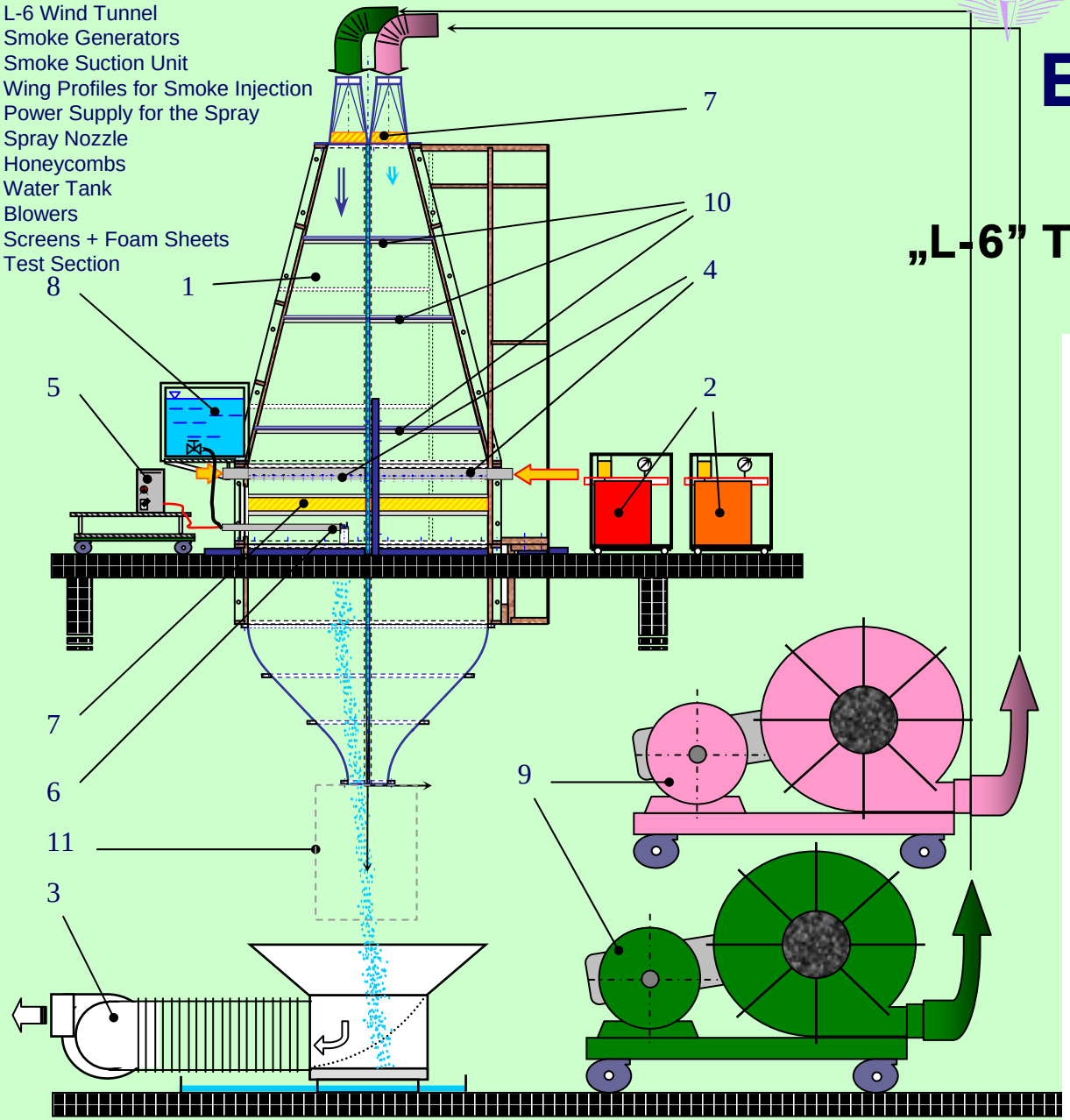
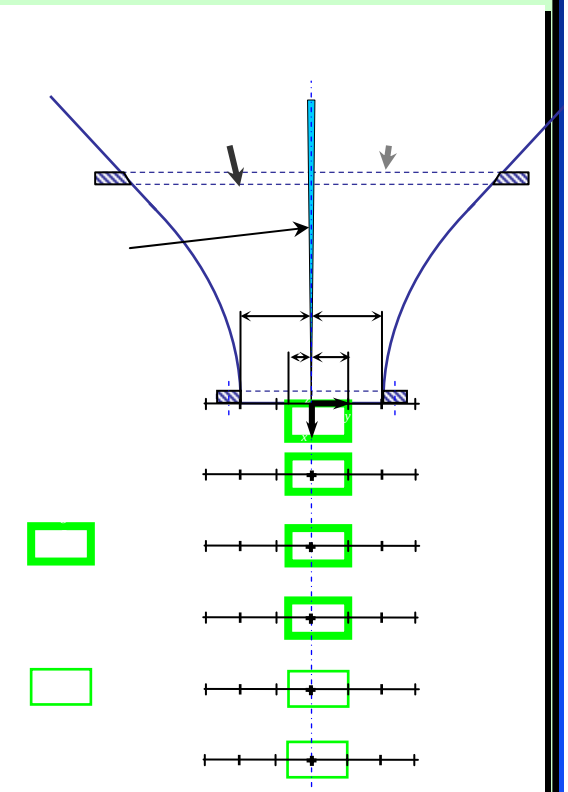
Experimental Apparatus

