Novel internal target source for future storage ring experiments

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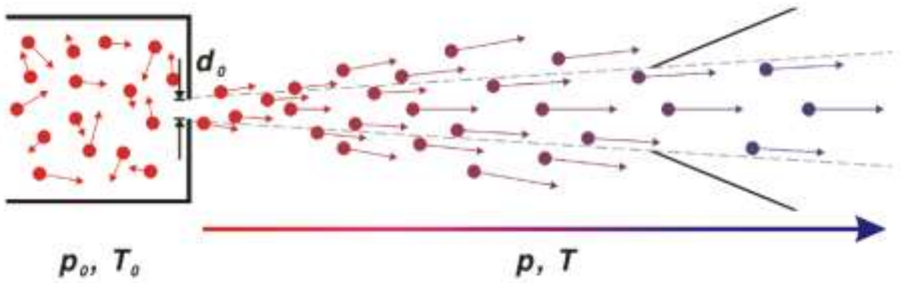
Target beam generation

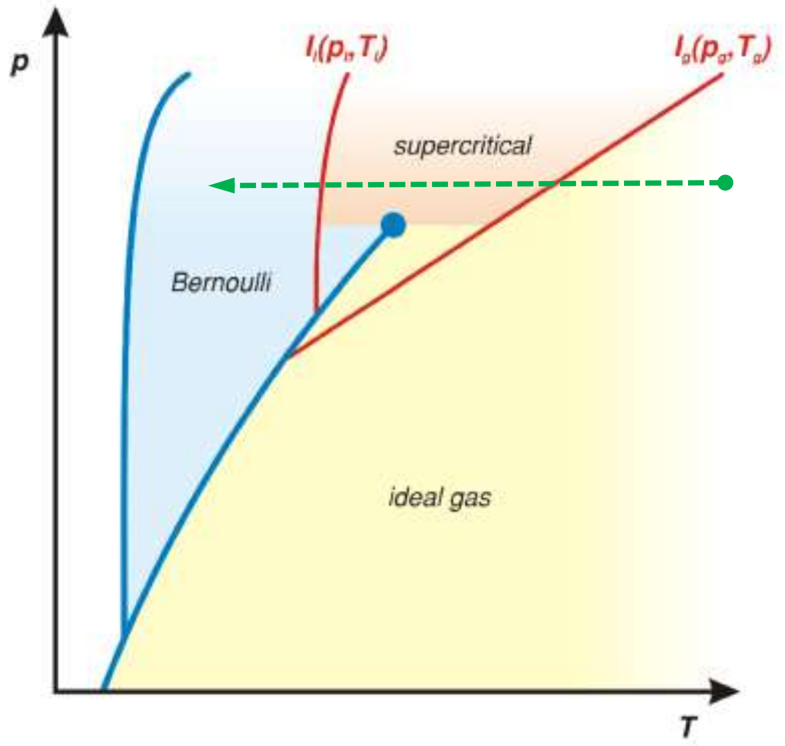
- Isentropic expansion of the fluid into vacuum

- The nozzle parameters temperature *(T_0)*, pressure *(p_0)*, diameter *(d_0)* and geometry define the achievable density

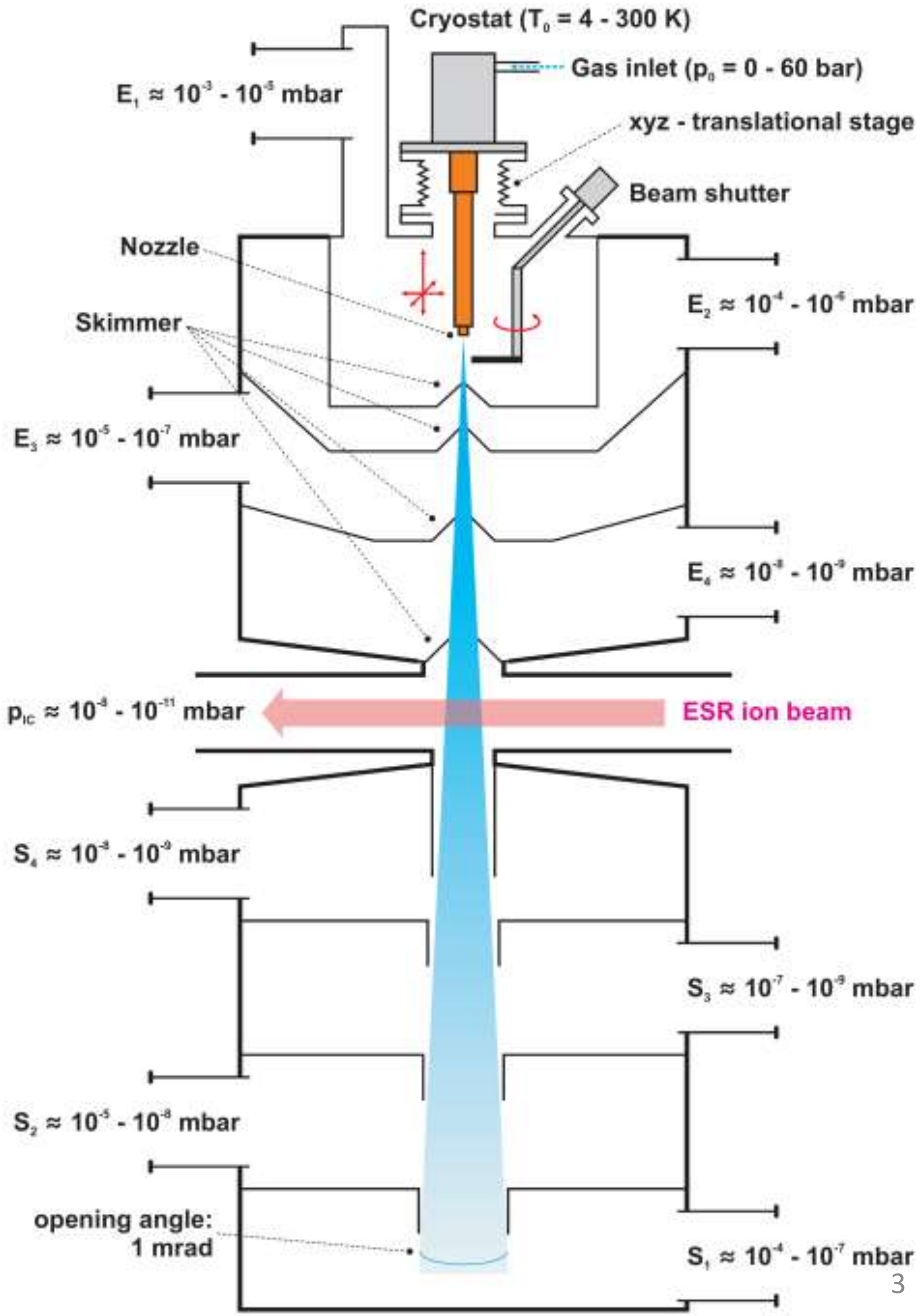
- The fluid can be expanded from its gaseous, supercritical or liquid phase, yielding a supersonic jet, cluster or microdroplet beam: **multiphase target !**

