A Supersonic Pulsed Gas-Jet Target for SPARC Experiments at FAIR

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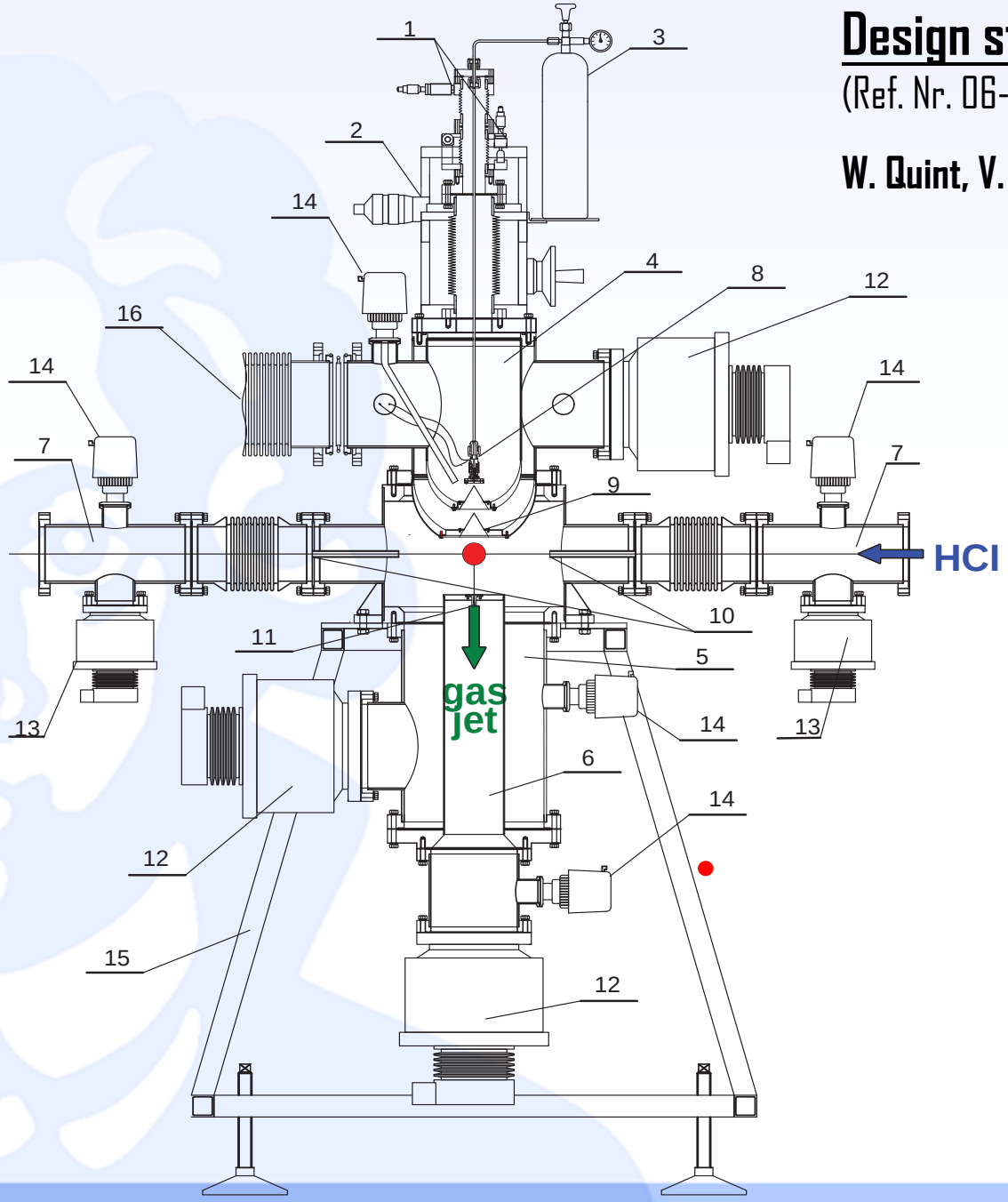
Universal device for experiments at the external beam line of HITRAP:

Precision x-ray spectroscopy with very slow highly charged ions

Design study in the frame of INTAS:

(Ref. Nr. 06-1000012-8956).