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

1 L-6 Wind Tunnel
2 Smoke Generators
3 Smoke Suction Unit
4 Wing Profiles for Smoke Injection
5 Power Supply for the Spray
6 Spray Nozzle
7 Honeycombs
8 Water Tank
9 Blowers
10 Screens + Foam Sheets
11 Test Section





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

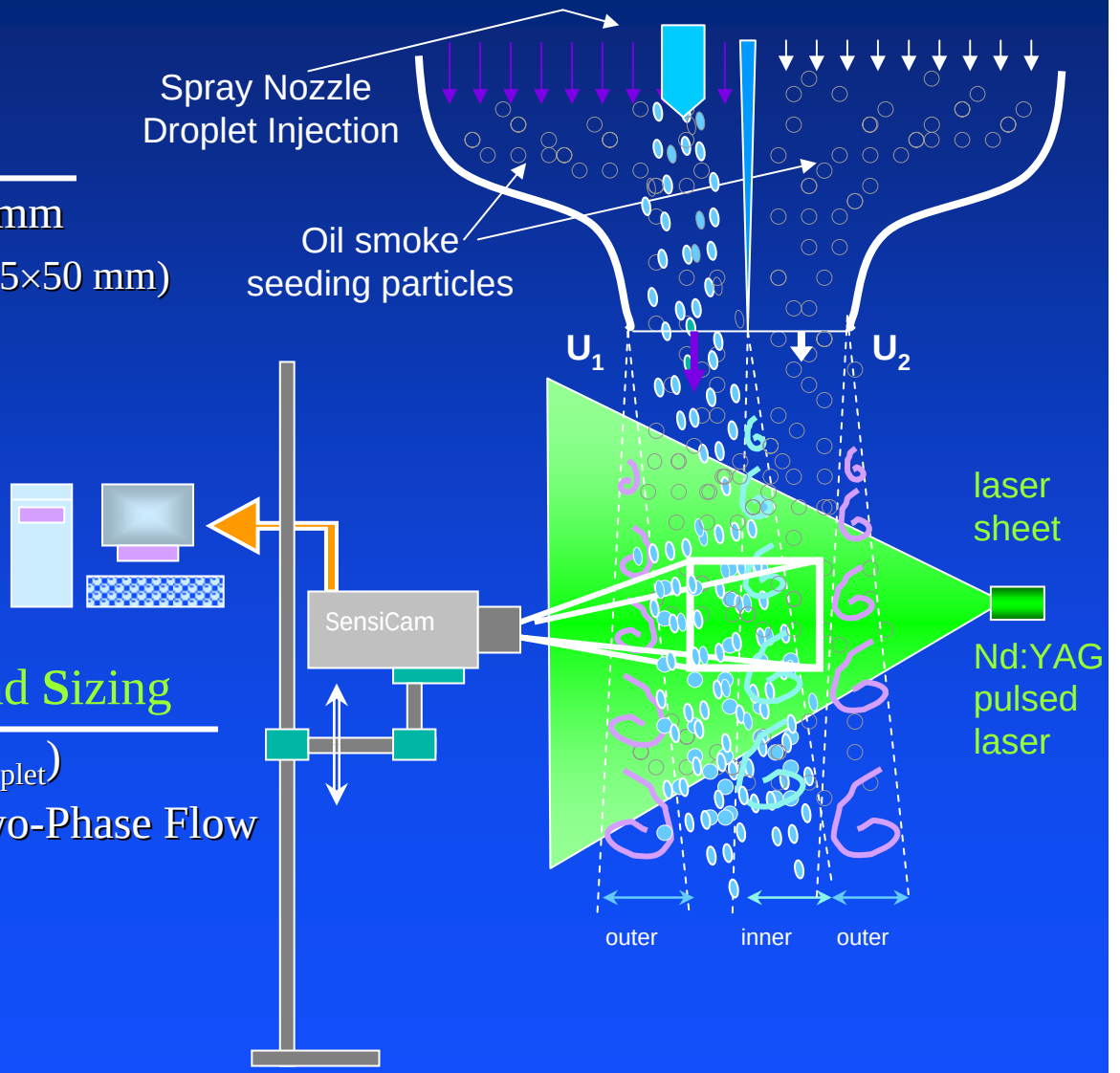
PTV(S) /for two-phase flow/

Particle **T**racking **V**elocimetry and **S**izing

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

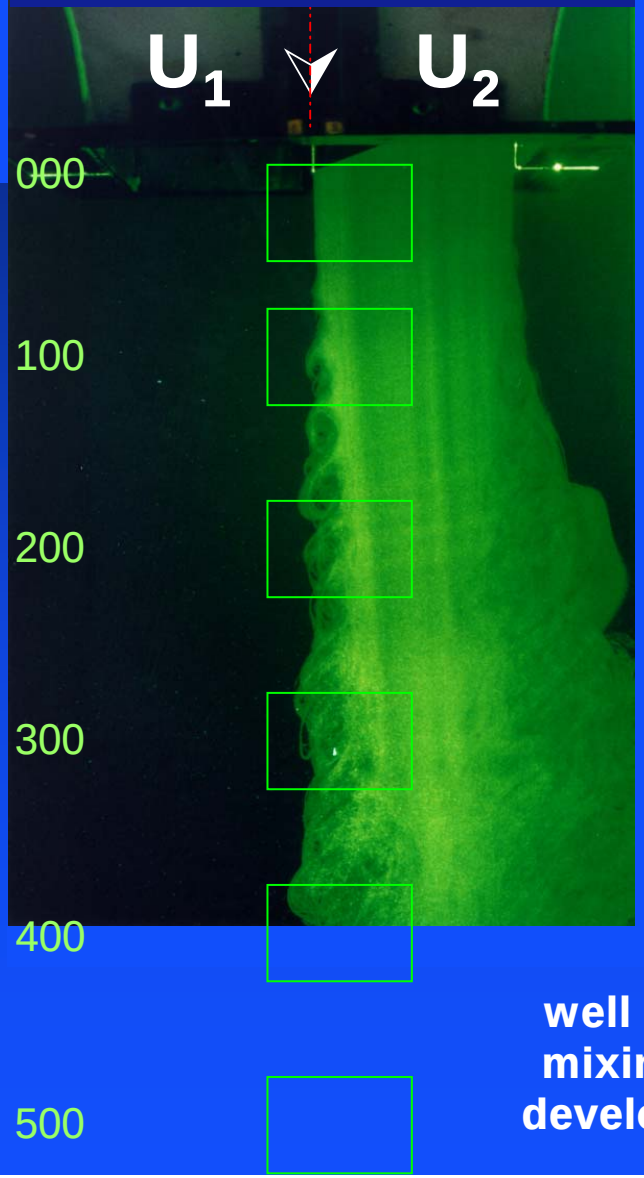
Post-processing:

- Matlab, TecPlot, Excel

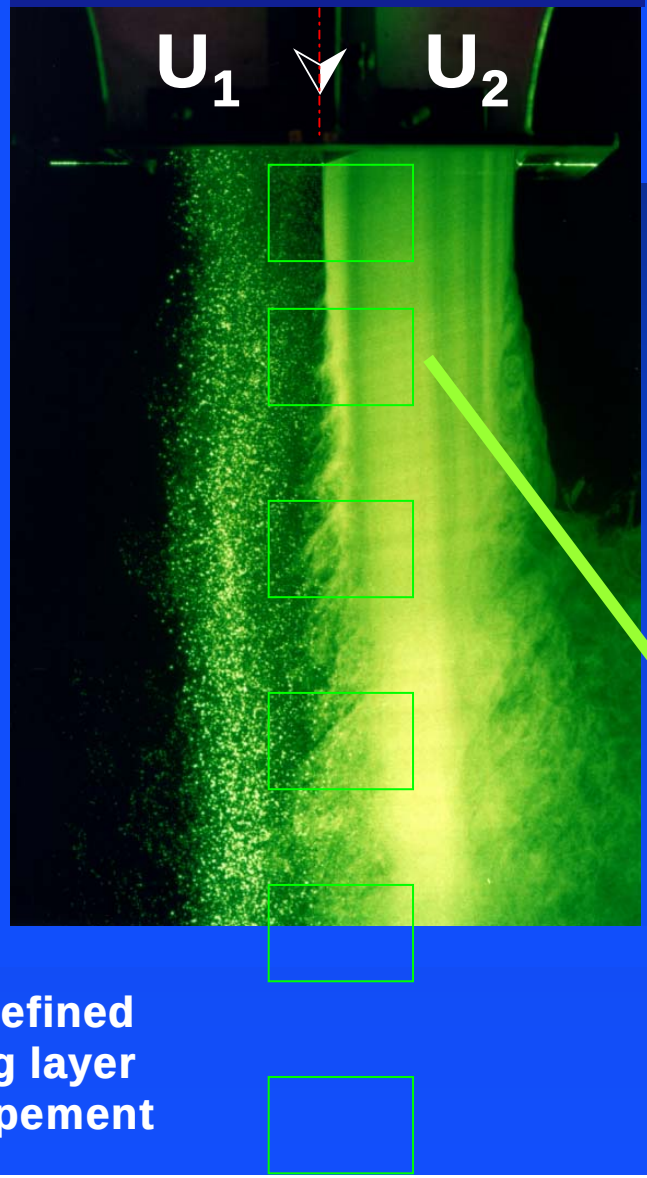


Flow Visualization

Single-phase flow



Two-phase flow



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

well defined mixing layer developement

Digital Image Recording for Particle Imaging Velocimetry

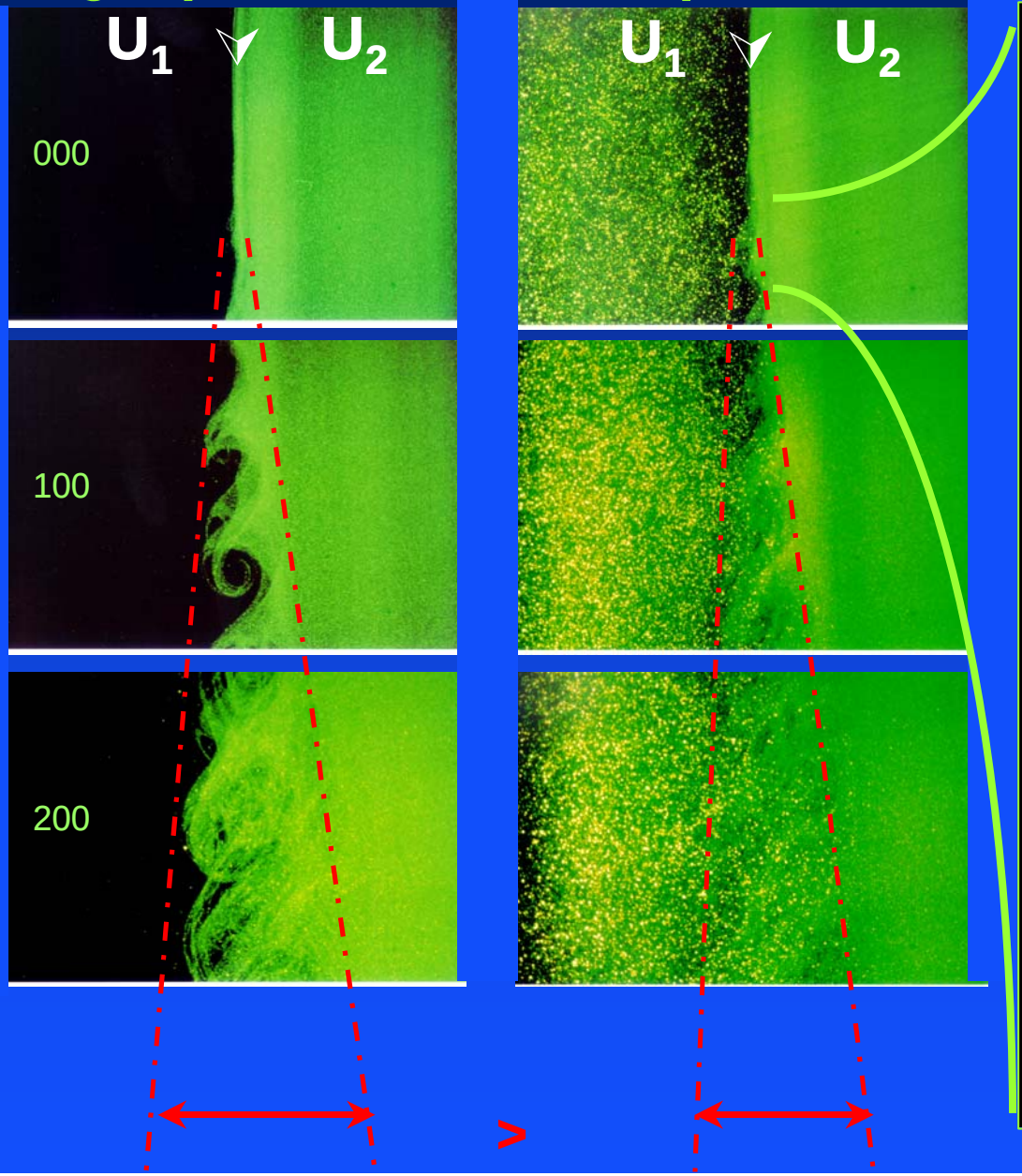
PIV | **PTV(S)**

Nr3)

