

RECENT DEVELOPMENT OF THE SUPERSONIC GAS-JET BEAM PROFILE MONITOR

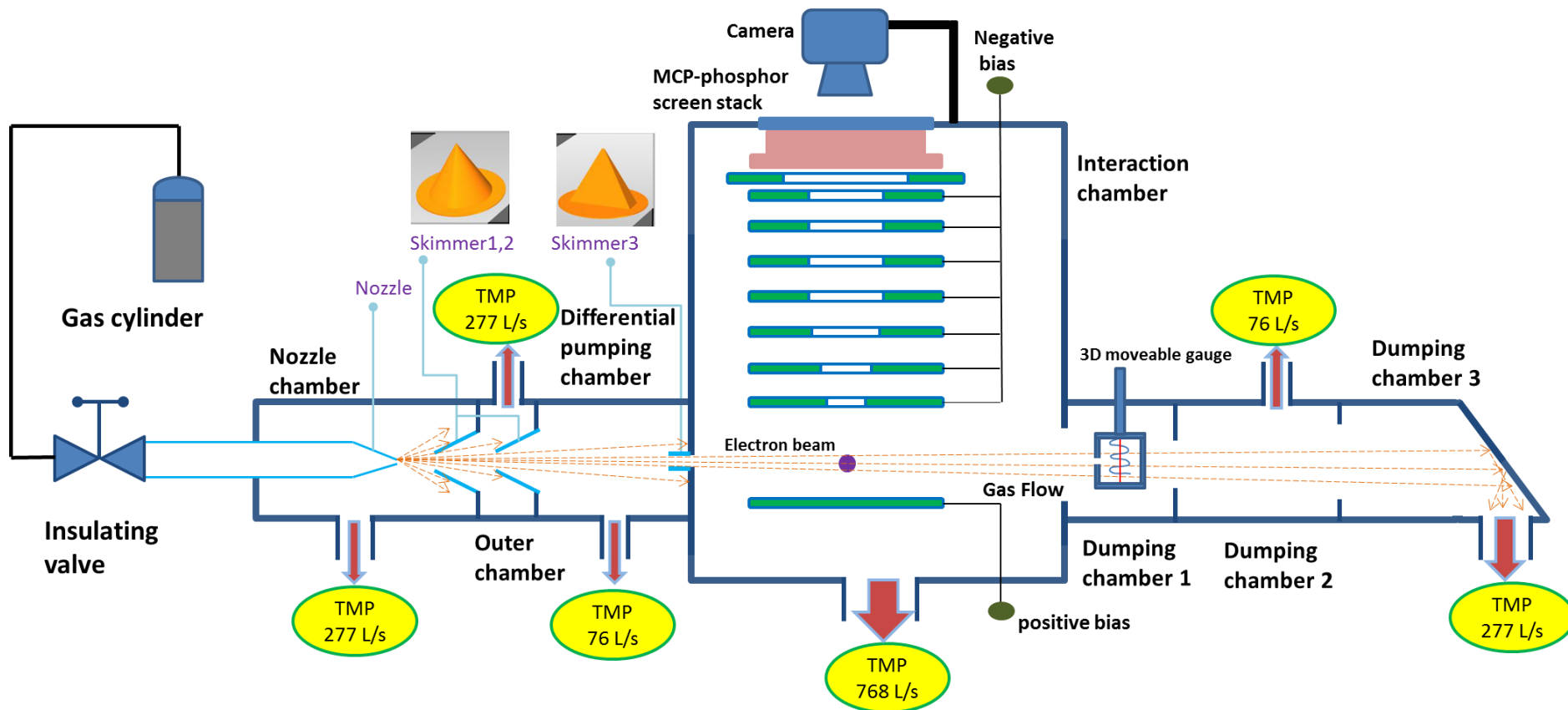
Outline

- Motivation
- Experimental Setup
- Skimmer size and resolution
- Jet distribution measurement

Motivation

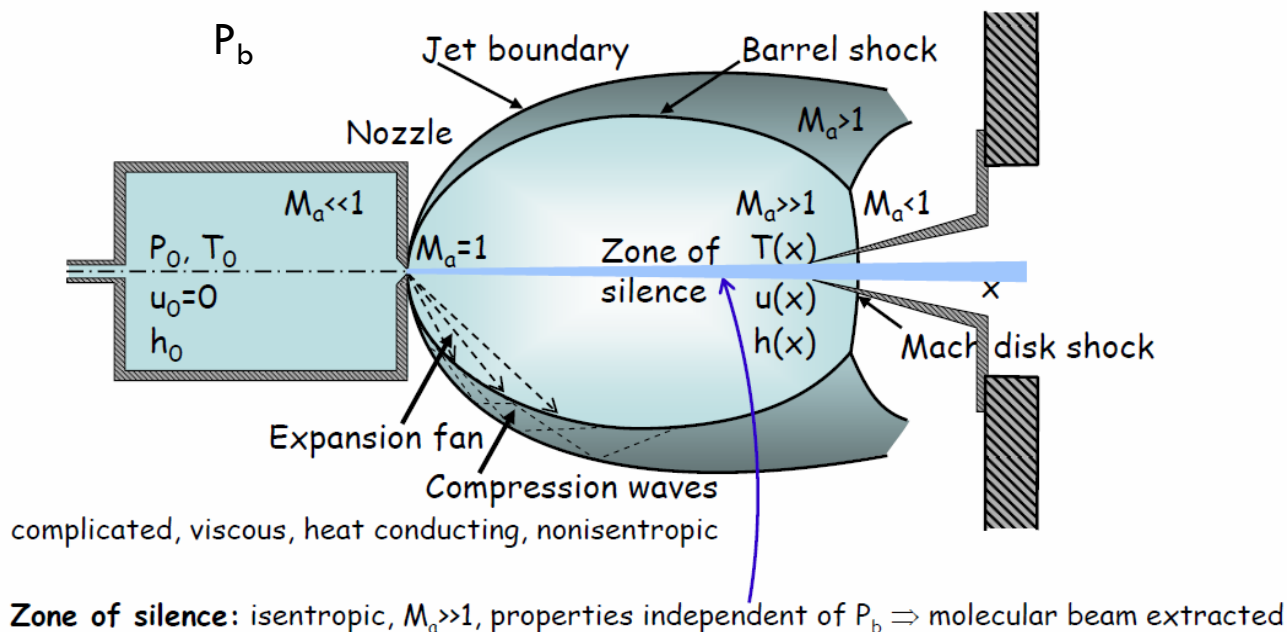
- Diagnose the particle beam non-invasively
- Preserve the vacuum more effectively
- Better understand the gas-jet dynamics when using this monitor

