A High Density Cluster-Jet-Target for 4π Detectors

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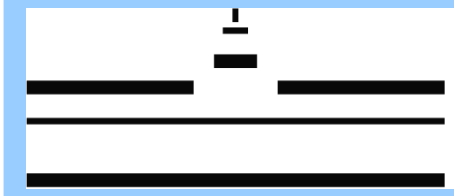
für Bildung
und Forschung



Westfälische
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Motivation

cluster-jet targets are important for internal target experiments at storage rings:

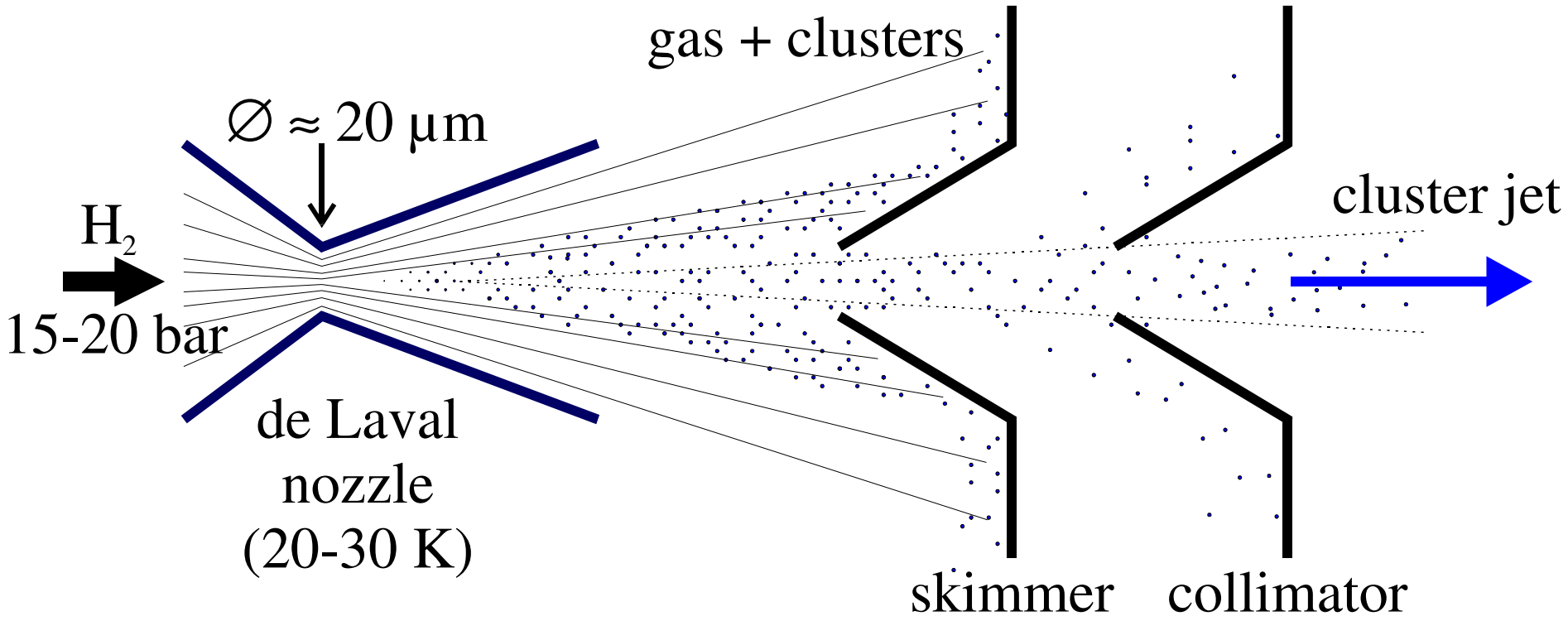
- target thickness is adjustable
- high purity of target material
- low influence on vacuum conditions in the accelerator
- target size and shape are customisable
- possibility to switch the target on/off at any time

Cluster-jet targets

principle of operation:

purified H_2 or D_2 gas passes a de Laval nozzle

$\Rightarrow$ formation of clusters surrounded by gas

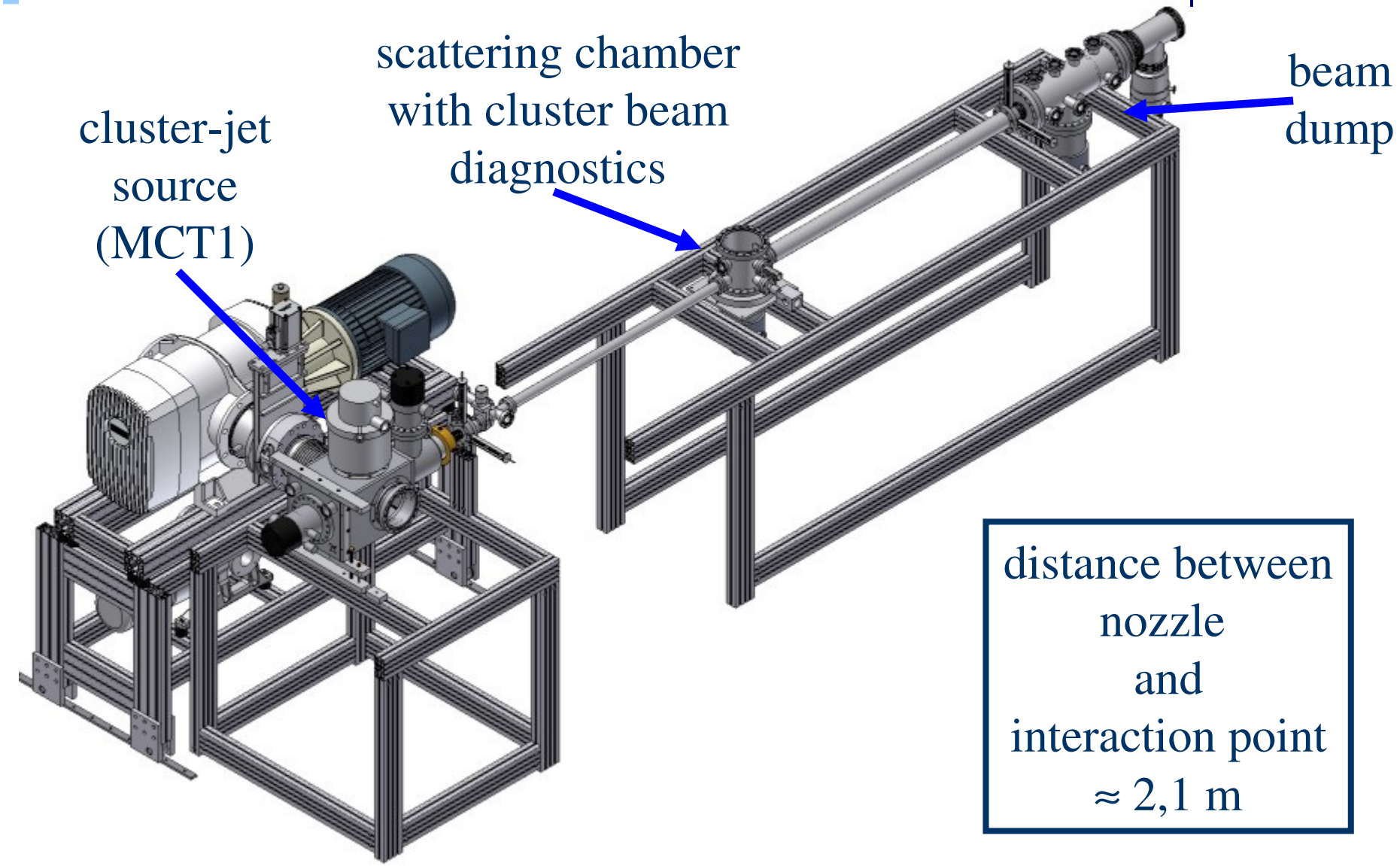


Target thickness of hydrogen cluster-jet targets

- established cluster-jet targets:
  - distance from nozzle to interaction point: 0.2 – 0.6 m
  - target thickness: > 10^{14} atoms/cm^2
- next generation experiments (e.g. PANDA):
  - distance from nozzle to interaction point: **2 m**
  - target thickness $\propto$ 1/(distance)^2

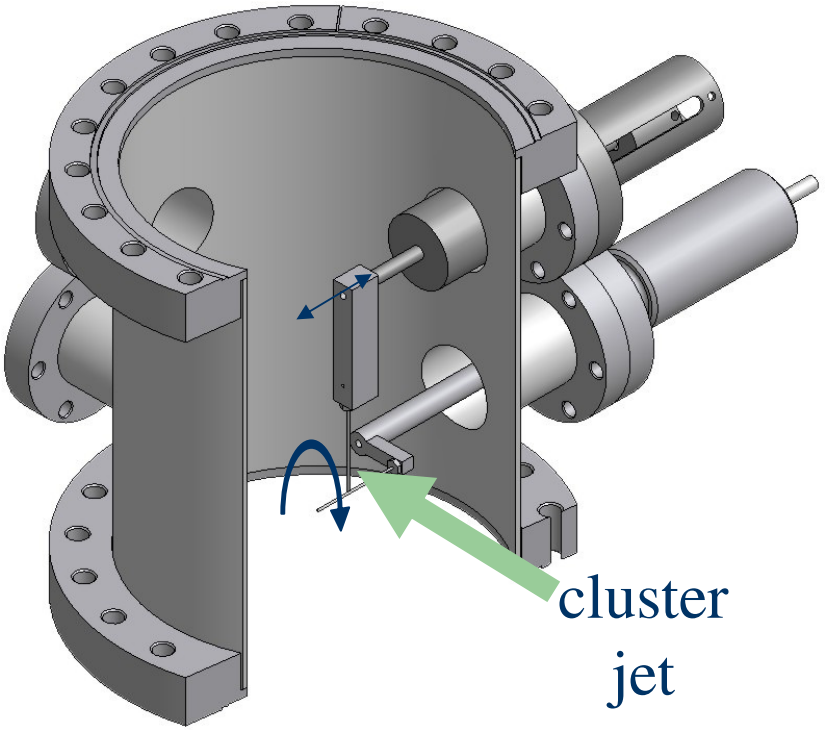
$\Rightarrow$ **target thickness must be improved by 1-2 orders of magnitude**