W. Quint, V. Varentsov, A. Warczak

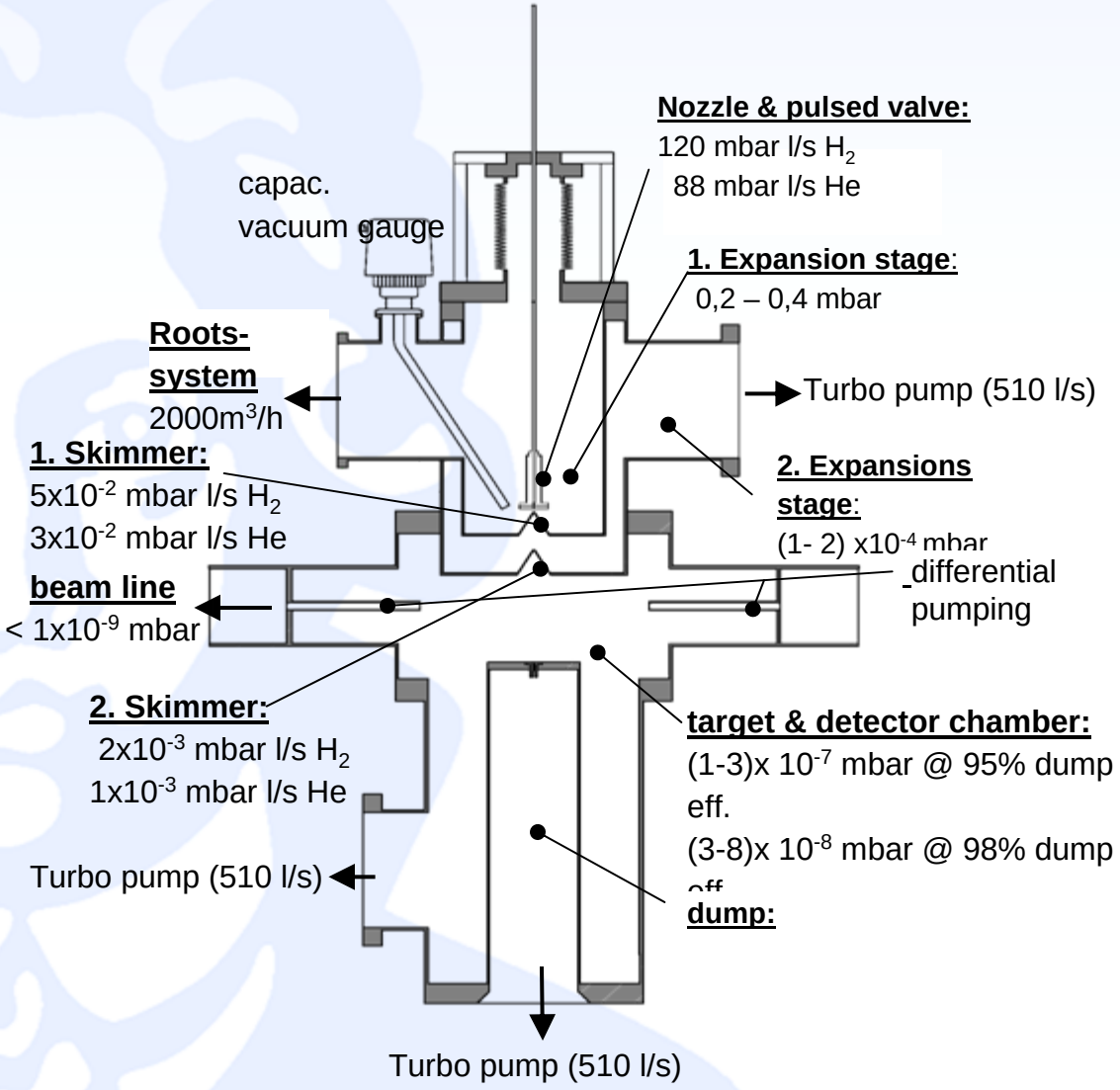


1. port aligners (angle)
2. triple axis aligners (x,y,z)
3. gas bottle
4. differential gas jet stages
5. pump chamber
6. gas dump
7. beam line
8. pulsed valve nozzle
9. skimmers
10. differential chamber
11. Collimator
12. turbo pumps 500 l/s
13. turbo pumps 300 l/s
14. vacuum gauges
15. support structure
16. to roots pump

● interaction point

Gas dynamical calculations:

(V.Varentsov)