- The target beam is self replenishing





Internal target at the ESR



- The cryostat allows the nozzle operation at temperatures down to $T_0 = 4\ K$

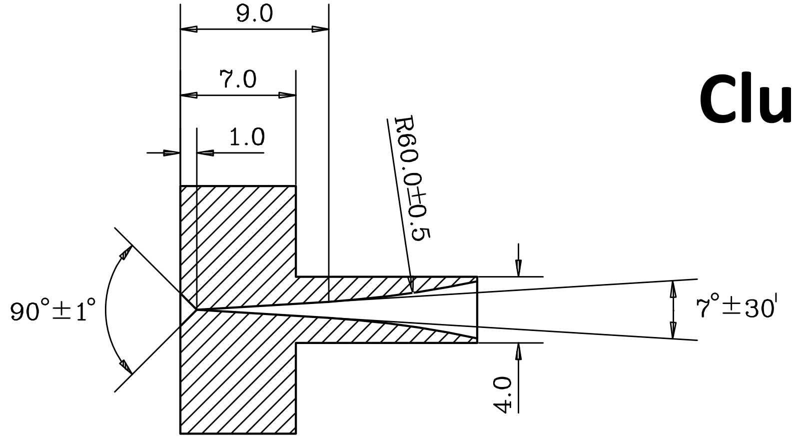
- The target density can be derived from the pressure increase in the dump pressure chambers $S_1 - S_4$