Get-jet Monitor Setup



Generation of Supersonic Gas jet*

Free Jet Expansion



Mach disk location $(x_M/d) = 0.67 (P_0/P_b)^{1/2}$ (γ independent)

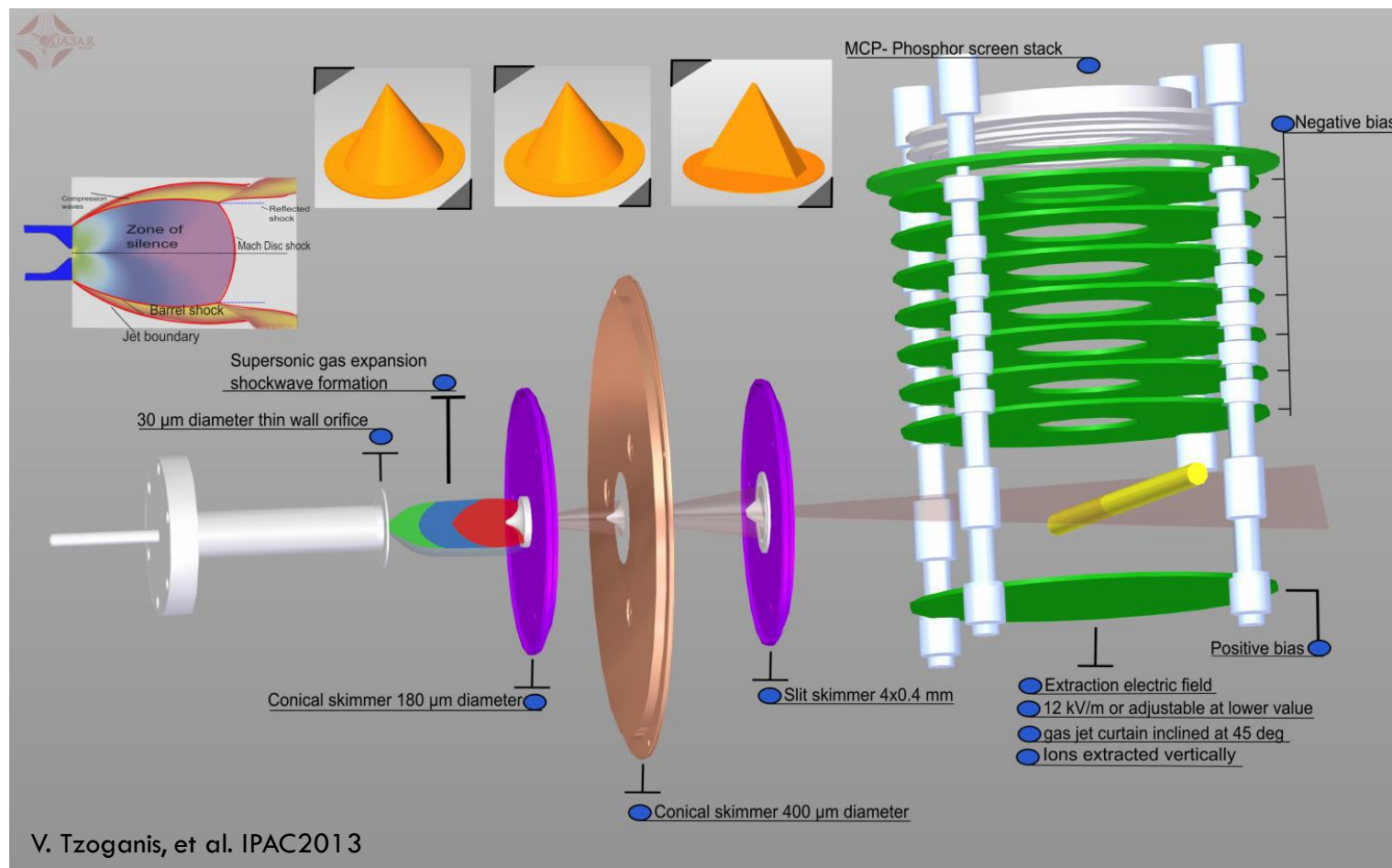
Mach diameter $\sim 0.5x_M$; Barrel shock width $\sim 0.75x_M$ ($\gamma, P_0/P_b$ dependent)

For our case, $P_0 = 5 \text{ bar}$, $P_b \sim 1.0e-3 \text{ mbar} \Rightarrow x_M/d = 1500$; $d = 30 \mu\text{m} \Rightarrow x_M = 45 \text{ mm}$

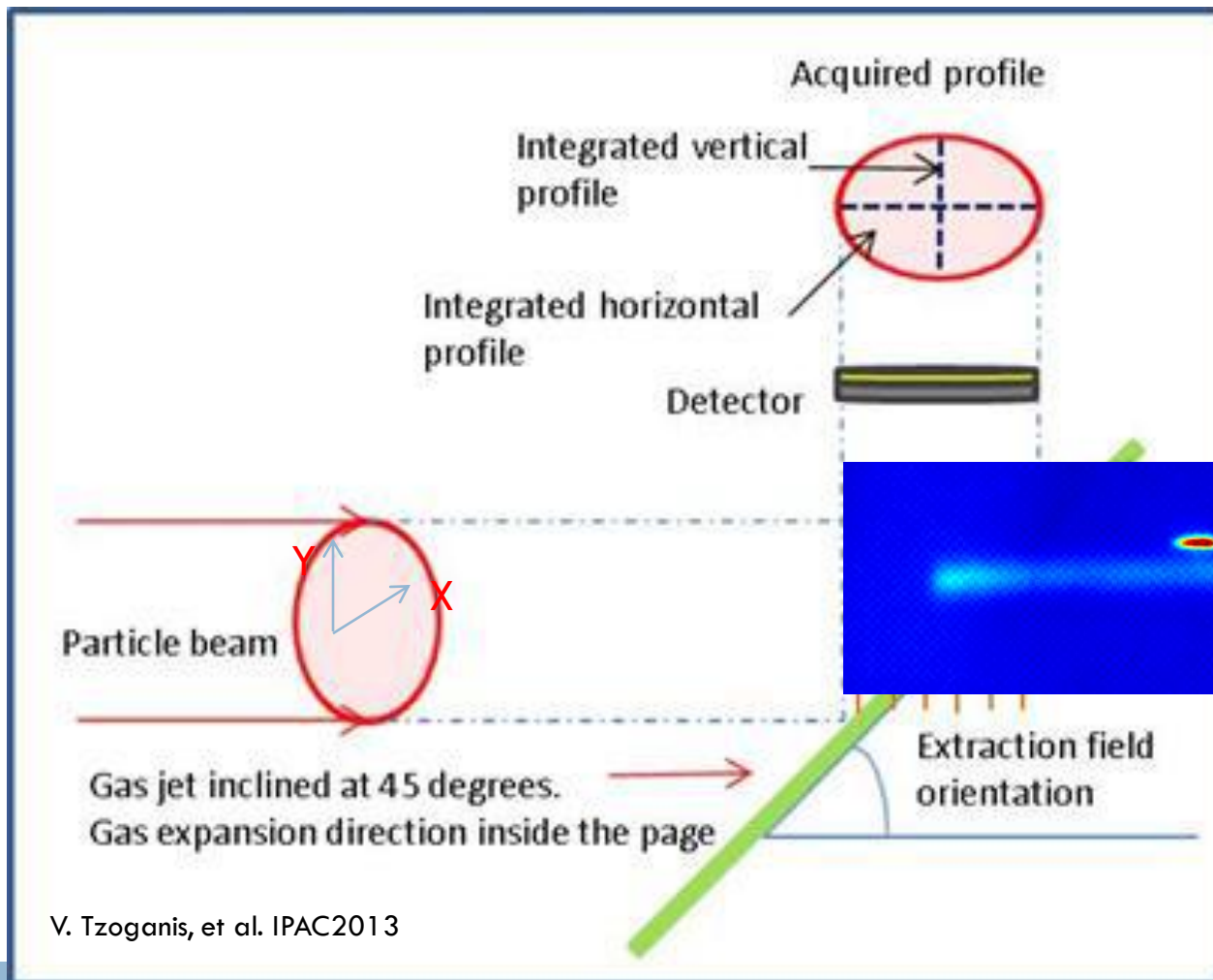
* 2010/05/25-29, ICONIC Training School, Freiburg

