

# Characteristics of Spray and its Surrounding Flow Initiated from a Swirl Spray

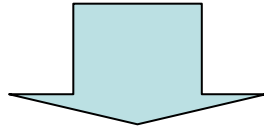
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# Background

- It is well known that the spray formation is changed by the ambient conditions, which are represented by pressure and temperature.
- To know detail of the spray formation and its surrounding motion, it is better to use several measuring techniques.

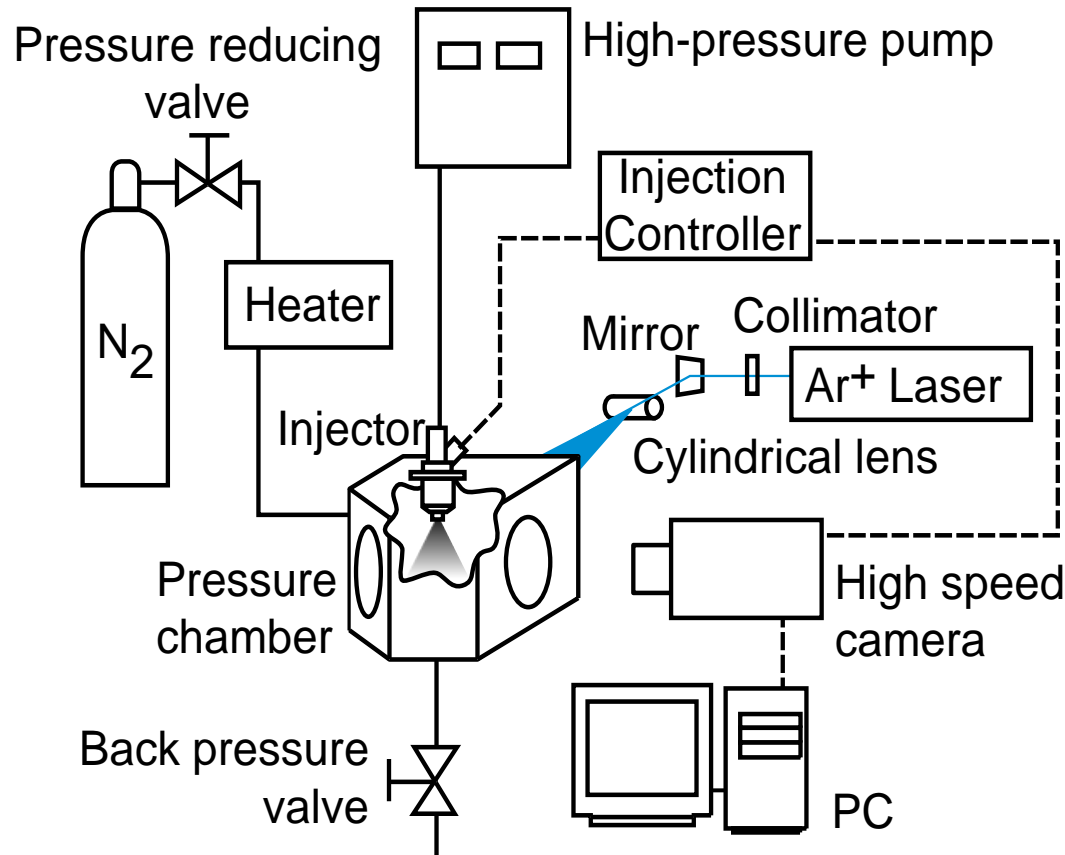
# Objectives

To clarify the effect of ambient conditions on spray formation;



- Observe the spray and surrounding air motion by high speed video camera.
- Measure their velocity profiles.

