Massimiliano Putignano

Development of a Least-Interceptive Beam Profile Monitor Based on a Supersonic Gas-Jet Screen

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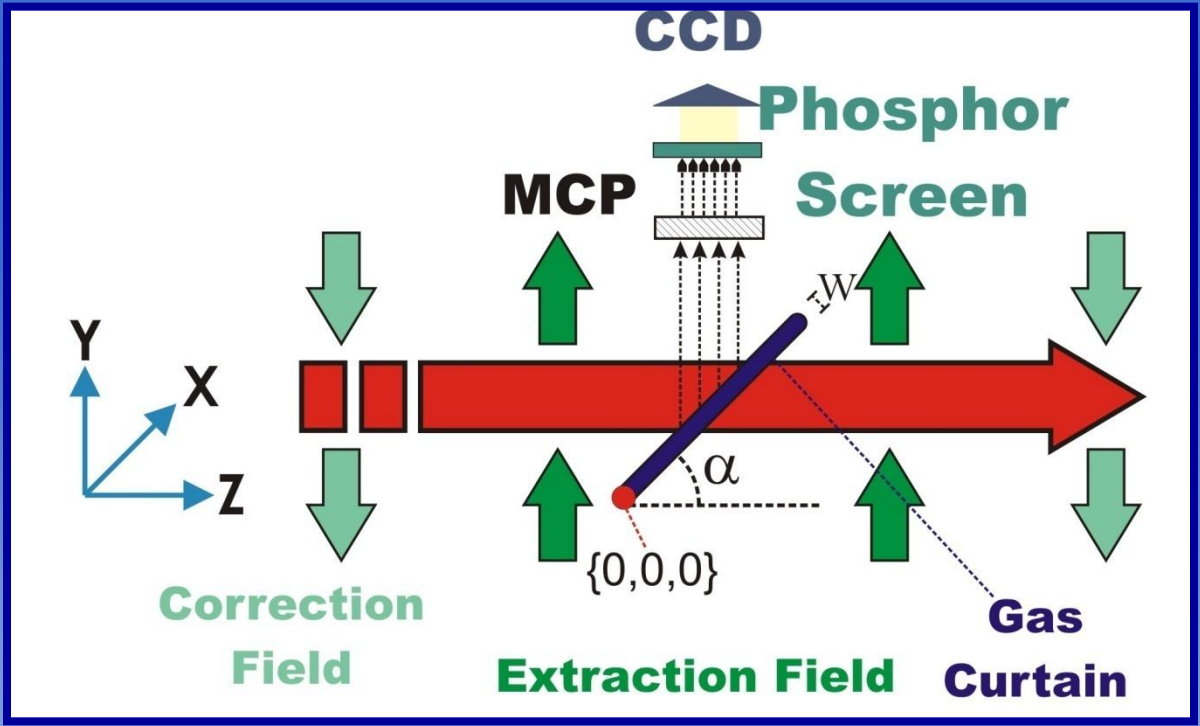
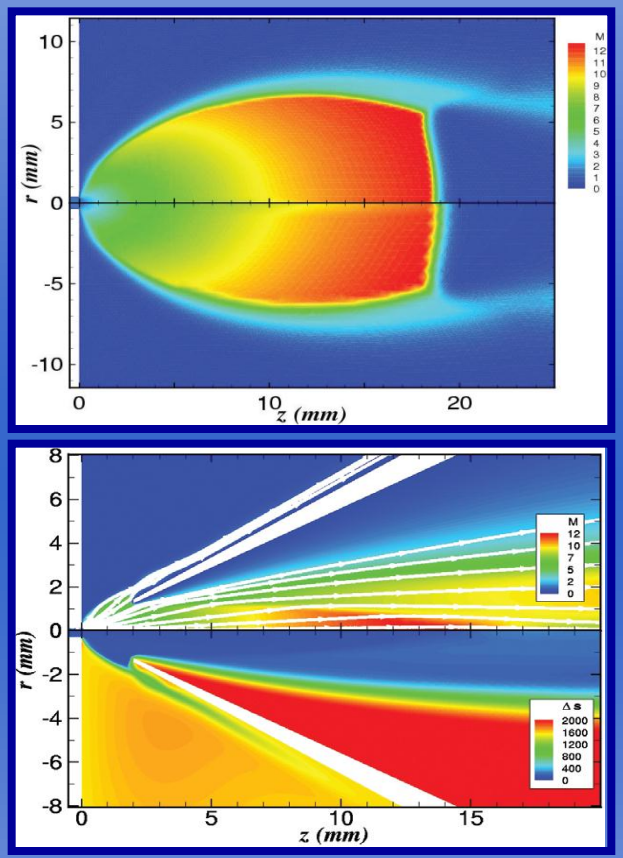
- **Gas Screen Monitor[1,2,4,5]**
  - **Non-perturbing to both vacuum and beam**
  - **Main application: low energies**