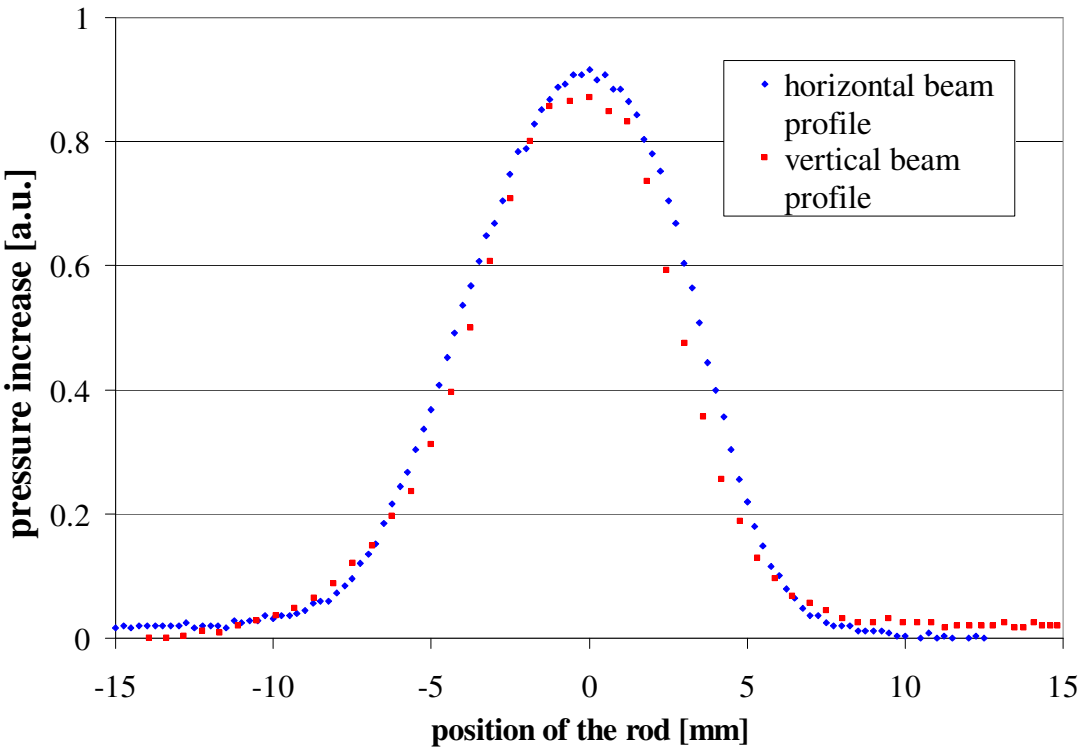
The cluster target setup in Münster



distance between
nozzle
and
interaction point
≈ 2,1 m

Measurement of the target thickness





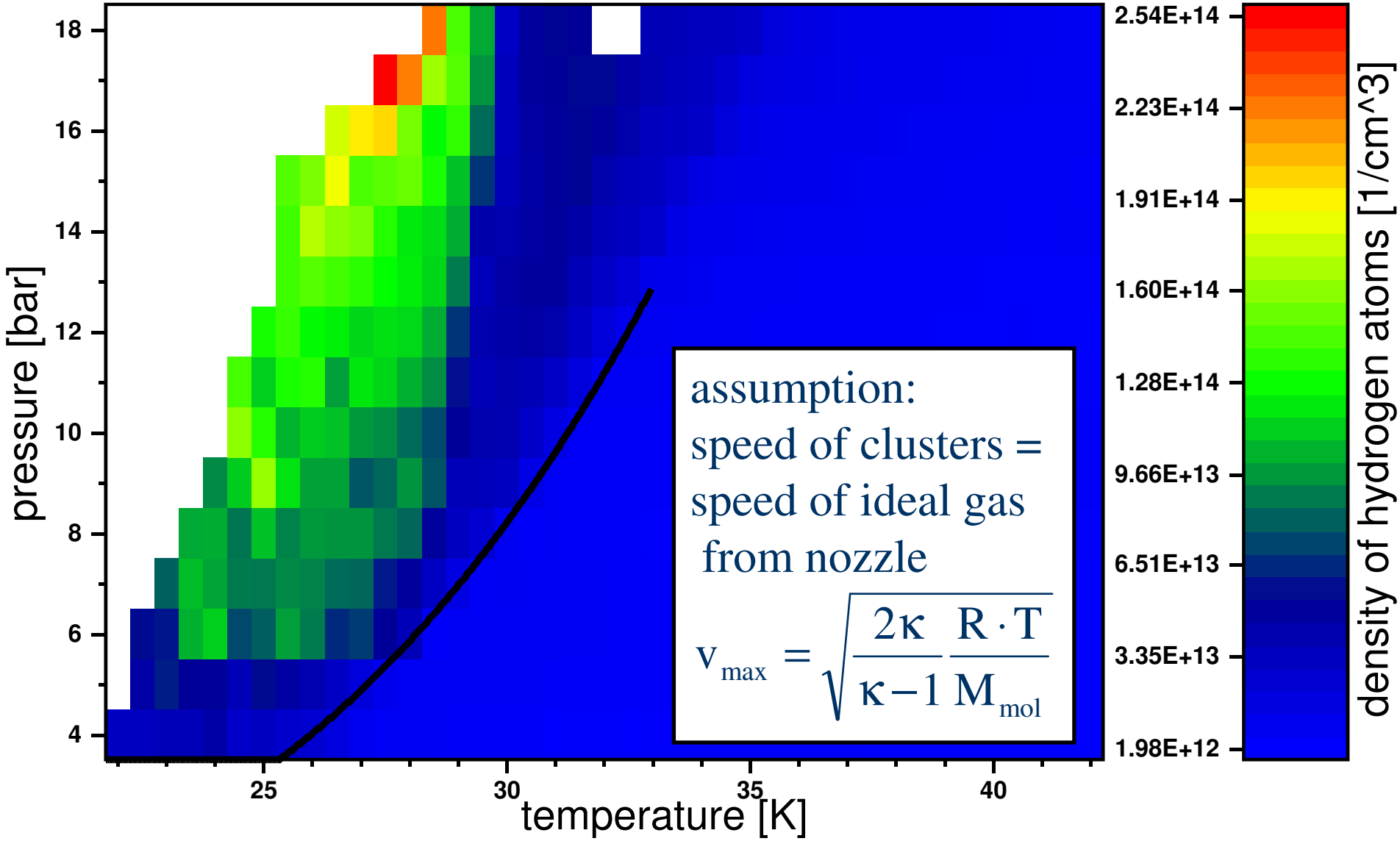
$$n_T = \frac{\Phi_{jet}}{A \cdot v_{jet}}$$

Φ_{jet} = cluster jet flow (atoms/s)

