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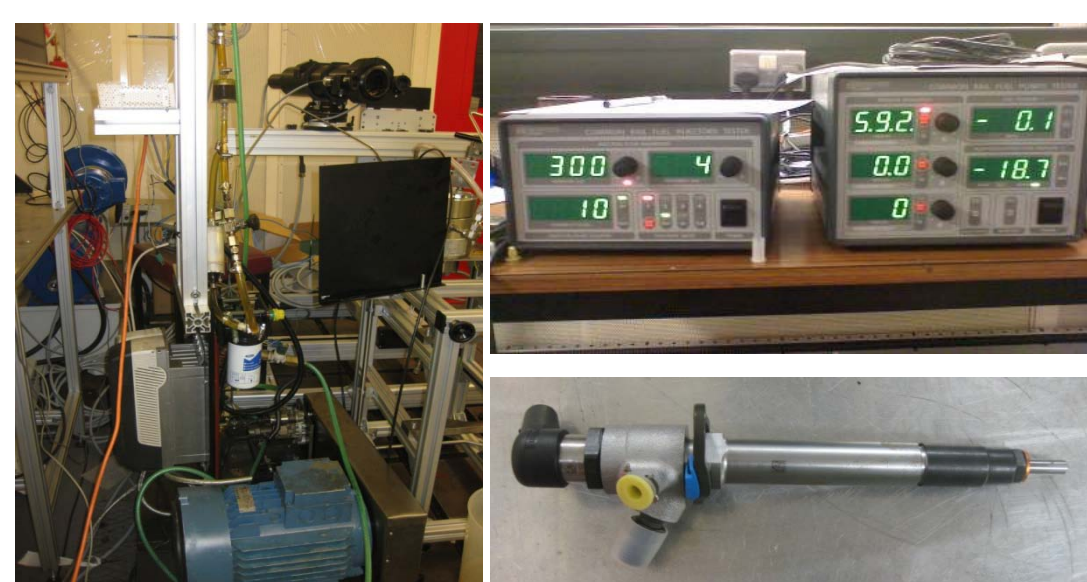
# Experimental Investigation into Biofuel Spray Characteristics

## Objective

- Study physiochemical properties effect on spray characteristics with different biofuel
- Provide the information of spray characteristics of modern injection system for validation of CFD code
- Fundamental study on laminar flame mechanism used to develop numerical combustion model

## Experimental Setup

- Composed of high pressure vessel, fuel injection system, and image acquisition system
- Working pressure up to 110 Bar, highest initial gas temperature > 500°C
- Camera speed up to 1,000,000 fps with high resolution
- Multiple injector holders for different optical diagnostics



