

YEARS / ANS **CERN**

Beam observation monitors in ELENA ring at CERN

Presented by

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*(In framework of collaboration between
CERN and GTU)*



Subjects

Introduction

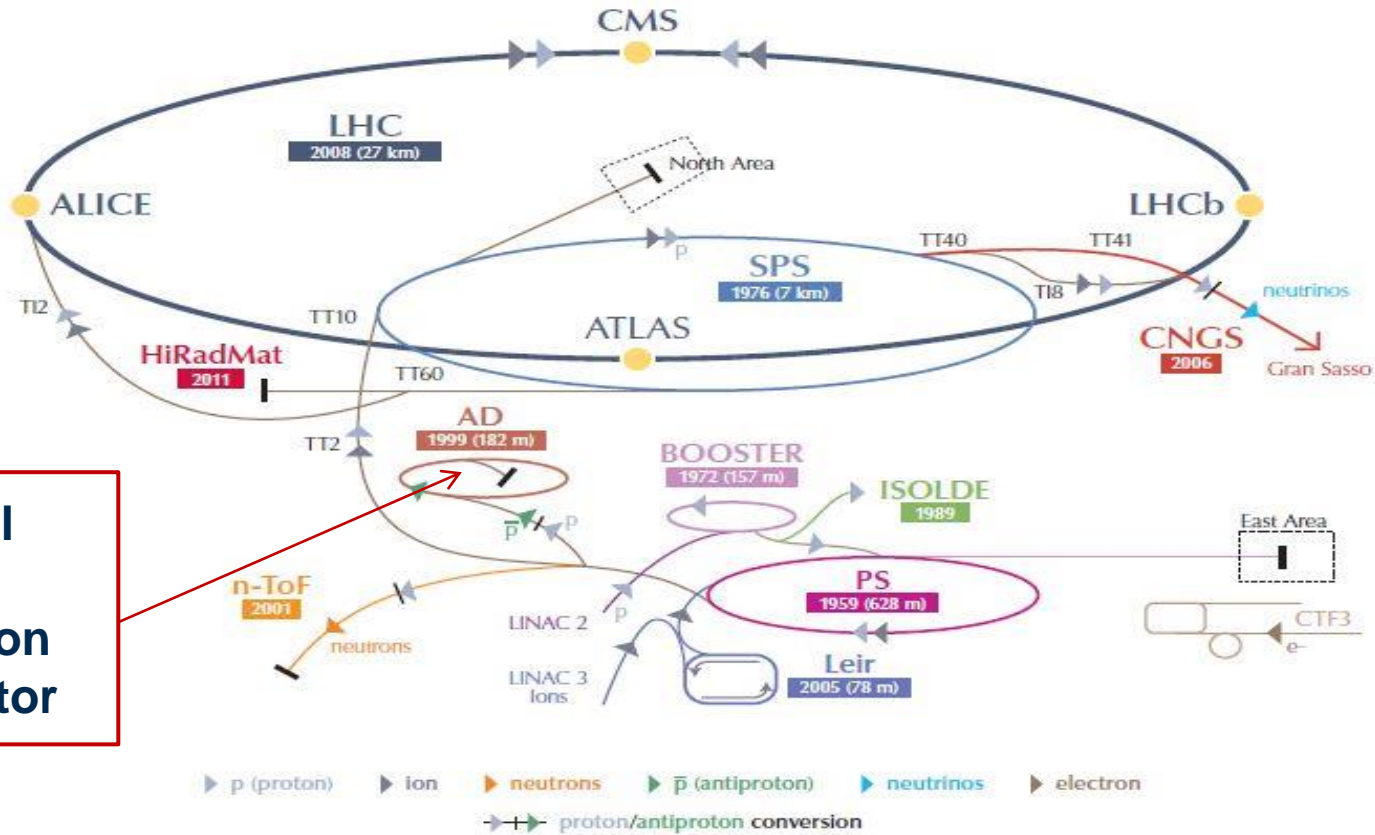
- General overview of AD (Antiproton decelerator) at CERN
- ELENA ring – objectives and capacities

Beam observation monitors (BOM)

- Electronics/image processing
- Mechanical composition
- Magnetically coupled Push pull device as a new technology under implementation at CERN