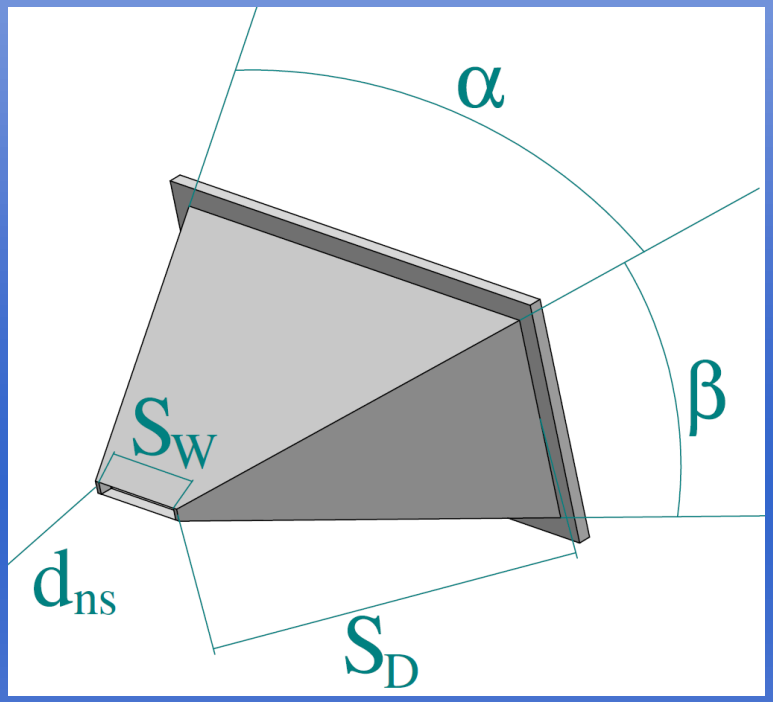
Study of the gas-jet: state of the art

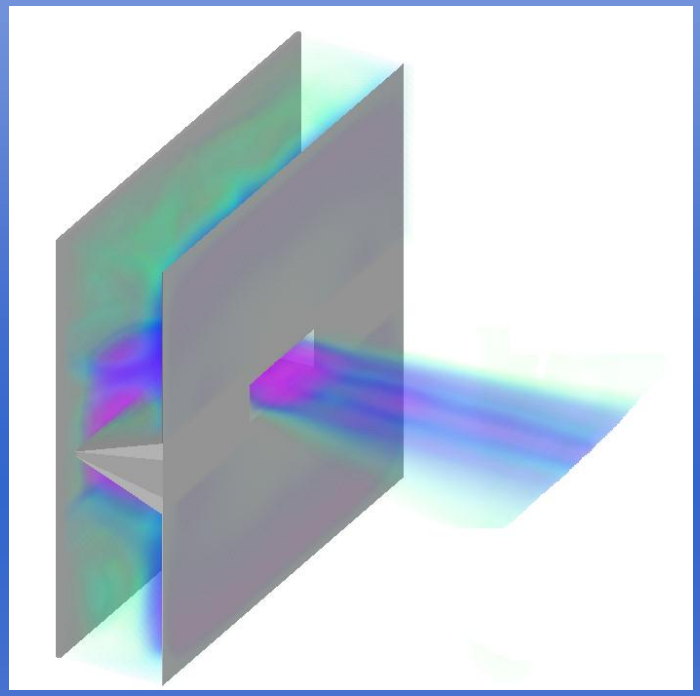


M.Jugroot *et al* [3].