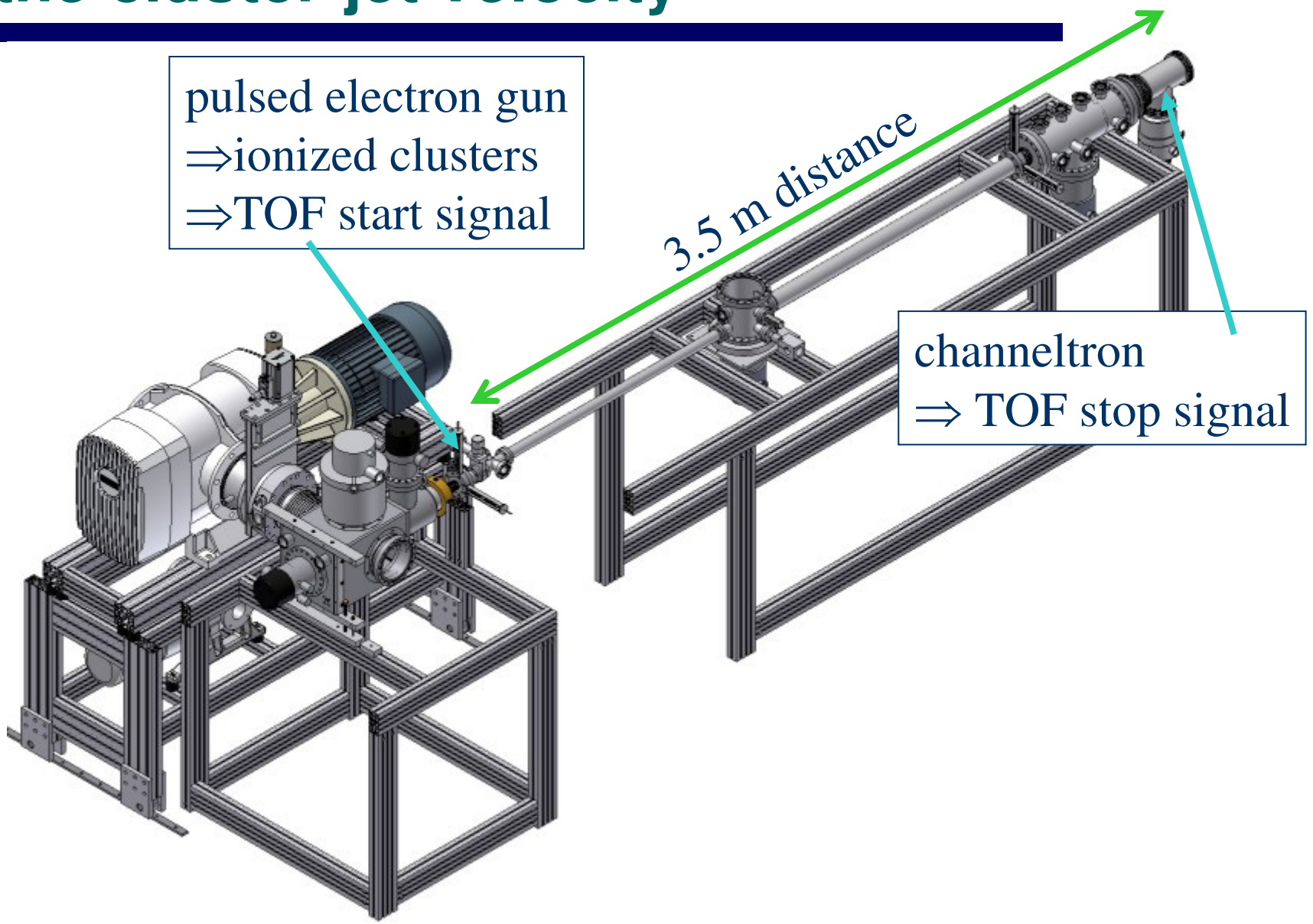
A = cluster jet cross section

v_{jet} = cluster jet velocity

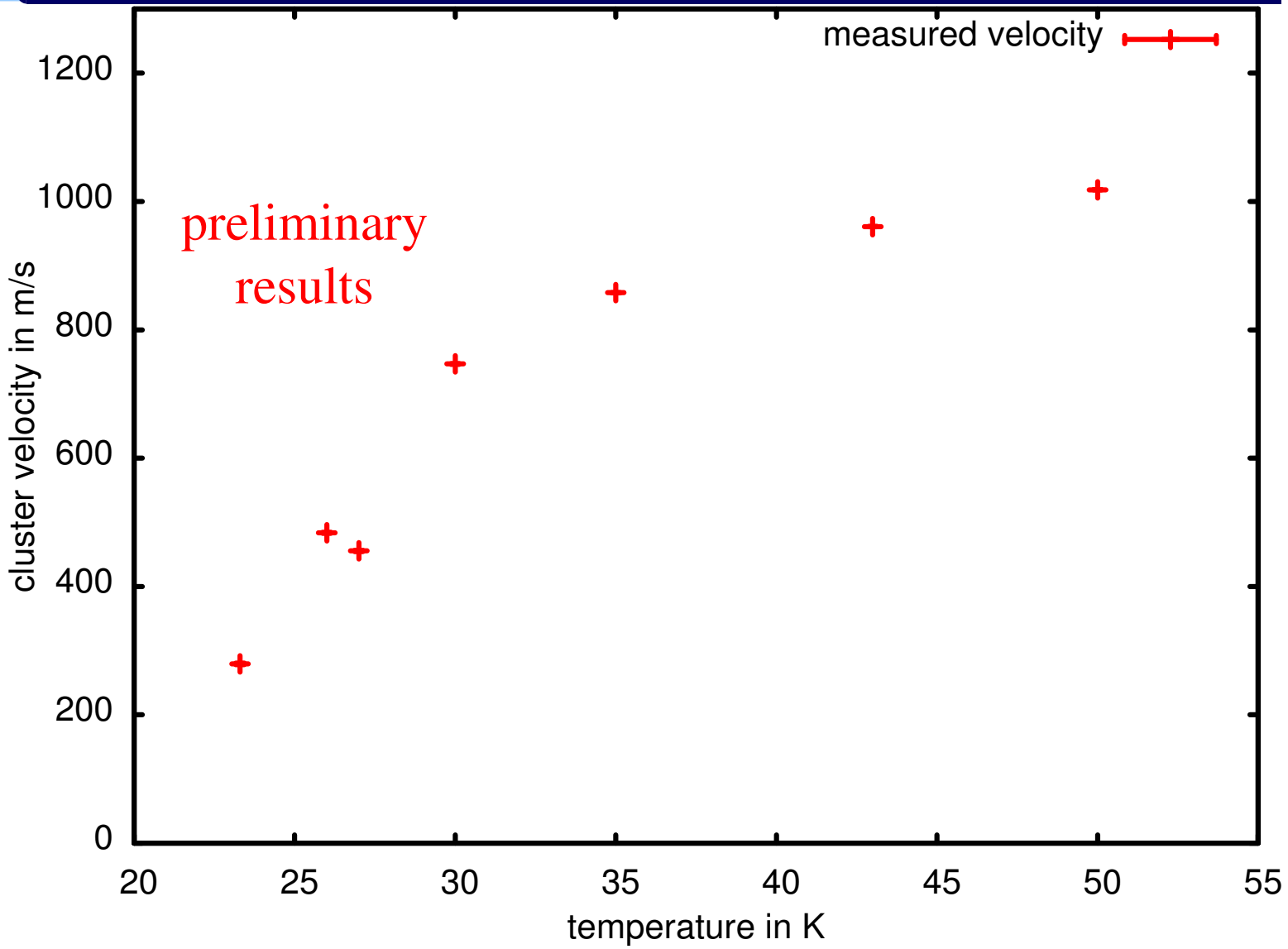
Density map of the cluster jet target in Münster