Accelerators @ CERN



LHC Large Hadron Collider SPS Super Proton Synchrotron PS Proton Synchrotron

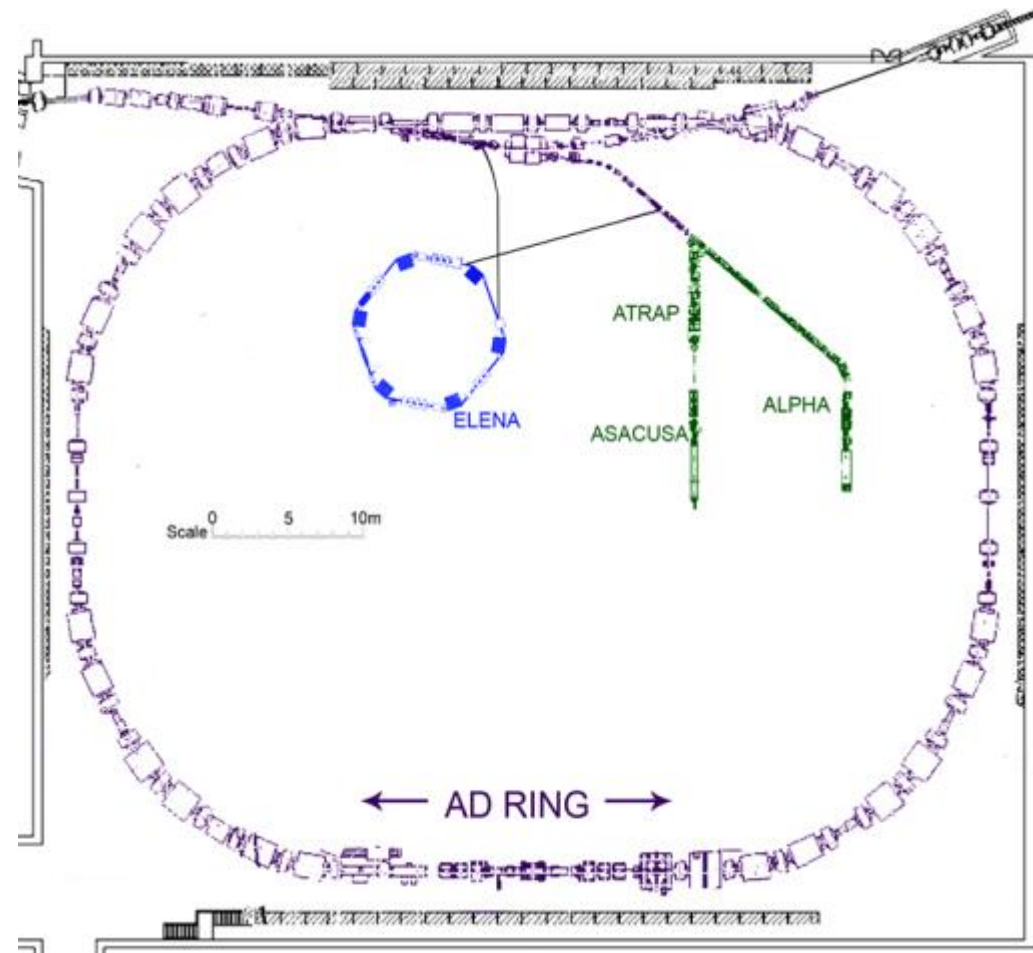
AD Antiproton Decelerator CTF3 Clic Test Facility CNGS Cern Neutrinos to Gran Sasso ISOLDE Isotope Separator OnLine Device
 LEIR Low Energy Ion Ring LINAC LINear ACcelerator n-ToF Neutrons Time Of Flight HiRadMat High-Radiation to Materials



Introduction to AD

Objectives

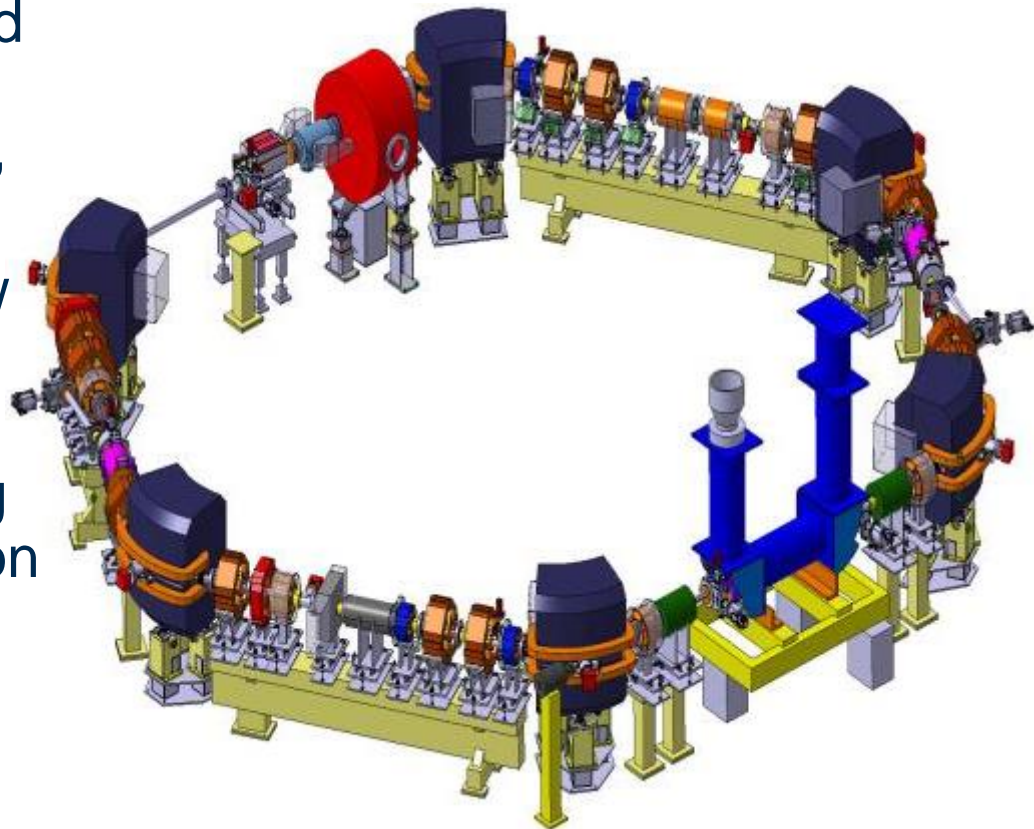
- Study is focused on trapping antiprotons.
- Performing spectroscopy on antihydrogen atoms and to investigate the effect of the gravitational force on matter and antimatter.
- Unites five experiments
ATHENA/ATRAP/ASACUSA/ACE/
/ALPHA/AEGIS.



