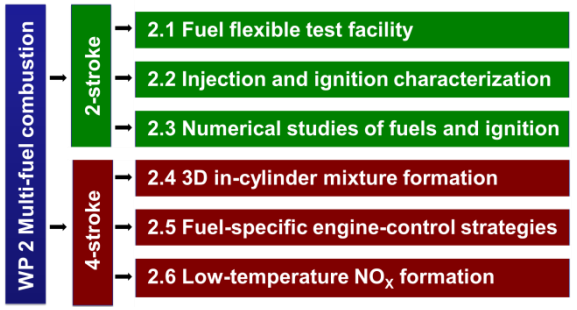
Objectives of Work Package

WP Leaders: Dr. Johan Hult
Christian Kunkel

- Further improve fuel flexibility of marine engines
- Increase understanding of injection, ignition, combustion and emissions formation for novel and mixed fuels → efficient operation
- Develop experimental and numerical tools required to exploit alternative fuels in marine engines:
  - ➢ Experimental facilities with optical access
  - ➢ Development of numerical tools
  - ➢ Development of novel control strategies

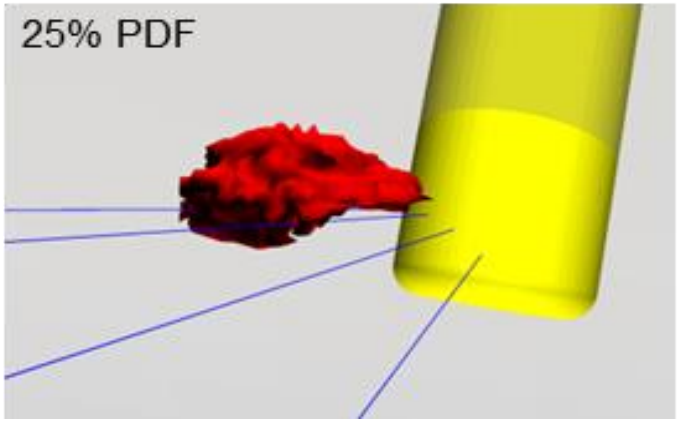


Partners: MAN, Lund University, DTU, Technische Universität München, Politecnico Milano 1863

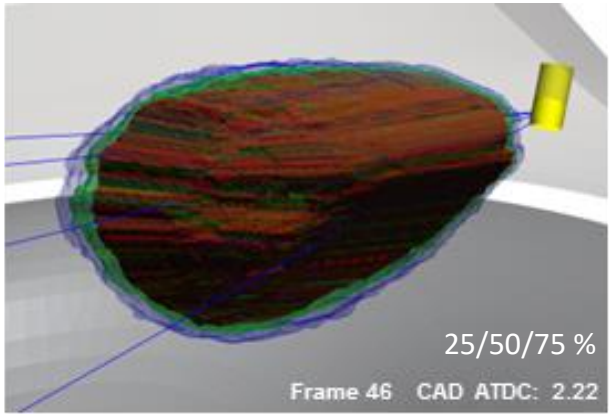
Progress M30-M36 (WP2.1 & WP2.2)

- Fuel flexible injection and ignition facility: deliverable submitted
- Data processing of tri-camera data for CFD validation
- Optical access for LPG tests, tests scheduled in spring
- Preparations for next optical tests (MAN+LUND) in progress, scheduled in spring-summer