- Detailed study of expansion structure
- Assessment of the impact on jet parameters of:
  - Nozzle-skimmer geometry
  - Stagnation quantities
- Indications on how to optimize the axis-symmetric jet for use as a target.

All optimization studies performed for an axis-symmetric jet.





Observables

H_ρ – Homogeneity of curtain density

G_R – Geometric Ratio (Resolution)

K – Confinement (% gas enclosed in curtain)

- System can be optimized through nozzle-skimmer geometry.
- Slit nozzle (instead of circular nozzle)
- Nozzle and skimmer slits have to be perpendicular
- Shaping of the gas curtain is feasible.

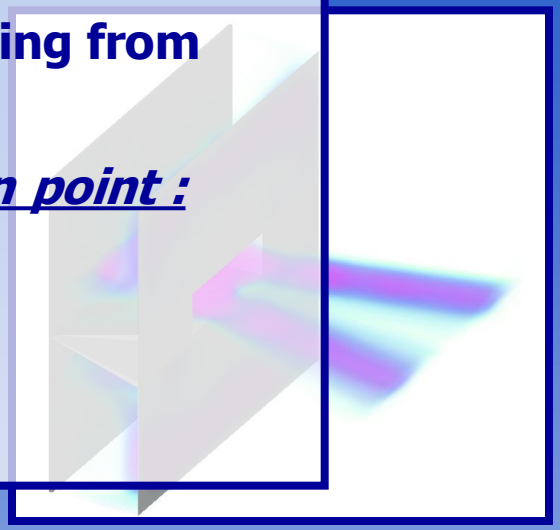
Geometric ratio: G_R :

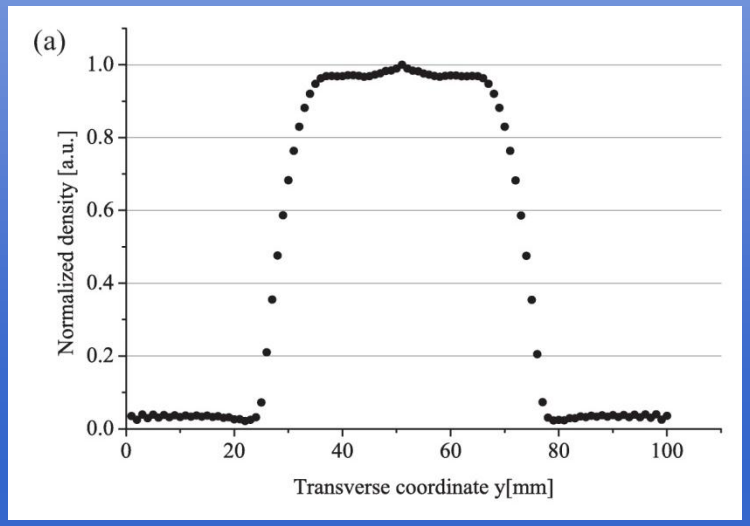
Decreases of a factor of 2-3 moving from *Slit nozzle to Circular nozzle.*

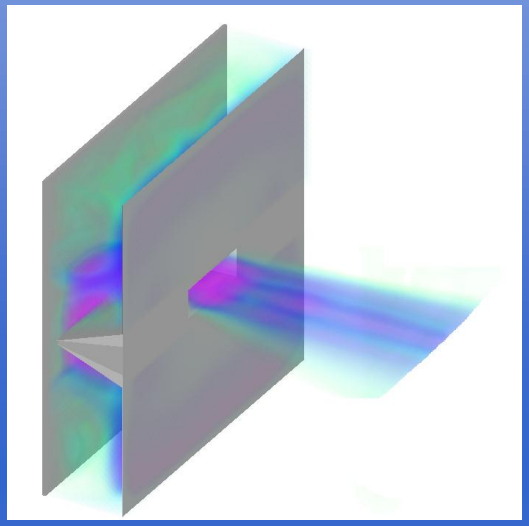
Homogeneity of gas screen at interaction point :