M. Fárník: I Molecular Beams

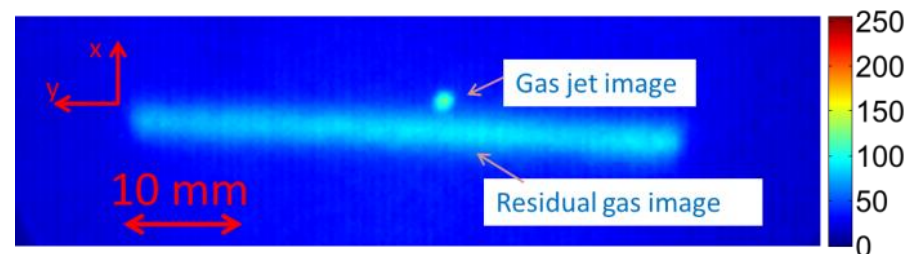
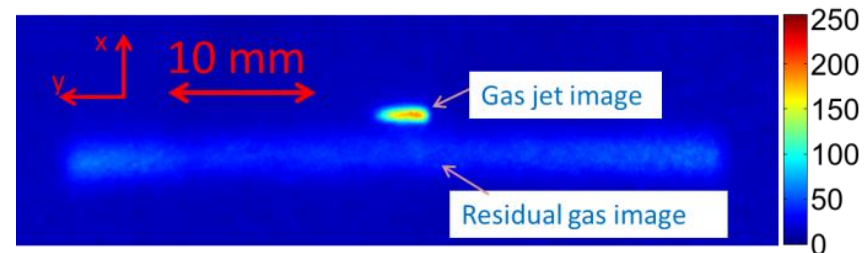
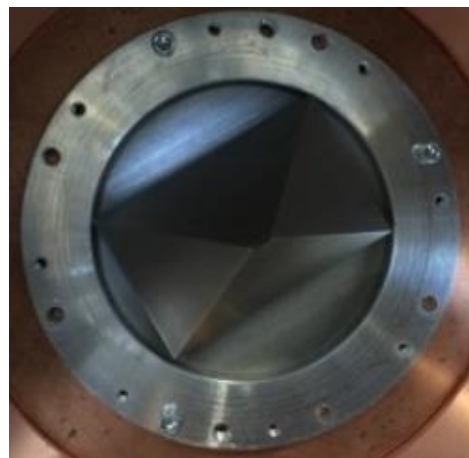
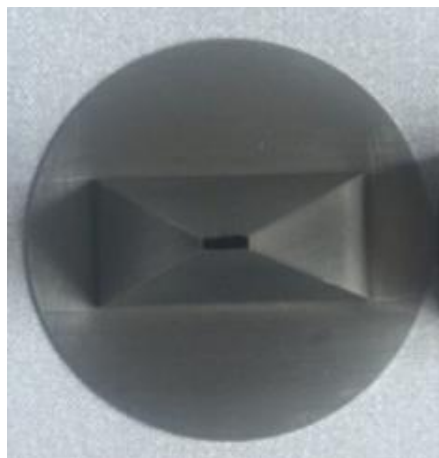
Skimmers & MCP



2-dimensional profile imaging



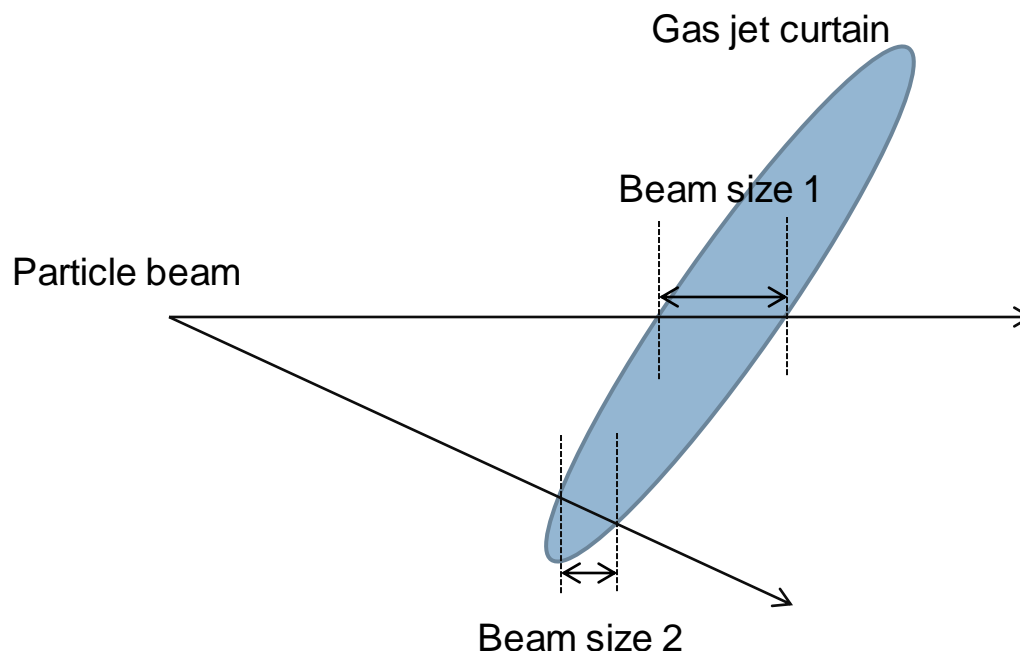
Resolution VS 3rd skimmer size



Skimmer size	7.2×1.8 mm ²	4×0.4 mm ²
Oriental angle	45°	32°

Beam size	mm	mm
σ_x (Gas jet)	0.42	0.56
σ_y (Gas jet)	1.23	0.53
σ_x (Residual Gas)	1.01	1.52

