

# Chemiluminescence and IR imaging of pre-chamber jet penetration, ignition, and combustion in a HD-NG engine

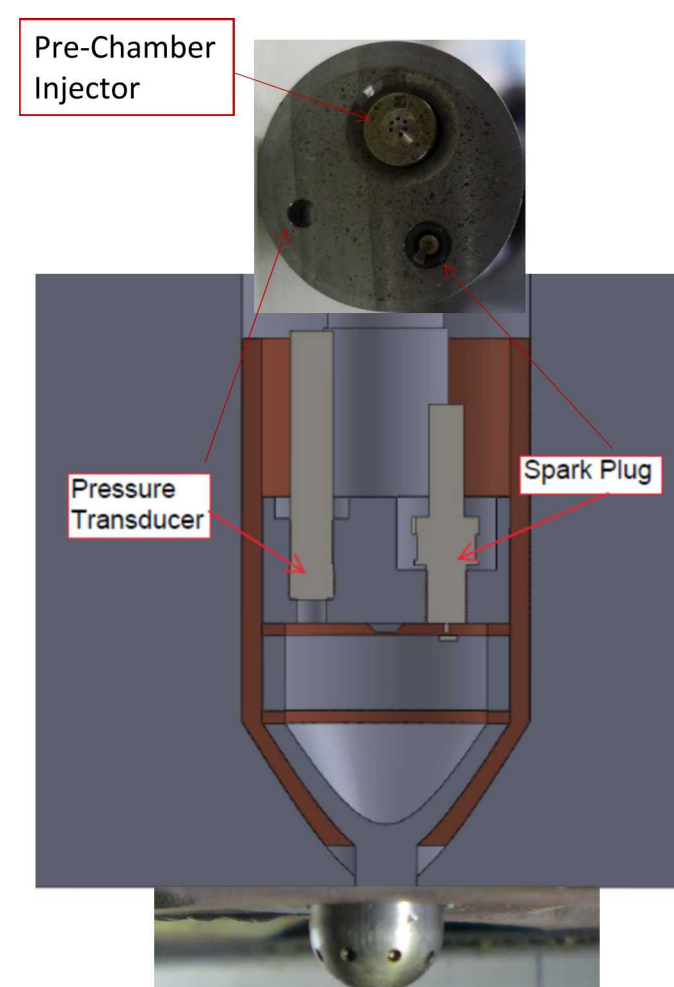
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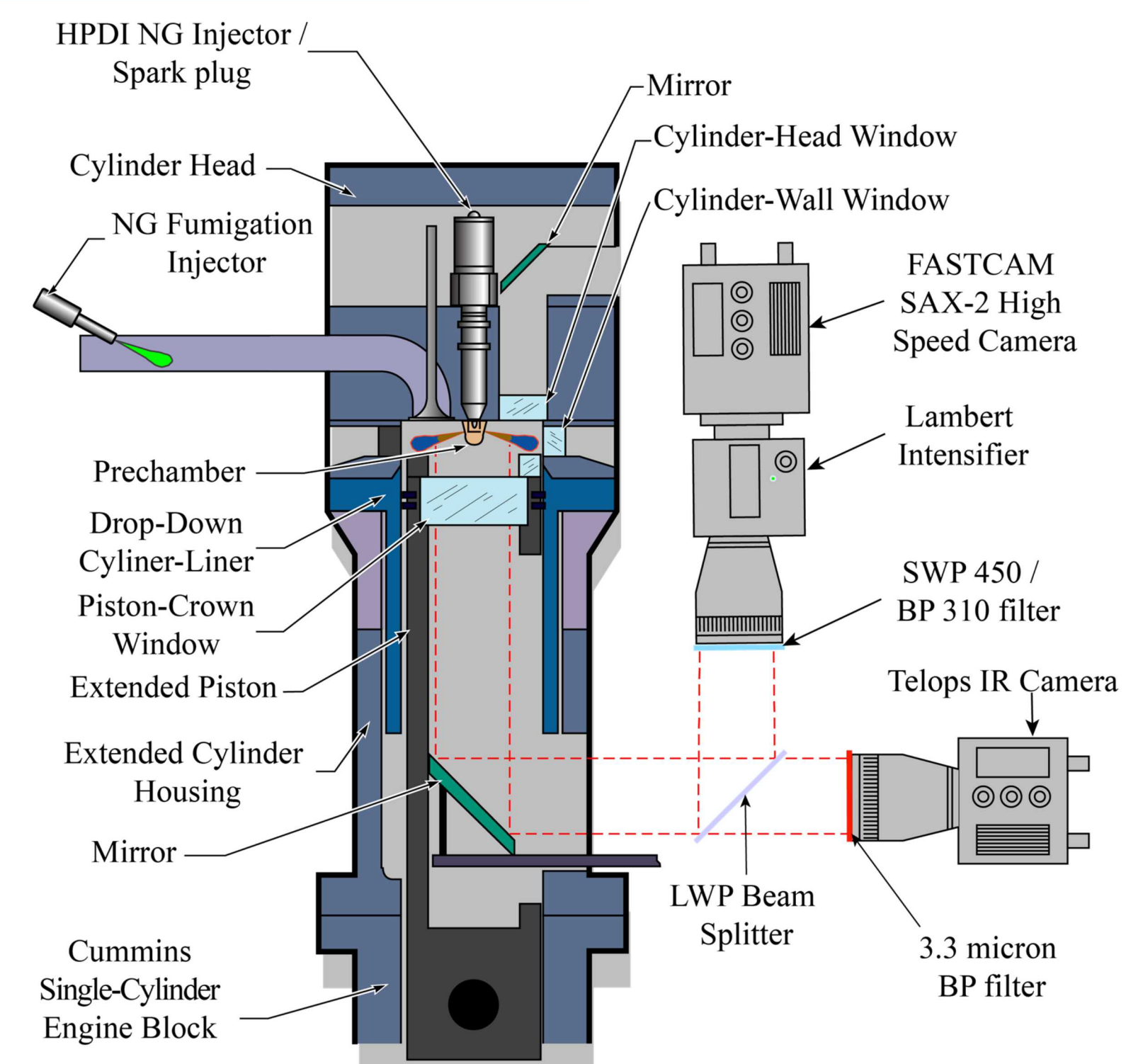
## OBJECTIVES

