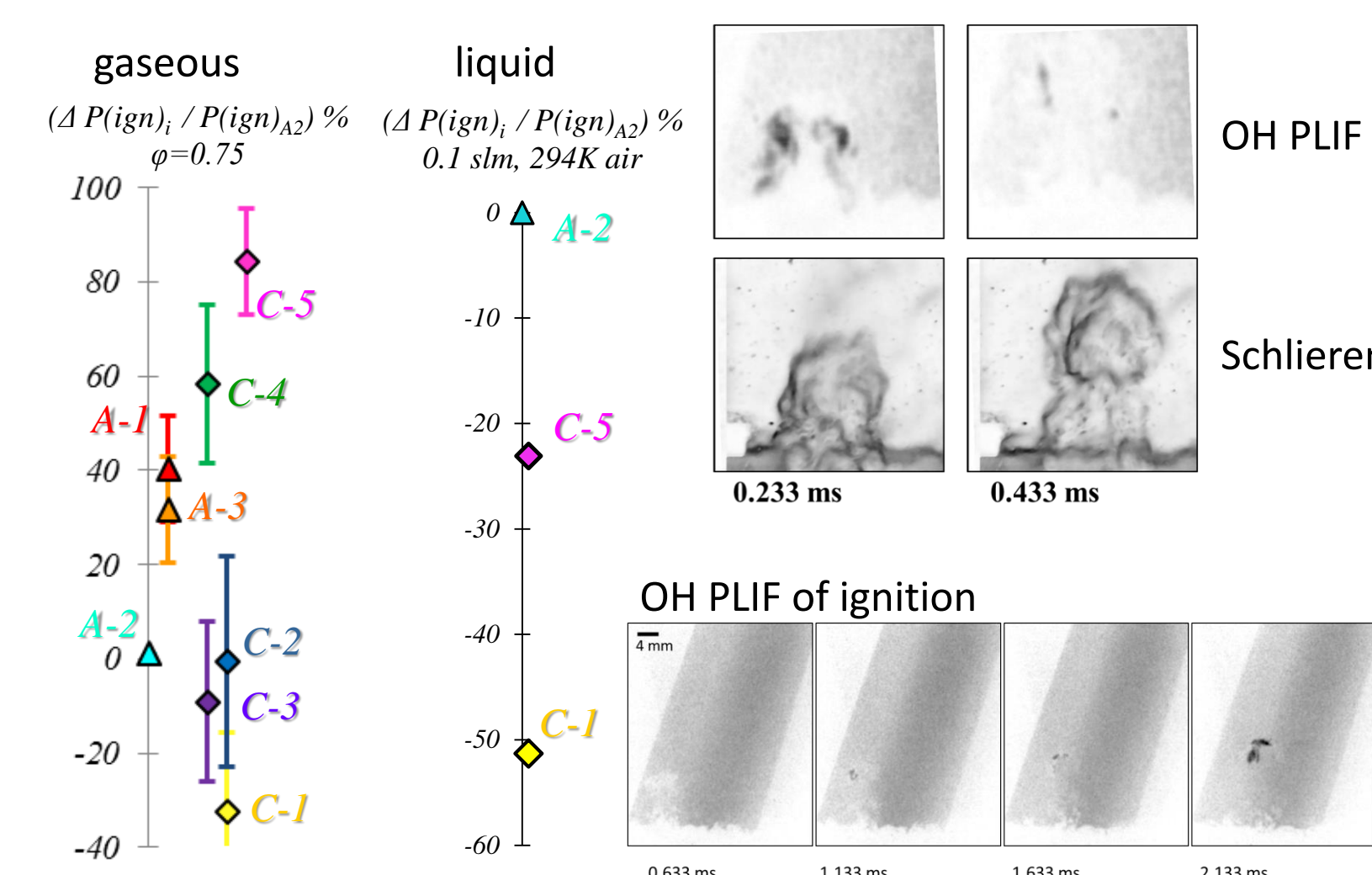
### Task 2. Forced Ignition

#### Flame Speed

Screening demonstrates fuel sensitivities



Screening demonstrates fuel sensitivities Detailed diagnostics of kernel



## Conclusions and Next Steps

### Three Tasks: Sensitive to Fuel Properties

- **All tasks demonstrated fuel sensitivity and providing detailed diagnostic sets**
- Blowout physics & related fuel properties depend on operating conditions
- Ignition influenced by chemical properties for prevaporized conditions; physical properties dominate spray ignition
- Turbulent flame speed task produces large fuel sensitivity parameter studies