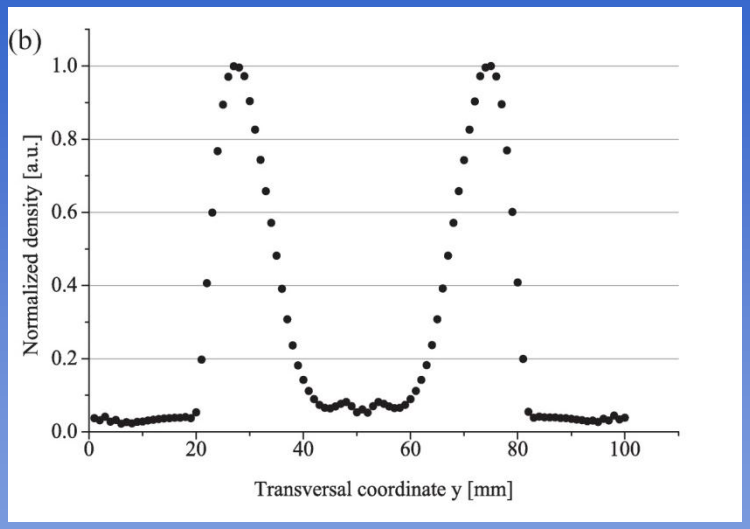
Nozzle-Skimmer system:

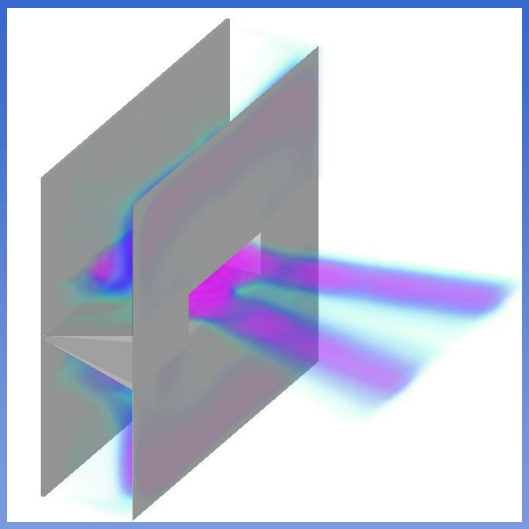
Perpendicular	Parallel
7%	26%



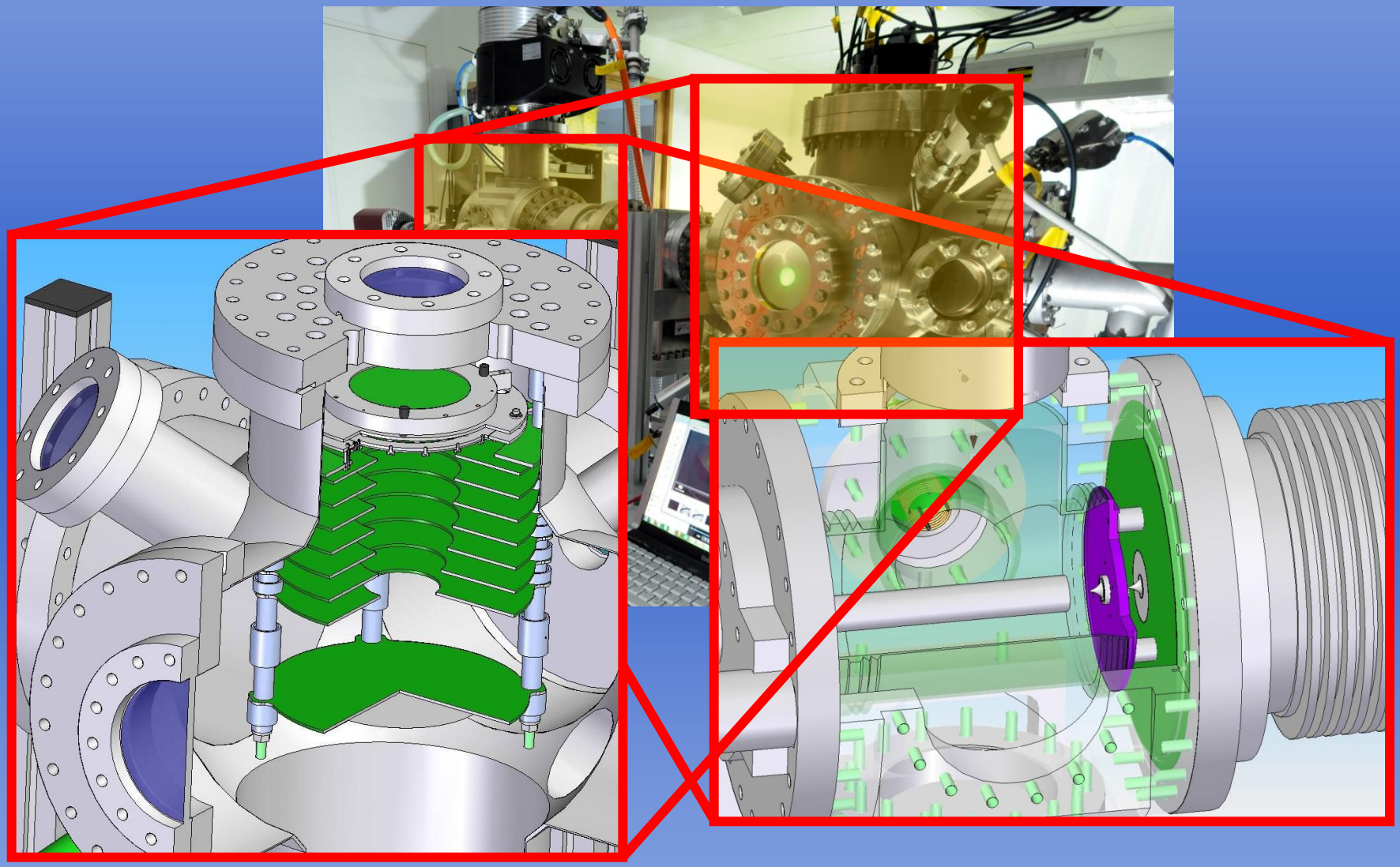








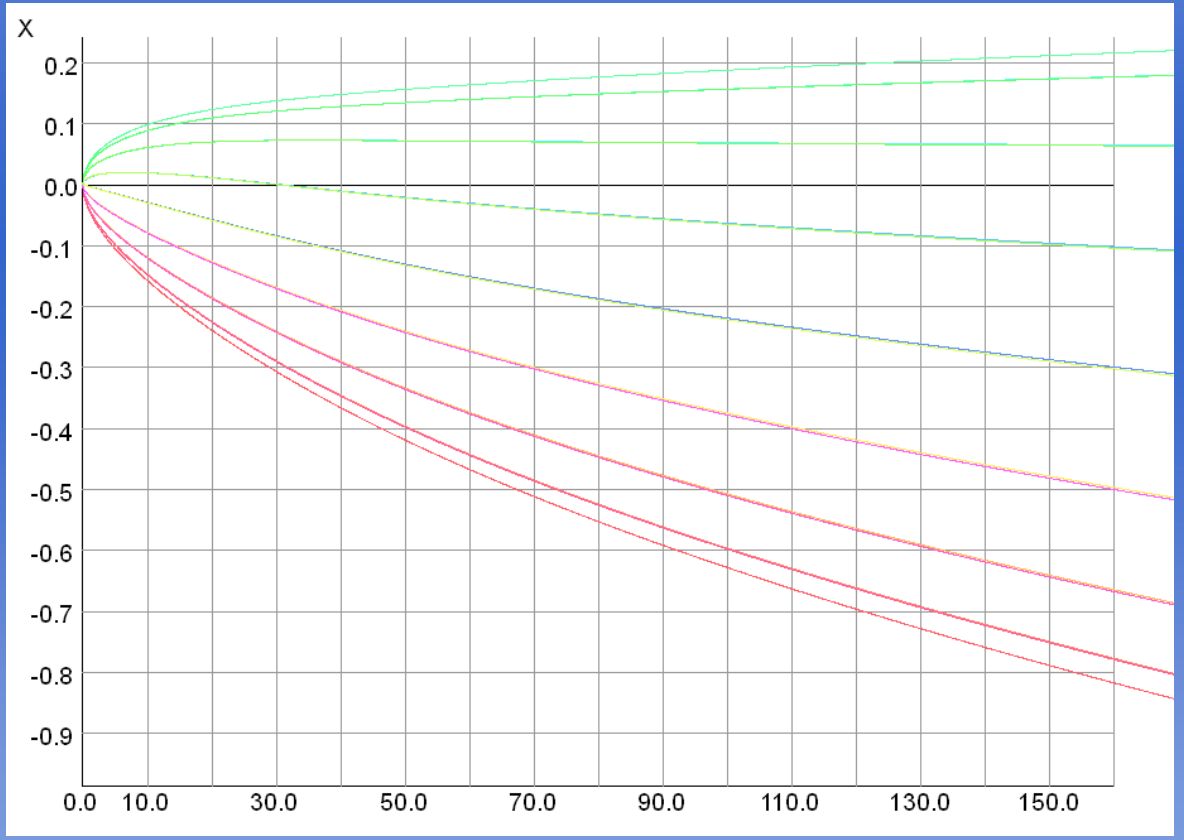
- Shaping of gas curtain possible through sole manipulation of **Pressure and Temperature** of Gas Reservoir.
- **1 order of magnitude** density difference between core and side strands
- **Factor 2.5 in peak intensity** between full and split jet



- Resolution is limited by target ion initial momentum (ignoring space charge).
  - Temperature
  - Impact recoil