Diesel Fuel Injection System



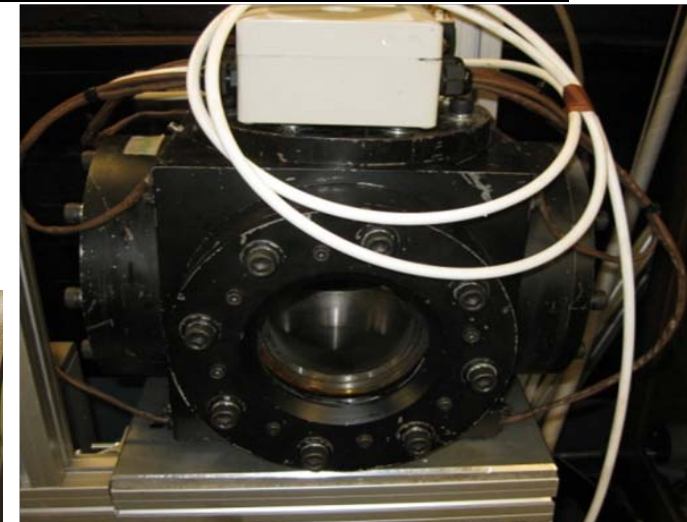
High Pressure Vessel



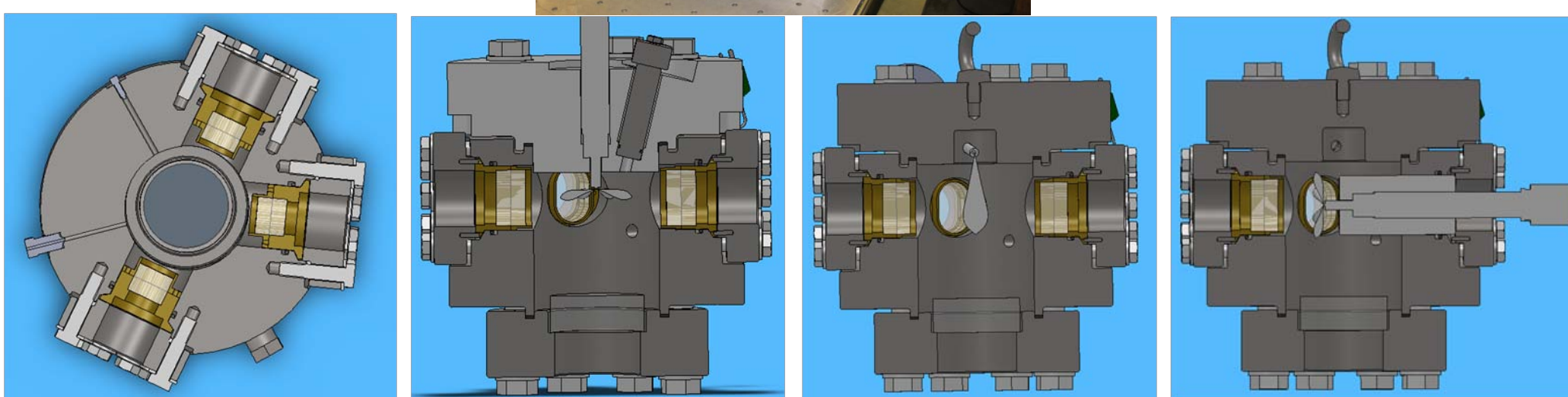
Phantom SpeedSense V710 with Intensifier