- Supersonic nozzle: orifice D,1mm, conically diverging (opening angle 90°)
- 1st skimmer D = 0.3mm
- 2nd skimmer D = 0.53mm
- Distance between skimmers 50mm
- Distance 2nd skimmer ion beam 75mm
- Distance ion-beam to beam-dump aperture 75mm

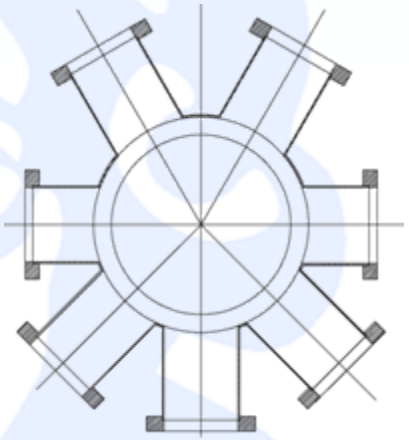
- Target beam diameter ca. **1 mm**
- expected target density = **2 x 10^{13}atoms/cm³**

Universal device for experiments at the external beam line of HITRAP:

x-ray spectroscopy:

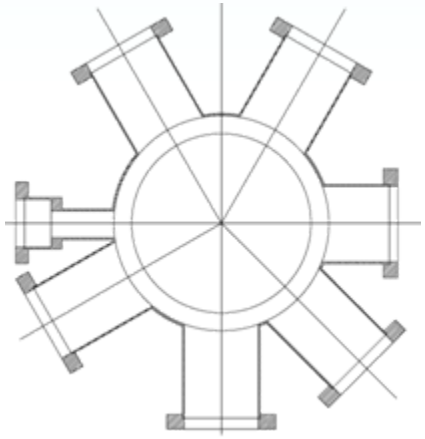
- Standard solid state x-ray detectors installed into special cups to be mounted in 5 CF-100 ports at:

45°- 60° - 90° - 120° - 135°



beam →

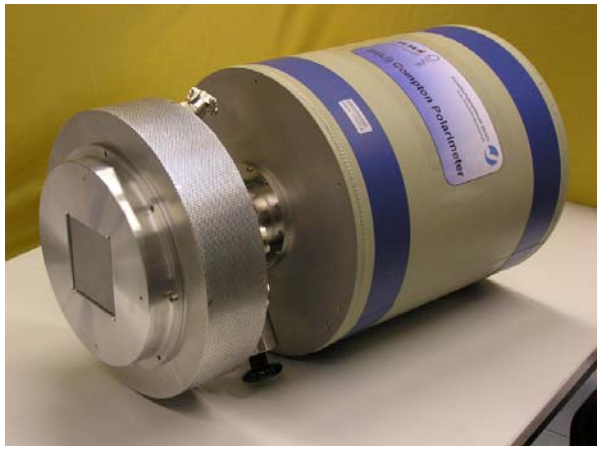
30°- 60° - 90° - 120° - 135°

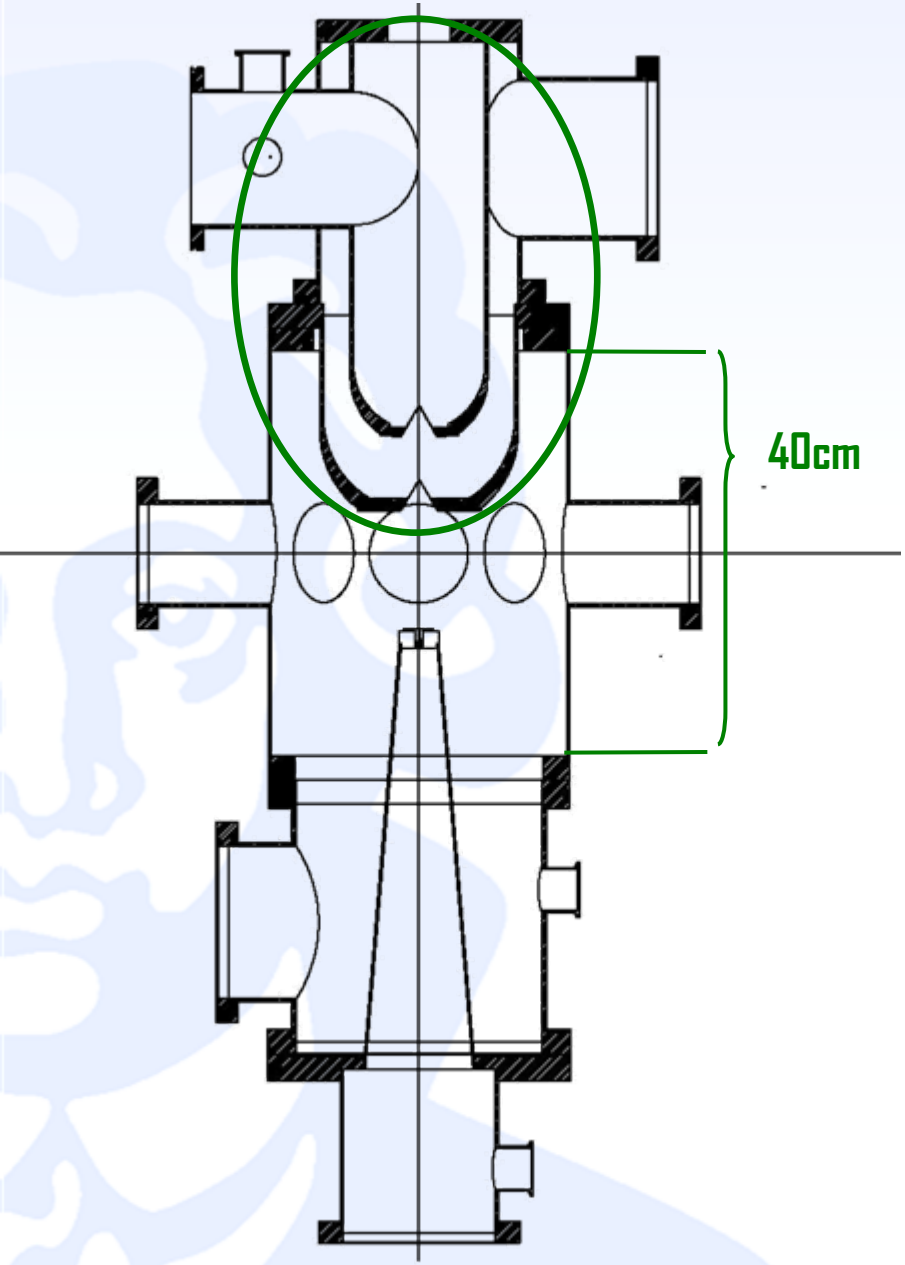


- what is with position resolving x-ray spectrometers ?

  (Diameter 40 cm at the detector head !!!)

- other detector arrays (imaging, reaction microscope, ...)





Changes to the first design:

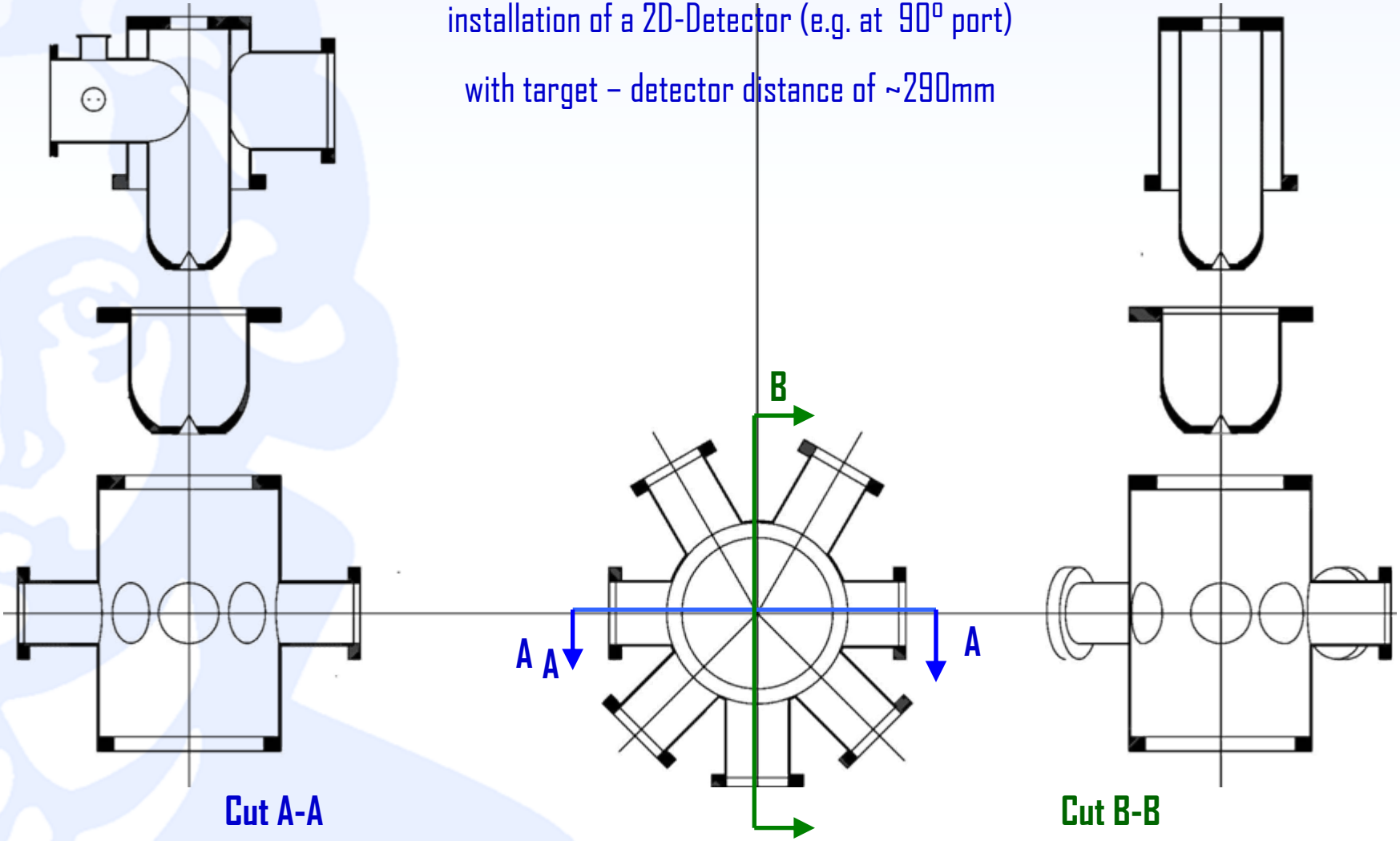
- Higher detector chamber of at least 400mm free height to e.g. accommodate:
  - large x-ray detectors
  - other detector assemblies
- This implies longer expansion stages at otherwise same total height
- To reduce costs.
  - simplified positioning system
  - Harmonize to standard CF-sizes

Exploded view of the new design:

standard chamber (symmetric) 45°- 60° - 90° - 120° - 135° geometry

installation of a 2D-Detector (e.g. at 90° port)