Introduction to ELENA ring

ELENA

- Compact ring for cooling and further decelerating antiprotons delivered by AD, (assembled within AD ring)
- Unique facility delivering low energy antiproton beams of highest quality.
- Equipped with beam cooling – leading to high deceleration efficiency and resulting an increased number of antiprotons.

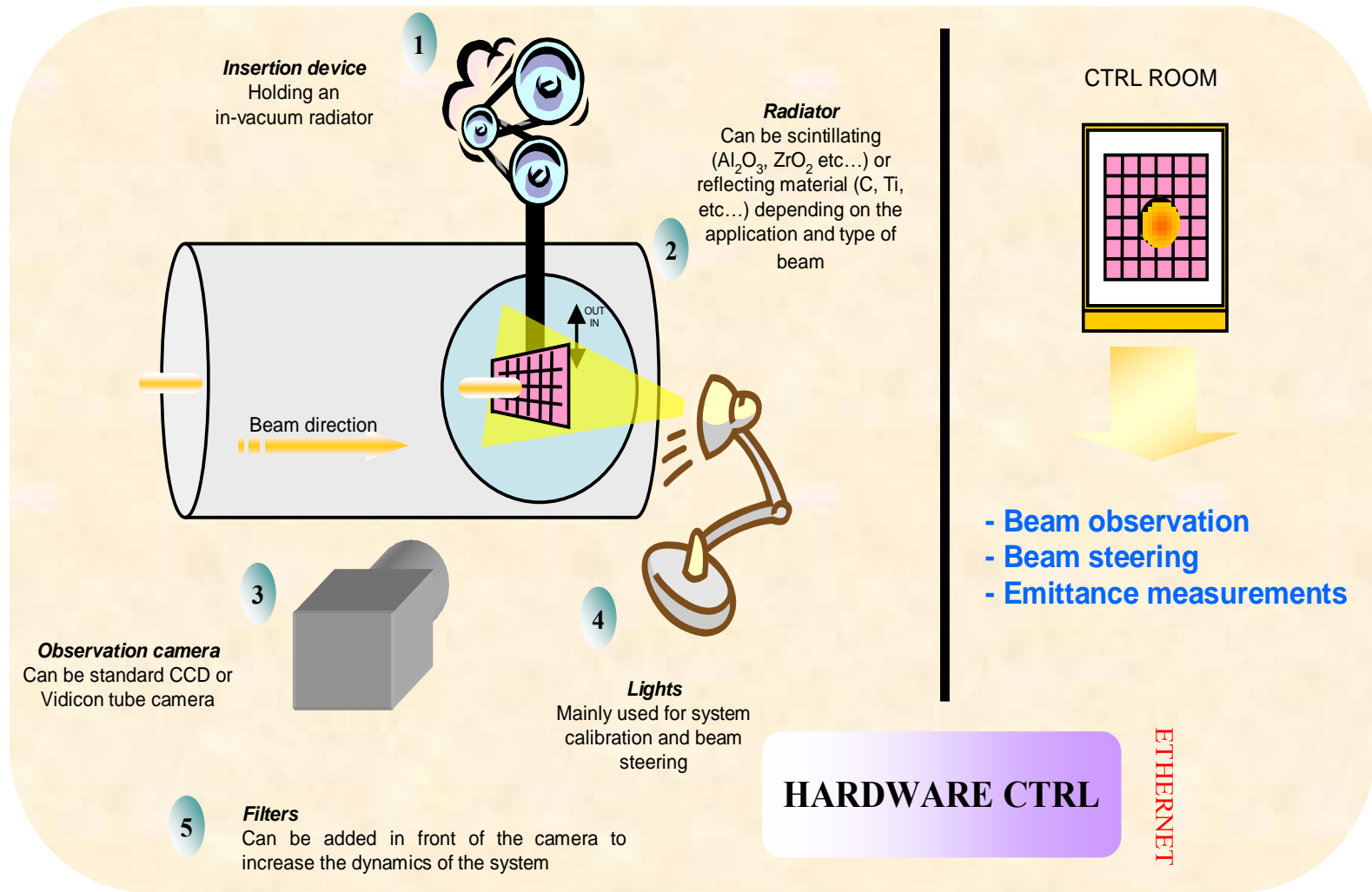


Beam observation monitor

- To optimize and calibrate injection and circulating beam profiles
- Composed of two screen in/out systems
- Situated on cross section of AD and ELENA beam lines
- Vacuum pressure – $3e^{-12}$ mBar
- Mass – 100kg



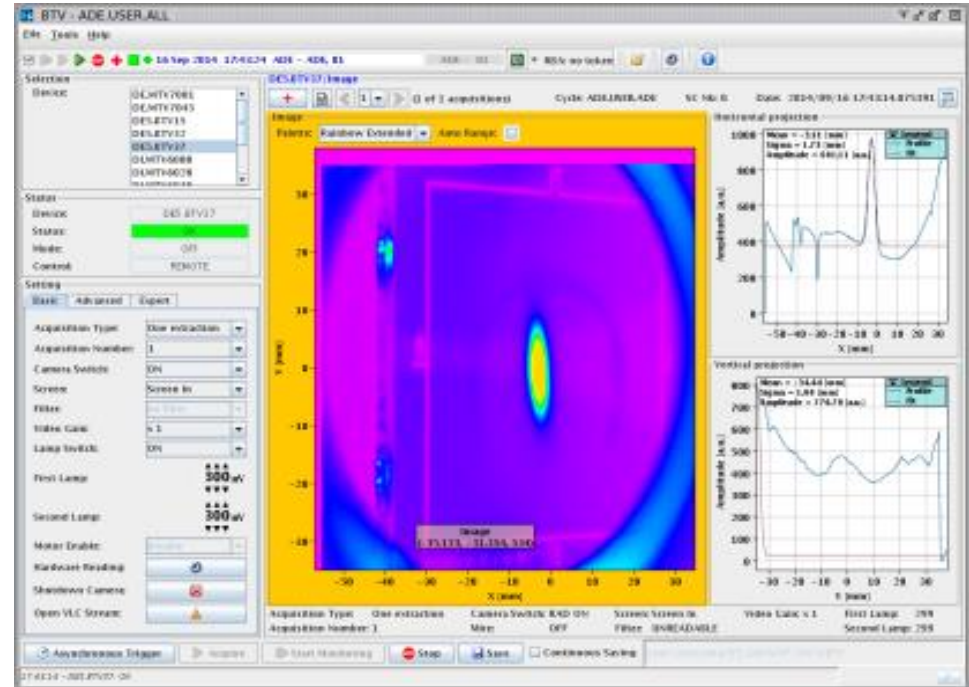
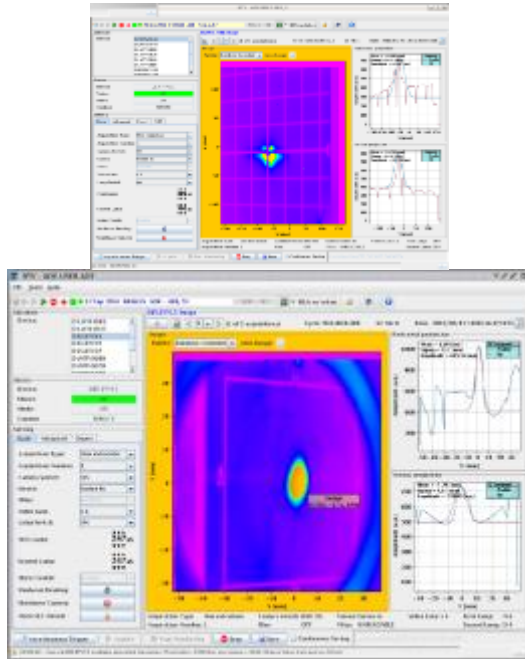
Electronics and image processing