Nozzle geometries

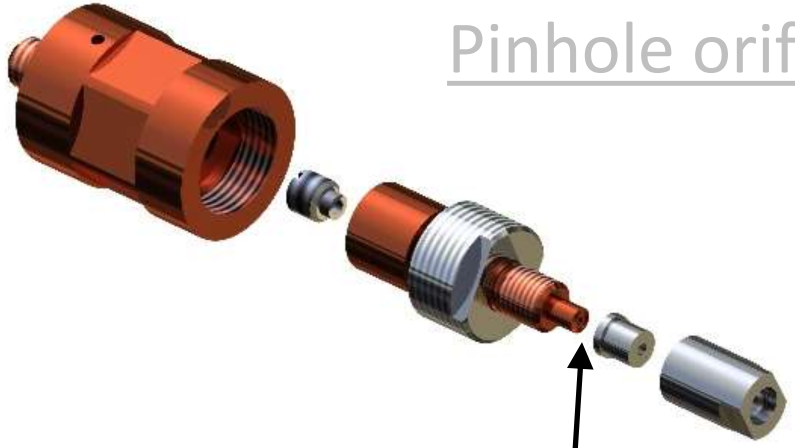
<u>Trumpet shaped</u>

Gas expansion

Cluster beam



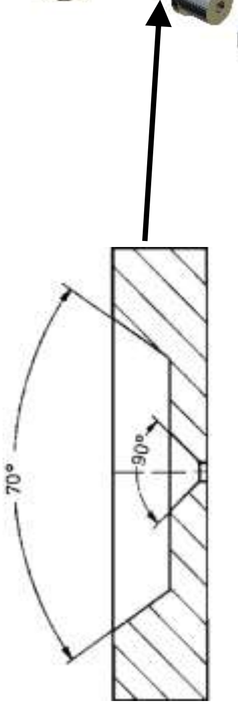
d_0 = 15 µm



<u>Pinhole orifice</u>

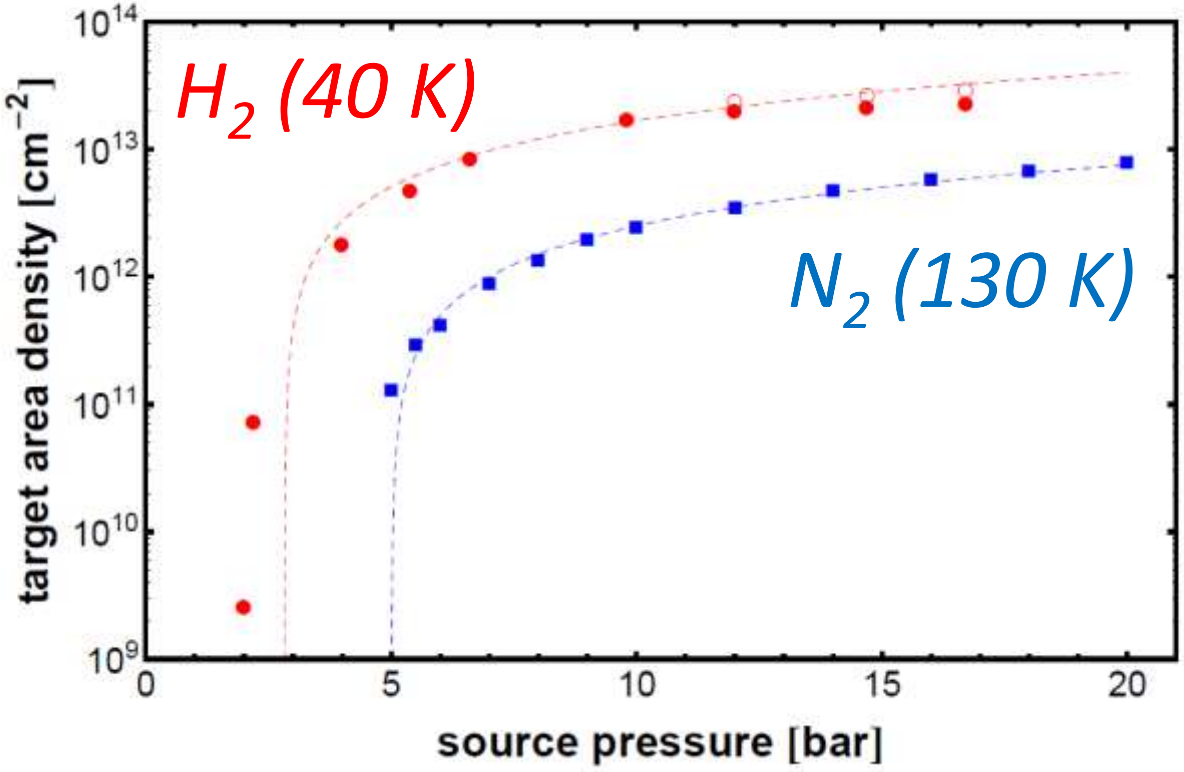
Liquid expansion

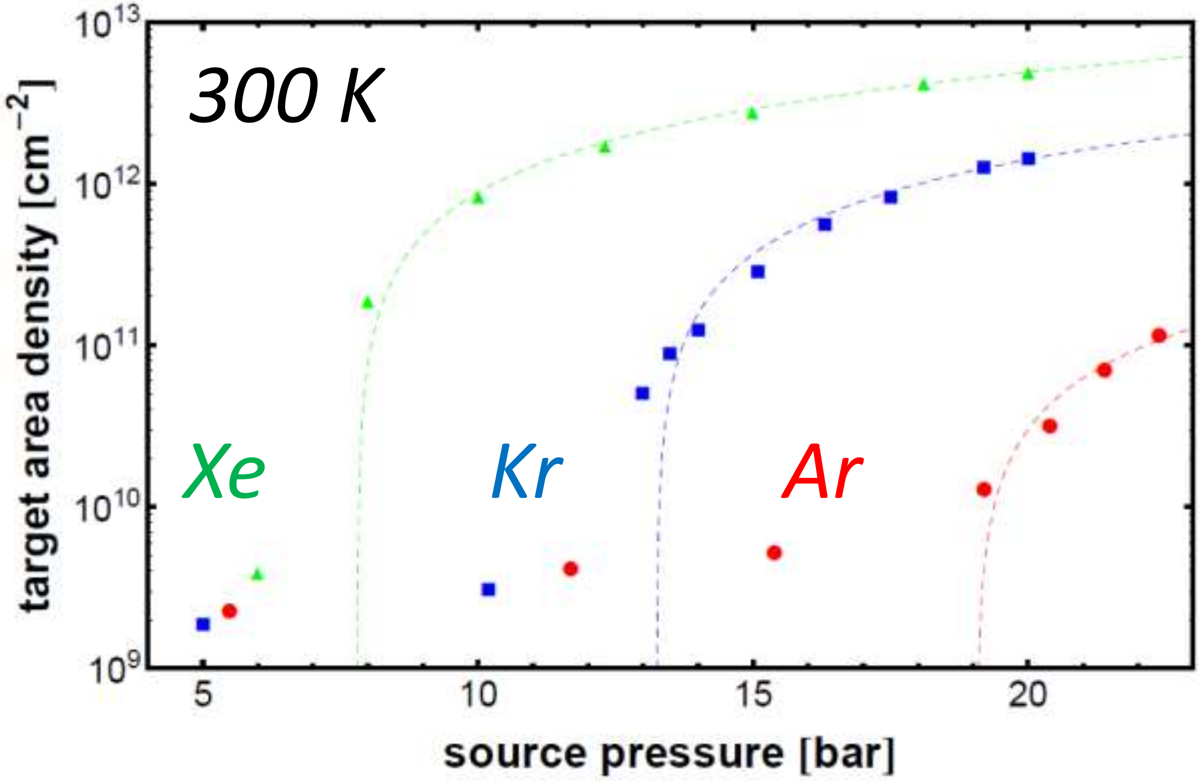
