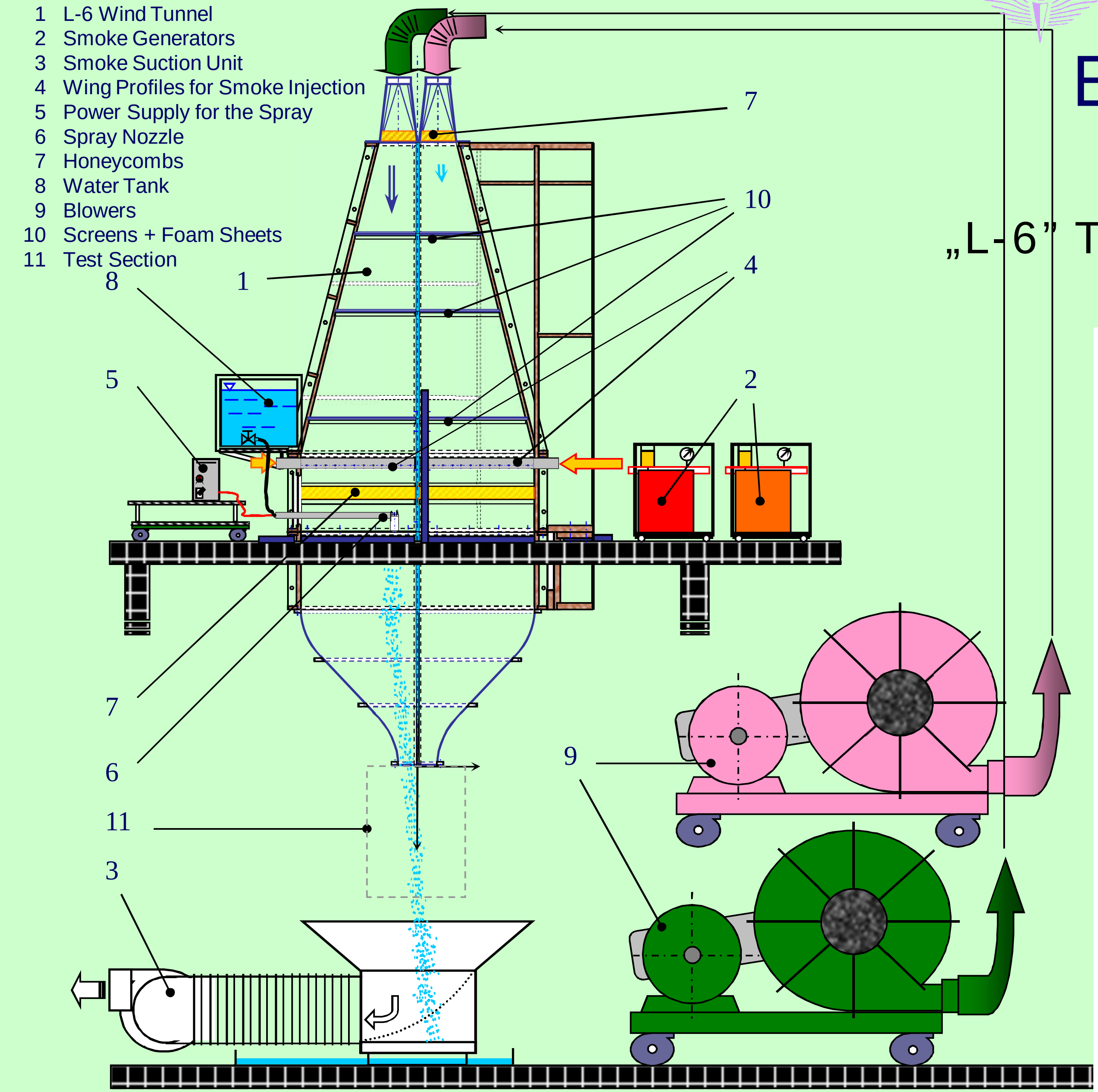
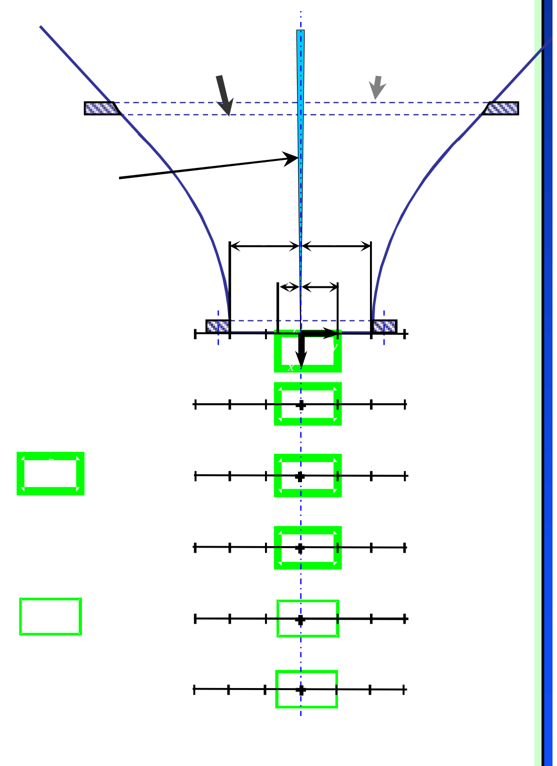
Experimental Apparatus