# Experimental setup



High speed video camera:  
Photoron APX

Laser source:  
Spectra physics 2017 6W

PIV:  
Dantec Flowmap 2000

PDA:  
Aerometrics PDPA

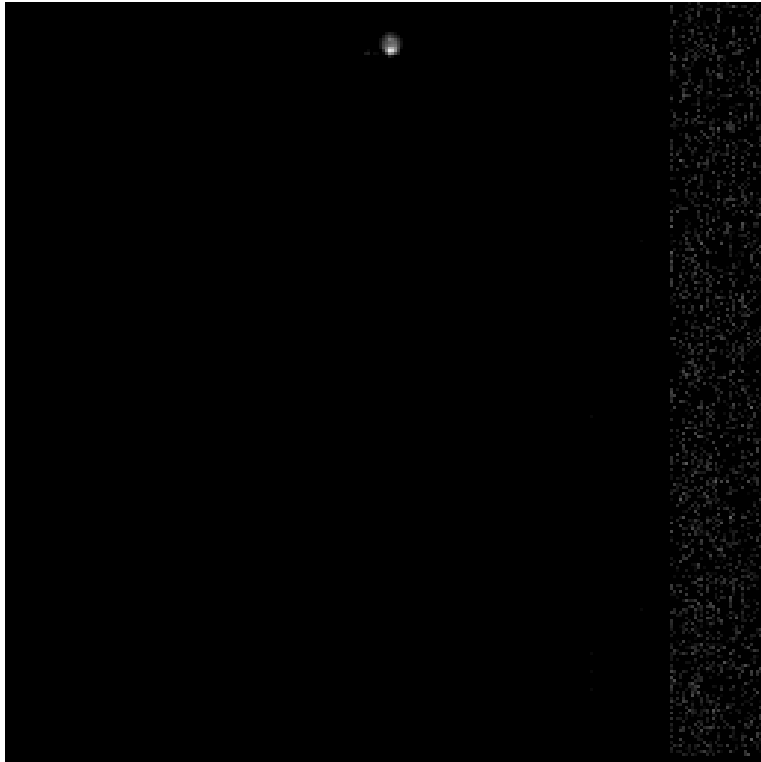
# Experimental condition

Injector	Swirl type
Fuel pressure	10 MPa
Injection duration	0.7 ms
Ambient temperature	293 K and 423 K
Ambient pressure	0.1 MPa and 1.1 MPa
Air flow rate in pressure chamber	4 l/min
Injection frequency	1 Hz