Shimadzu Hyper Vision HPV2



Pressure Vessel with Large windows



Window layout

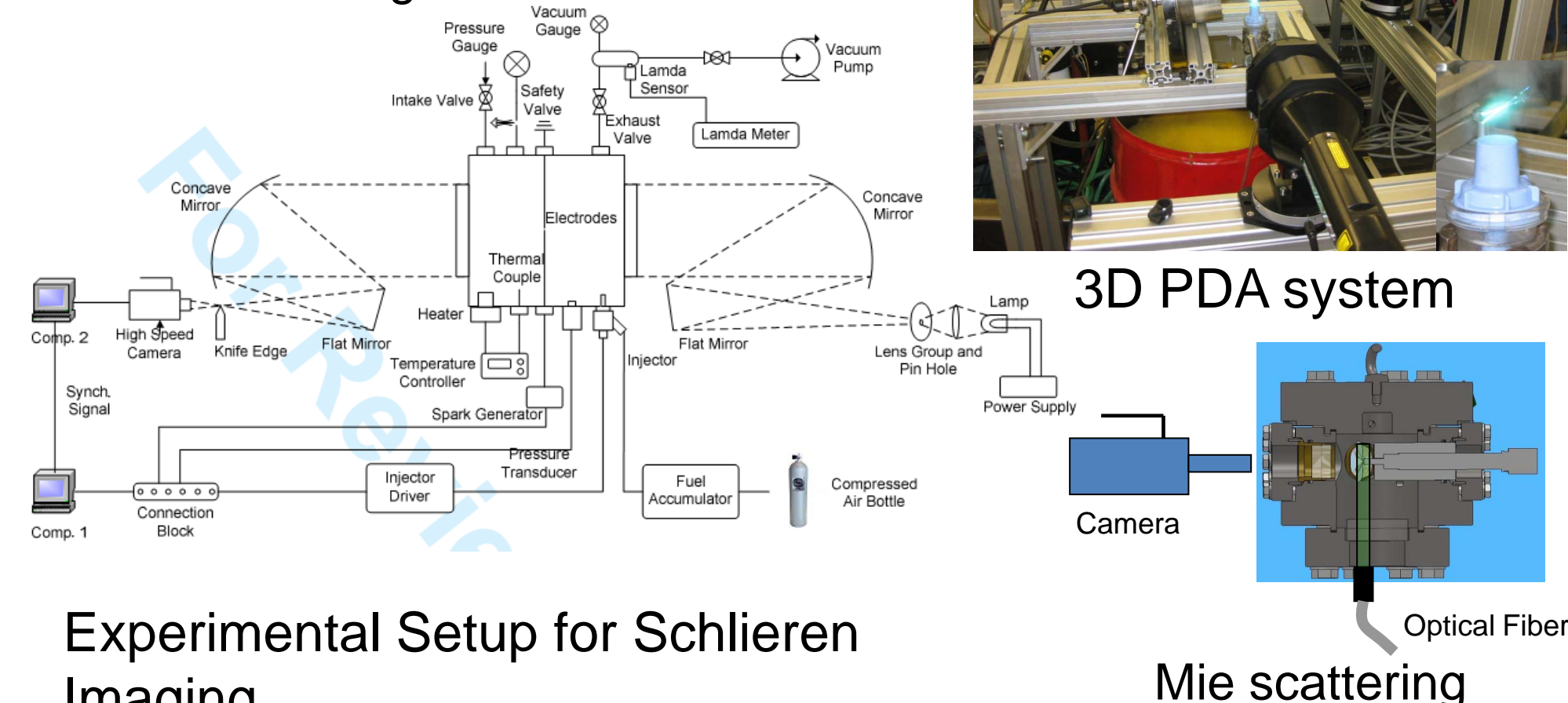
Different injector holders

## Methods

- 3D Phase Doppler Particle Analyser
- Schlieren/Shadowgraph