Droplet beam



d_0 = 5 µm

Measured cluster target densities



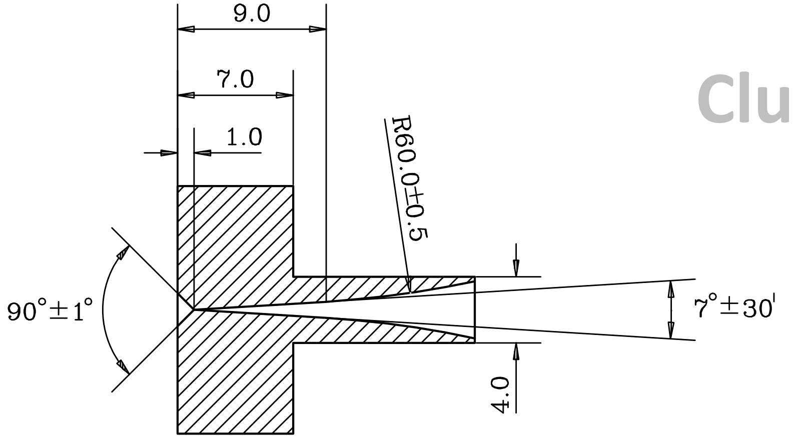


Nozzle geometries

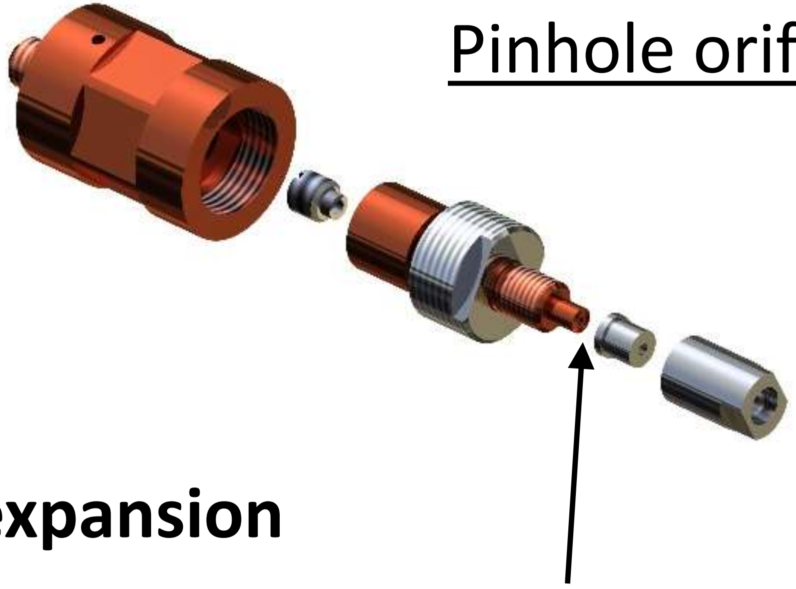
Trumpet shaped

Gas expansion

Cluster beam



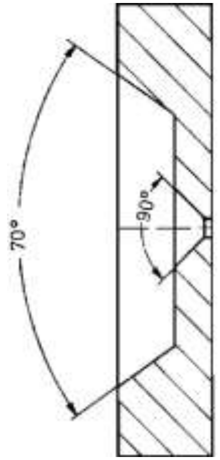
d_0 = 15 µm