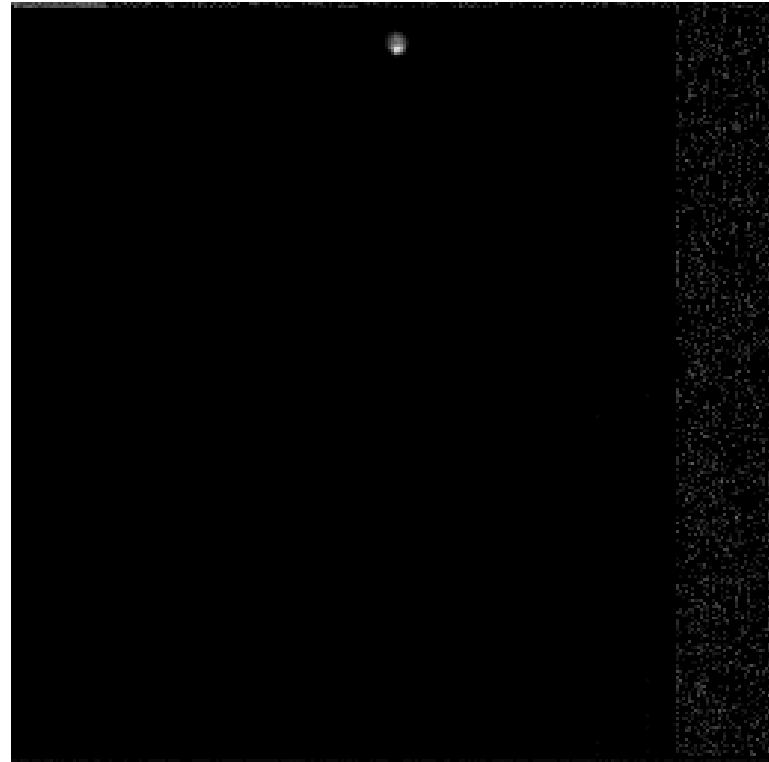
# Setting for high speed video camera

Frame rate	30,000fps
Shutter speed	2 $\mu$ s
Resolution	256x256pixel

# Effects of back pressure ( $T=293\text{K}$ , Swirl-type injector)



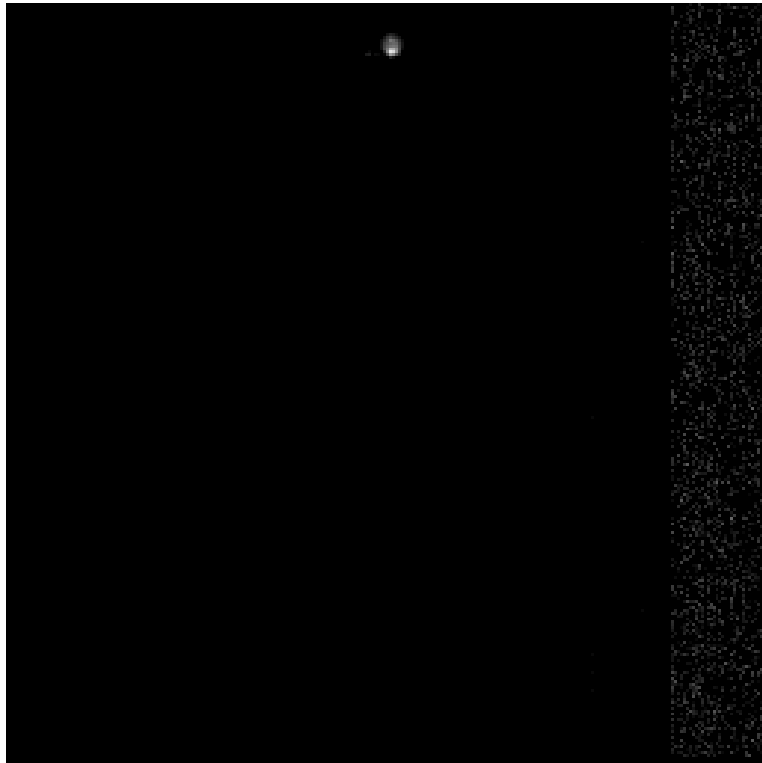