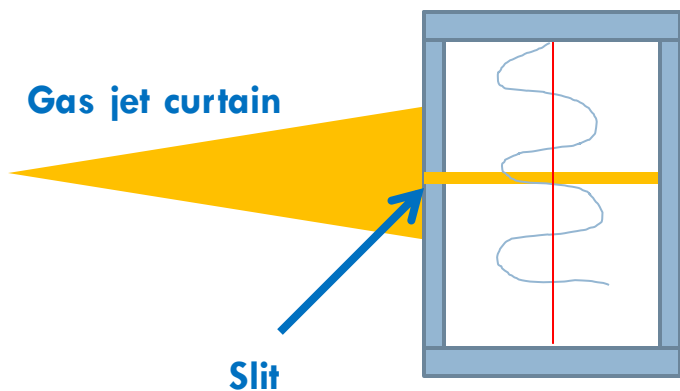
Resolution problem



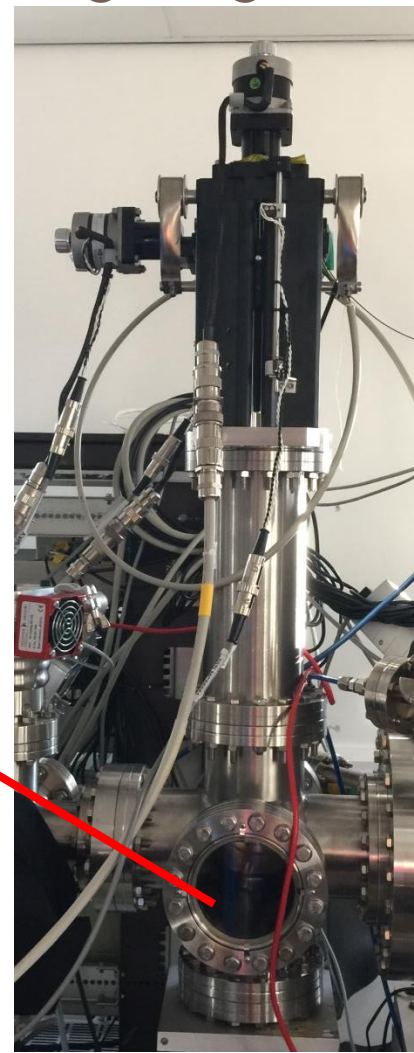
?! The gas curtain distribution will affect the resolution of this method. Having a method to know the pressure distribution of the system will help us understand the gas curtain distribution better.