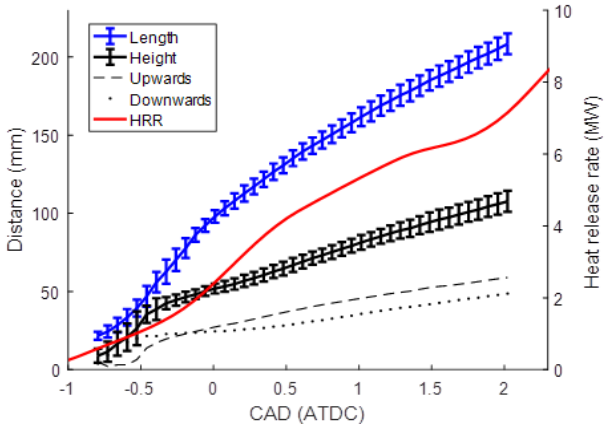
Tri-camera CFD validation data



Ignition kernel



Cycle-to-cycle variations



Flame propagation

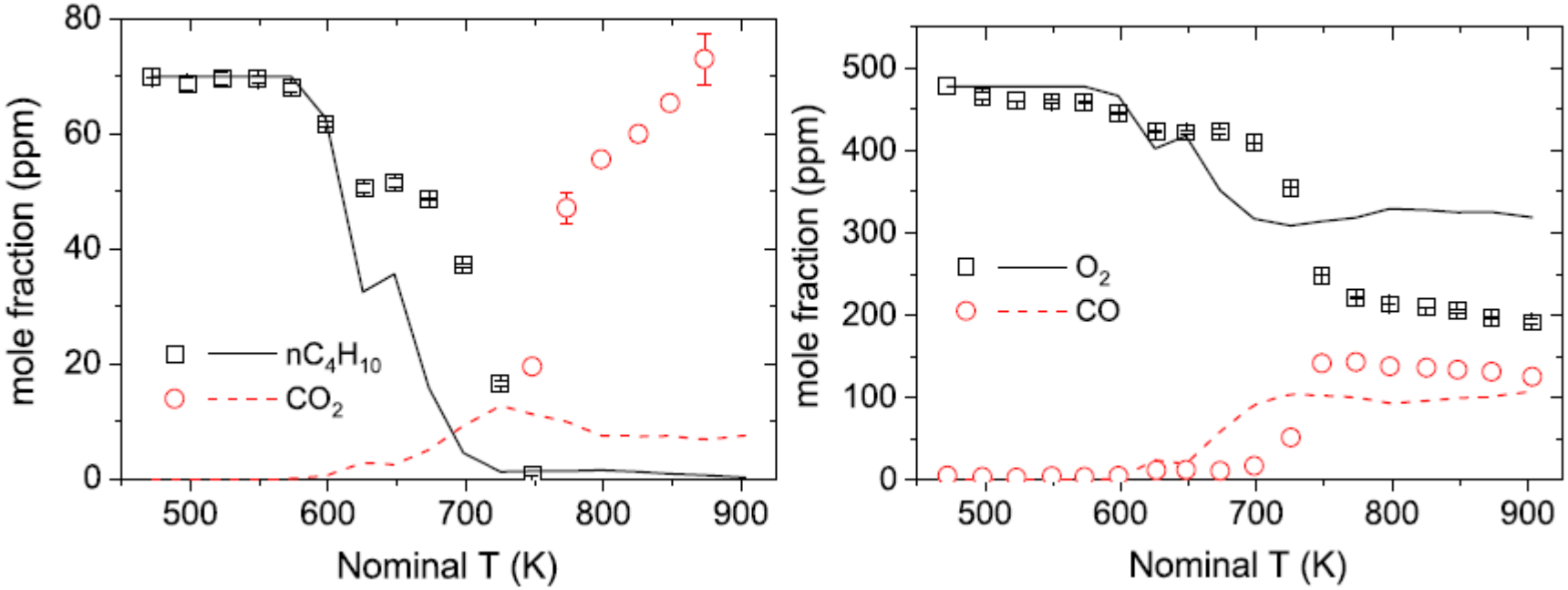
Progress M30-M36 (WP2.3)

- Detailed chemical kinetic models for new gaseous fuels completed and experimentally validated: NG, ethane, methanol, LPG (propane/butane*) ✓