$P_b=0.1\text{MPa}$



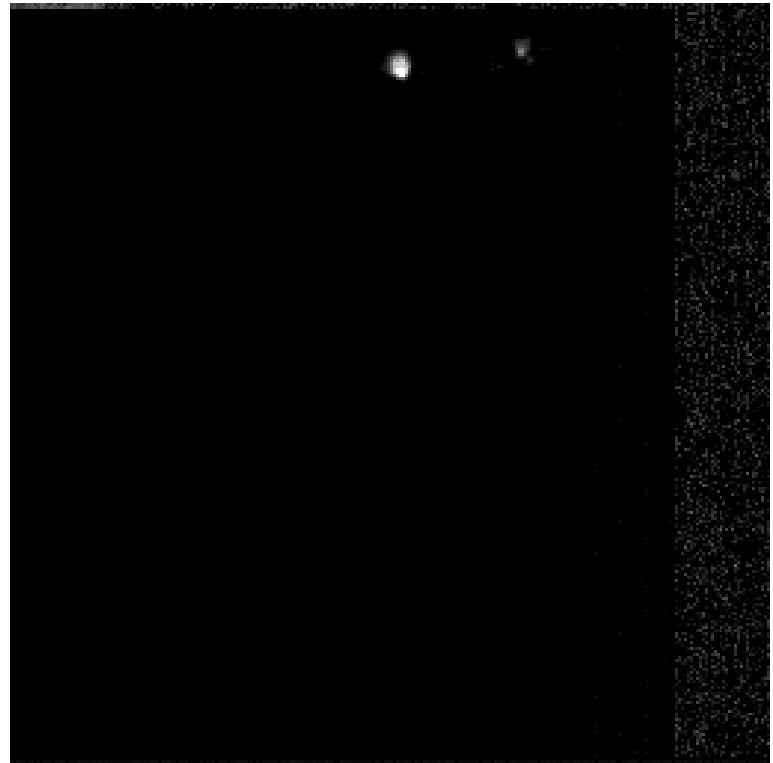
$P_b=1.1\text{MPa}$

20mm

# Effects of ambient temperature ( $P_b=0.1\text{ MPa}$ , Swirl-type injector)



$T=293\text{K}$

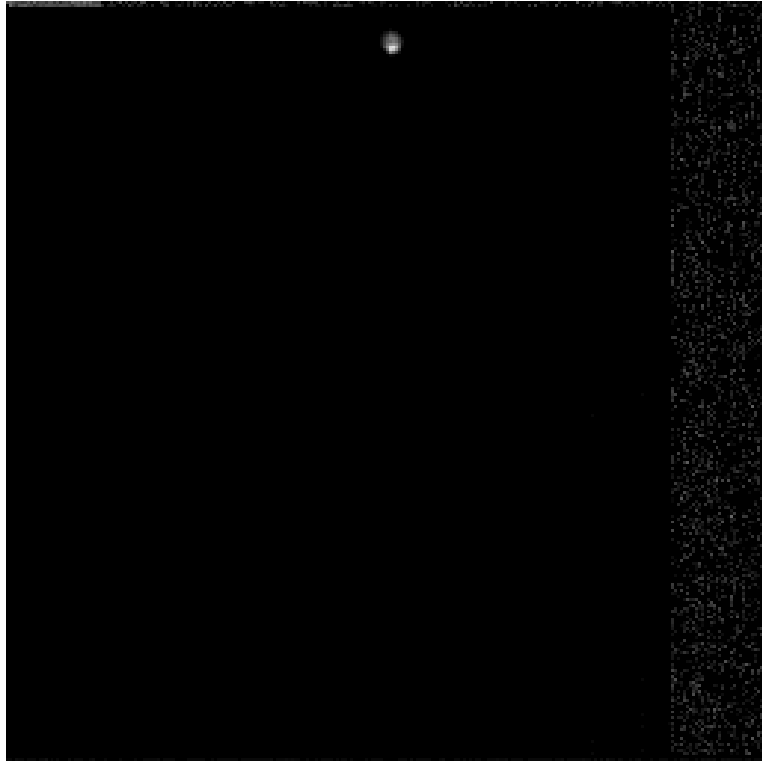