Newly installed compression gauge module

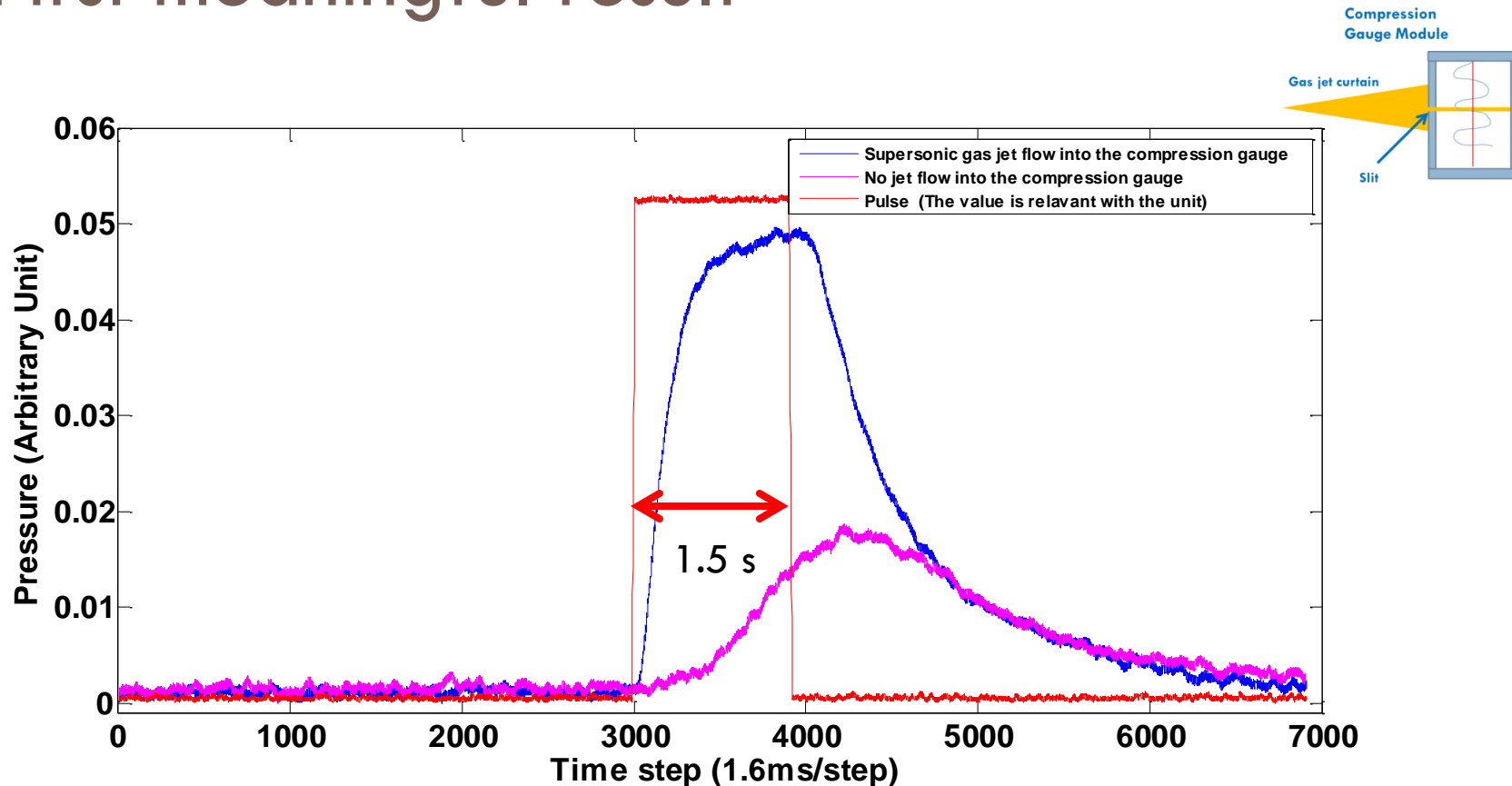
Compression Gauge Module



Slit size	$10.0 \times 2.0 \text{ mm}^2$
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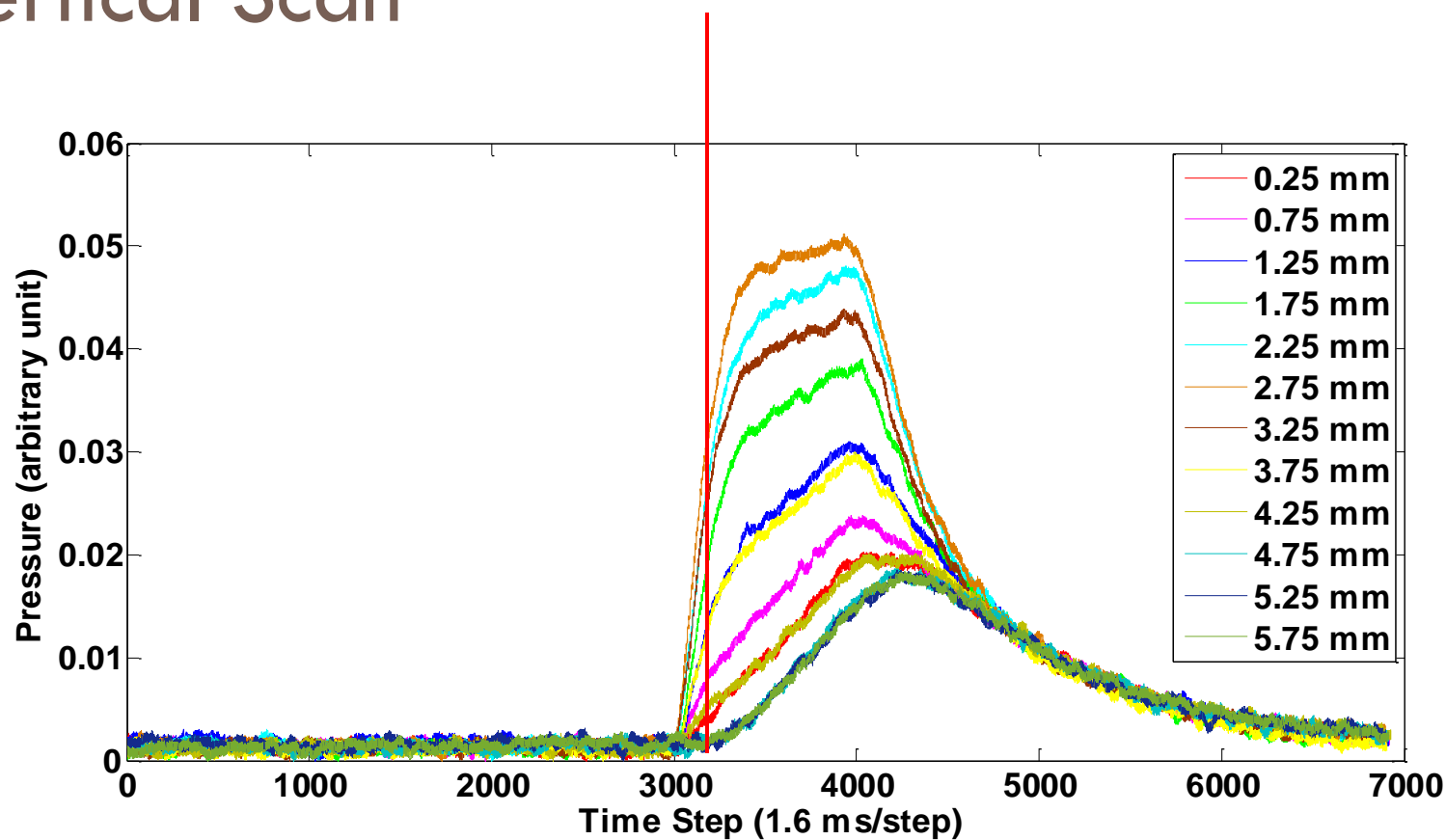