Pinhole orifice

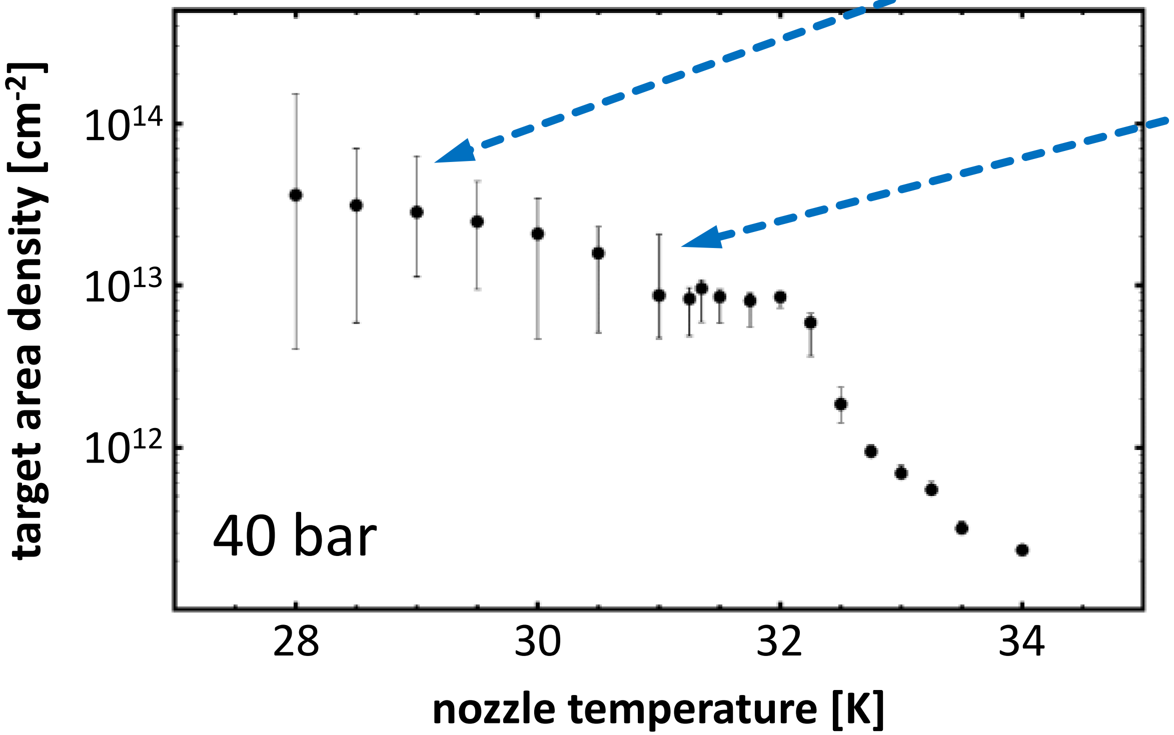
Liquid expansion

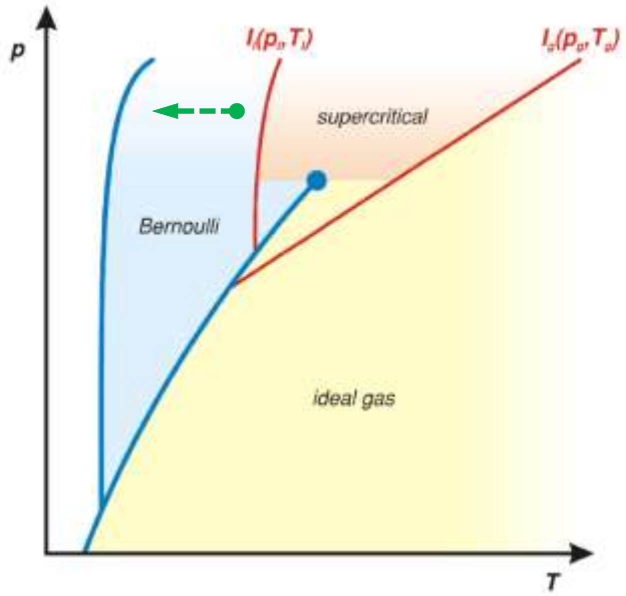
Droplet beam



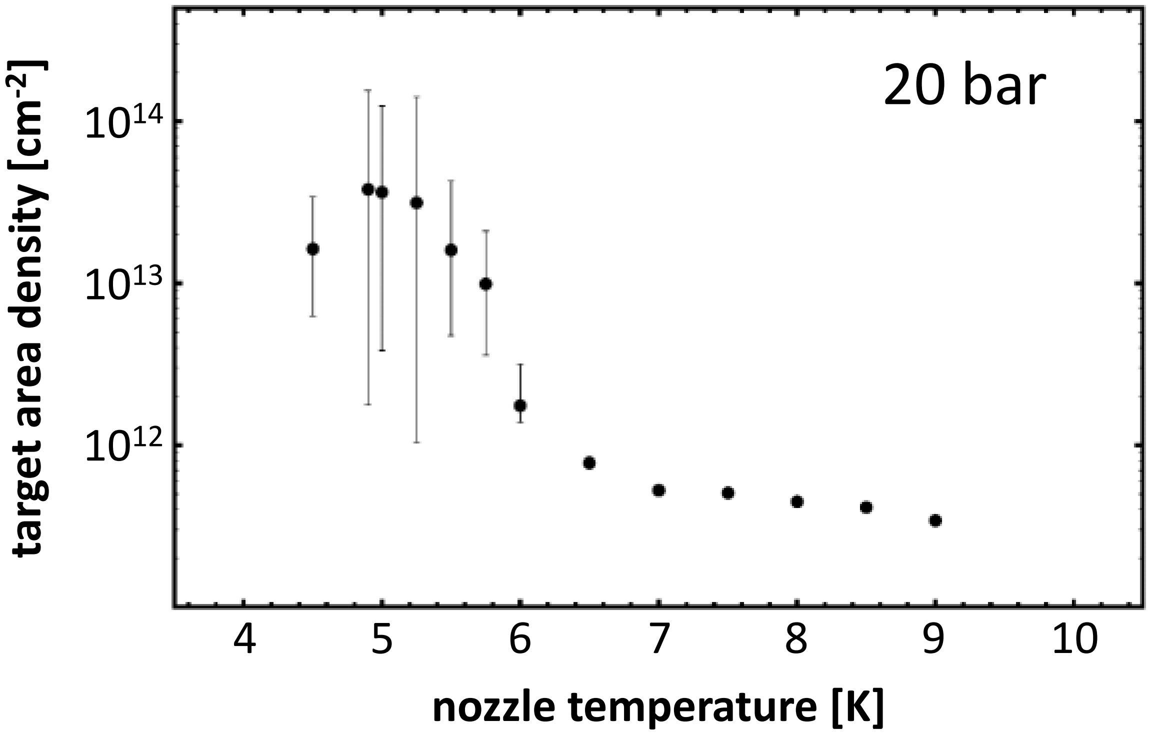
d_0 = 5 µm

Microdroplet target beam: H_2 area density

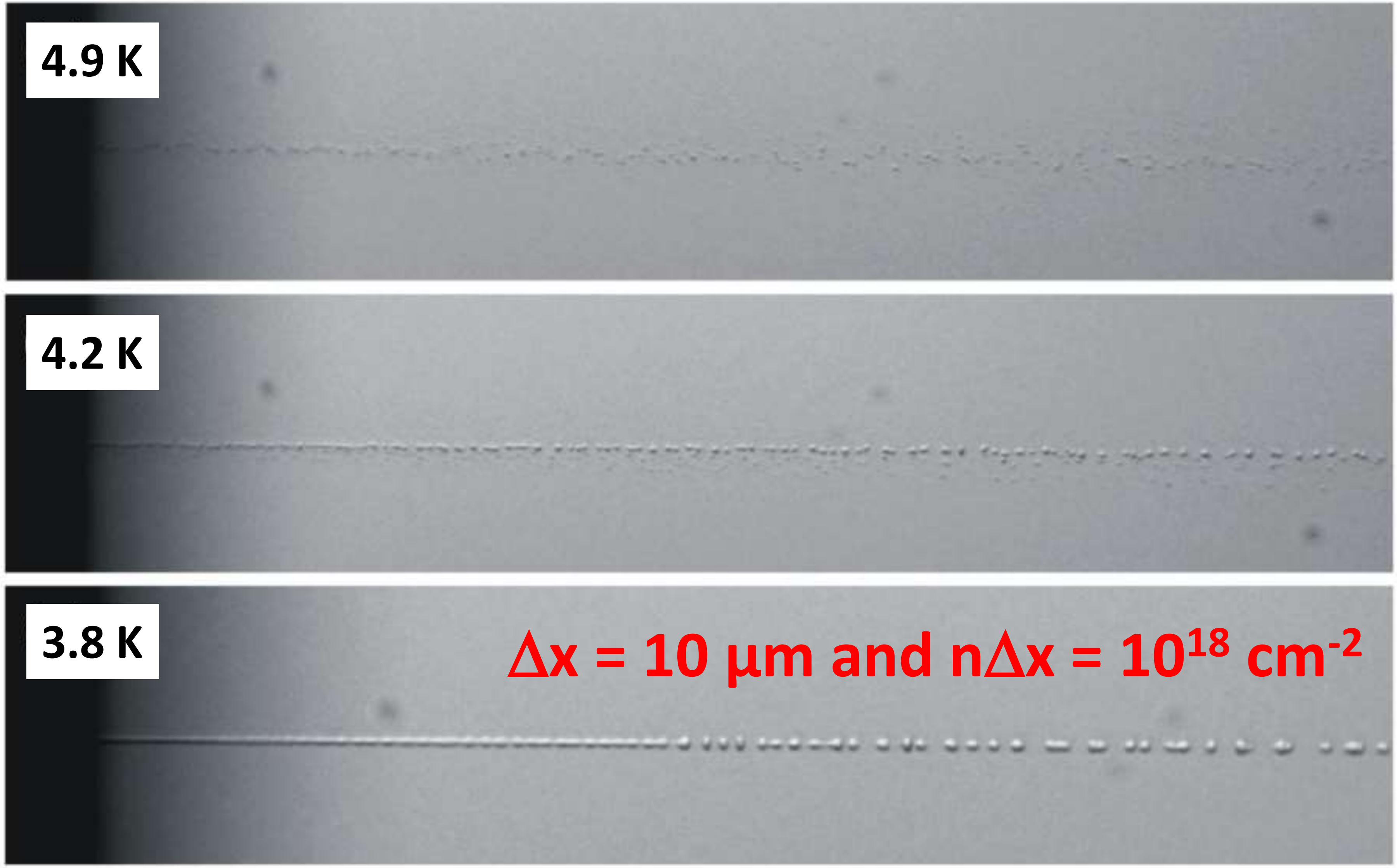