$T=423\text{K}$

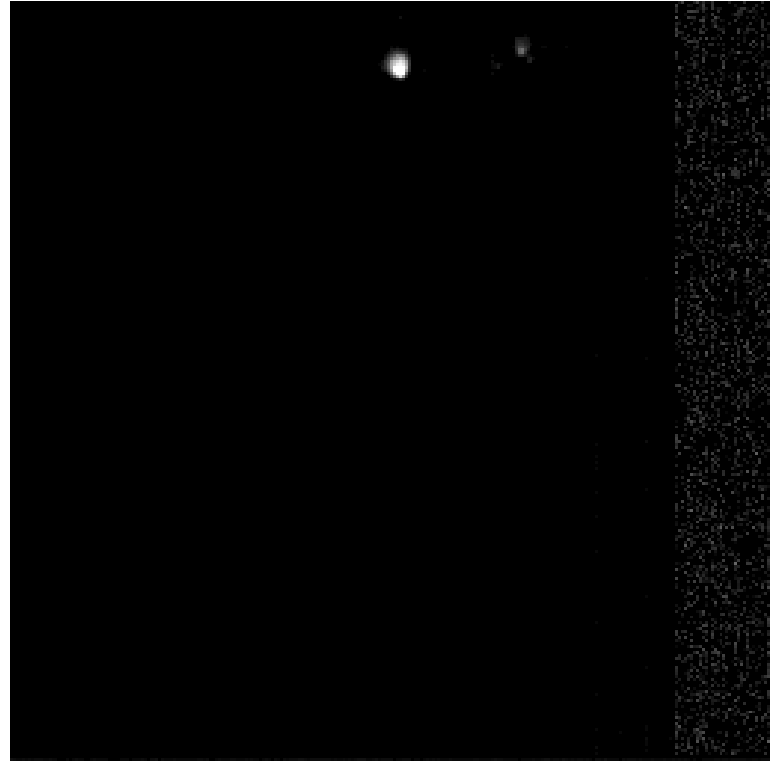
20mm



# Effects of ambient temperature ( $P_b=1.1\text{MPa}$ , Swirl-type injector)



$T=293\text{K}$



$T=423\text{K}$

20mm

T=293K  
Pb=0.1MPa

T=293K  
Pb=1.1MPa

T=423K  