- Description of relevant events related to the prechamber gas ejection and premixed flame front formation
- Evaluation of phenomena governing turbulent jet ignition
  - Thermal conditions
  - Presence of chemically active species
- Development of conceptual models and validation of CFD code predictions
- Evaluation of IR visualization as a combustion diagnostic tool



- Prechamber geometry
  - Number of holes: 8
  - Hole size: 1.6 mm
  - Included angle: 130°
  - Inner volume 4.67 ml
- Additional systems
  - Fueling: GDI injector
  - Pressure: uncooled piezoelectric
  - Spark plug: miniature "Rimfire"

## EXPERIMENTAL FACILITY

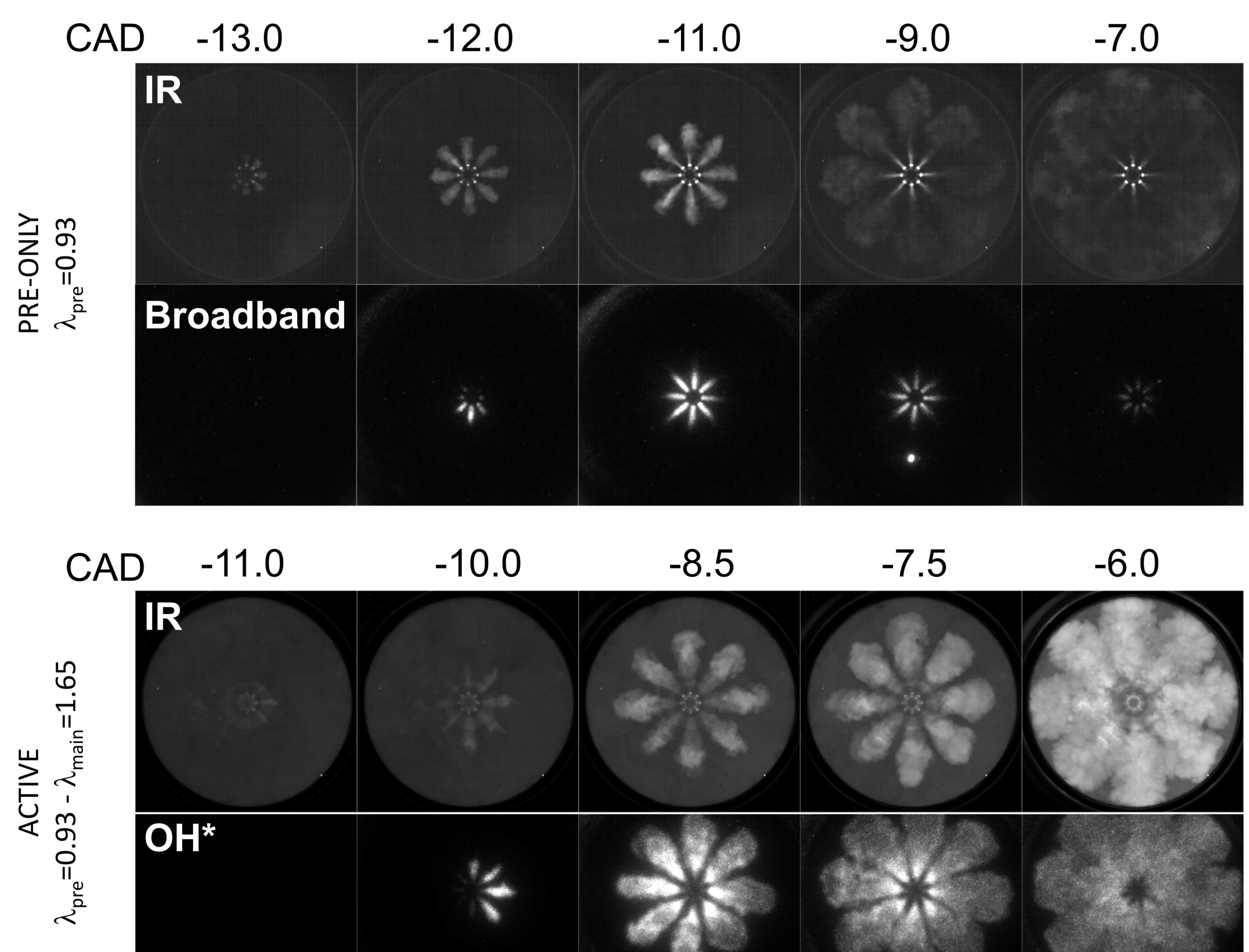
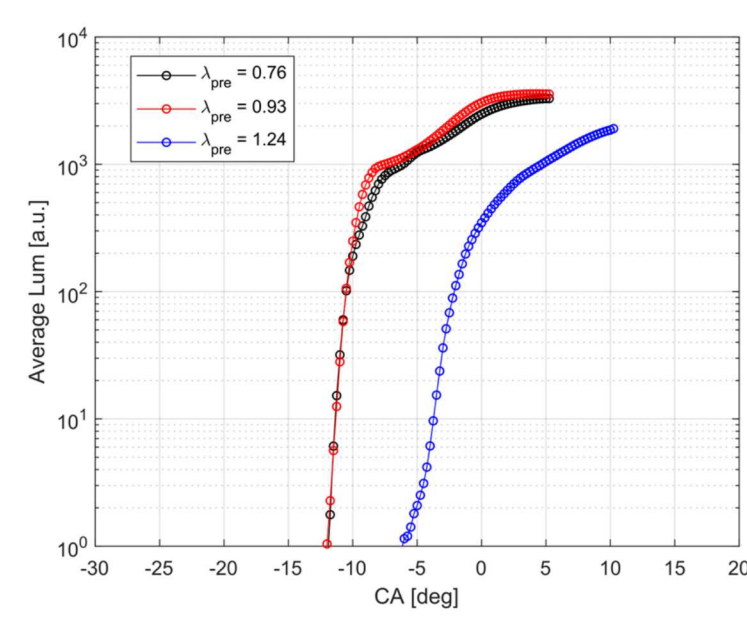
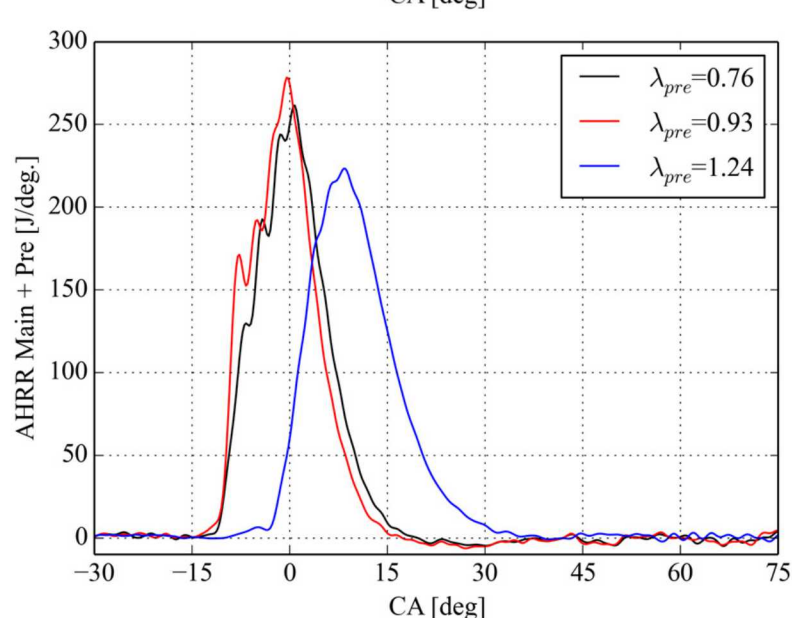
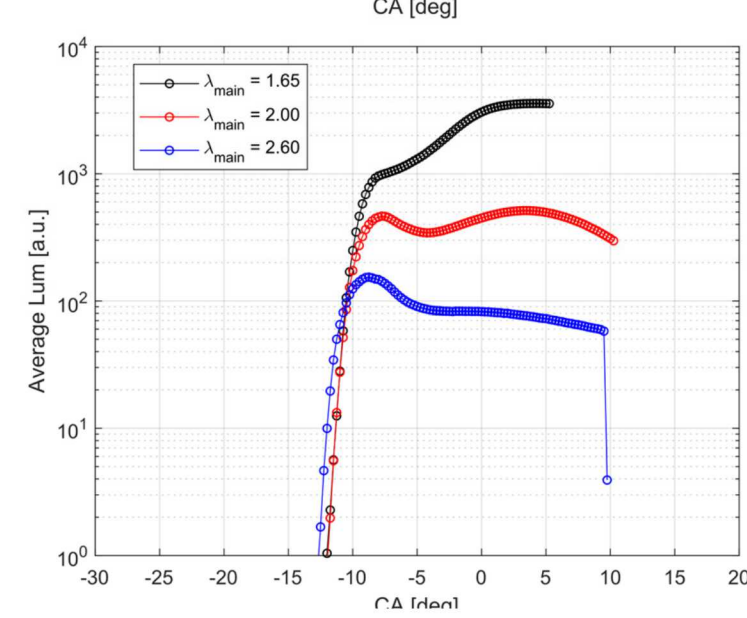
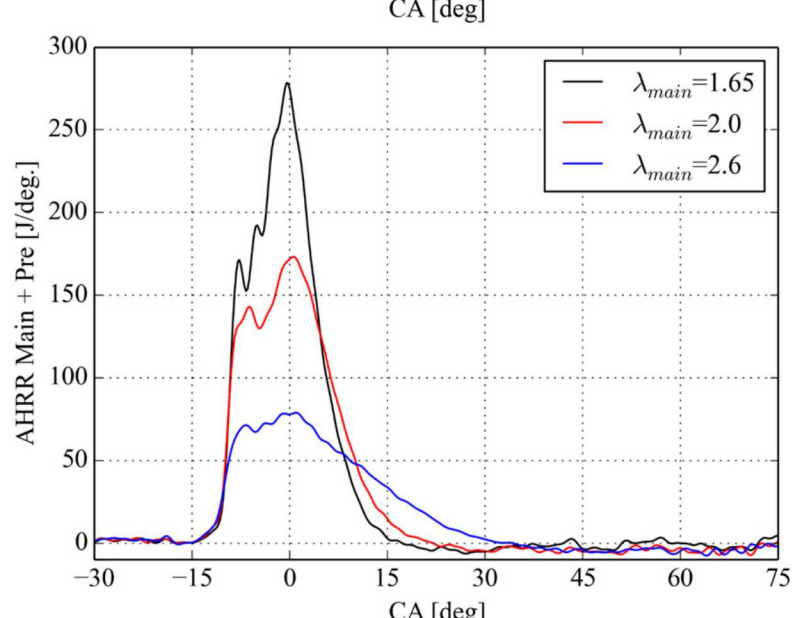
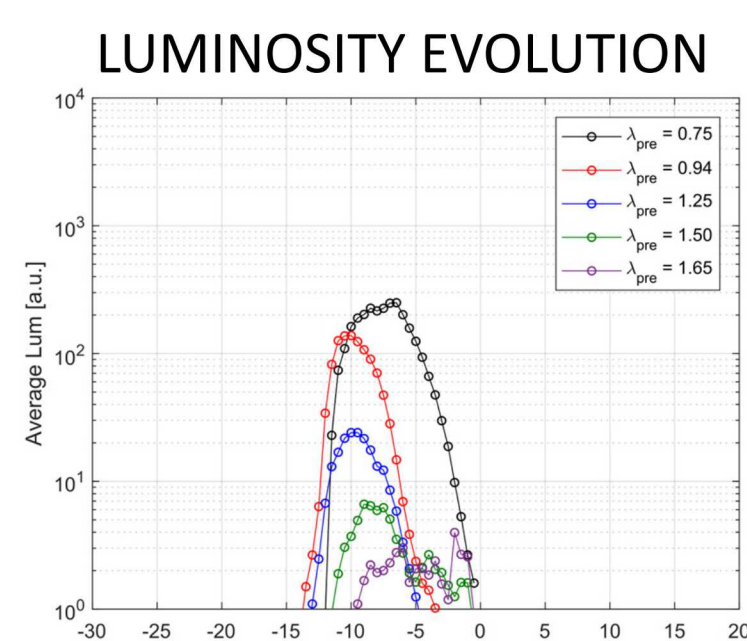
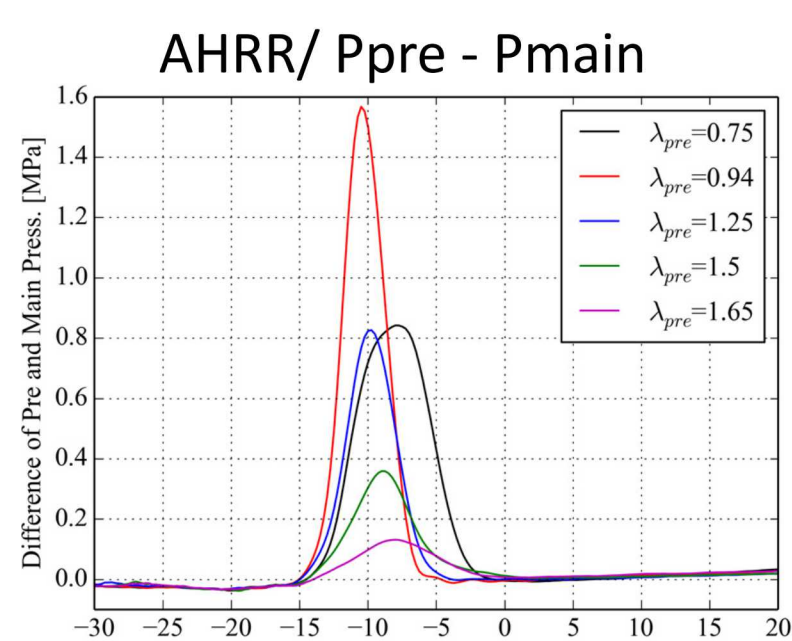


## ANALYSIS OF RESULTS

### OPERATING CONDITIONS

- Conditions at Spark timing (SOS)
  - $P_{SOS} = 19.34$  bar
  - $T_{SOS} = 730$  K
- Spark timing at -17.0 CAD
- Constant dwell between end-of-injection and SOS

	$\lambda_{main}$	$\lambda_{pre}$
PRE-ONLY	$\infty$ (air)	1.65 to 0.75
PASSIVE	1.5, 1.65	1.5, 1.65
ACTIVE	1.65 to 0.49 0.93	1.65 1.65 to 2.6



## CONCLUSIONS

- PRE-ONLY cases show ejected jet consists of two zones
  - Near-nozzle zone, narrow chemically active jet
  - Far-field, wider gas jet, high temperature but absence of radicals
- IR imaging delivers important diagnostic information for non-reacting jets
- ACTIVE cases show a similar structure
  - Near-nozzle zone, chemically active jet but wider than for PRE-ONLY cases
  - Far-field, wider gas jet, transition to a premixed flame front, later merging all jet structures

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