VON KÁRMÁN INSTITUTE FOR FLUID DYNAMICS

Single-phase flow

Two-phase flow

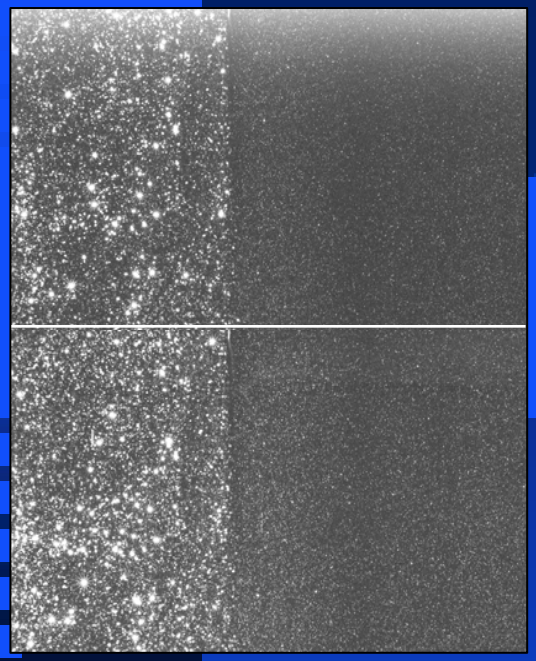


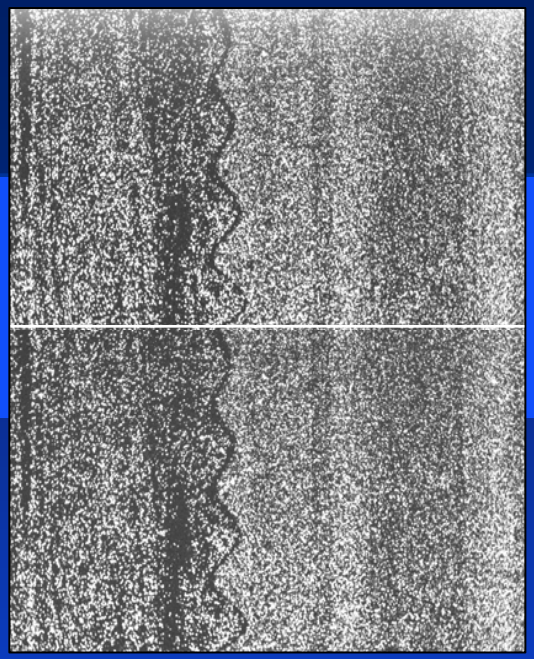
Flow Visualization

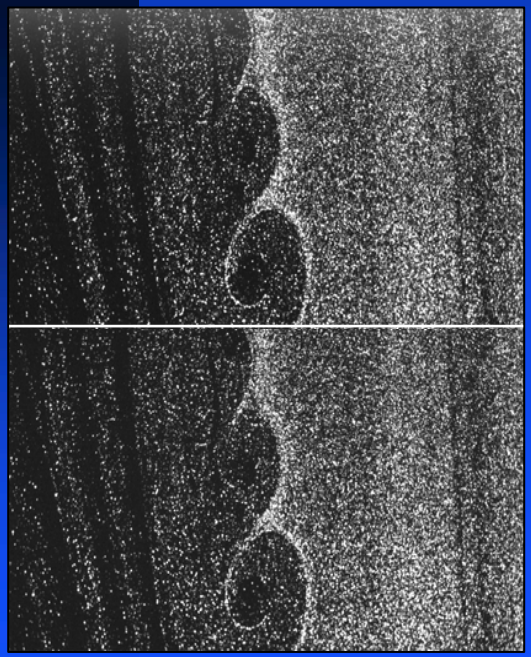
U_1 = 2 m/s
U_2 = 1 m/s

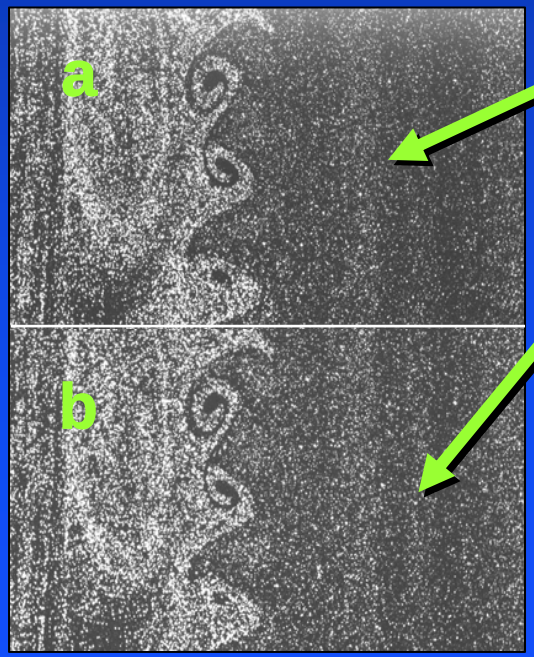
shear layer flow structure /droplets in the mixing layer/