Time of flight measurement of the cluster-jet velocity



Cluster jet velocity at constant nozzle pressure (8 bar)



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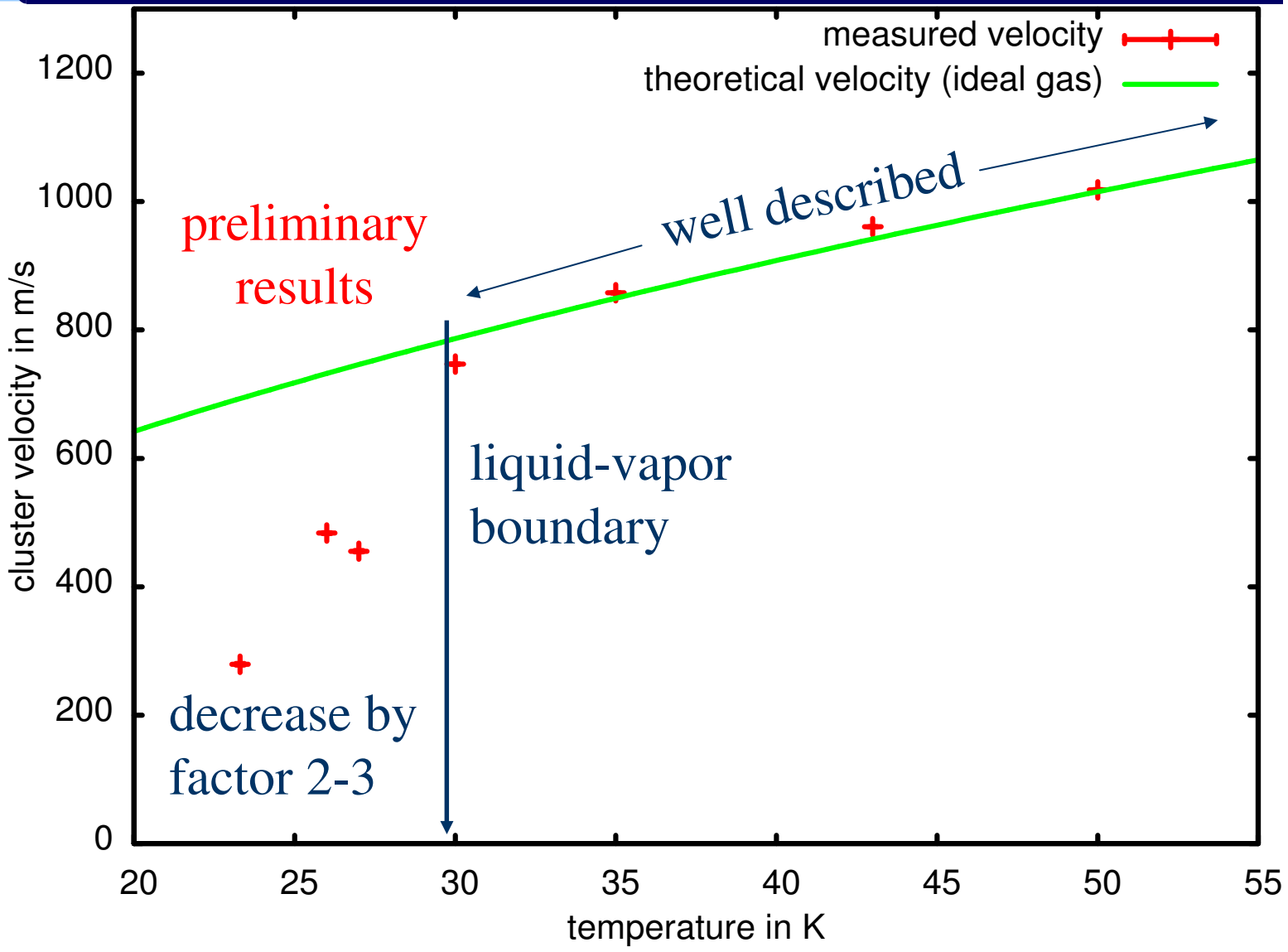