Pb=0.1MPa

T=423K  
Pb=1.1MPa

t=0.3ms



t=0.7ms

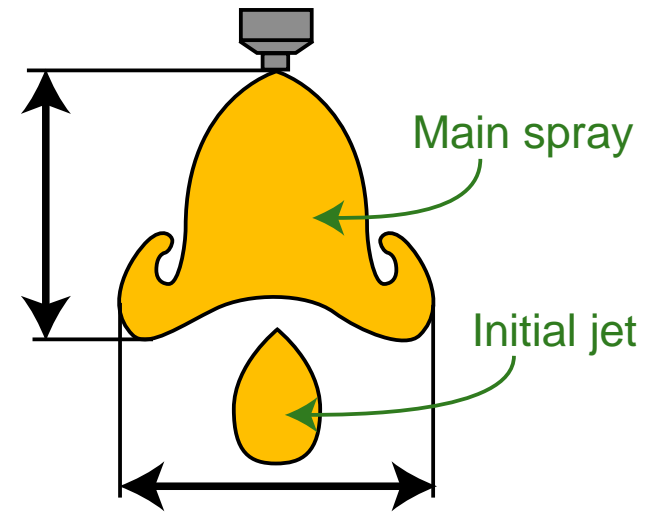


t=1.1ms

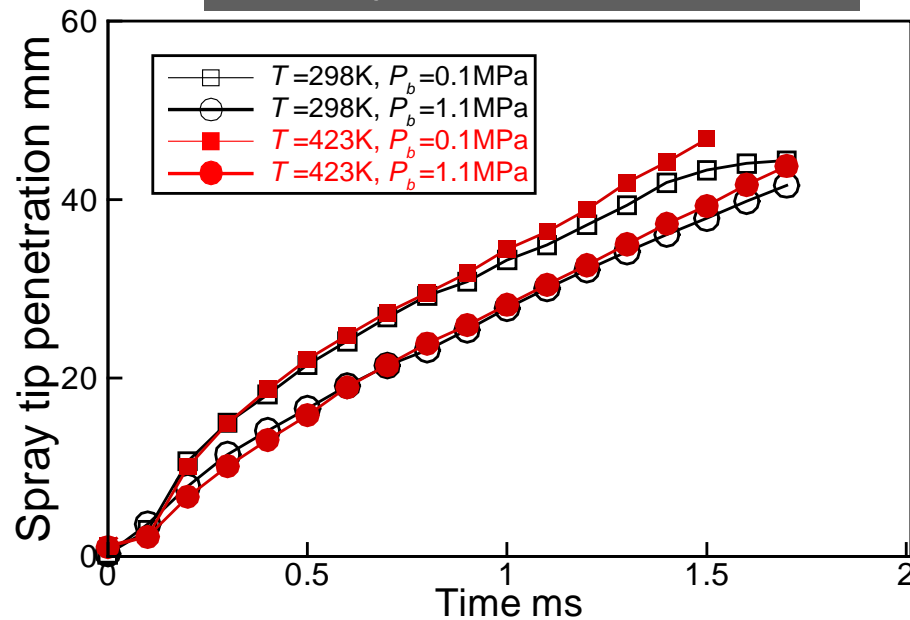


40mm

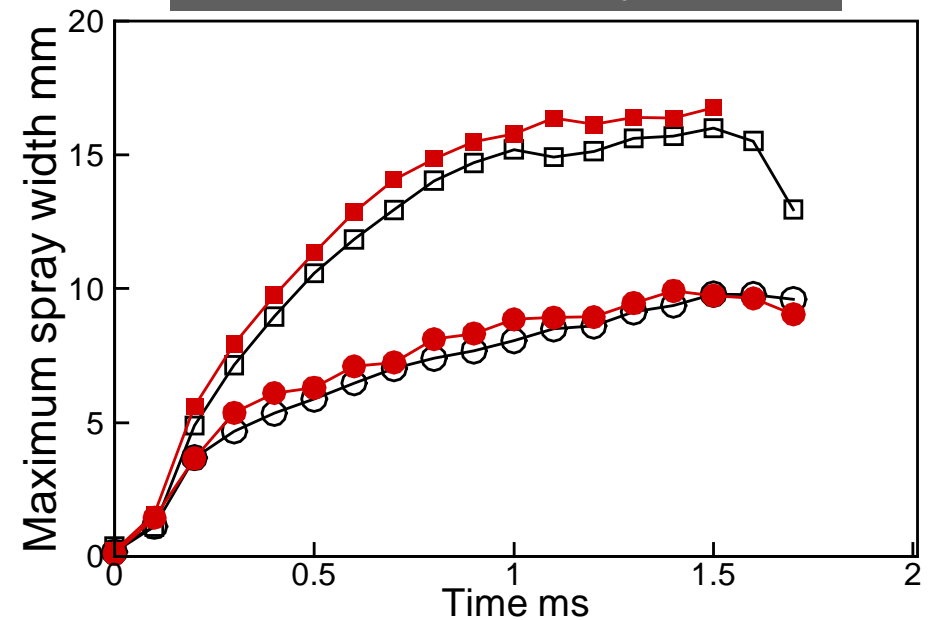
# Spray-tip penetration and maximum-spray width