with target – detector distance of ~290mm



Cut A-A

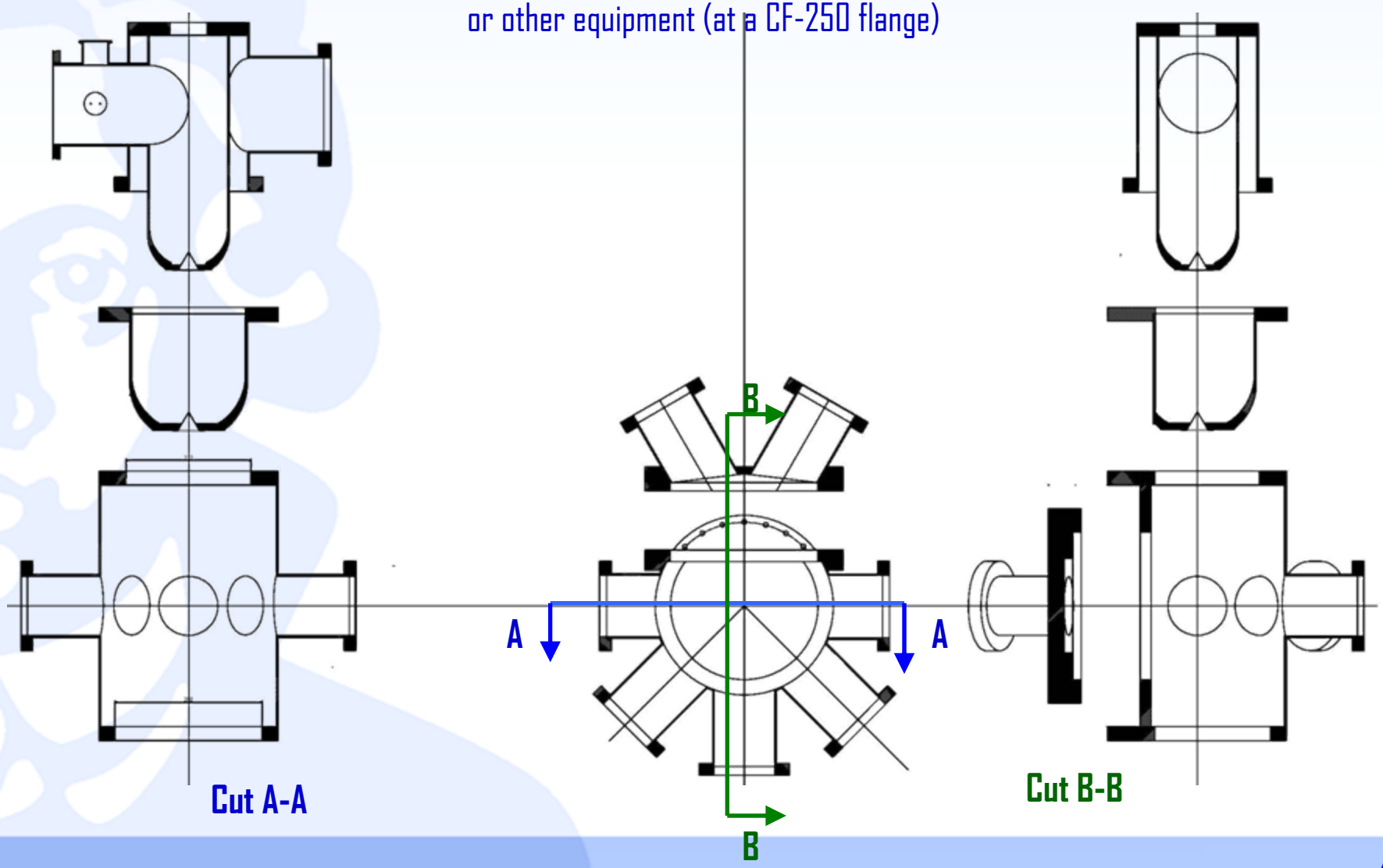
Cut B-B

Exploded view of the new design:

new chamber (asymmetric) 45°- 60° - 90° - 120° - 135° geometry,

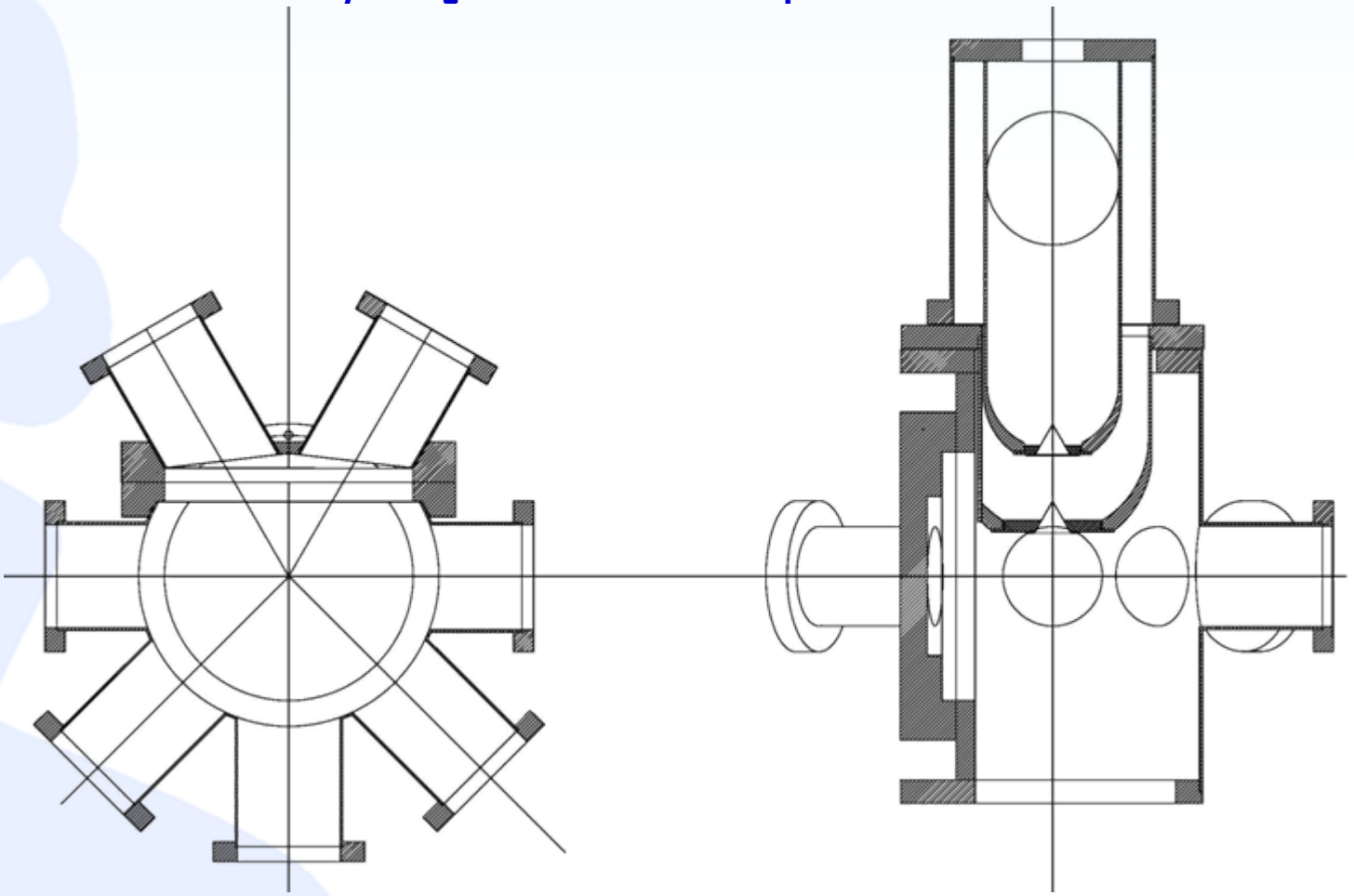
allows also implemetation of a 2D-Detector (closest distance of the detector to target 125mm)