First meaningful result

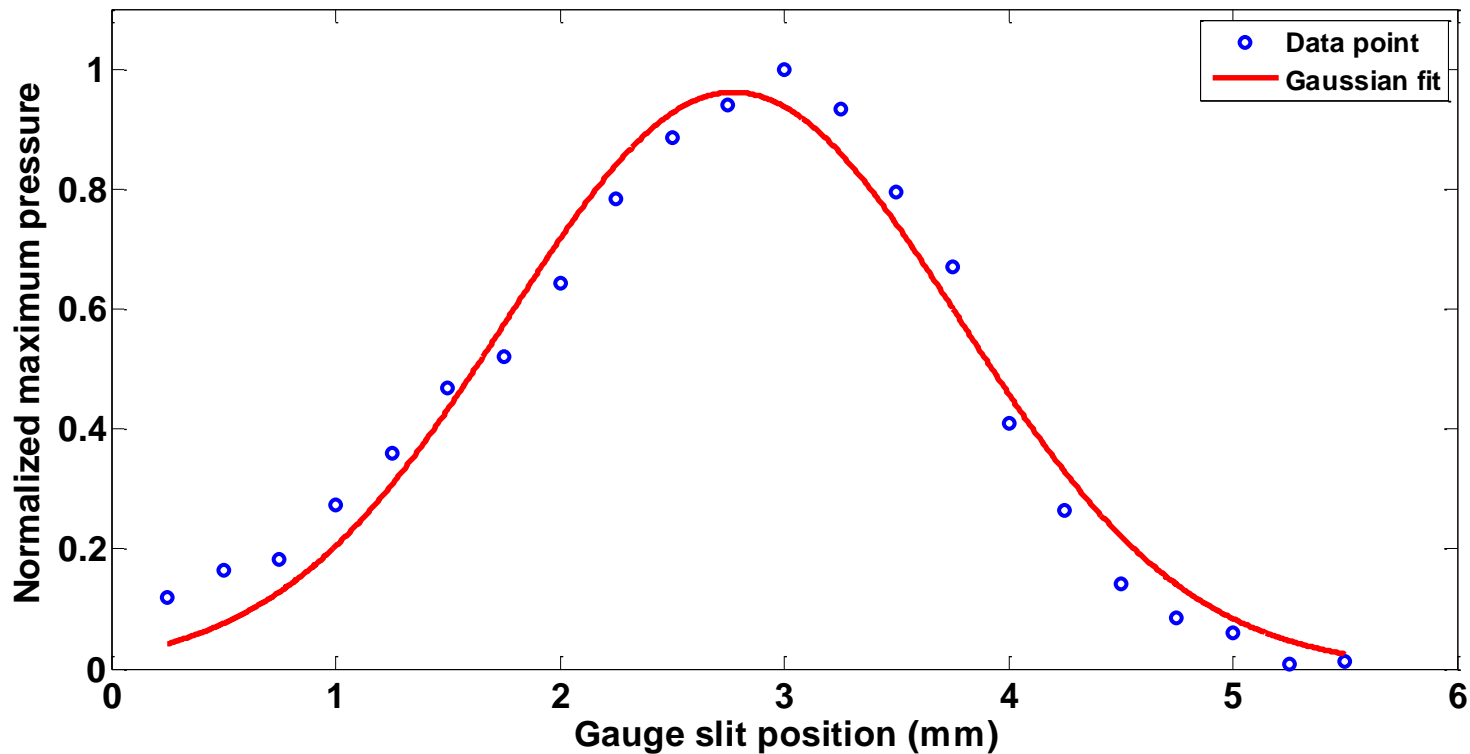


The blue curve represent the case when partial of the jet enters the compression gauge module through the slit, while the purple one shows the case that there is no jet entering the slit and the pressure bump is from the overall pressure change due to the jet flowing into the first dump chamber

Vertical Scan



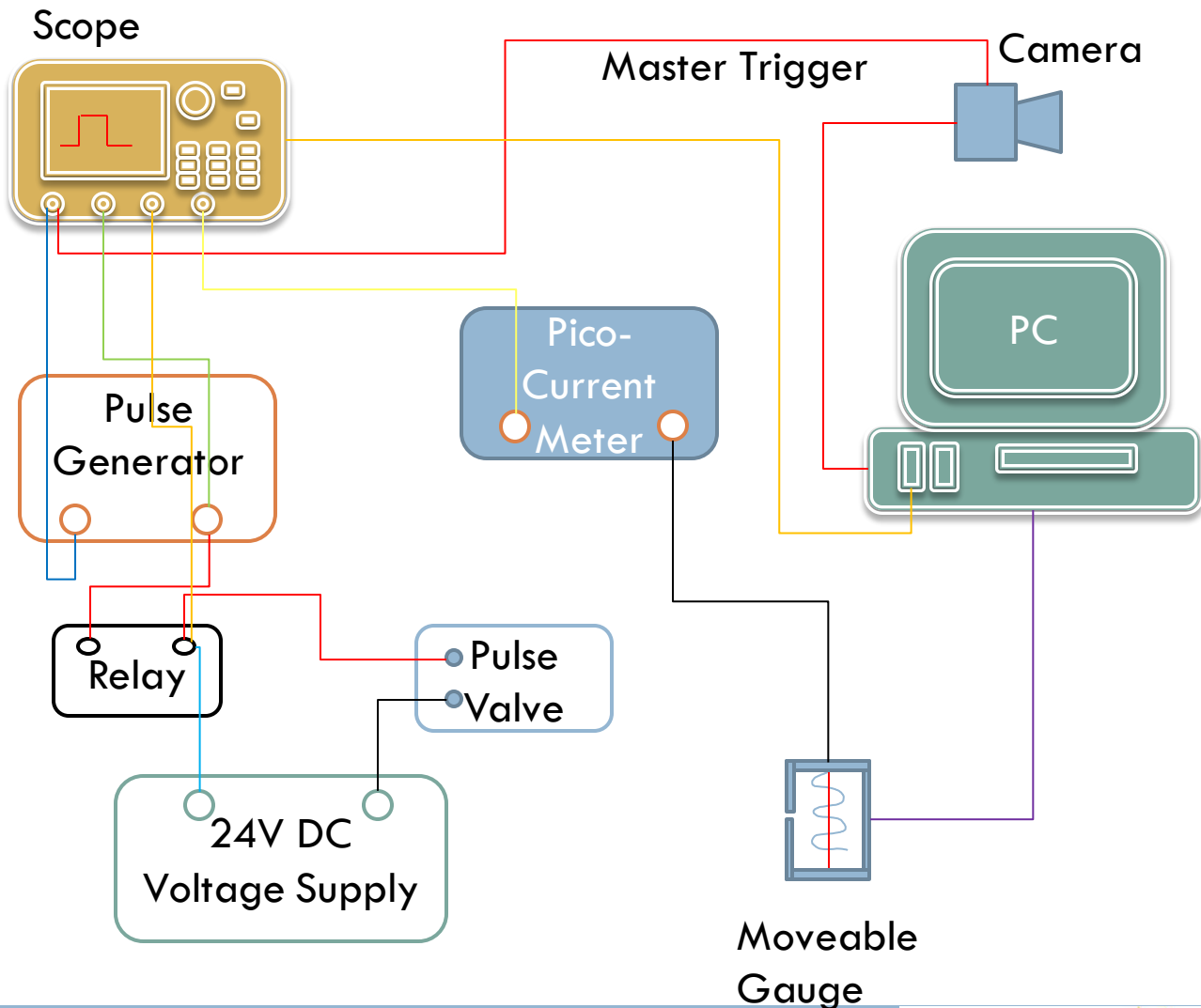
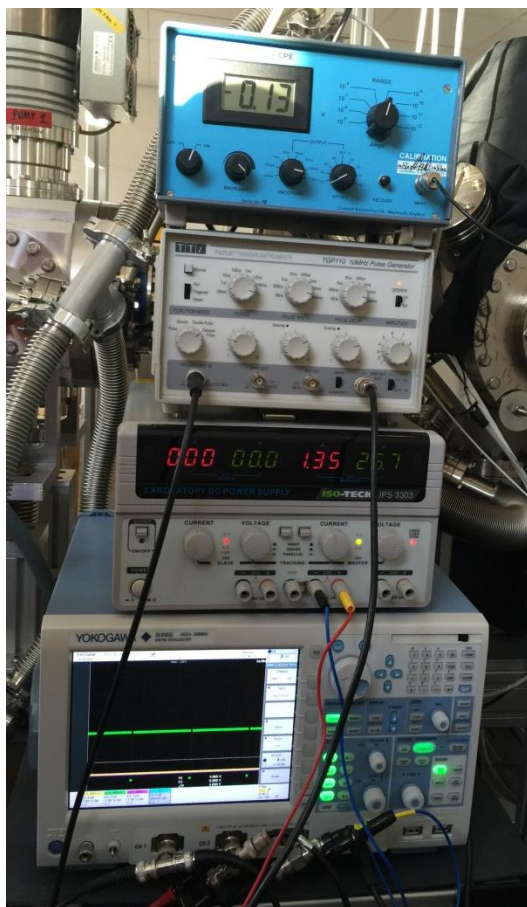
Gaussian fit