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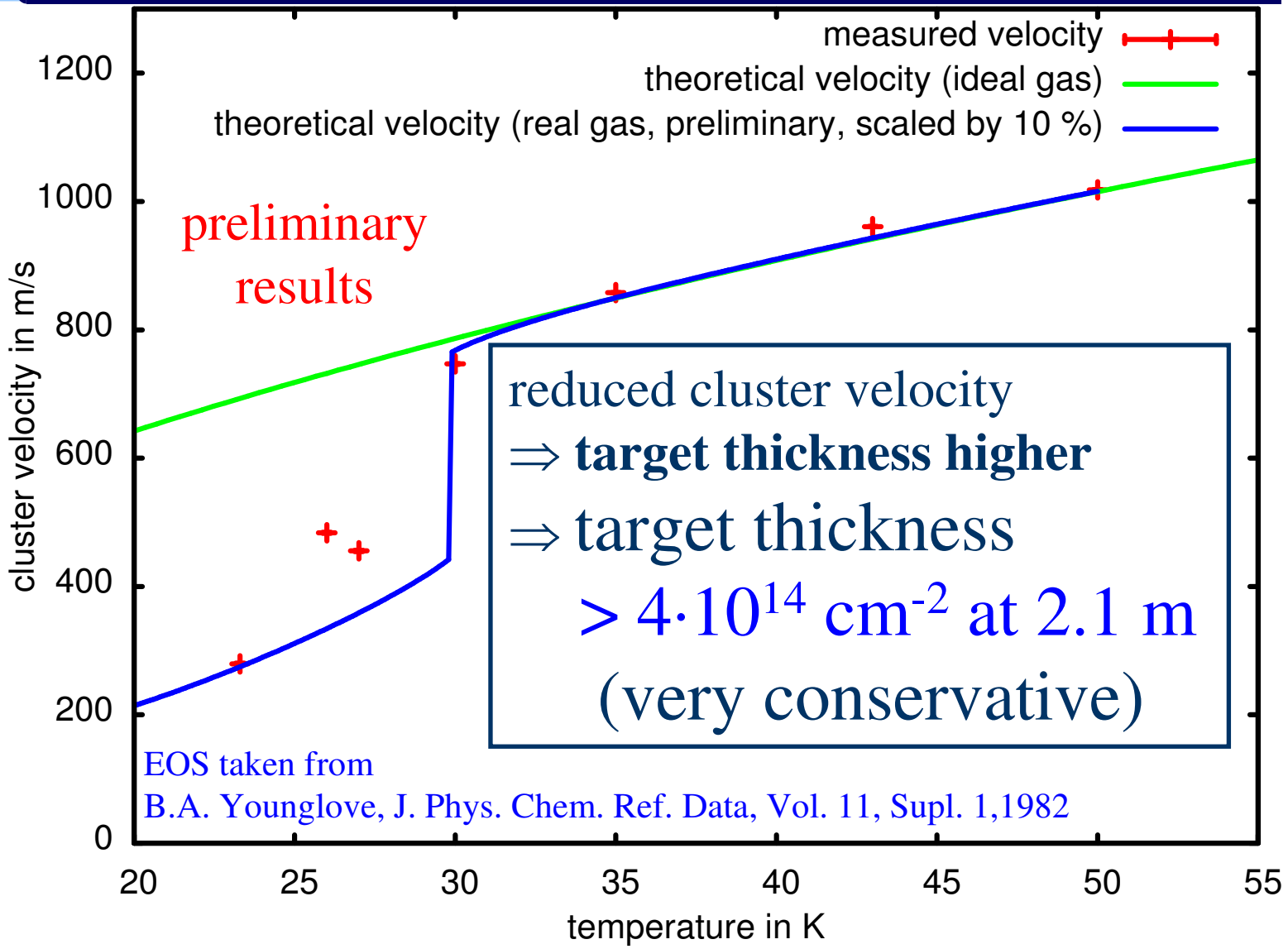
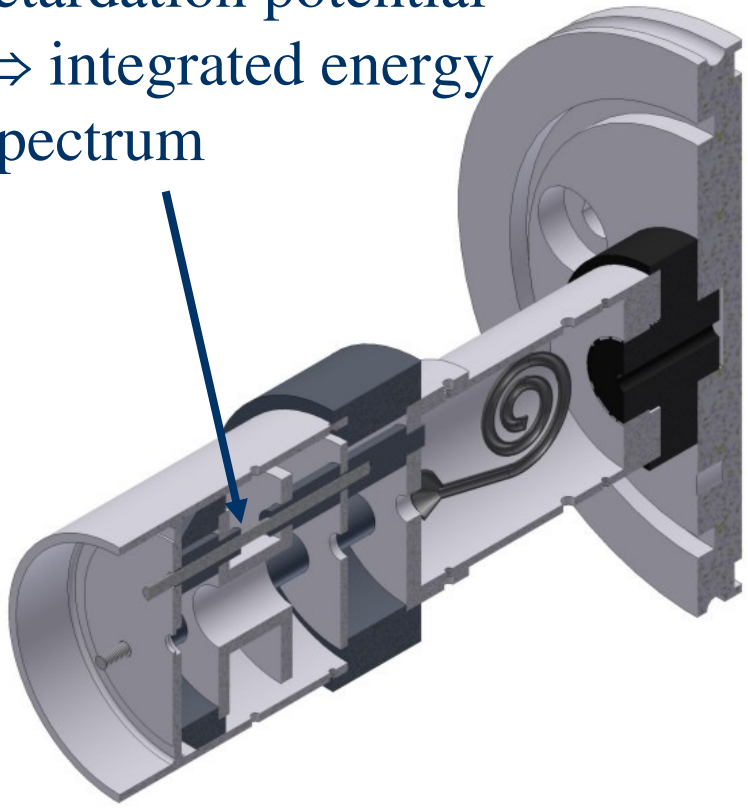
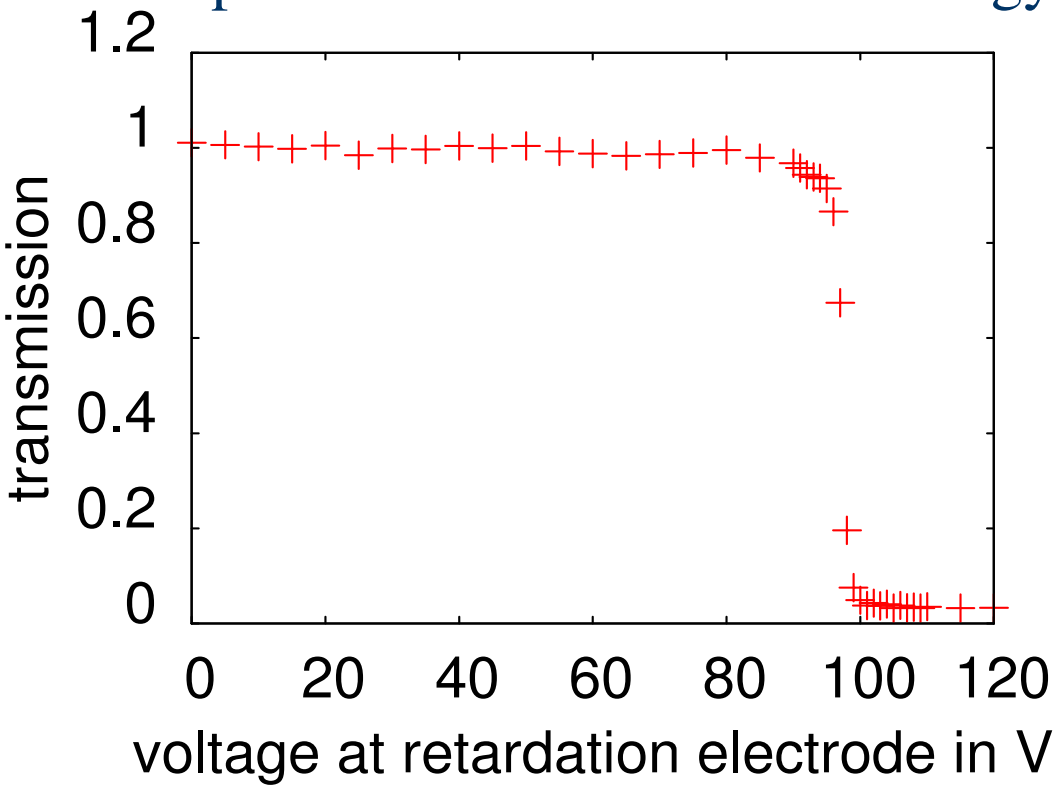