Experimental Results





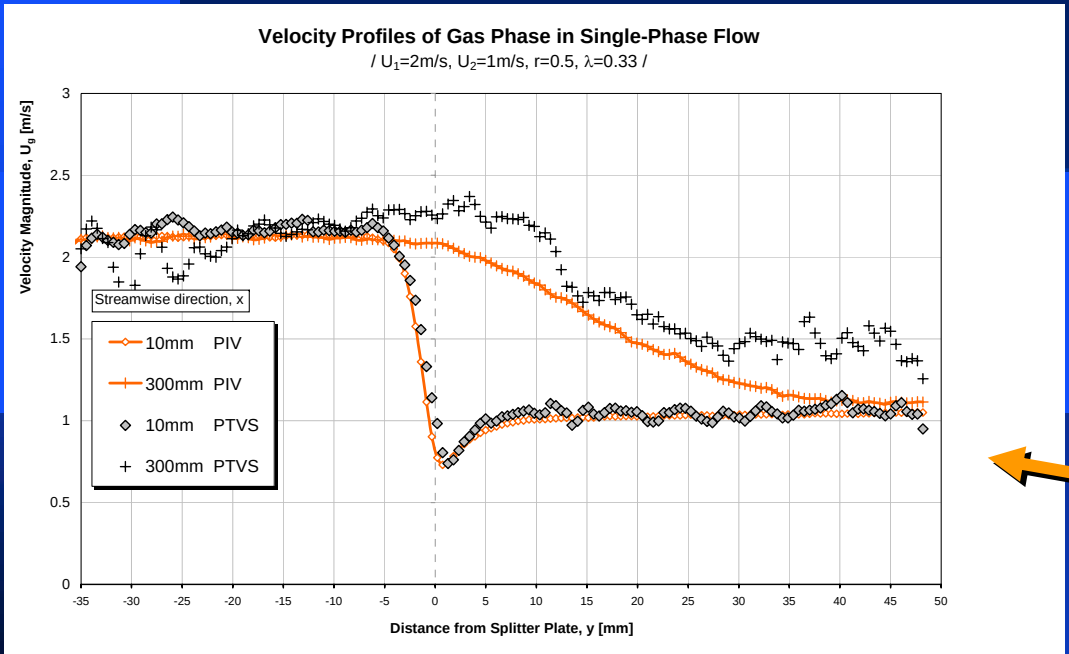




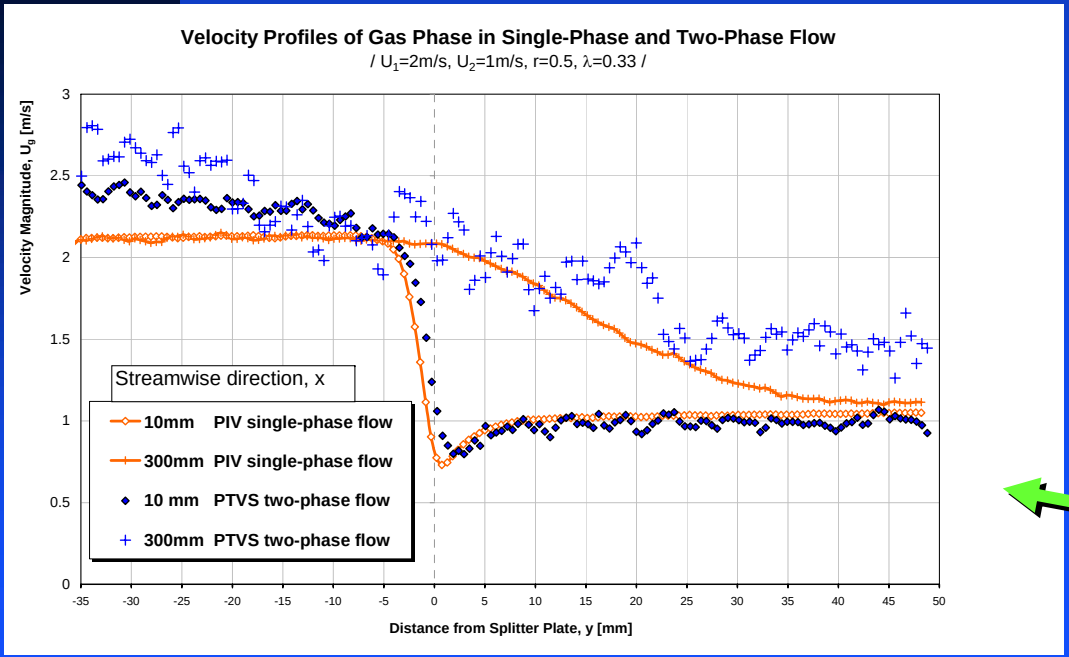
Digitally recorded successive images

Δt_{a-b}

Experimental Results