** Refinement required*

→ Engineering tool for ignition delay time evaluation ✓

→ Engineering tool for laminar flame speed evaluation ✓

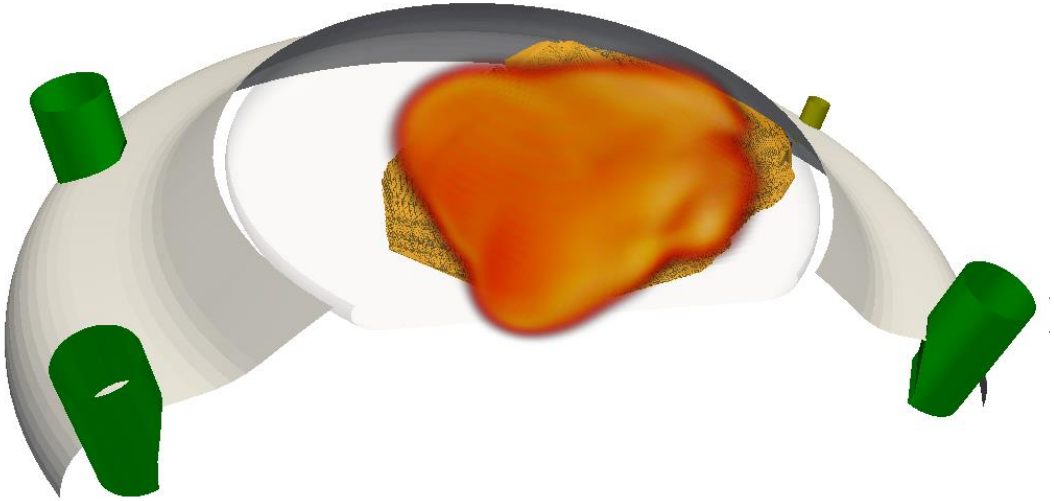


Butane experiments and model (stoichiometric at 100 bar)

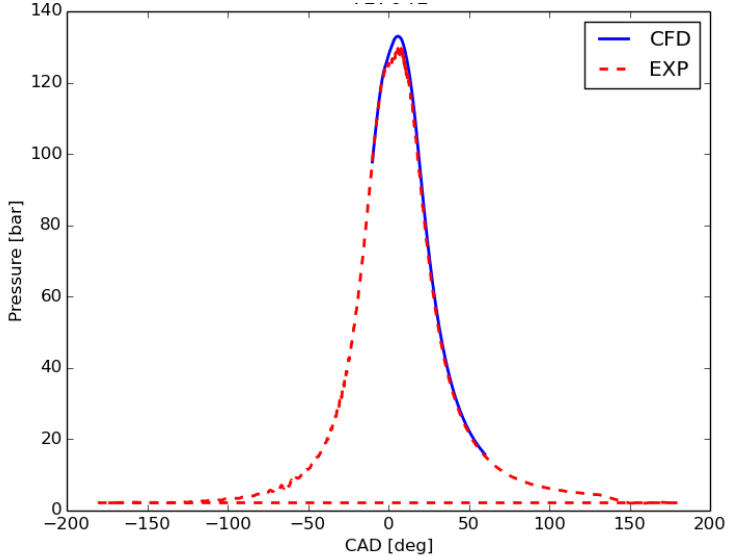
Progress M30-M36 (WP2.3)

• CFD is focusing on using detailed chemistry for LNG (from DTU). To boost progress new partner groups assist with:

- *Mesh motion handling for fast and robust CFD simulations (Milano)* ✅
- *Charge preparation & tabulated chemistry (Milano)* ⚠ ← **DF-CFD in progress**
- *Turbulence/chemistry interactions and cell clustering for detailed chemistry (Lund)* ⚠



Comparison between simulated and measured flame location and shape (diesel case)



ECFM-3Z (MDT) reference calibration for diesel on multiple camera tests

Remaining work

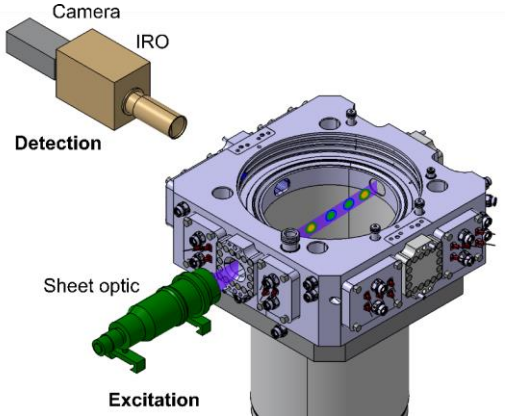
- Optical engine tests:
  - *LPG (MDT)*
  - *high-speed Schlieren/shadowgraph (MDT&Lund)*
  - *lubrication visualisation (MDT&Lund)*
- CFD:
  - *Complete cycle simulation for DF combustion*
  - *Validation using tri-camera data*