or other equipment (at a CF-250 flange)

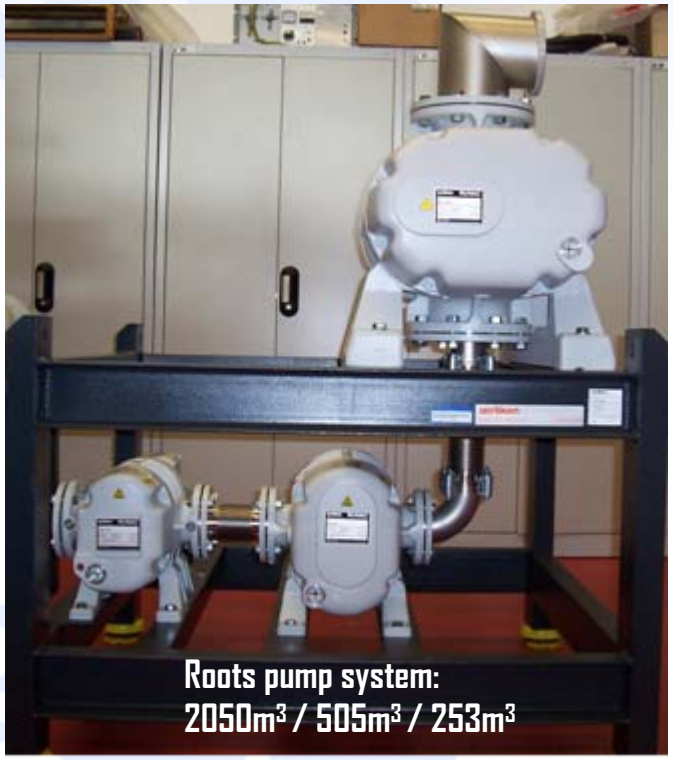


Assembled view of the new design:

- only the lower part from the 2nd expansion stage is modified
- upper part with manipulator and 1st expansion stage unchanged
- a large CF-250 port will ease the assembly of e. g. a reaction microscope



Next steps:



- most parts of the set up already delivered
- Vacuum chambers:
  - most of the parts cam be ordered directly
  - 1. test of the asymmetric assembly of expansion stages in an available vacuum chamber (Pitot pipe, rest-gas monitor)
  - 2. make final decision for the detector chamber
  - 3. order
- Assembly — end of 2010
- test of jet — 1st 1/2 of 2011
- Test experiments at IKF and set up at HITRAP — 07.2011 - 06.2012

IKF 14Ghz-ECRIS-RFQ facility (100-200 keV/u)

and/or at the 0°-line of FLSR (<= 50keV)

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