

# Spray Activities at TKK/ICEL

## Experimental research

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# Diesel Spray Measurements in 1993-2004

- Pressurized measurement chambers at room temperature
- orifice sizes 0.14...0.9 mm, mechanical and CR-injection systems



- Measured parameters

## Imaging

### Spray geometry

spray tip penetration, width of the spray

### Droplet size

shadowgraphy, forward scattering

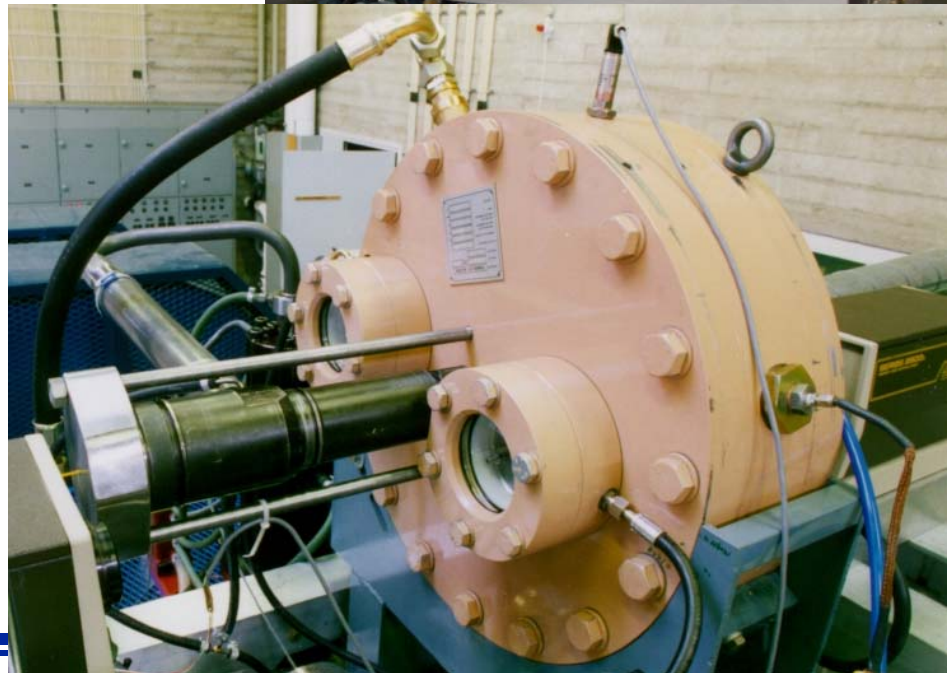
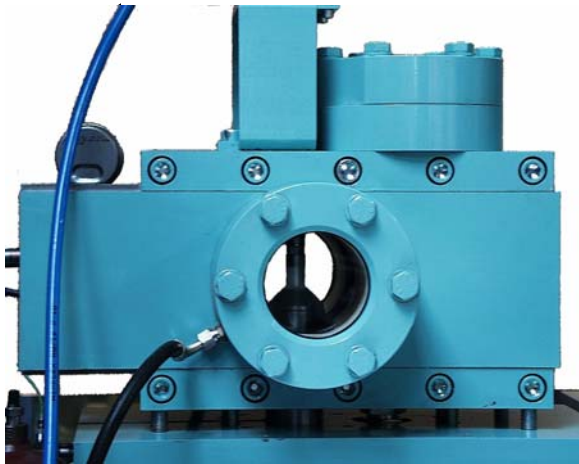
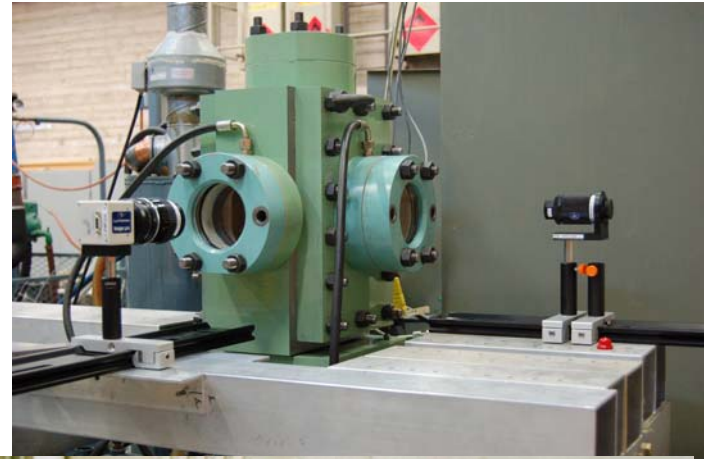
### Velocities

FFT, LDV



# Fuel spray at room temperature

- Pressurized measurement chambers at room temperature
- Gas densities up to  $50 \text{ kg/m}^3$
- orifice sizes 0.14...0.9 mm, mechanical and CR-injection



# Spray measurement instruments

## Imaging

### Spray geometry

**Particle Image Velocimetry ( PIV )**, flowfield

**Laser Induced Incandescence ( LII )**, soot

**Laser Induced Fluorescence ( LIF )** OH, NO, CH

### Tracer-LIF

- Mixing of air and fuel, concentration of fuel
- Exhaust gas circulation,

### Droplet size:

Forward scattering

Background illuminated images

LIF/Mie scattering ratio

### 2-d pyrometry



# Equipment mainly for PIV

- **Double pulsed Nd:YAG laser**
  - New Wave Gemini 200-15, 2x200 mJ @ 532 nm, 15 Hz
- **Laser guide arm**
- **CCD camera:** pair, Imager Pro 4M, cross correlation, 15 frames/s, 2048x2048 pixel
- **Camera lens:** pair, 50mm f1.8
- **Bandpass filters:** pair, 532nm
- **Scheimpflug mount:** pair
- **Calibration kit**
- **Aerosol seeding generator:** up to 10 bar
- **Solid particle generator**