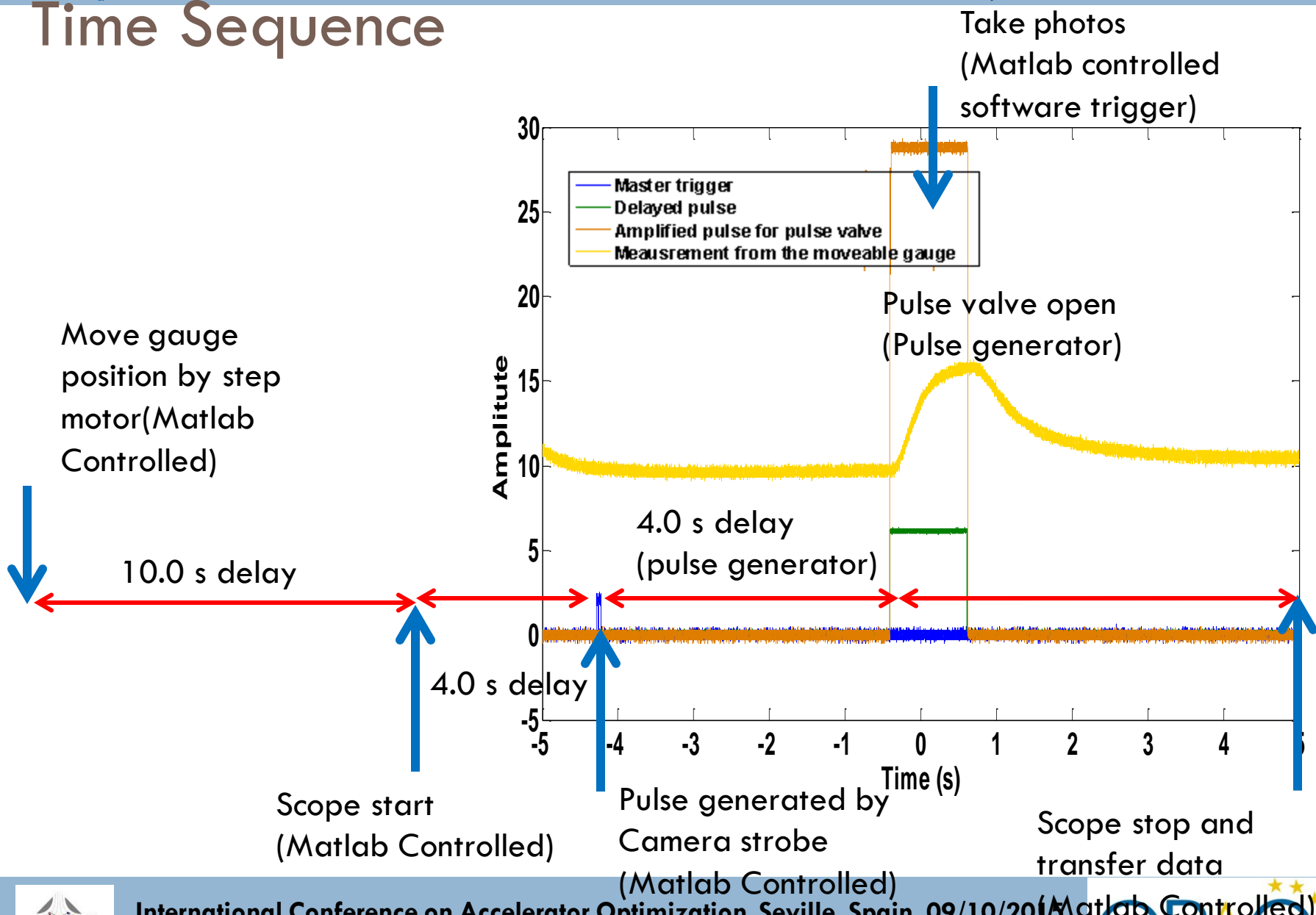
σ (mm)