„L-6" Twin-Jet Shear Layer Wind Tunnel





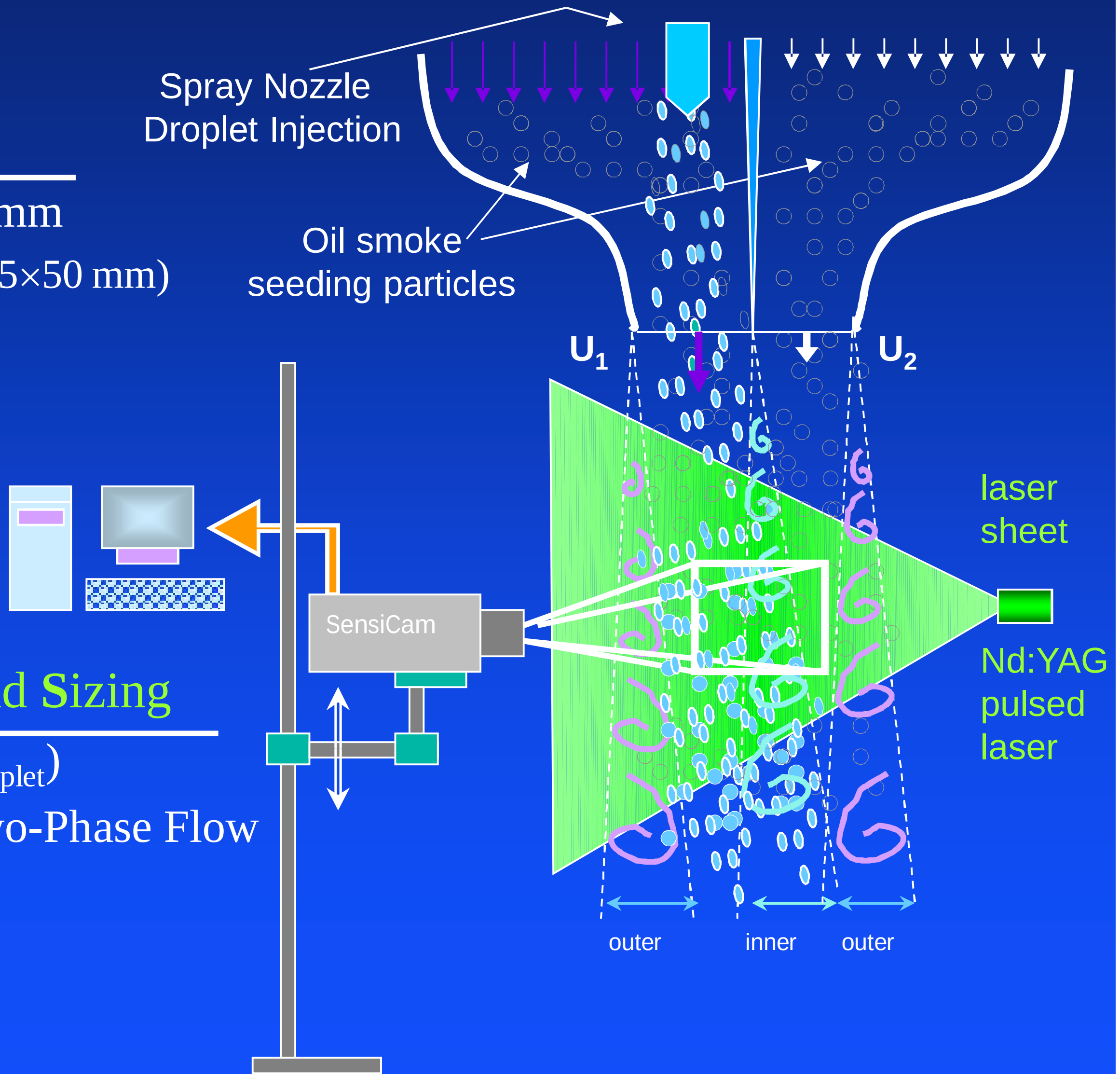
Test Section

Measurement Techniques

PARTICLE IMAGING VELOCIMETRY

PIV /for single-phase flow/

- new PCO camera + NIKKOR 35mm
  - Image size: 1280×768 pixel (≈ 85×50 mm)
- Nd:YAG pulsed laser /6W/
- Positioning system
- SensiCam acquisition software



PTV(S) /for two-phase flow/

Particle Tracking Velocimetry and Sizing

- Size Discriminating ($d_{seeding}$ « $d_{droplet}$)
- Gas Phase Flow Field Data in Two-Phase Flow

Post-processing:

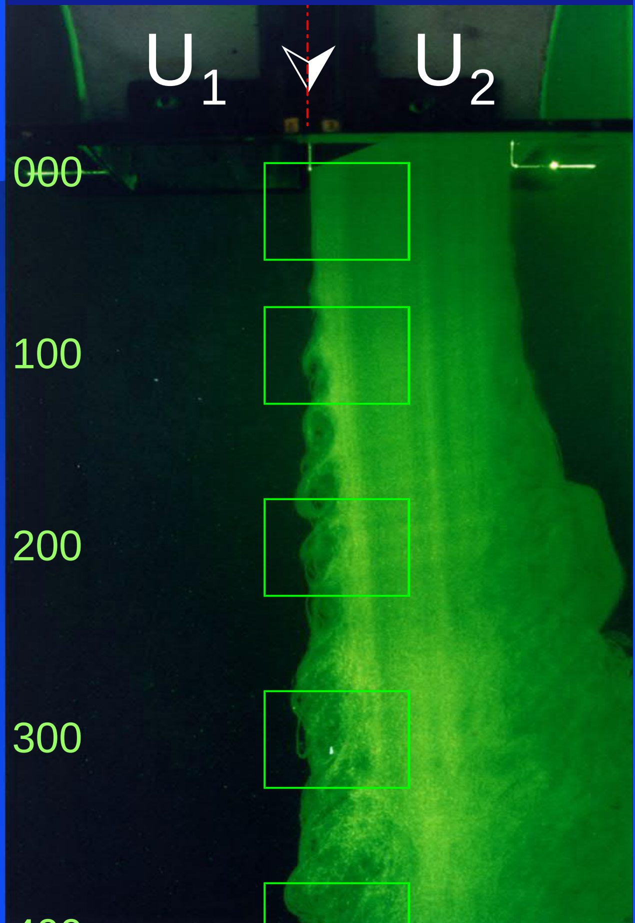
- Matlab, TecPlot, Excel

VON KÁRMÁN INSTITUTE FOR FLUID DYNAMICS

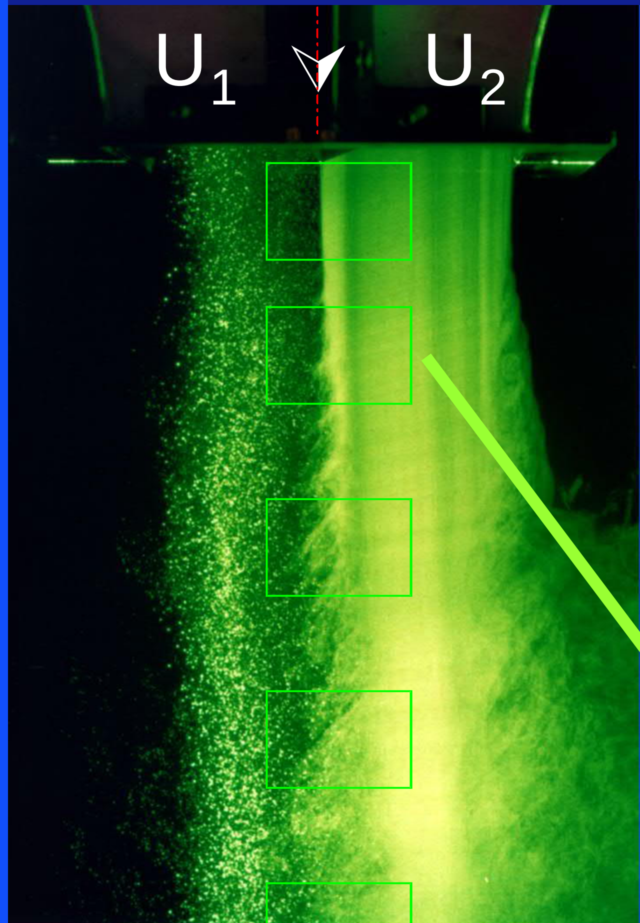
Flow Visualization

$U_1 = 2$ m/s
$U_2 = 1$ m/s