Electronics and image processing

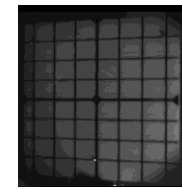
Measurement examples

AD extraction line



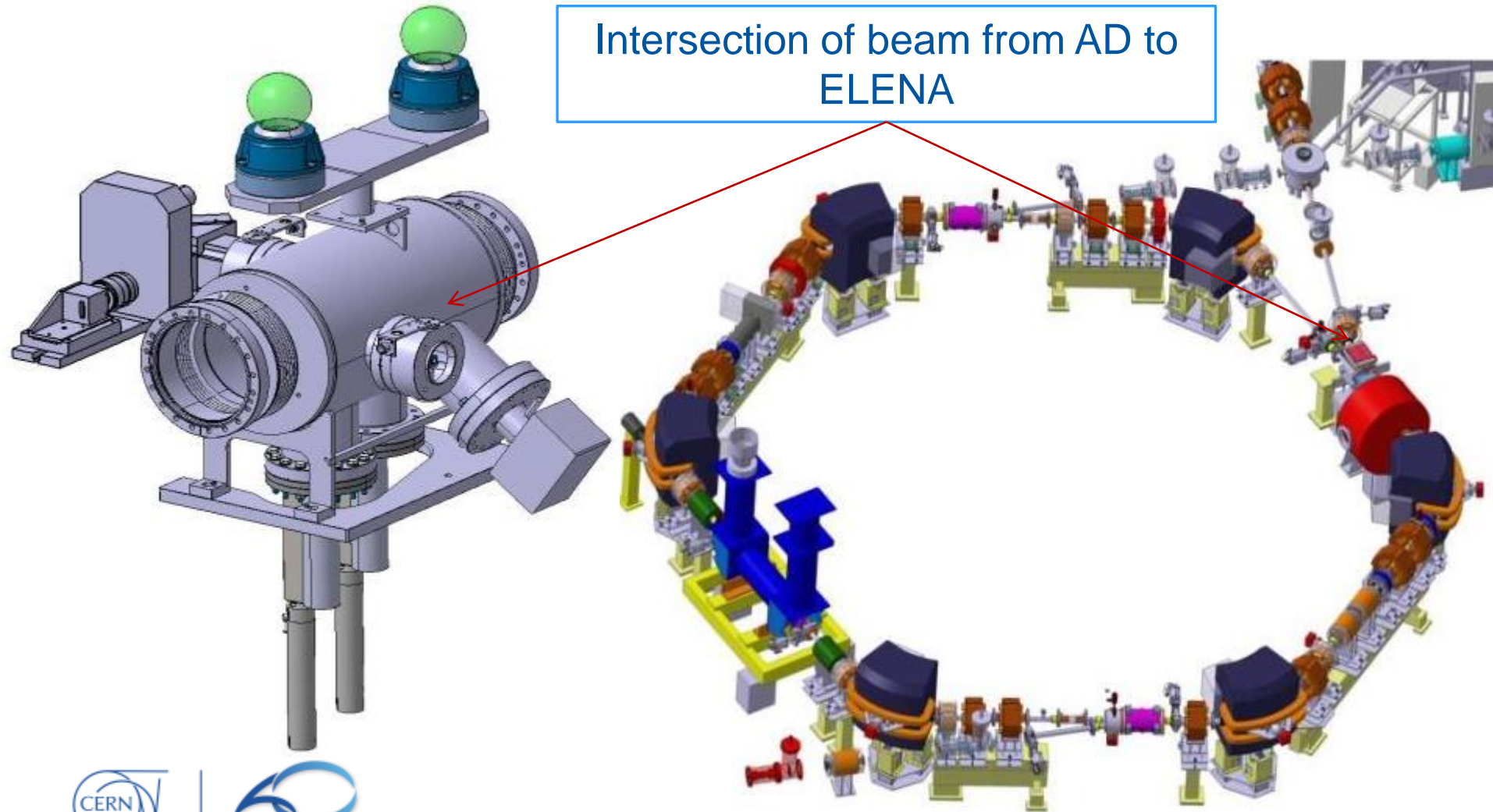
These measurements validated the use of BTV instruments for AD extraction lines (BASE + ELENA)

Screen Type : Al₂O₃:CrO₂
 Thickness : 1mm
 Calibration marks: No grid anymore to better optimize the S/N with image digitalization