Microdroplet target beam: He area density



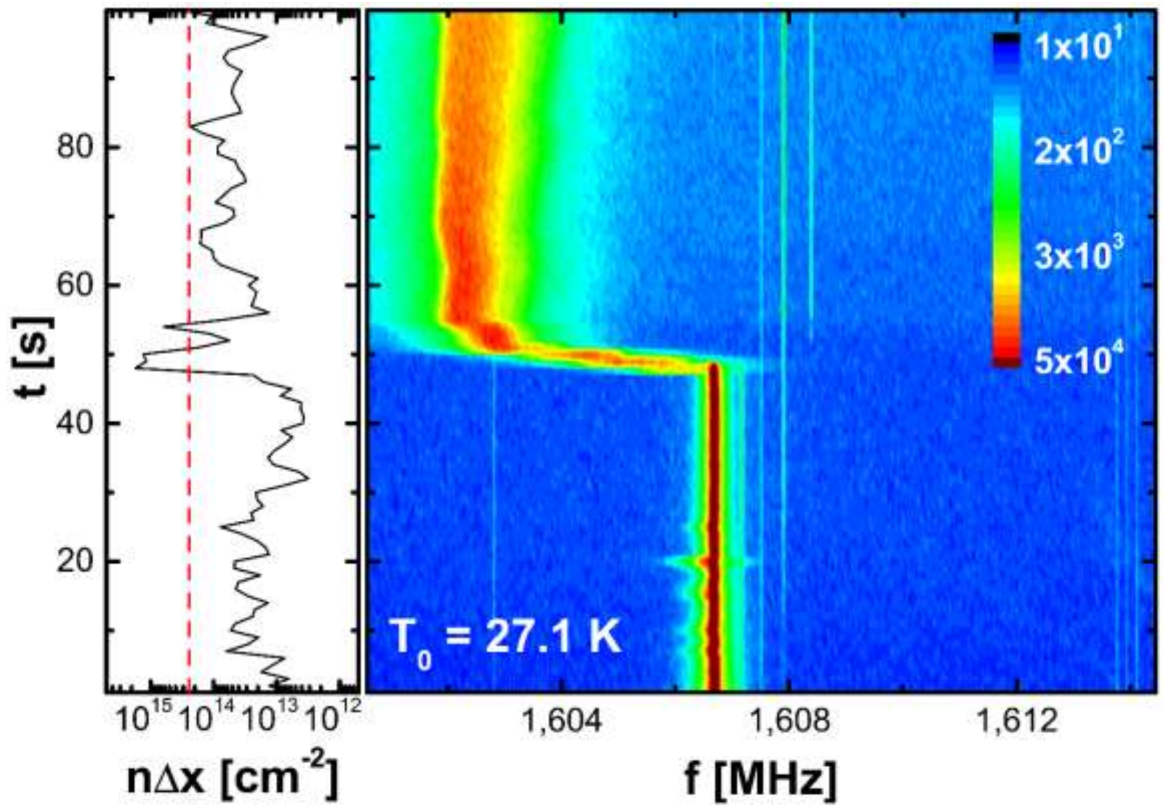
Helium Droplet Beams at p_0 = 10 bar



Electron cooler performance at high densities

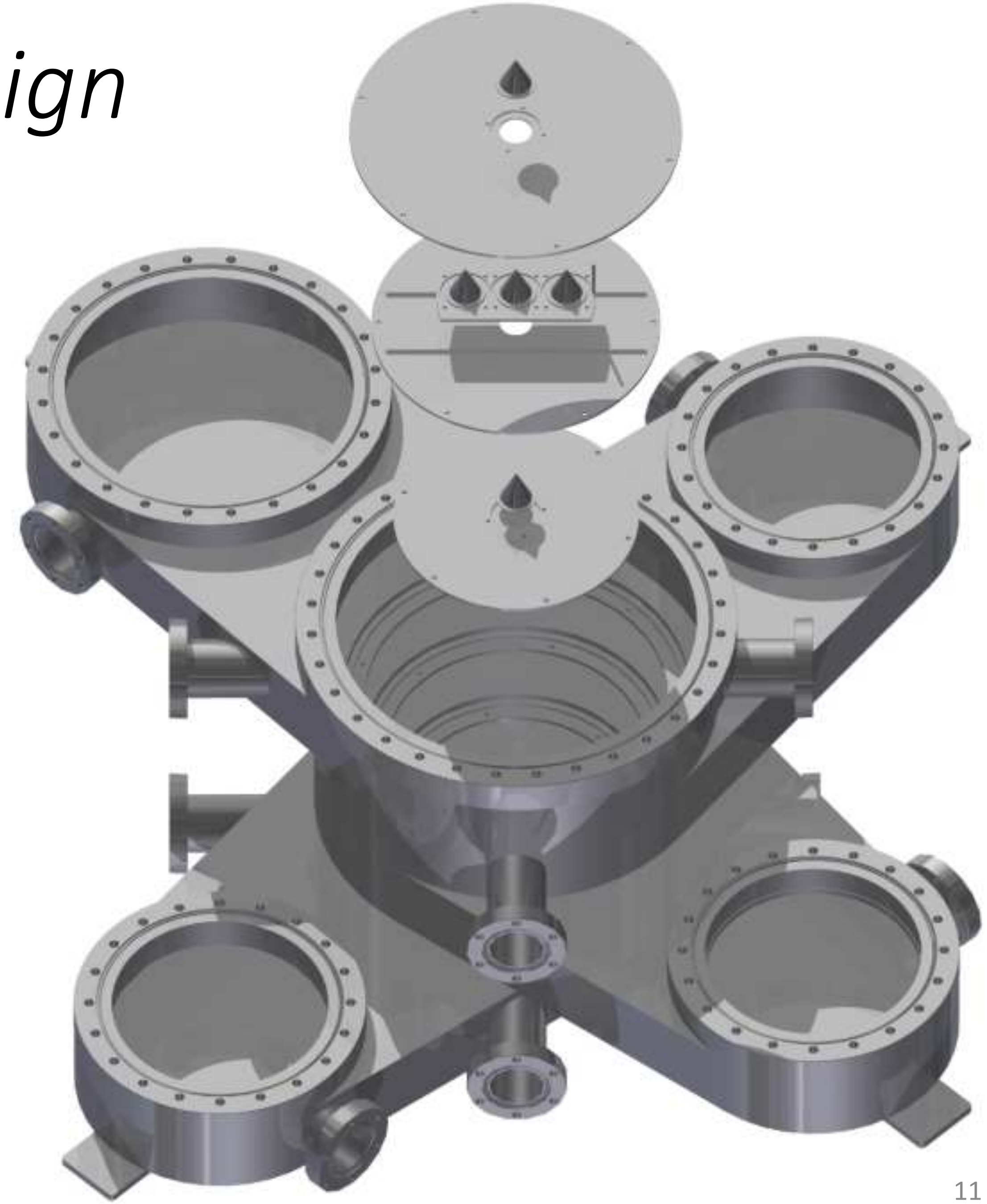
- The electron cooler may not be able to compensate the energy loss