## Spray-tip penetration



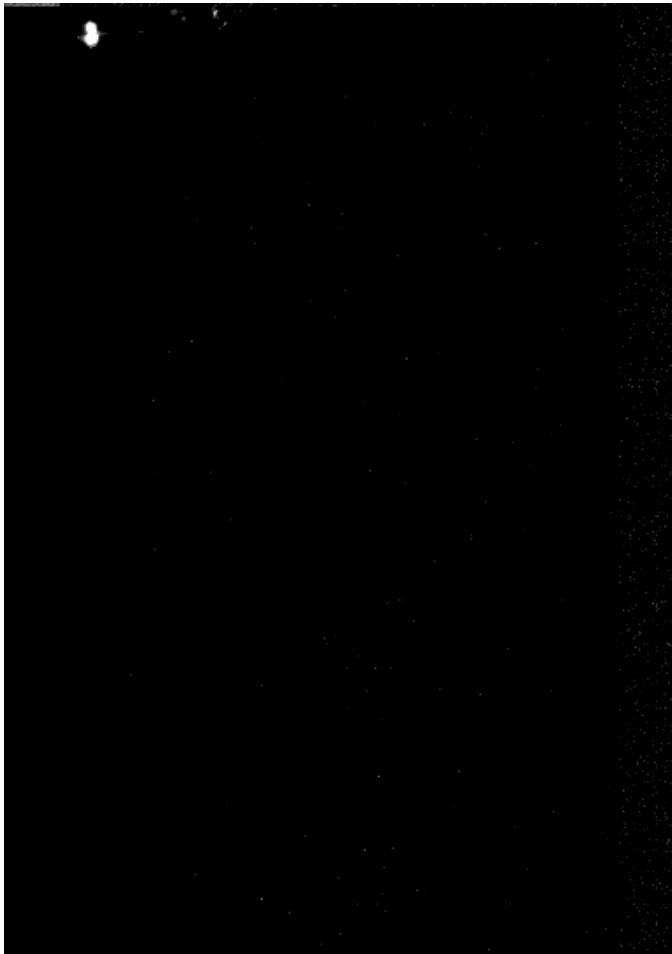
## Maximum-spray width



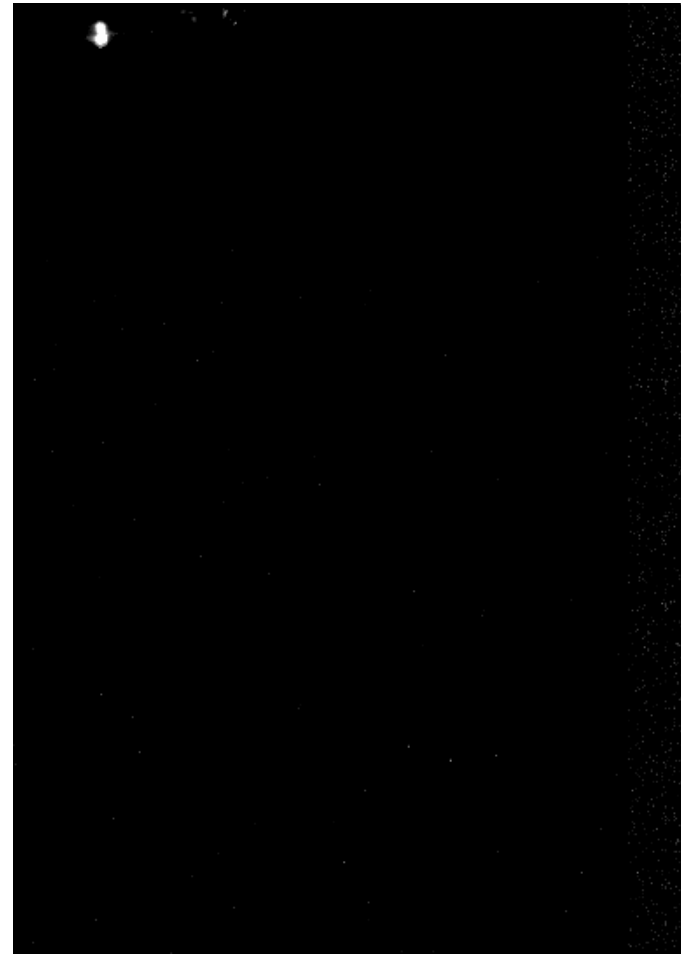
# Setting for high speed video camera

Frame rate	10,000fps
Shutter speed	17 $\mu$ s
Resolution	384x544pixel or 512x512pixel