- Mie scattering



3D PDA system

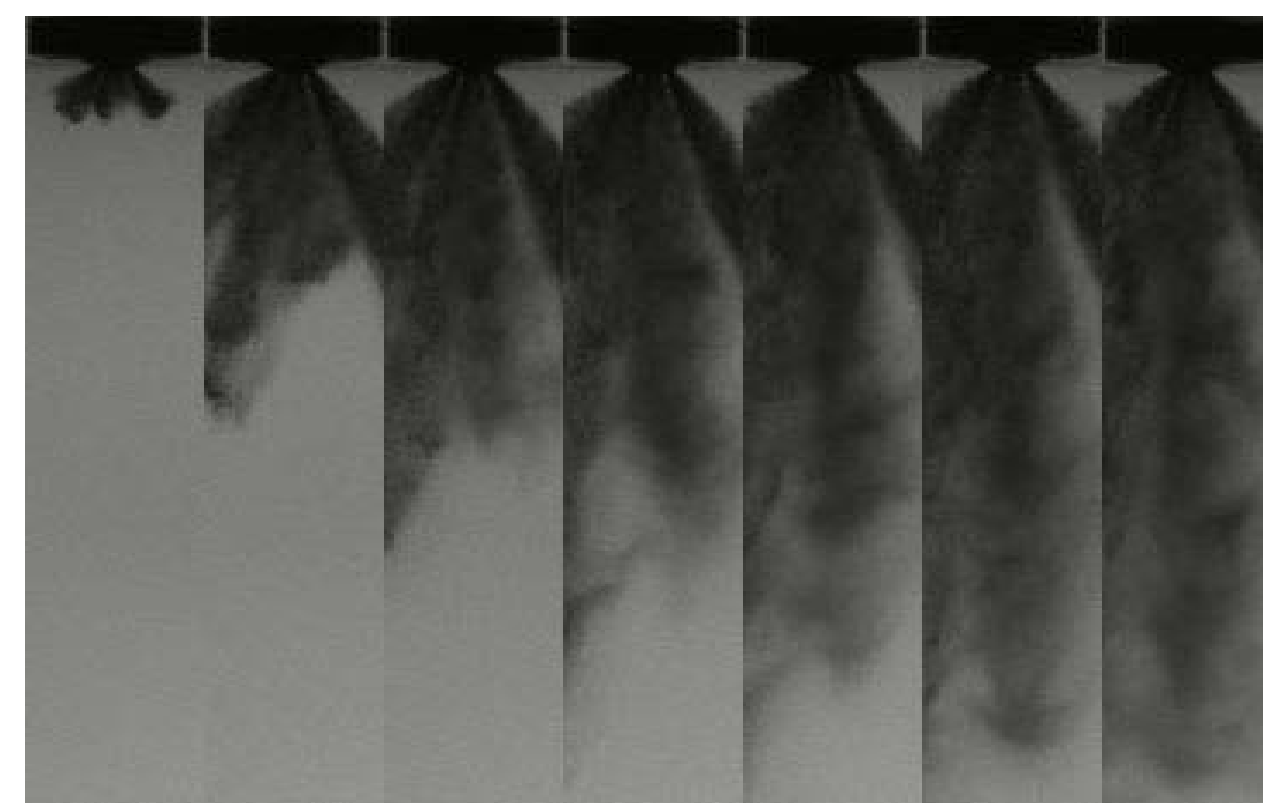


Experimental Setup for Schlieren Imaging

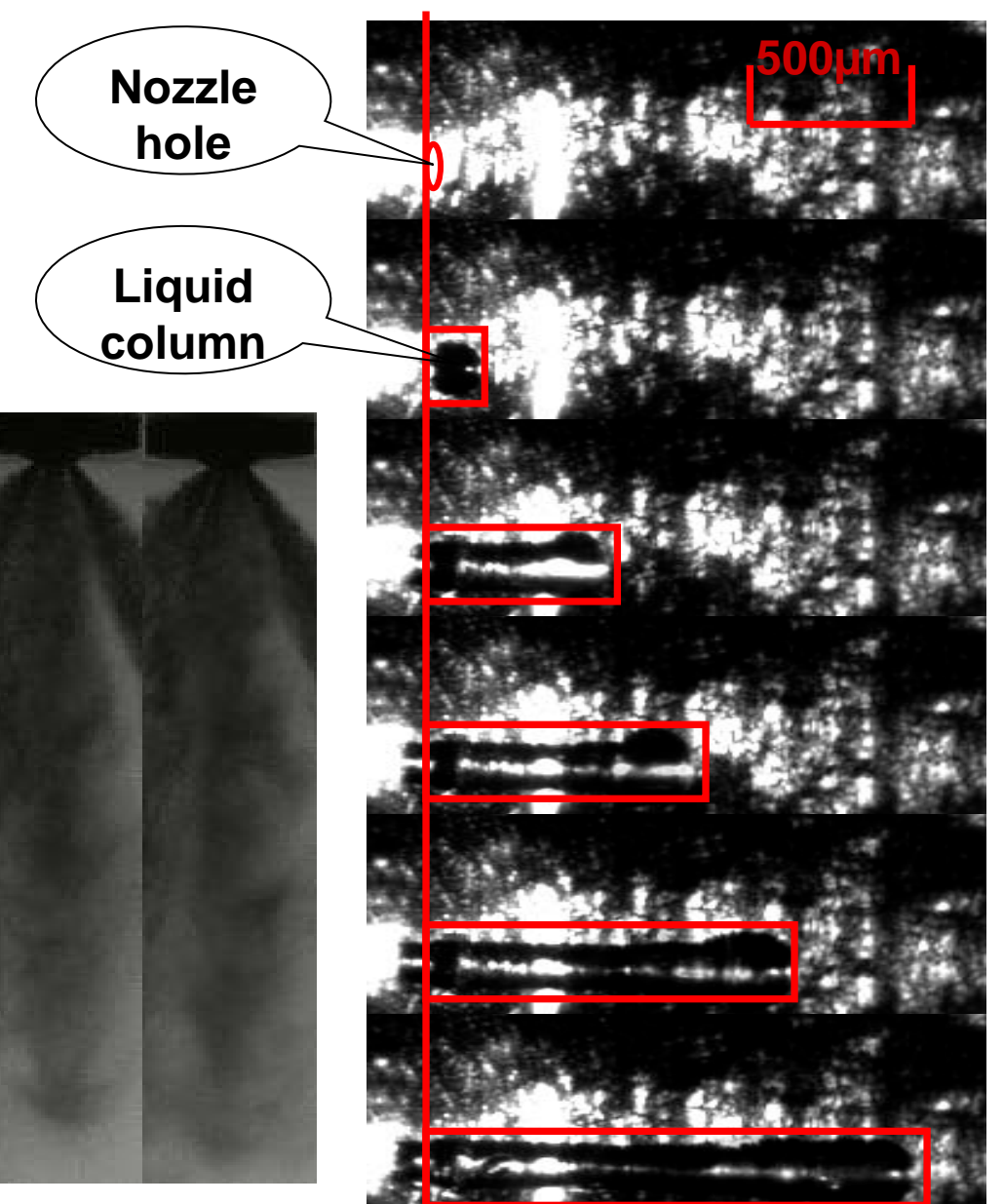
Mie scattering

## Fuel Spray Structure

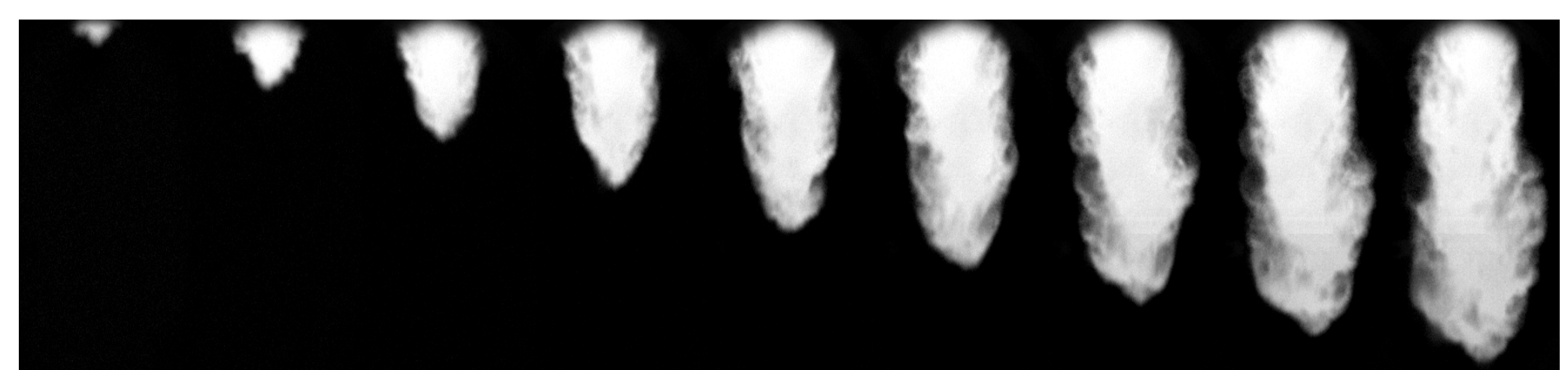
- Fuel spray development at different conditions
- Spray structure of initial injection from diesel injector



DMF multi-spray Evolution ( $P_{inj}=100\text{bar}$  atmospheric pressure)