Single-phase flow



Two-phase flow



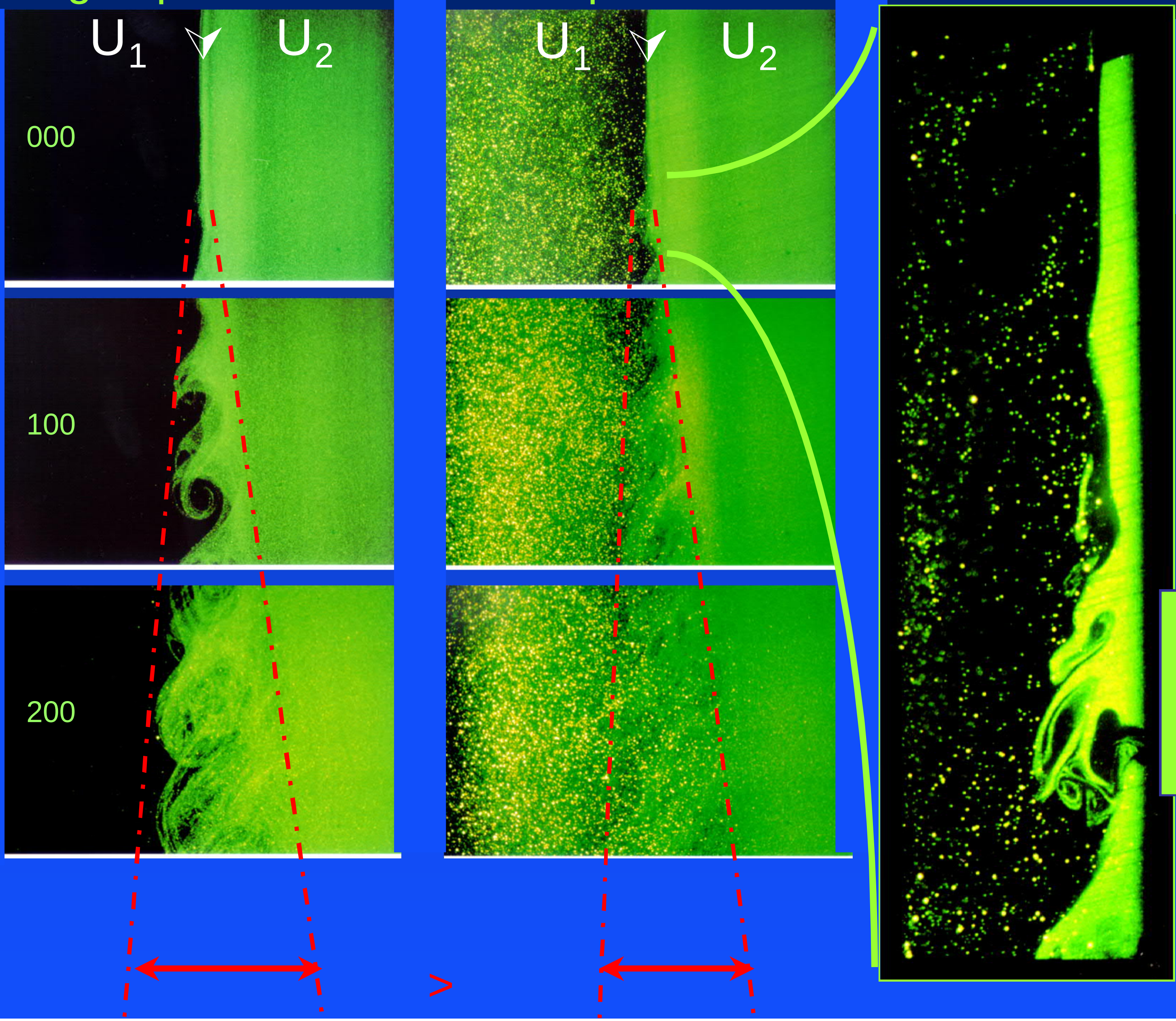
well defined
mixing layer
developement

Digital Image Recording for Particle Imaging Velocimetry

PIV | PTV(S)

Nr3)