- Good agreement between the expected value and the measurement shows no indication of droplet influence



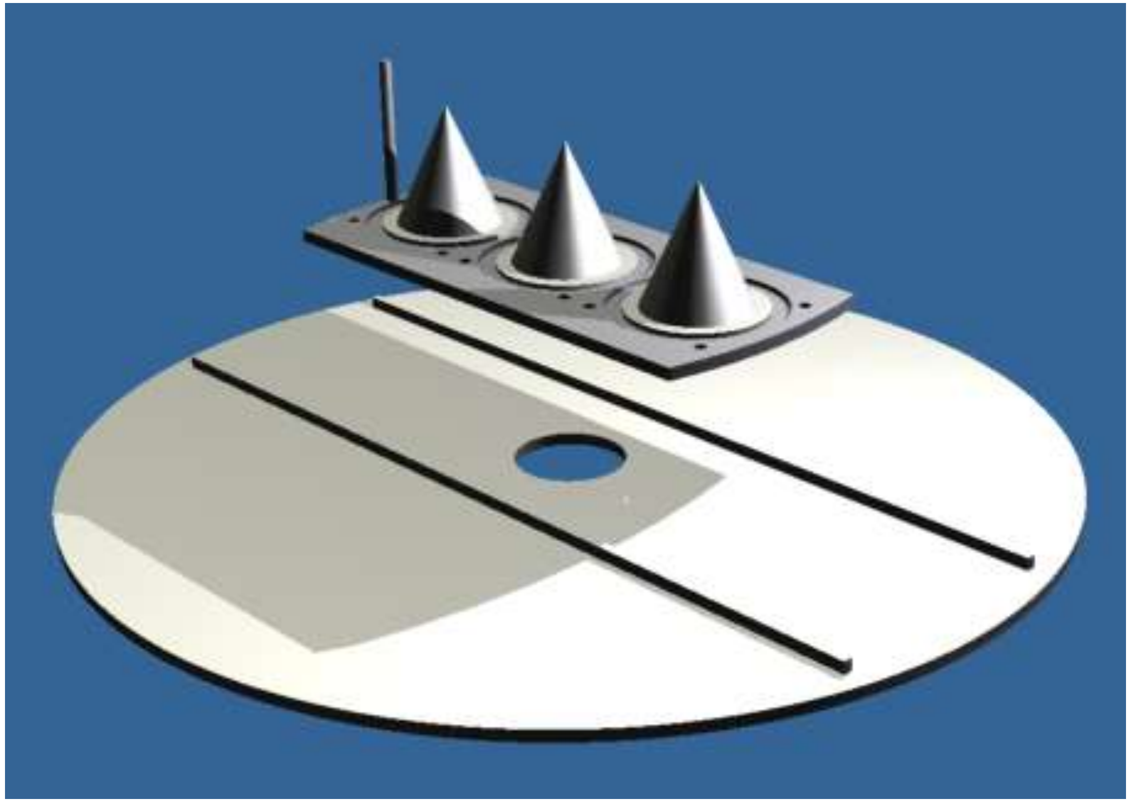
New inlet chamber design

- Modular, accessible and compact
- Even higher target densities for all required gases ranging from helium to xenon
- Offers smaller target width



Reduced interaction legth

- Modular, accessible and compact
- Even higher target densities for all required gases ranging from helium to xenon
- Offers smaller target width (remotably movable panel and interchangeable skimmers)