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

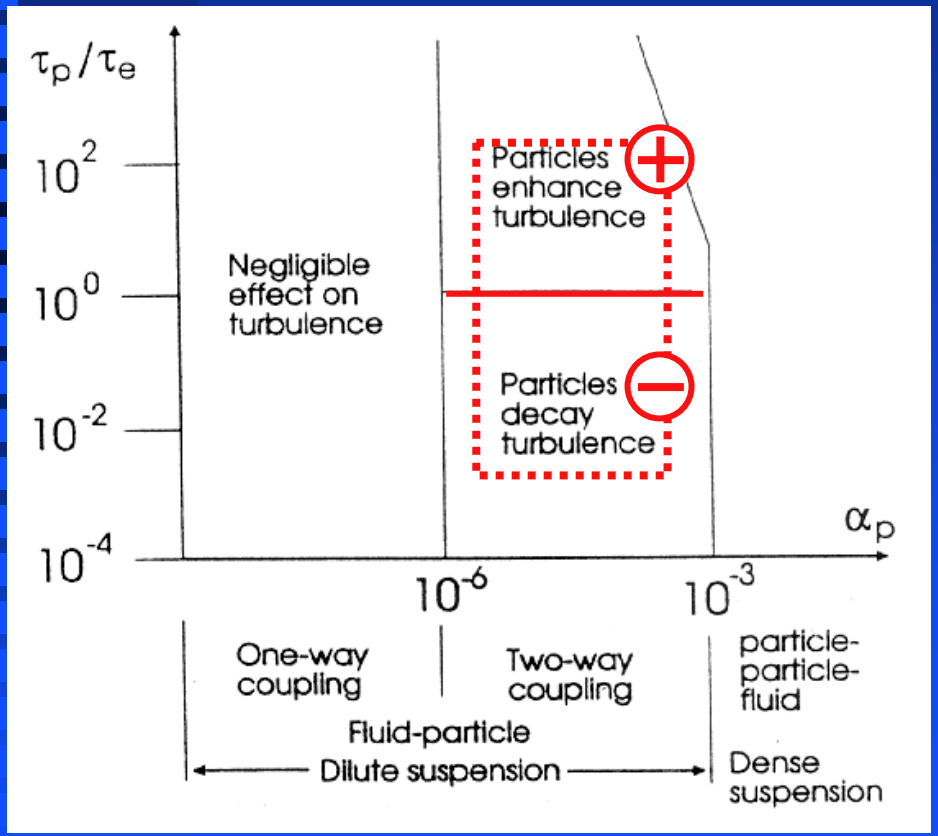


two-phase flow
PTV(S)

Two-phase flow characteristics

Introduction

[ELGHOBASHI, 1994]



[GORE and CROWE, 1989]