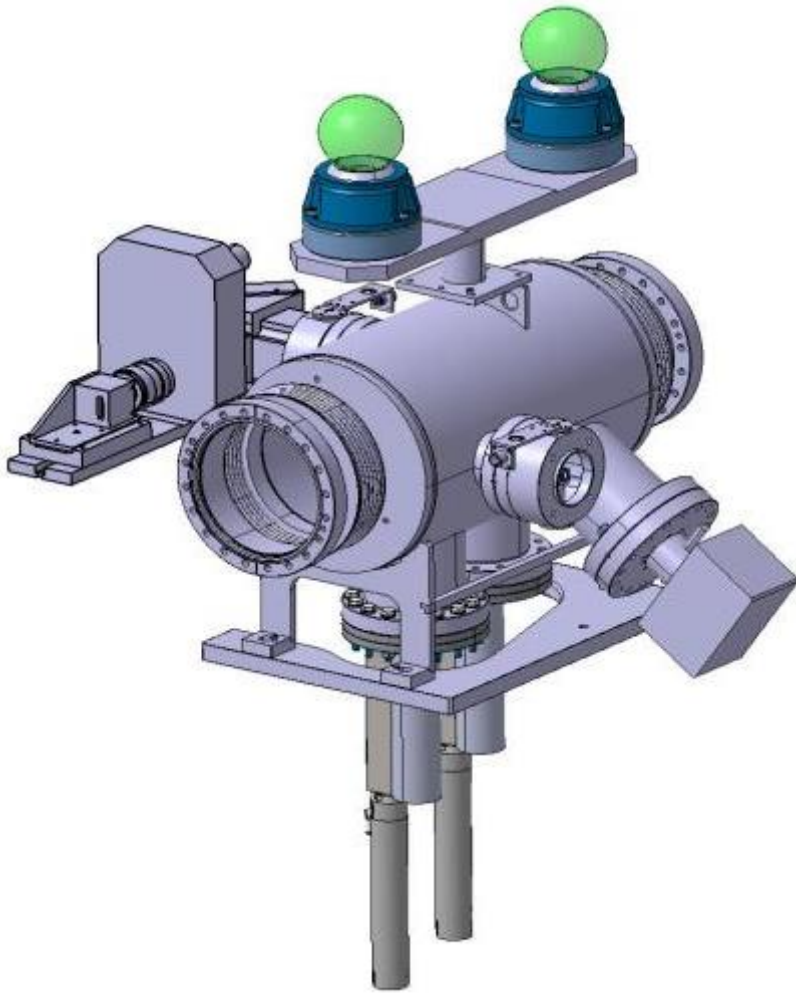


BOM position in ELENA ring

Intersection of beam from AD to ELENA



BOM mechanical aspects

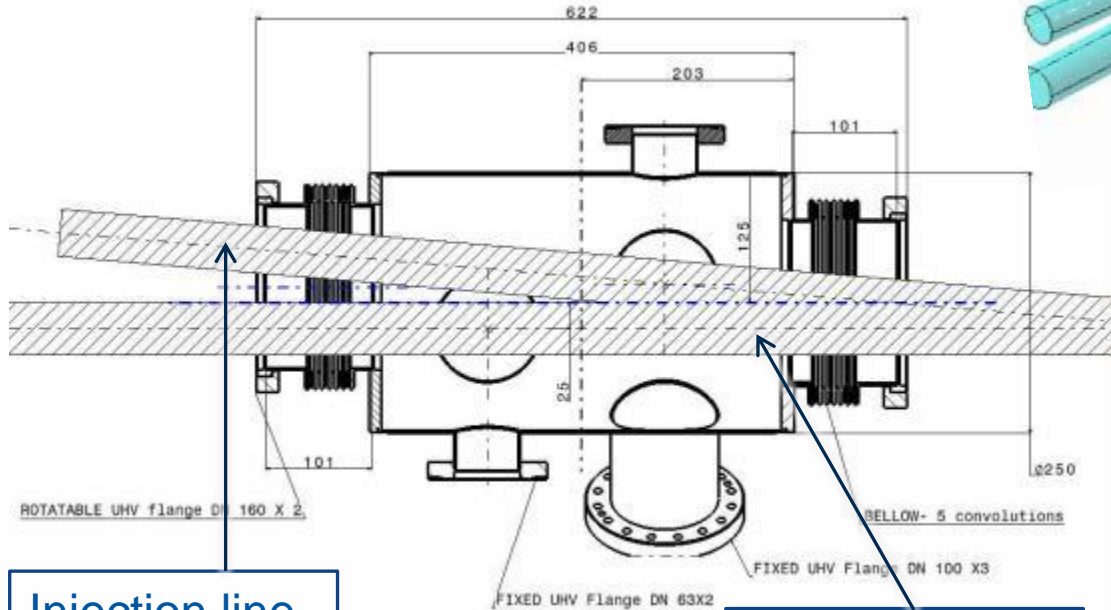


Composition

- Two hydro formed bellows
- Two magnetically coupled in/out systems (*MPPL – 100- P*)
- NEG pump - non evaporable getter (*NEXTorr D1000 -10*)
- Total length constraint of the vessel – 622mm
- Diameter – 250mm
- Thickness – 3mm
- Material – stainless steel 316LN.1.4429
- 2 viewports
- Two optical systems – BTV SI – LHC