$2\sigma \Rightarrow \approx 0.5\text{mm}$

$6\sigma \Rightarrow \approx 1\text{ mm}$

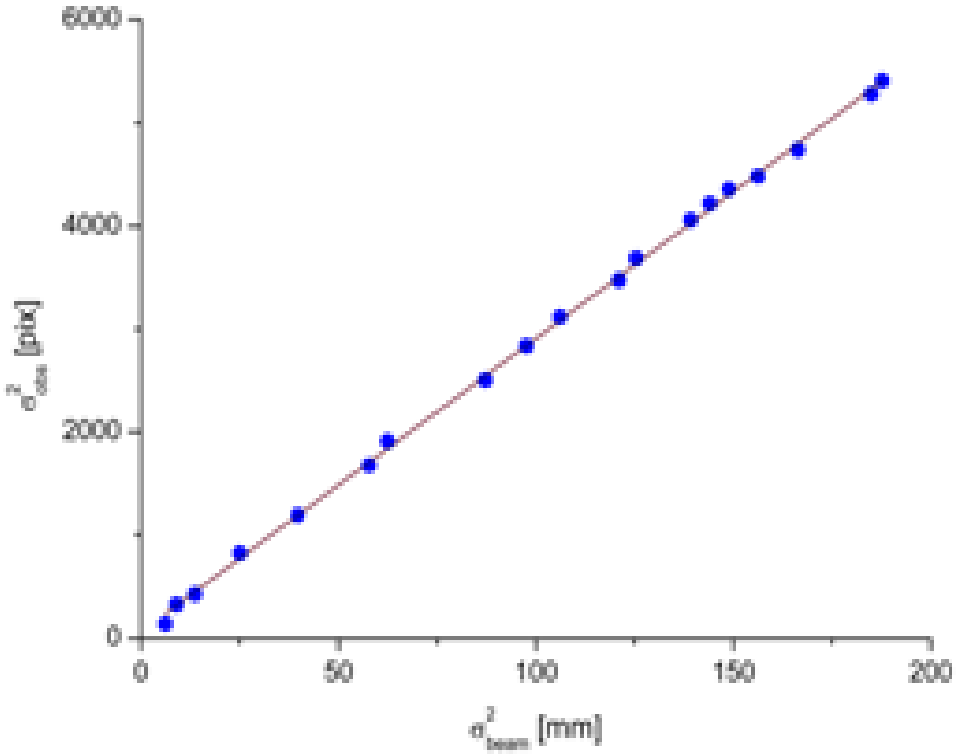


$$\sigma_{obs\,[pix]} = \sqrt{\sigma^2_{beam\,[mm]} + \sigma^2_{drift\,[mm]}} \cdot R_{pix/mm}$$

$$\sigma^2_{obs\,[pix]} = \sigma^2_{beam\,[mm]} \cdot R^2_{pix/mm} + \sigma^2_{drift\,[mm]} \cdot R^2_{pix/mm}$$

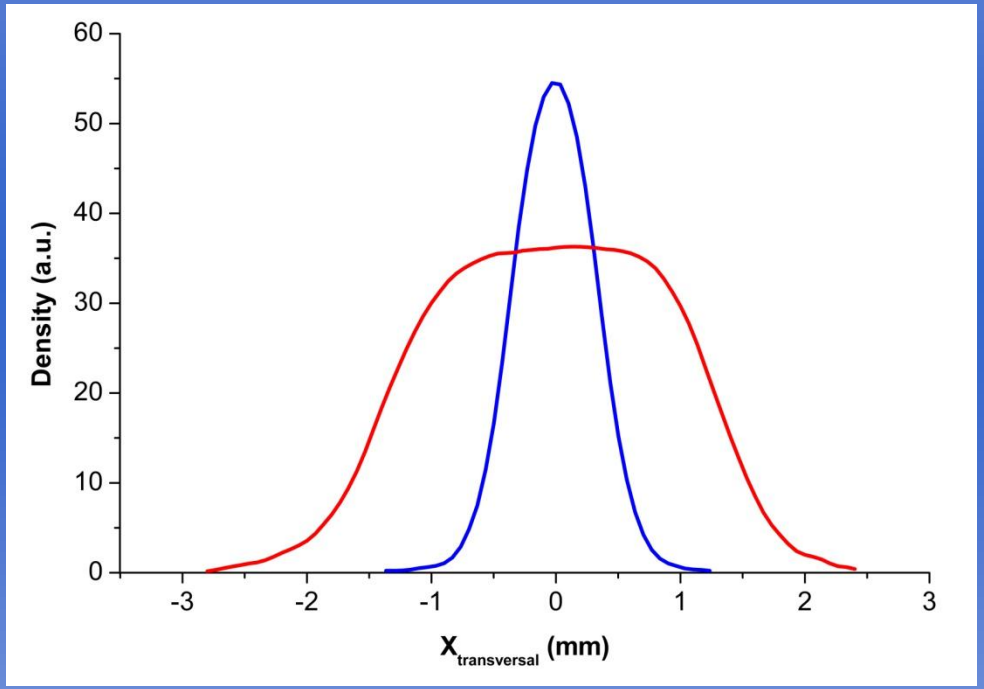
- Measured ion drift compatible with simulations:

  0.9 ± 0.15 mm



Electron Gun beam (5keV, 10 μA, 10^{-7}mbar)

