

# TWO-DIMENSIONAL QUANTIFICATION OF FUEL-AIR-RATIOS OF DIESEL DIRECT INJECTION UNDER ENGINE-LIKE CONDITIONS

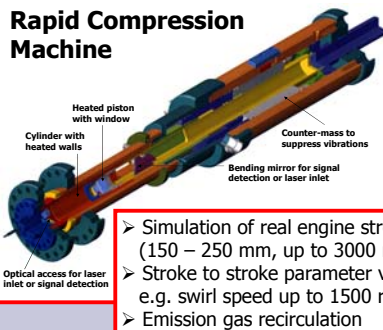
U. Leidenberger, C. Hüttl, M. Schäfer and D. Brüggemann

LTTT, Bayreuth Engine Research Center (BERC), Universität Bayreuth, 95440 Bayreuth, Germany, [www.ltt.uni-bayreuth.de](http://www.ltt.uni-bayreuth.de), [lttt@uni-bayreuth.de](mailto:lttt@uni-bayreuth.de)

## Objectives

- Quantitative and time resolved examination of injection
- Development of an effective method to determine local  $\lambda$ -values
- 2-D  $\lambda$ -mapping at variable in-cylinder plains

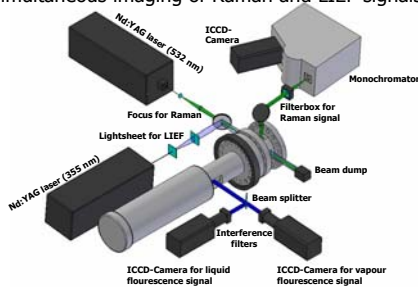
## Rapid Compression Machine



- Simulation of real engine strokes (150 – 250 mm, up to 3000 rpm)
- Stroke to stroke parameter variations, e.g. swirl speed up to 1500 rad/s
- Emission gas recirculation

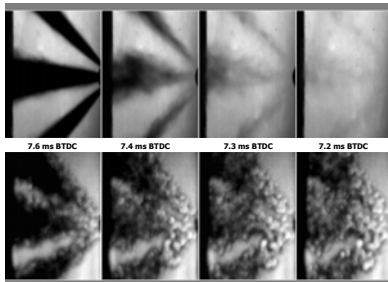
## Experimental Setup

Simultaneous imaging of Raman and LIEF signals



## High Speed Imaging

Shadow images (liquid phase)



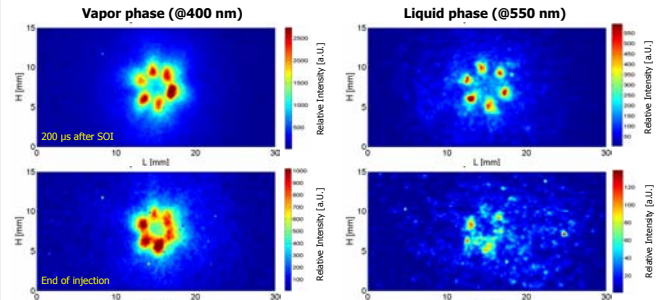
Schlieren images (liquid and vapor phase)

## Time resolved visualization:

- Start of injection
- Start of fuel evaporation
- Spray/vapor propagation

## Laser Induced Exciplex Fluorescence (LIEF)

Averaged images of a diesel fuel direct injection (6-hole-nozzle)

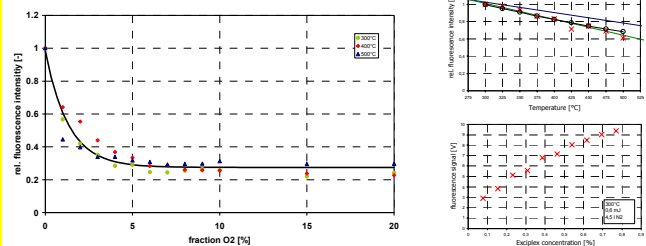


## Simultaneous acquisition of vapor and liquid phase:

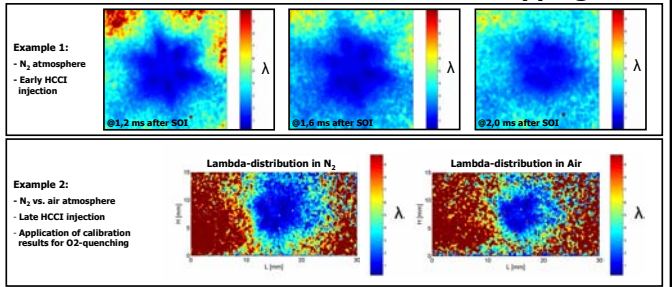
- Quantitative predictions on evaporation and mixture formation
- 2-D visualization of spray propagation
- Quantification through calibration ( $f(p, T, p_{O_2})$ )

## LIEF Calibration in $N_2$ and Air

Influence of  $T$ ,  $p$ ,  $c_{\text{Tracer}}$ ,  $I_{\text{Laser}}$ ,  $O_2$ ,  $H_2O$ ,  $CO_2$ , He

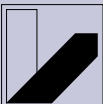


## Result: Time Resolved Lambda Mapping



## Work in progress / Future Research

- Measurement of gas-phase temperatures in evaporating sprays (temperature influence)
- More detailed study of  $O_2$ -quenching
- Further calibration and validation
- Reliable application under engine-like conditions



UNIVERSITÄT  
BAYREUTH



LEHRSTUHL FÜR  
TECHNISCHE  
THERMODYNAMIK UND  
TRANSPORTPROZESSE  
PROF. DR.-ING. D. BRÜGGMANN