BOM mechanical aspects

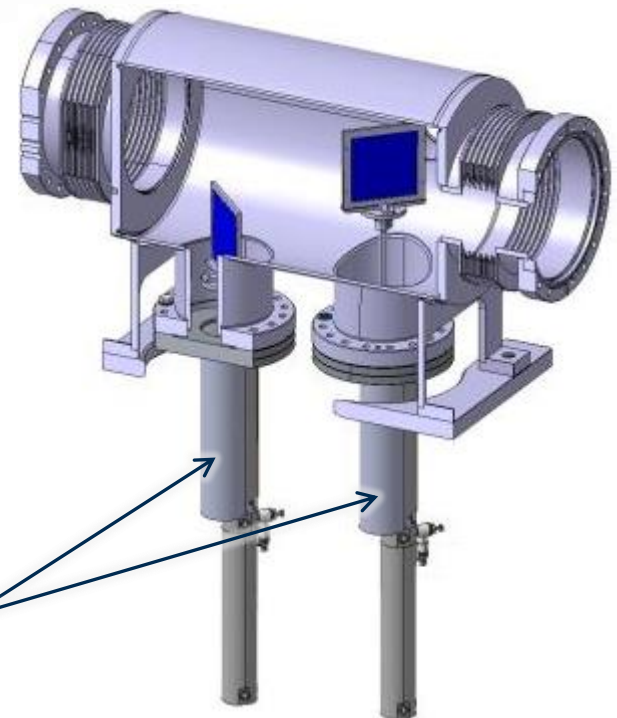
Beam line profile within BTV
(Top view cut)