1.01

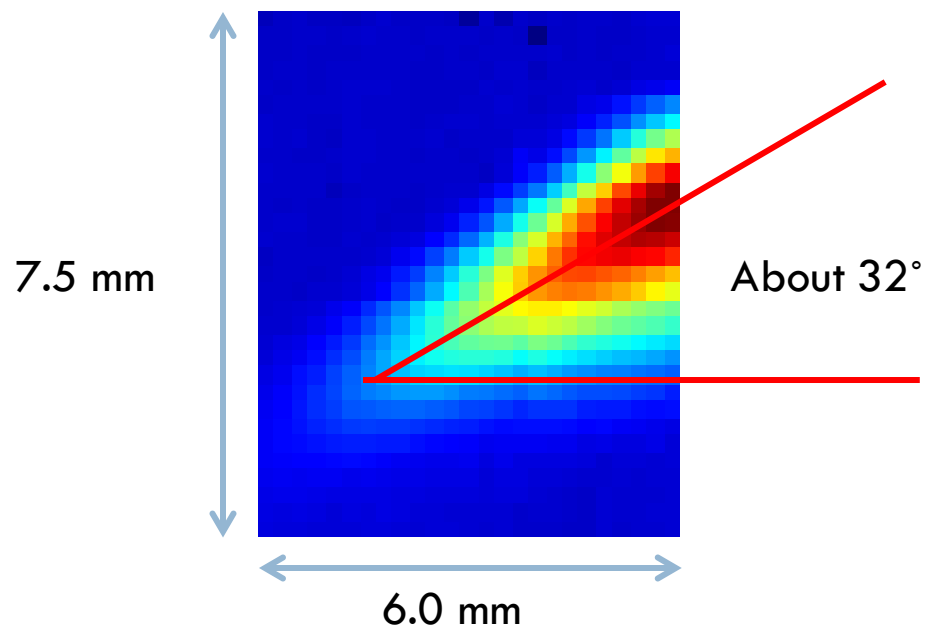
Automation for moveable Gauge Scan



Time Sequence

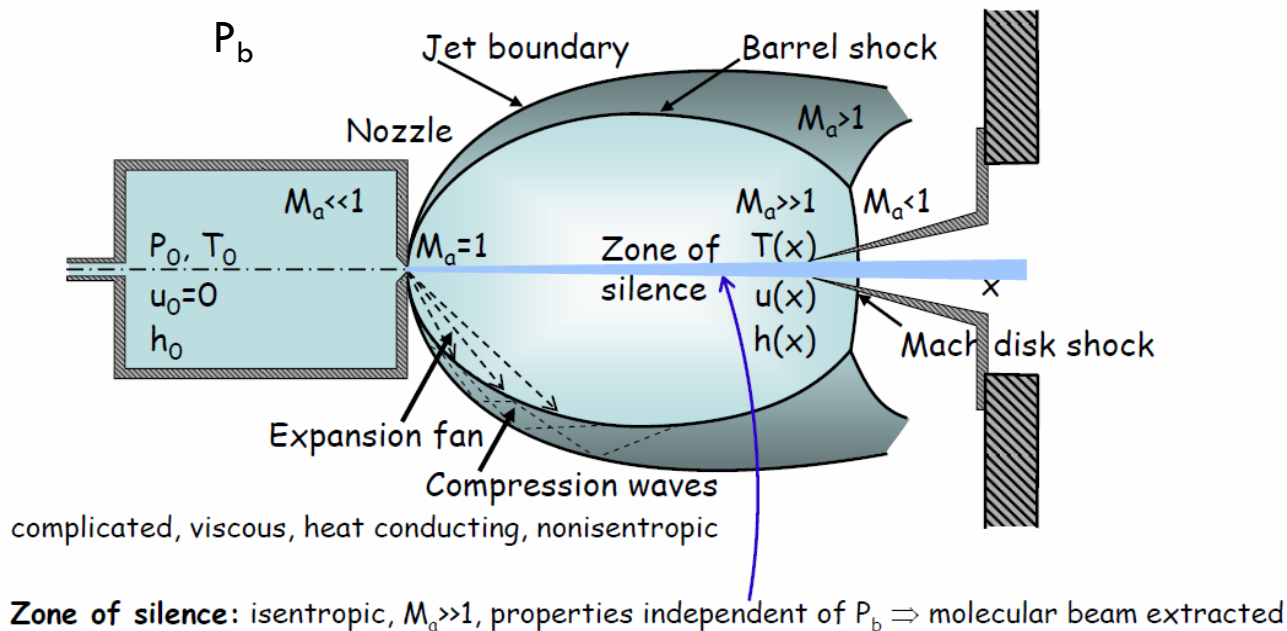


2D Scan



Mach Disc study

Free Jet Expansion

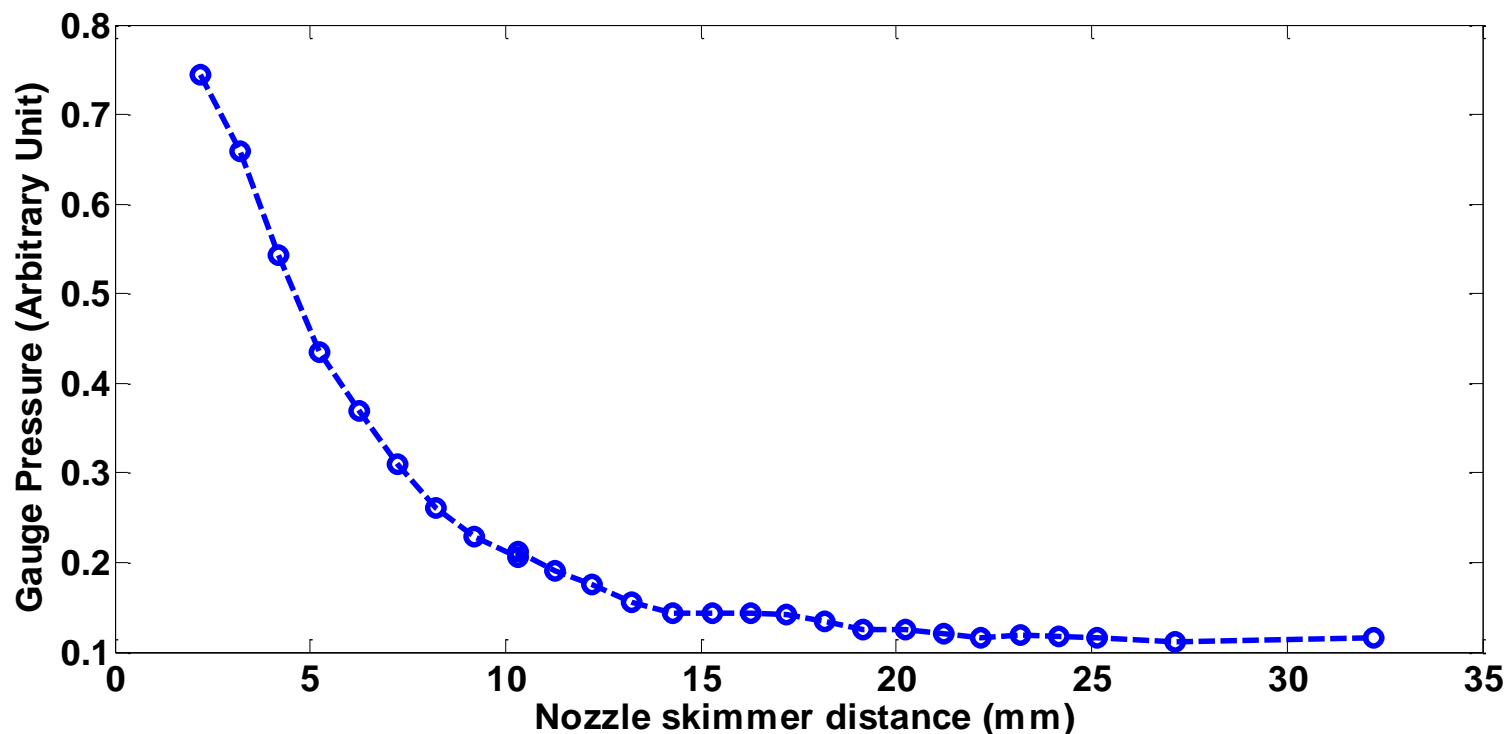


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Gauge pressure VS Nozzle skimmer distance



This curve give a Mach disk about 25 mm, which is in the same order of magnitude with the calculation.

Conclusion and Future Work

□ Summary

- By reducing the 3rd skimmer size, we improve the resolution of the jet image.
- Developed a moveable compression gauge module to measure the jet distribution.
- Automated the moveable gauge measurement process
- Preliminary result of the jet distribution agree with the setup
- Gas dynamics study about the Mach disk.

□ Any Questions?

Thank you