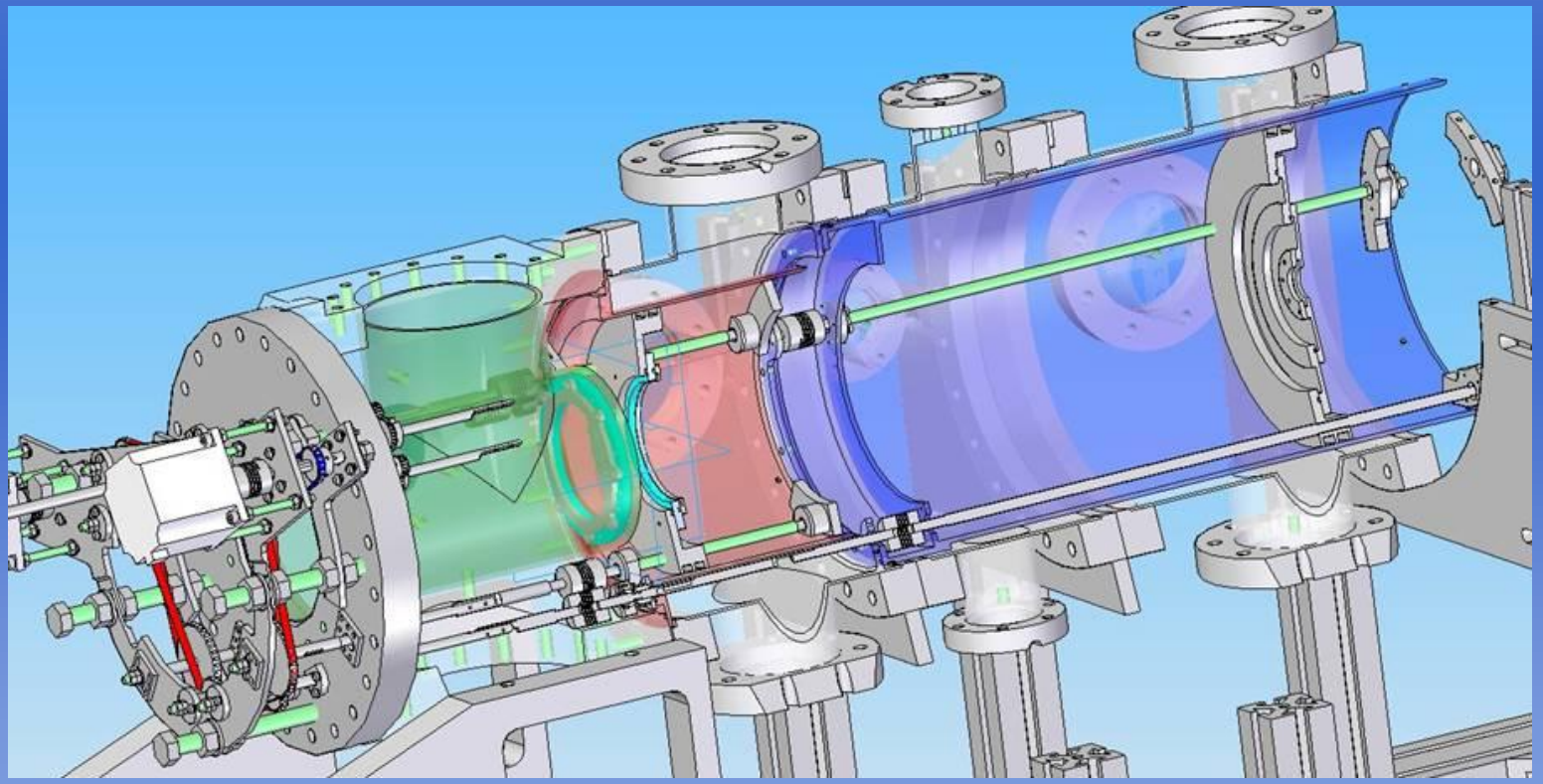
Integrated profile



Sub-mm **resolution**

(preliminary result)

- Optimized Jet Screen Operation
- Parameters detailed analysis



Special Thanks:

Angela Intermite PhD-Candidate

Dominic Borrows Undergraduate Researcher

Claus-Dieter Schroeter Senior Researcher (MPI Heidelberg)

- References:

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2. M. Putignano *et al.*: Design of a nozzle-skimmer system for a low perturbation ionization beam profile monitor – DIPAC09 Proceedings.
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7. M. Putignano *et al:* Numerical Study on the Generation of a Planar Supersonic Gas Jet – Nucl. Instr. Meth. Phys. Res. A, *submitted*.

Thank you for your attention