# Equipment mainly for LIF

- **Nd:Yag laser**, Spectra Physics LAB 170
  - 3rd and 4th harmonic generator, repetition rate 15 Hz, max pulse energy @ 532 nm: 450 mJ, @ 355 nm: 220 mJ, @ 266 nm: 90 mJ
- **Dye laser**, Sirah Cobra Stretch
  - Wavelength range 220-600 nm, line width 0.05 cm<sup>-1</sup> @ 570 nm
- **Laser shutter**
- **On-line energy monitor**
- **Moveable laser cradle and optics** for Nd:Yag and dye laser
- **Light sheet optics**
- **Filters**: 532nm band pass, for LIF measurement of OH, CH and NO, for fuel at 266 nm excitation, for Mie at 266 nm, spray exciplex, LII
- **CCD camera**: cross correlation, 12 bit, 1376x1040 pixel, pixel size 6.45 μm, 10 frames/s
- **Image intensifier**: lens coupled 25 mm high resolution
- **UV camera lens**: 94 mm f4.1
- **Mechanical camera shutter**



# Research engines with optical access

- **EVE**

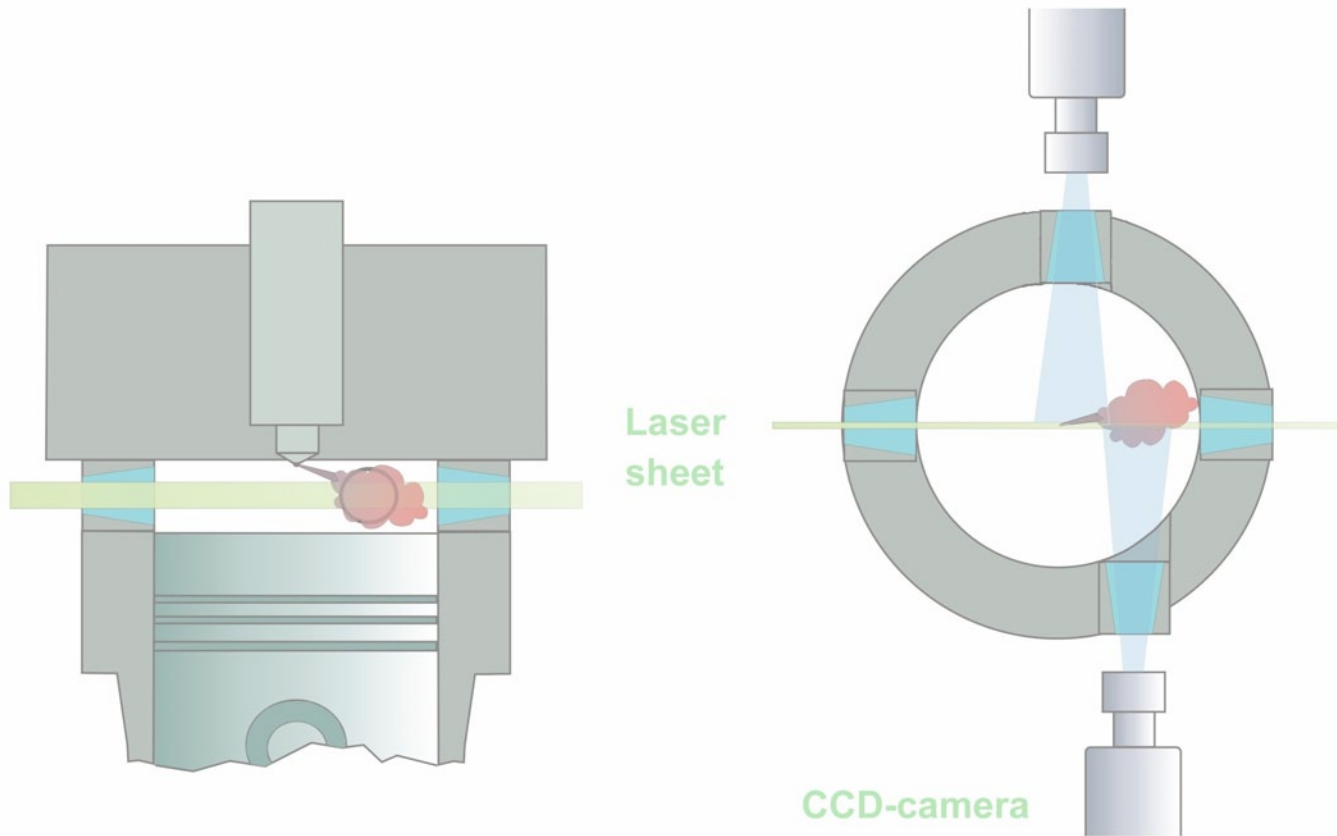
- single cylinder, full electro-hydraulic control (no camshaft)
- bore 200 mm, design pressure 200 bar
- optical access in 2006

- **LEO**

- six cylinder off-road engine with one cylinder in use
- bore 111 mm, design pressure 120 bar
- In use at beginning of year 2007



# Research engine with optical access





# Research engine with optical access