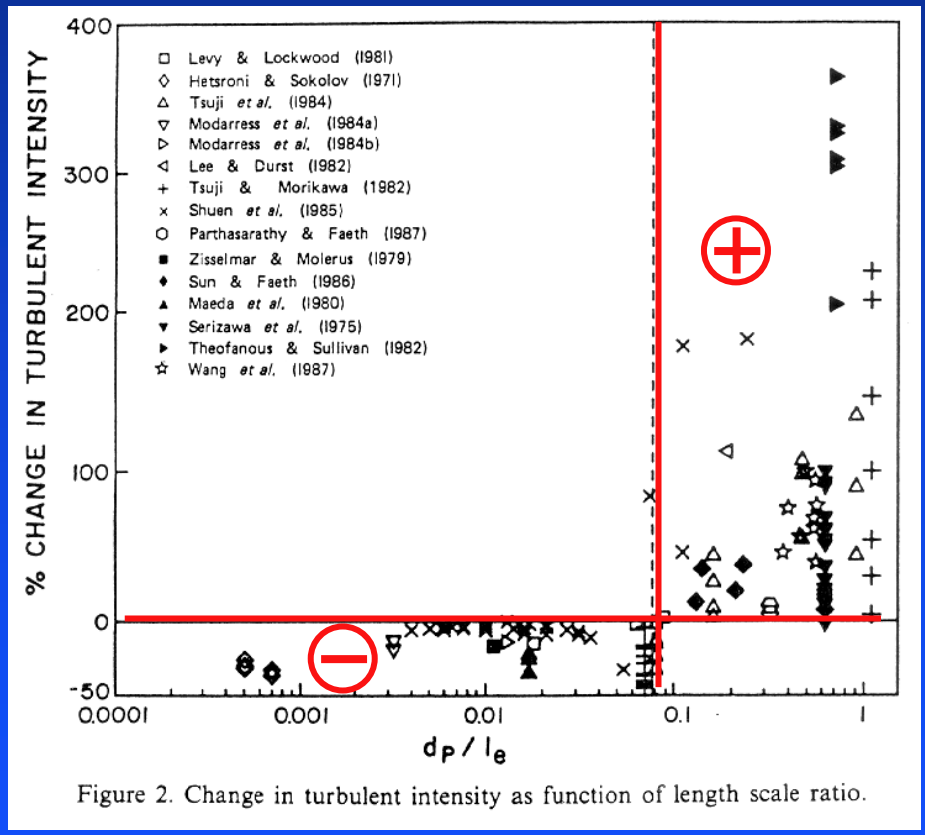


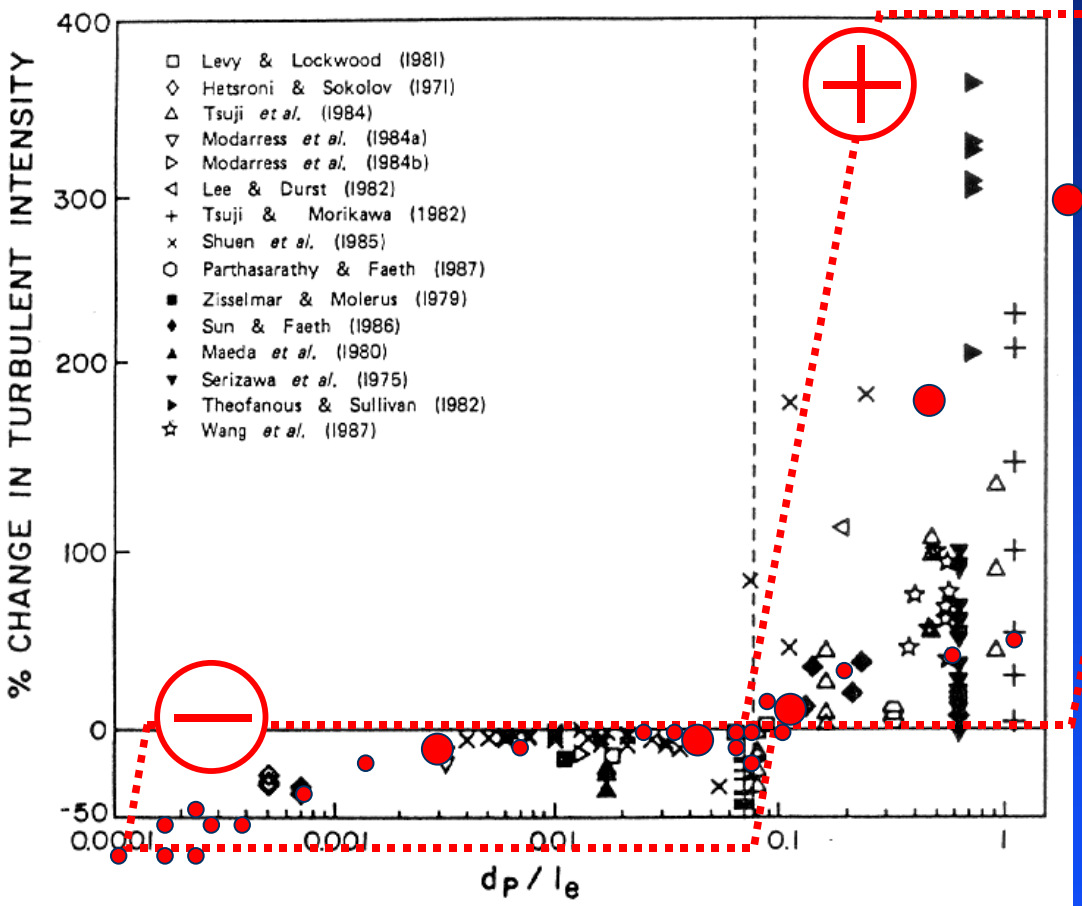
Figure 2. Change in turbulent intensity as function of length scale ratio.