Progress update

2.4 In-cylinder mixture formation

lateral access:

- Tested up to 100% ➔ finished
- Investigation of flame luminescence ➔ finished
- Measurement: 3D mixture formation ➔ ongoing



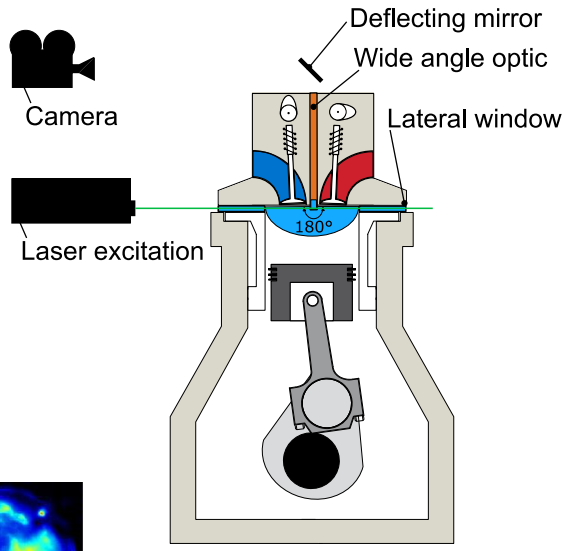
Design for measuring mixture distribution

vertical access:

- Tested up to 100% ➔ finished
- Investigation of flame luminescence ➔ finished

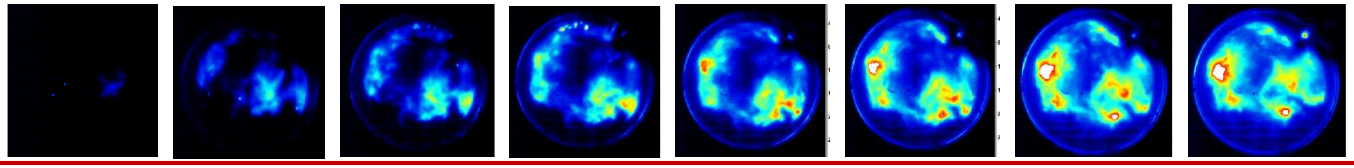
Tracer devices:

- Design and calculation ➔ finished
- Procurement and installation ➔ finished



Vertical optical access

measurement of flame luminescence with vertical access:



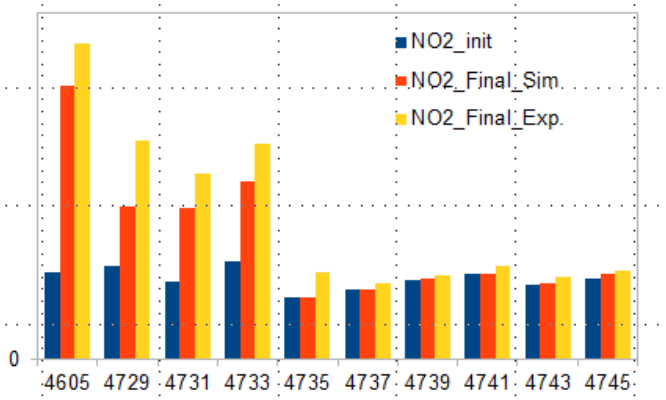
Progress update

2.5 Fuel-specific engine-control strategies

- Analyzation of base data (fuel1 and fuel2) ➔ finished
- Definition of strategy for adv. inj.-timing ➔ finished
- Validation strategy on full scale engine ➔ finished

2.6 Low temperature NO_X formation

- FTIR-measurements (diff. positions) ➔ finished
- Definition of appropriate kinetic mechanism ➔ finished
- Validation of model with engine data ➔ finished
- Deliverable D2.2 ➔ finished



Simulation (red) vs. experiment (yellow)

Future work

- Combination of 1st and 2nd optic release
- Further improvement of optical measurement techniques
- Measurements for in cylinder mixture formation with tracer and laser
- Interpretation of optical measurements
- Finish the reports for deliverables D2.7, D2.8