Single-phase flow   Two-phase flow

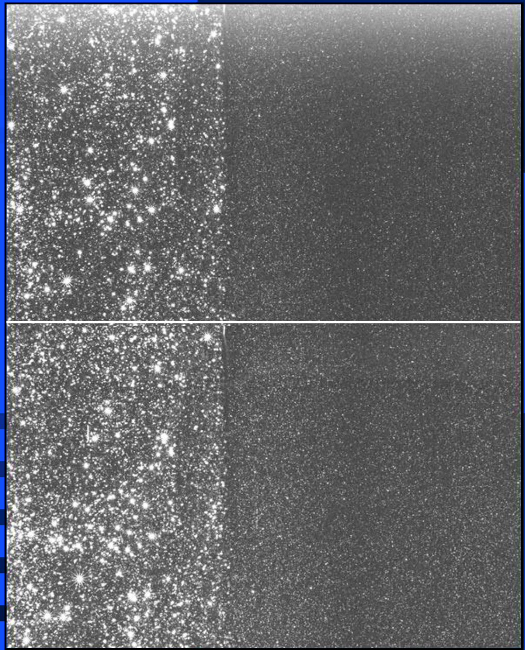


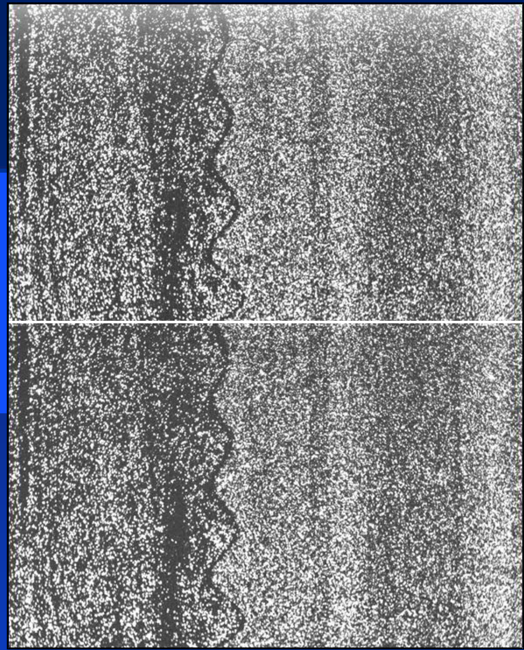
Flow Visualization

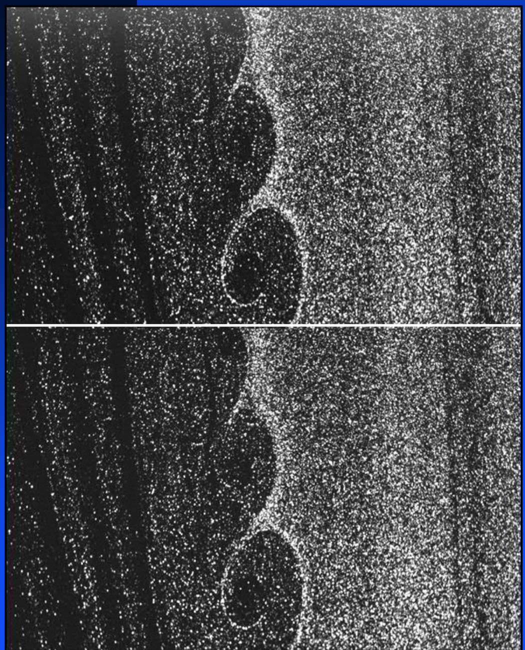
$U_1 = 2$ m/s
$U_2 = 1$ m/s

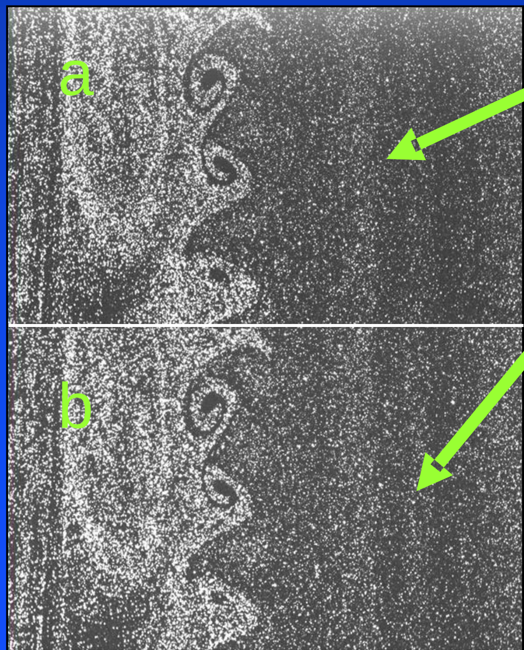
shear layer flow structure /droplets in the mixing layer/