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

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

Turbulence Modulation Map

- exp. results: Suda 2000.



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

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

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

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

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

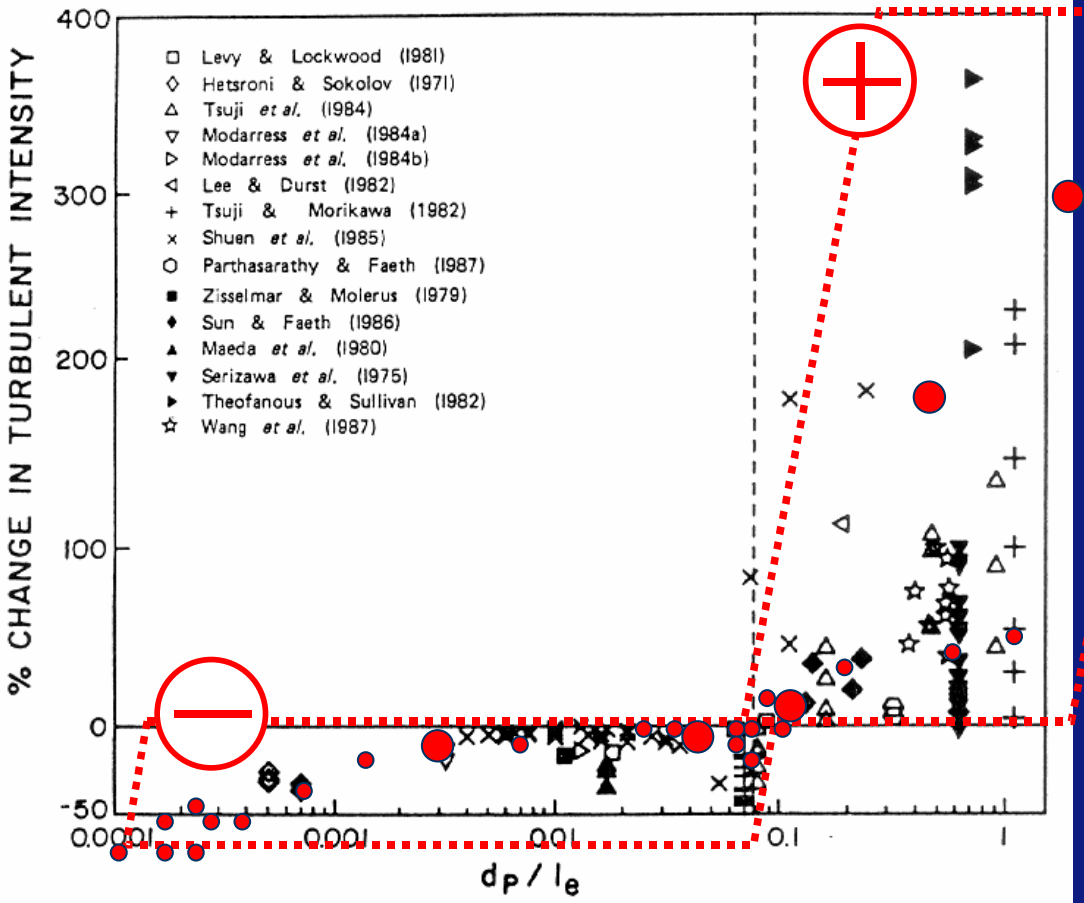
$$\Delta\left(T.I._{\text{carrier phase}}\right) = \frac{T.I._{\text{two-phase}} - T.I._{\text{single-phase}}}{T.I._{\text{single-phase}}}$$

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

Nr3)

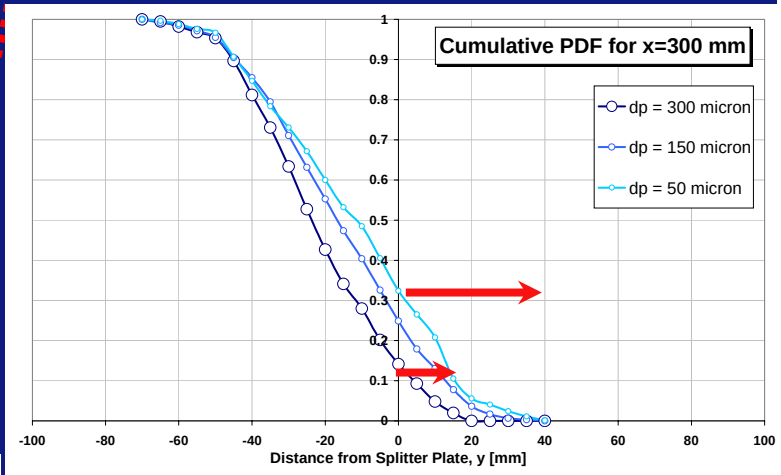
CHANGE in Turbulence Intensity CONCLUSIONS

- 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%)