# Effects of back pressure ( $T=293\text{K}$ , Swirl-type injector)



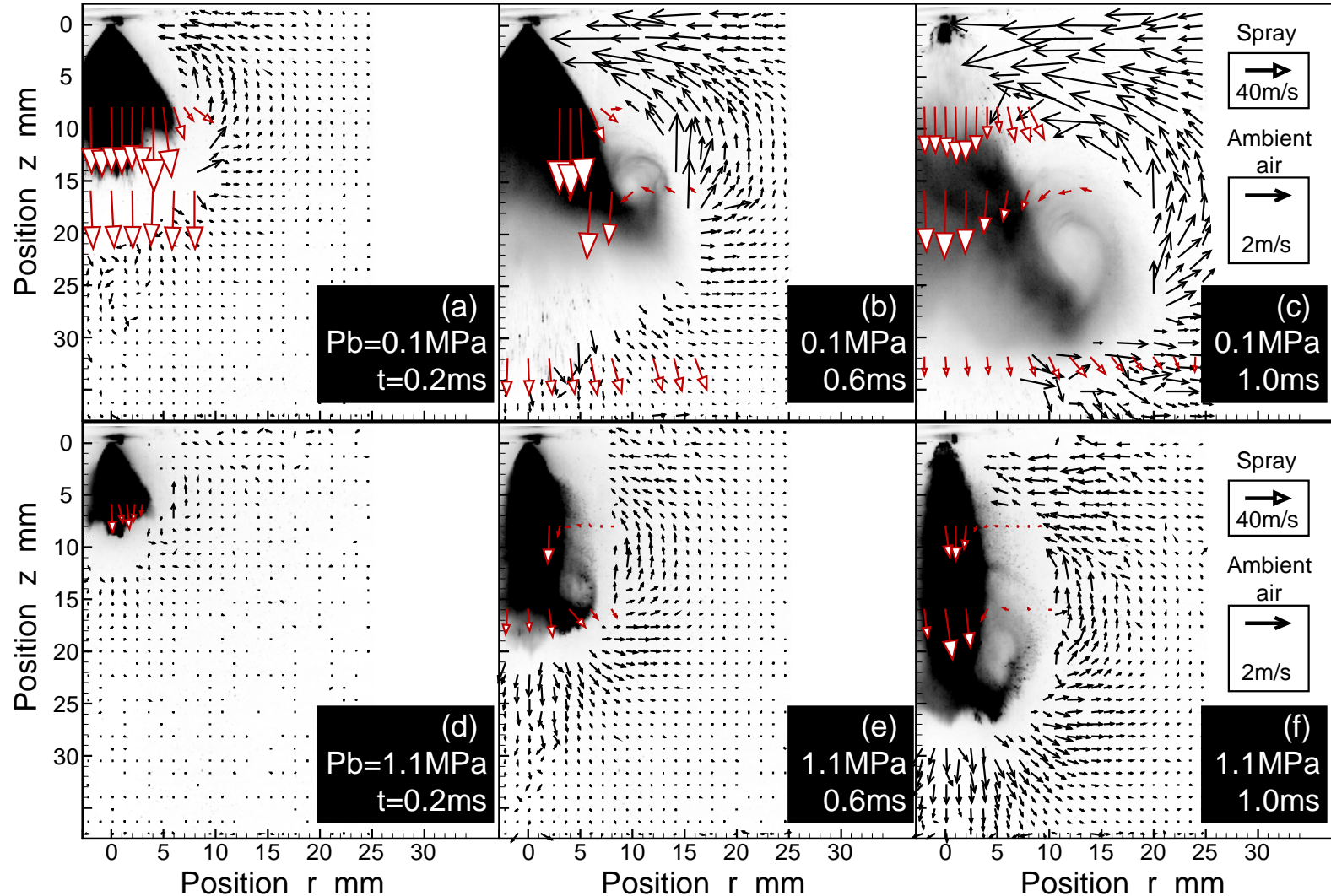
$P_b=0.1\text{MPa}$



$P_b=1.1\text{MPa}$

20mm

# Velocity of spray and ambient flow ( $T=293\text{K}$ , Swirl-type injector)



# Summary

- The analysis with high-speed video camera can be effective for observing the spray formation and ambient air motion.
- The vector map of the ambient air motion is obtained by using high-speed video camera and PIV processor.
- The difference in the spray formation and ambient flow field with the ambient pressure condition is measured.