Experimental Results









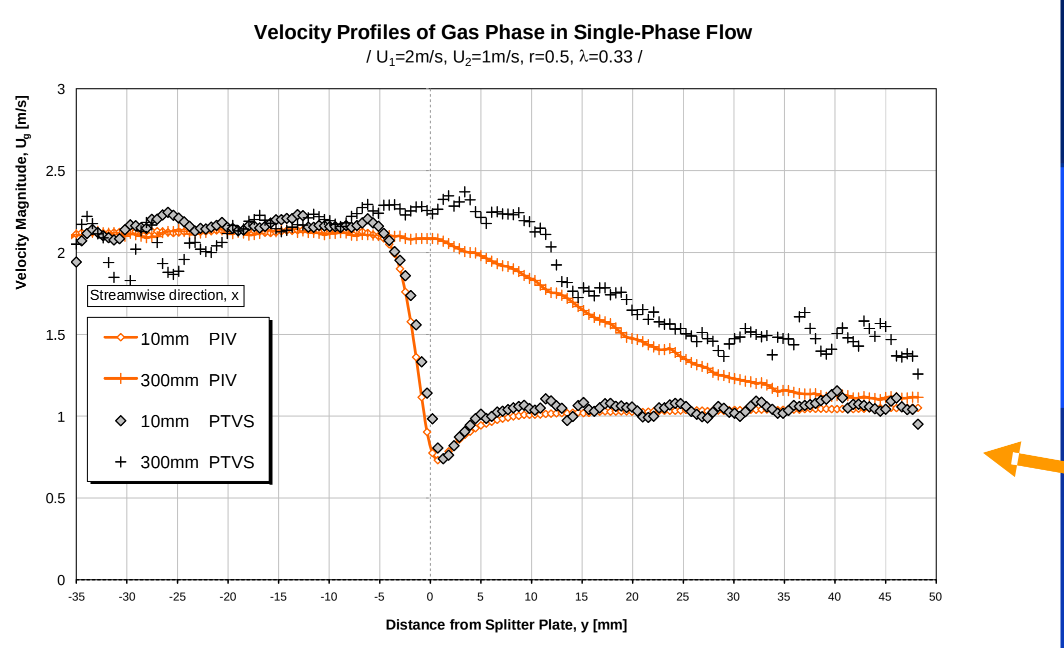
Digitally recorded successive images

Δt_{a-b}

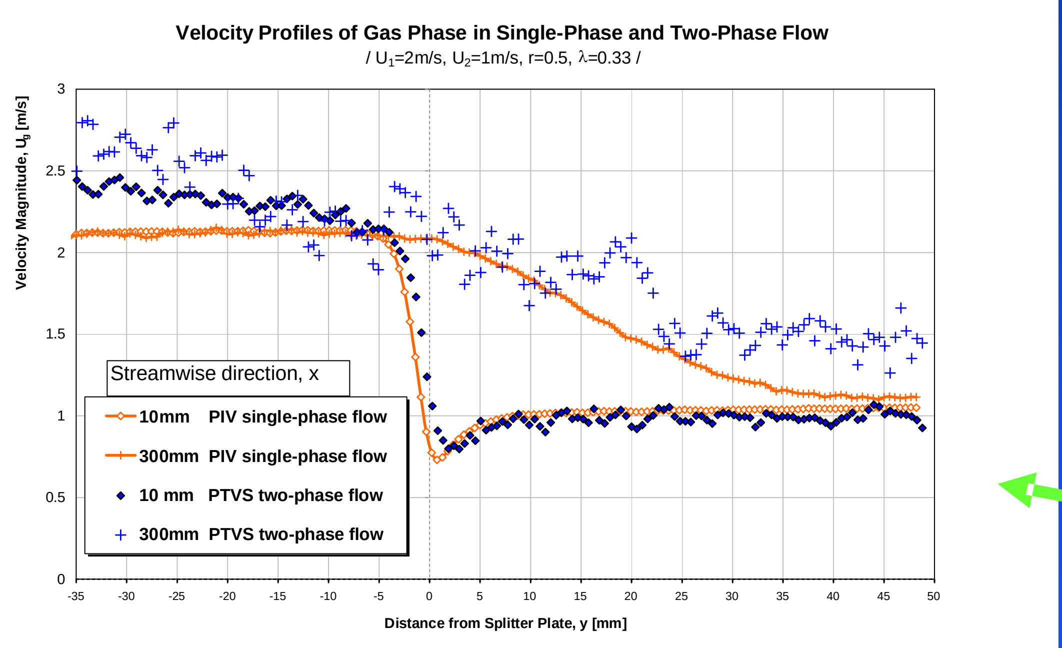
von Kármán Institute for Fluid Dynamics

N'3)

Experimental Results



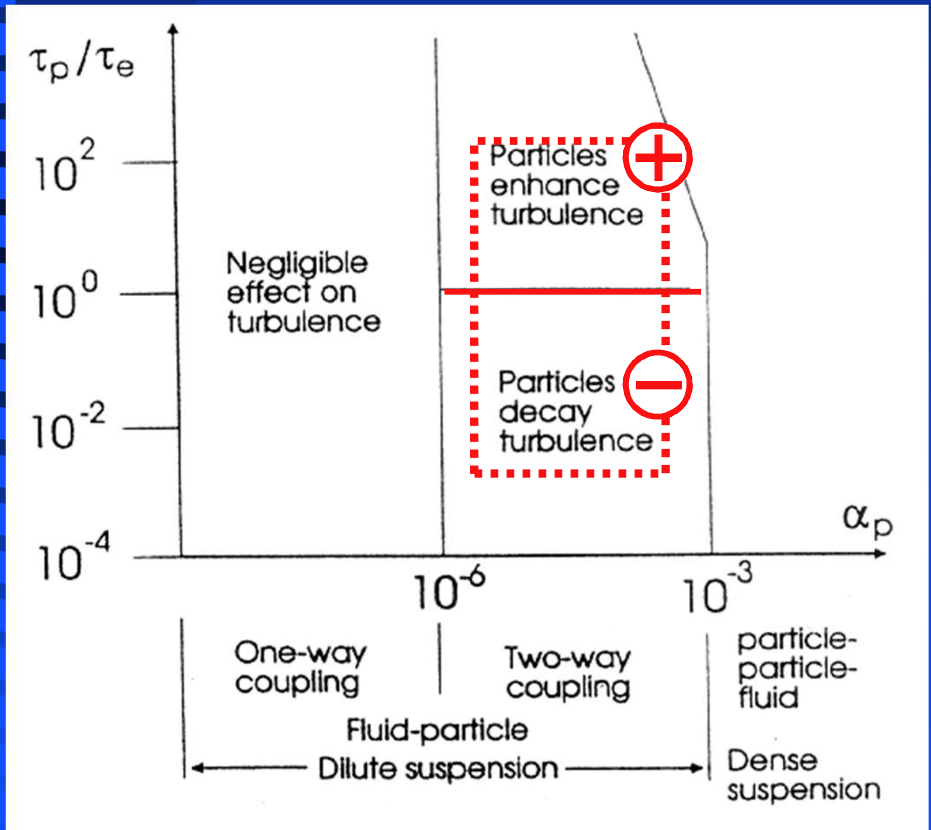
single-phase flow
PIV
/comparison of PIV-PTV(S)/



two-phase flow
PTV(S)

Two-phase flow characteristics

[ELGHOBASHI, 1994]



$\alpha_p = 10^{-4} \div 10^{-5}$ $St_p = 10^{-3} \div 10^{2}$

[GORE and CROWE, 1989]