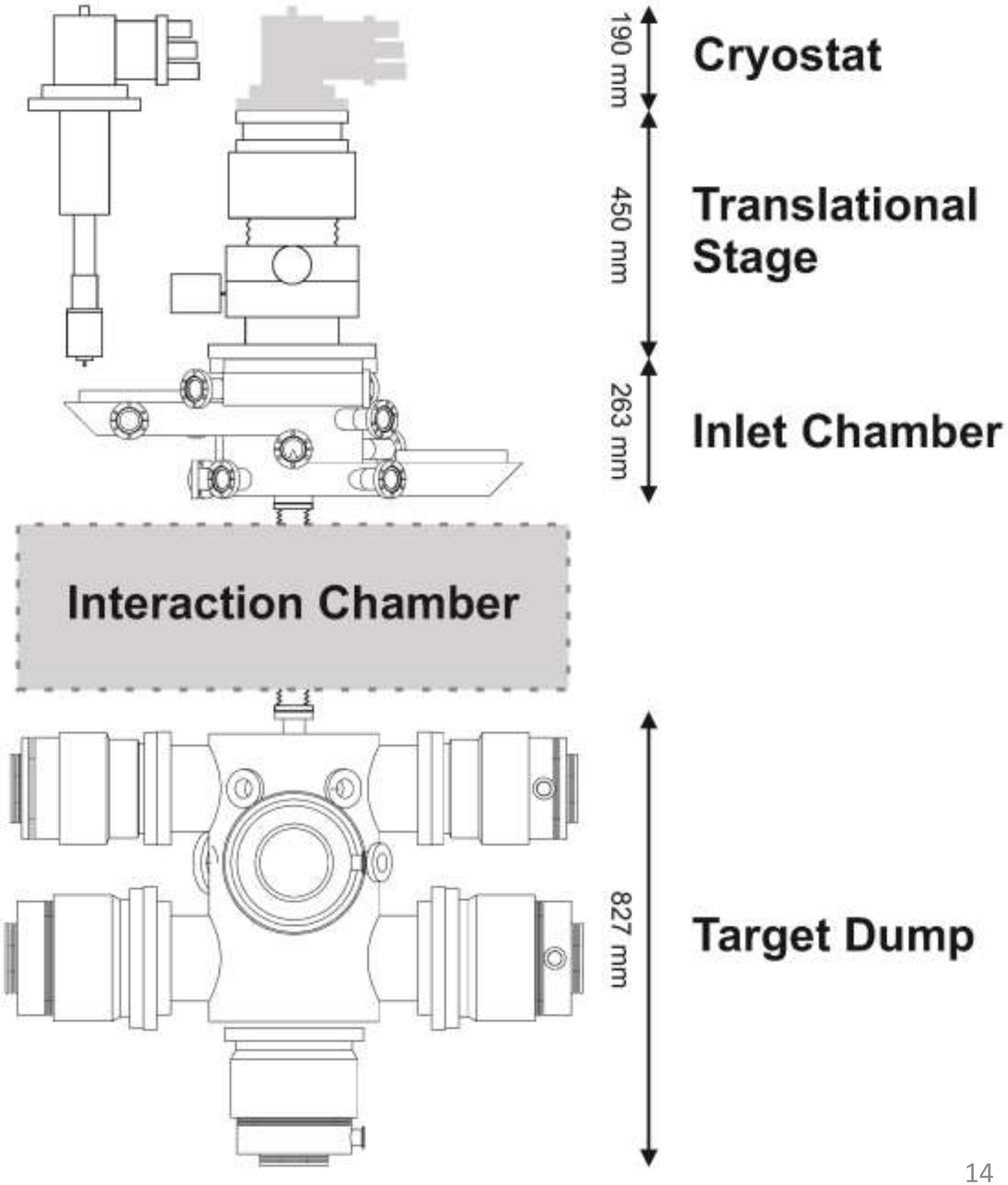


New chamber is currently being assembled

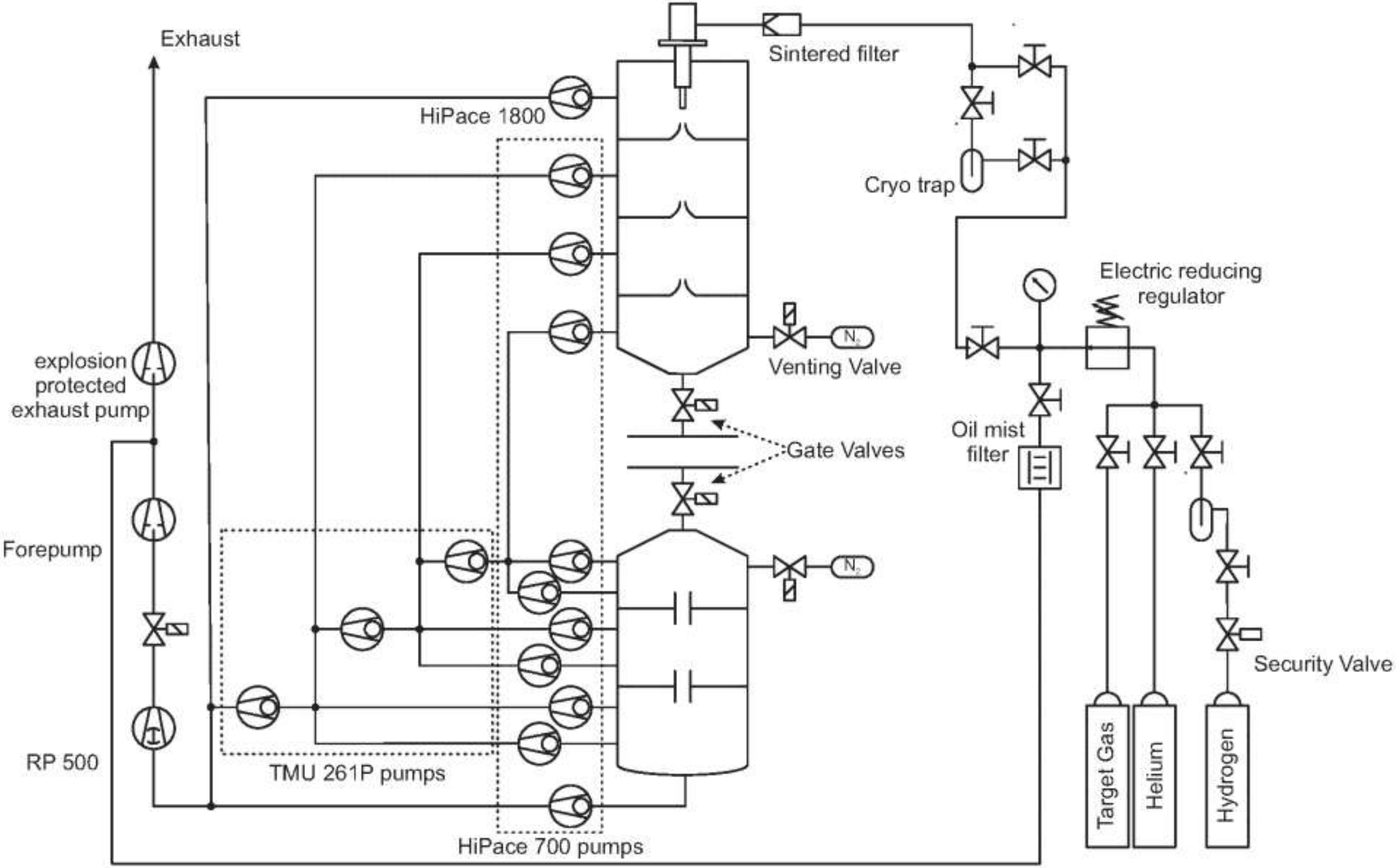
Prototype target setup

- Closed cycle cryostat (Sumitomo Refrigerator RDK-415D)
  - ➢push-button operation
  - ➢Cooling power of 1.5 W at 4.2 K is sufficient for liquid helium operation

- Target dump chamber
  - ➢PANDA design (Andrea Bersani, Genova, Italy)



Infrastructure



Summary

- ✓The technical design report for the new prototype target station was approved and the test setup is currently being assembled at GSI

- ✓Flexible target operation with exchangeable nozzle geometries

- ✓High densities for target species ranging from helium to xenon

- ✓New, compact inlet chamber design offers further optimization of target properties, e.g. smaller interaction length

- ➢Compact target station can be used at future / current storage rings (ESR, HESR, Cryring, …)

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Thank you for your attention … !