Current project: Determination of the cluster mass

electrode with retardation potential ⇒ integrated energy spectrum



transmission curve measured using a proton beam with 100 eV energy



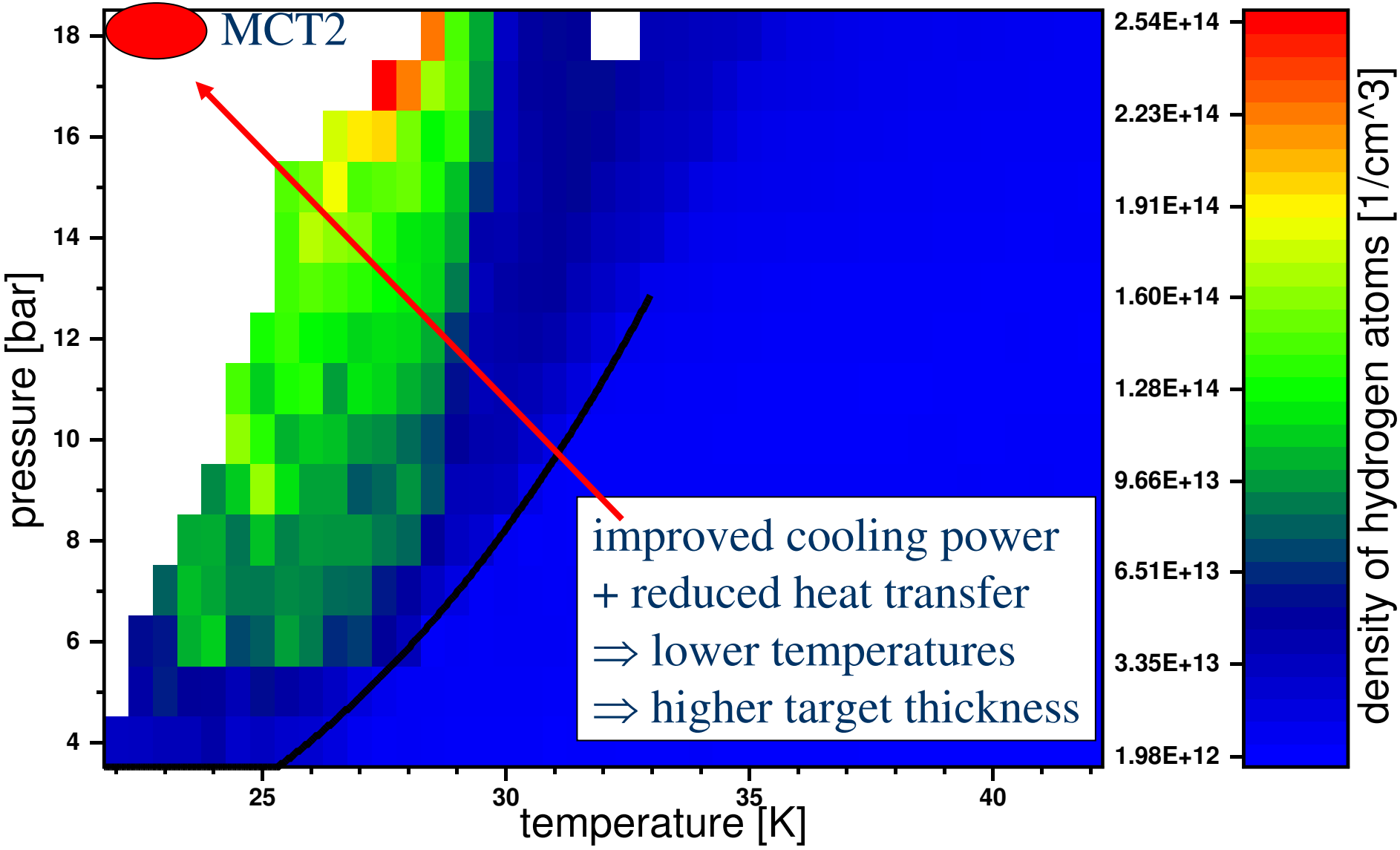
mass range up to $8 \cdot 10^5$ atoms

A prototype for the PANDA experiment

main design goals for MCT2:

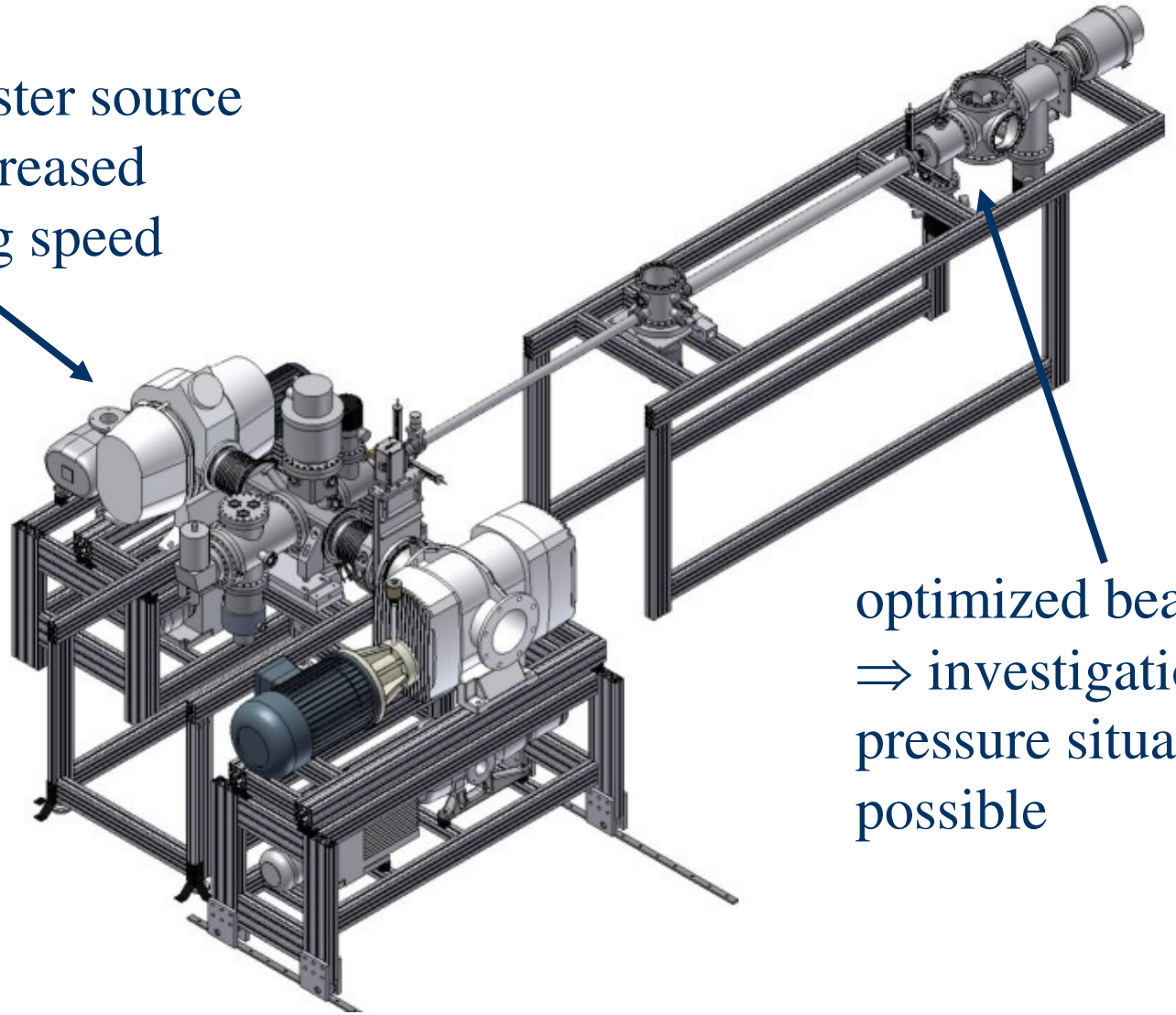
- lower nozzle temperature
  $\Rightarrow$ higher target thickness
- maintenance as easy as possible
- online adjustment of skimmer and collimator
  $\Rightarrow$ online adjustment of target axis

Point of operation of MCT2



Final design of the new cluster target source MCT2 as prototype for PANDA

new cluster source
with increased
pumping speed

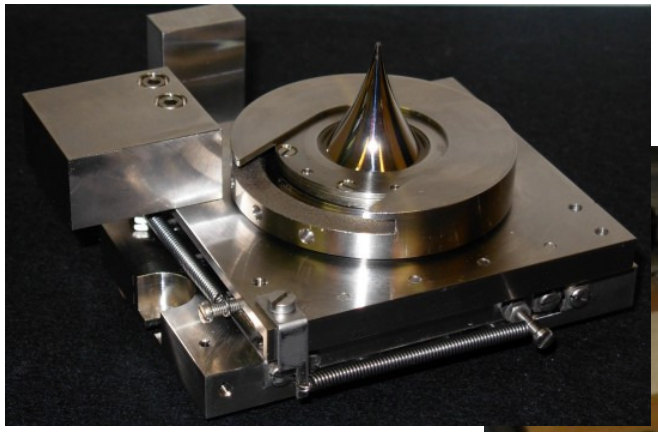


optimized beam dump
⇒ investigation of
pressure situation
possible

Summary and Outlook

- target thickness **> $4 \cdot 10^{14}$ atoms/cm^2** at **2.1 m**
  (very conservative estimation)
- online cluster velocity measurement
  $\Rightarrow$ target thickness can be calculated without assumptions
- investigation of cluster mass in progress
- currently:
  assembly of new cluster-jet source (MCT2)
- this summer:
  first cluster operation with MCT2

Thank you for your attention!



MCT2