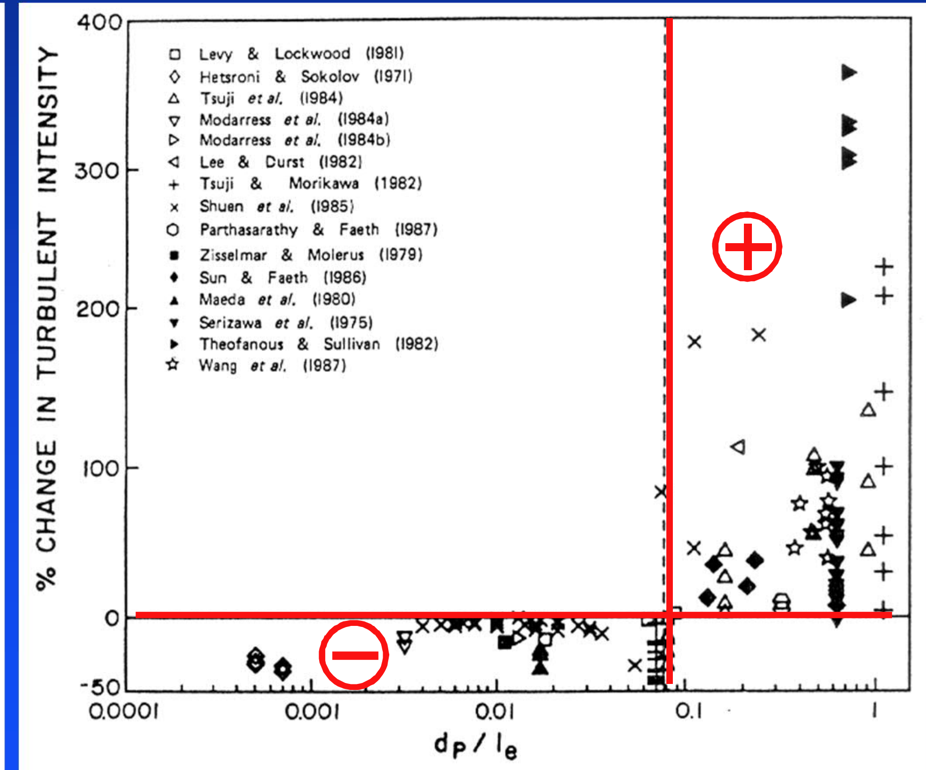
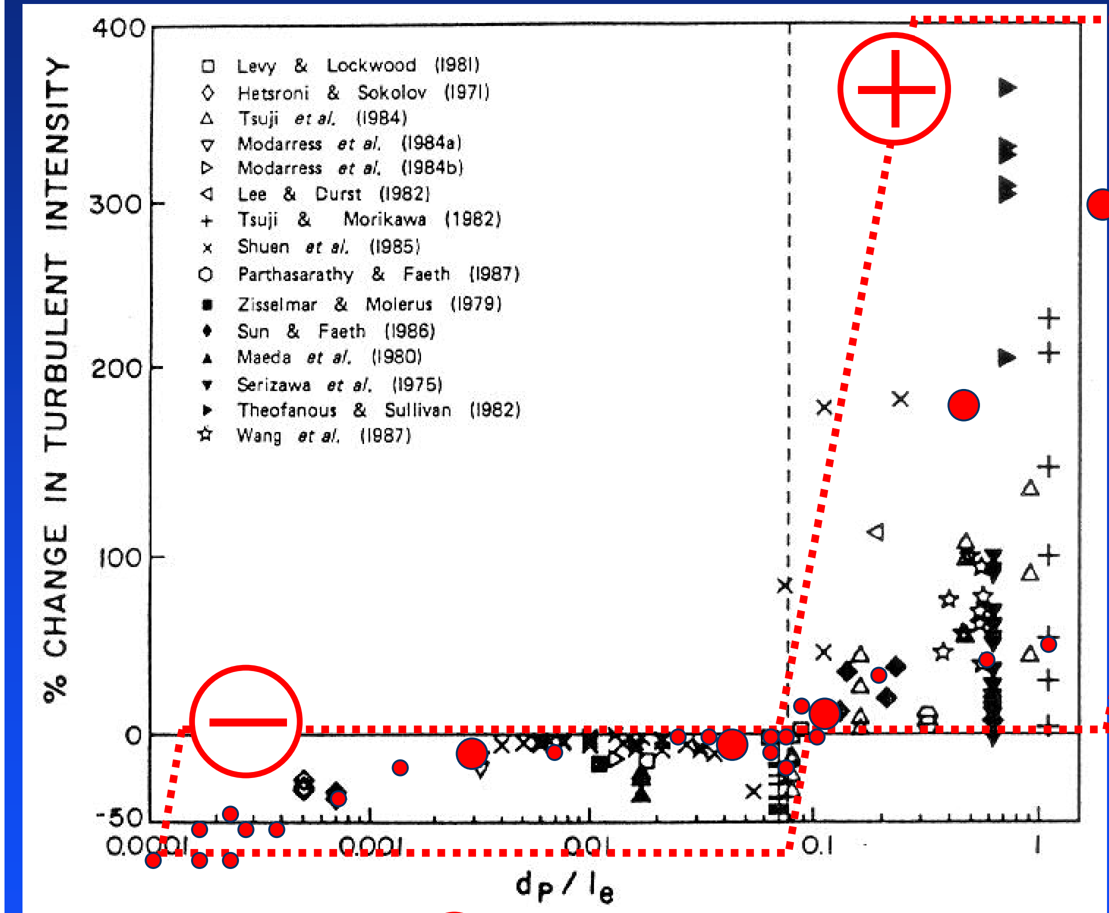


Figure 2. Change in turbulent intensity as function of length scale ratio.