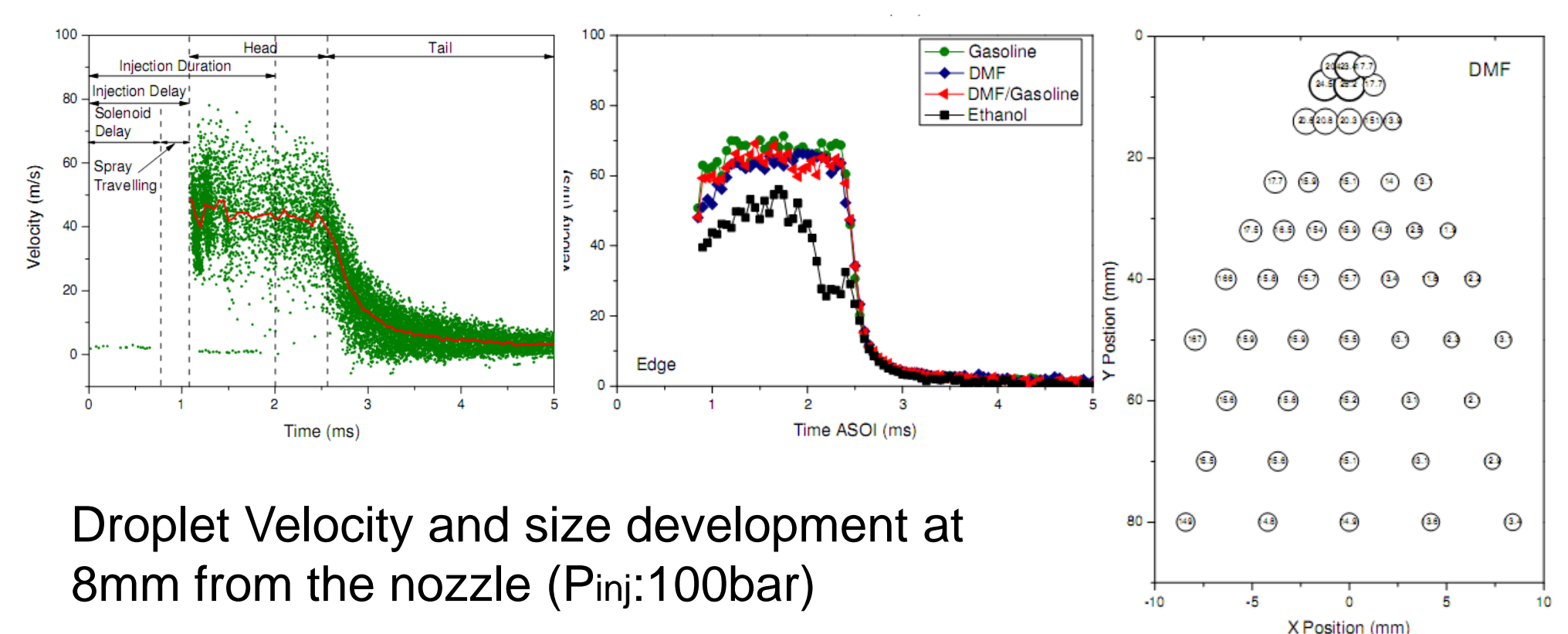


Initial Structure of Fuel Spray ( $P_{inj}=20\text{MPa}$ )

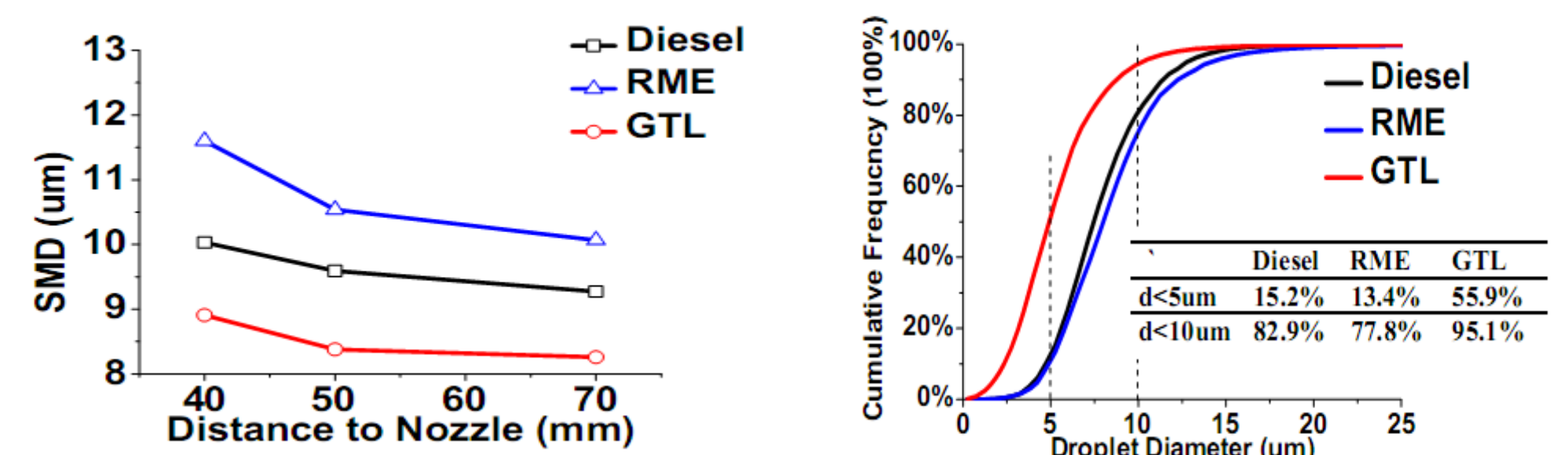


Diesel Spray Evolution ( $P_{back}=5\text{MPa}$ ,  $P_{inj}=80\text{MPa}$ , images captured from 23mm downstream the nozzle)

## Droplet Velocity and Sizing



Droplet Velocity and size development at 8mm from the nozzle ( $P_{inj}:100\text{bar}$ )



SMD along with the axial distance ( $P_{inj}:120\text{MPa}$ ,  $P_{back}:0.1\text{MPa}$ )

Droplet distribution 40mm downstream ( $P_{inj}:120\text{MPa}$ ,  $P_{back}:0.1\text{MPa}$ )

## Publications

1. Tian, G., et al., Spray Characteristics Study of DMF Using Phase Doppler Particle Analyzer. SAE International Journal of Passenger Cars - Mechanical Systems. 3(1): p. 948-958.
2. Li, Y. et al., Comparative Experimental Study on Microscopic Spray Characteristics of RME, GTL and Diesel, 2010, SAE paper 2010-01-2284
3. Tian, G., et al., Laminar Burning Velocities of 2,5-Dimethylfuran Compared with Ethanol and Gasoline. Energy & Fuels. 24(7): p. 3898-3905.