$\Delta(T.I.) = f\,(d_p/l_e)$

Turbulence Modulation Map

● **exp. results: Suda 2000.**



Mixing Layer: ⊖ **negative** rel. change (- 90%)
Main Flow: ⊕ **positive** rel. change (+1500%)

●Effect of **characteristic length scale ratio** on modulating turbulent intensity:

$$\Delta(\mathrm{T.I.}) = f\,(d_p/l_e)$$

d_p - particle diameter
l_e - fluid length scale (integral length scale or characteristic length of the most energetic eddy)

$$\Delta\left(T.I._{\text{carrier phase}}\right) = \frac{T.I._{\text{two-phase}} - T.I._{\text{single-phase}}}{T.I._{\text{single-phase}}}$$

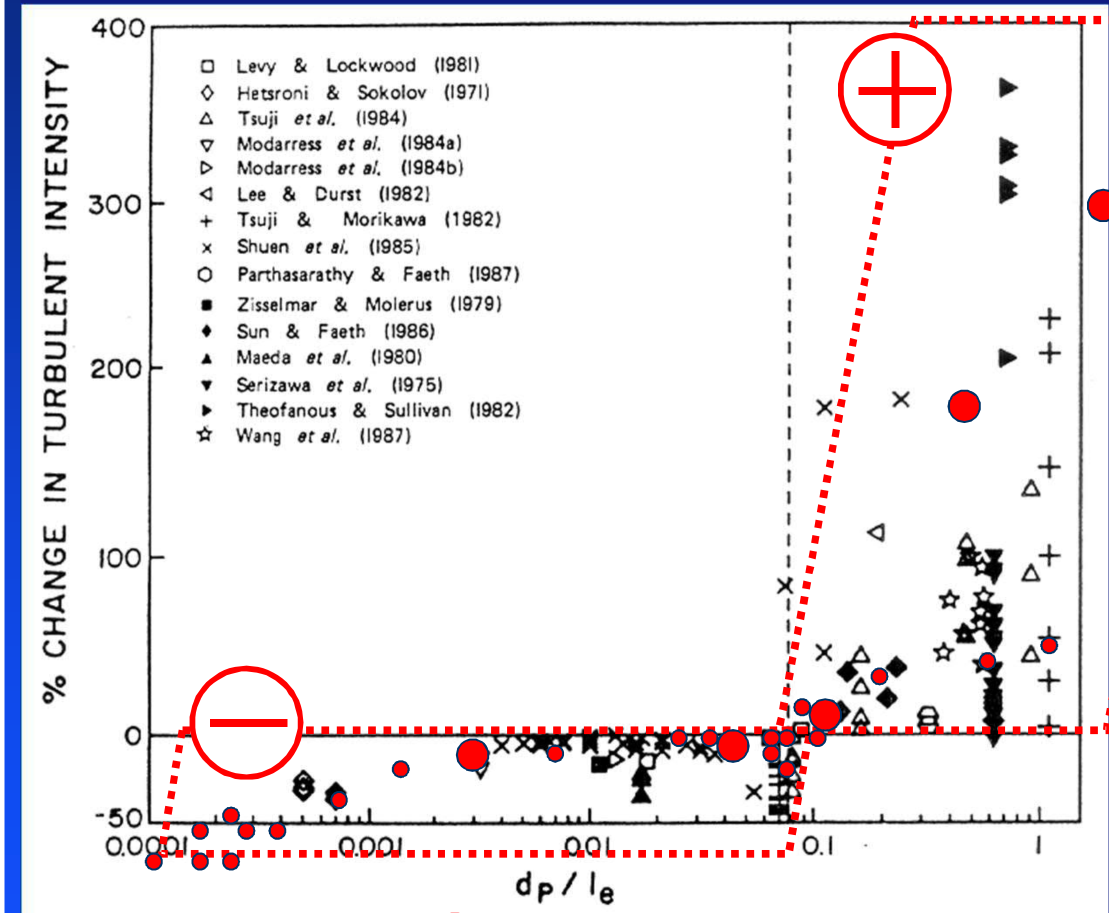
T.I. of the fluid based on PIV and PTVS velocity meas.

graph from [Gore and Crowe, 1989]
in Int. J. Multiphase Flow Vol.**15**. No.2, pp.279-285.

N'3)

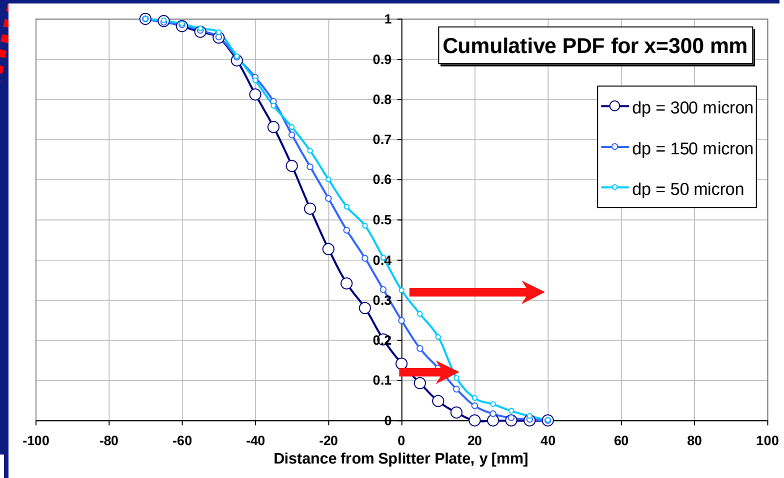
CHANGE in Turbulence Intensity CONCLUSIONS

● exp: [Suda, 2000]



33% of d_p= 50μm

14% of d_p=300μm



Mixing Layer: ⊖ **negative** rel change (- 90%)

Main Flow: ⊕ **positive** rel change (+1500%)