Injection line

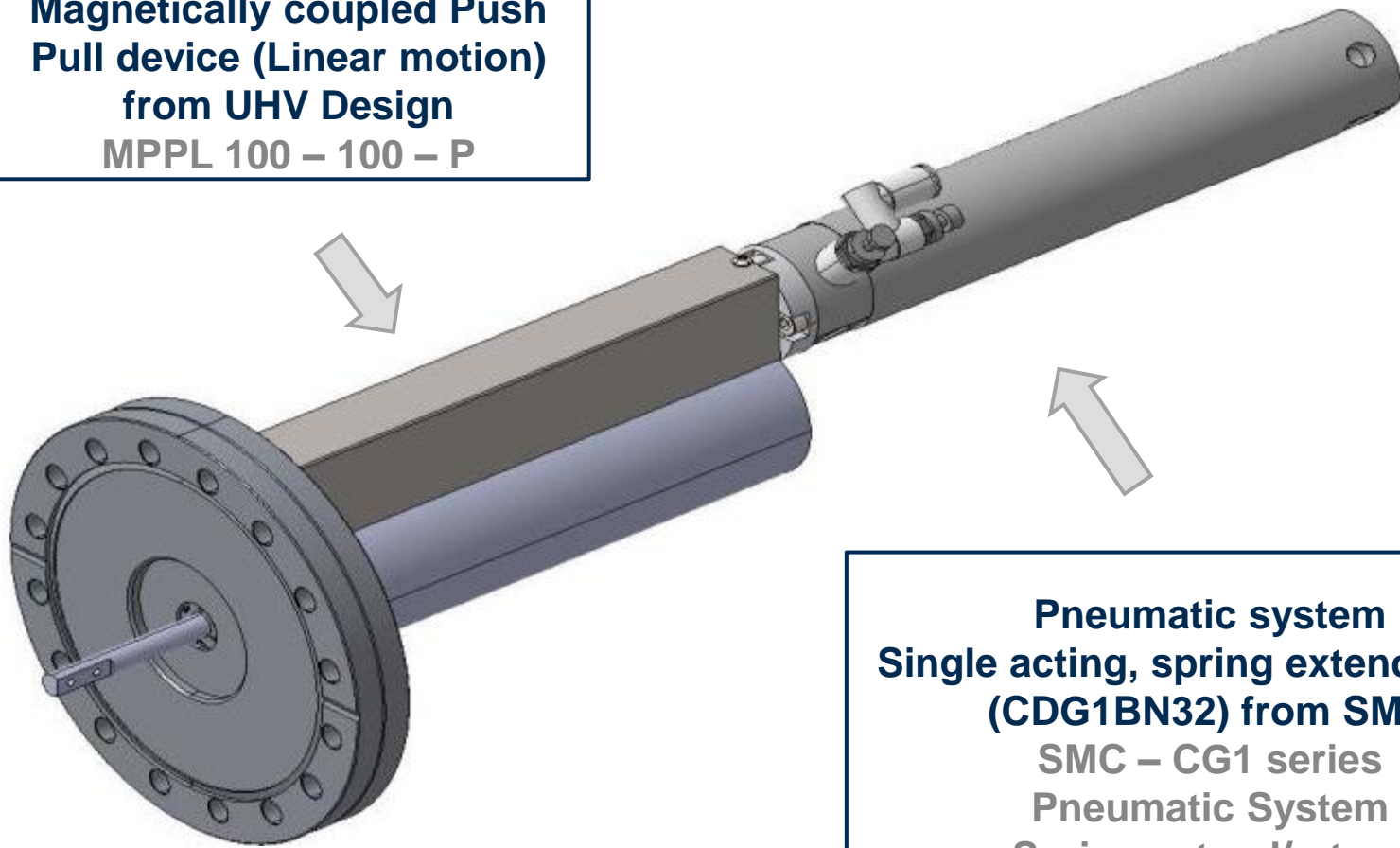
Circulating line

Magnetically coupled
in/out systems



Screen in/out system

**Magnetically coupled Push
Pull device (Linear motion)
from UHV Design
MPPL 100 – 100 – P**

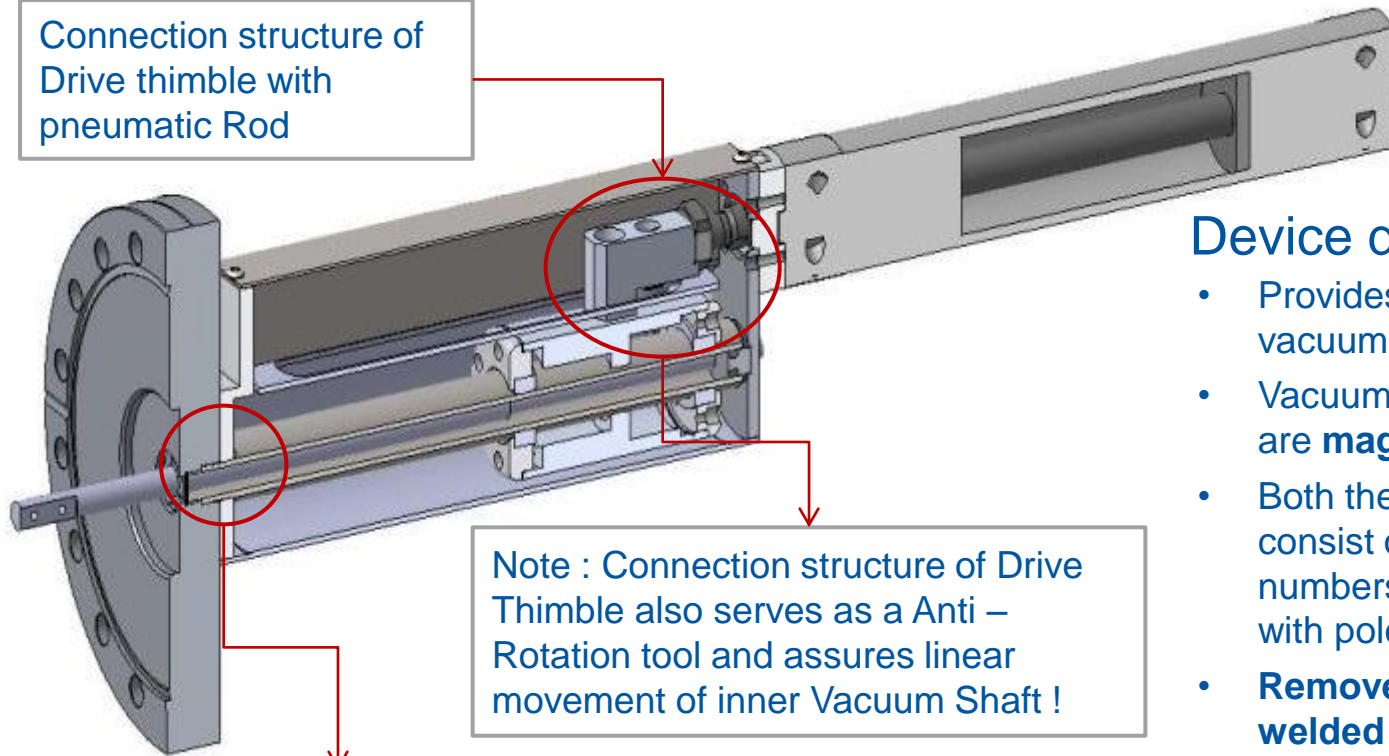


**Pneumatic system
Single acting, spring extend/return
(CDG1BN32) from SMC
SMC – CG1 series
Pneumatic System
Spring extend/return**

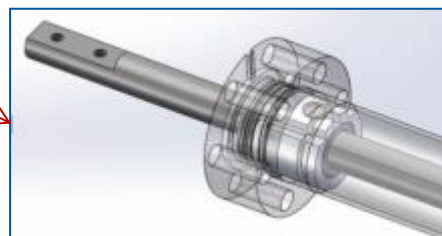
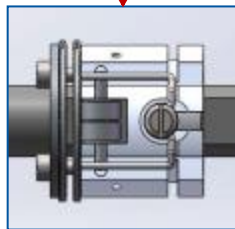


Screen in/out system

Connection structure of Drive thimble with pneumatic Rod



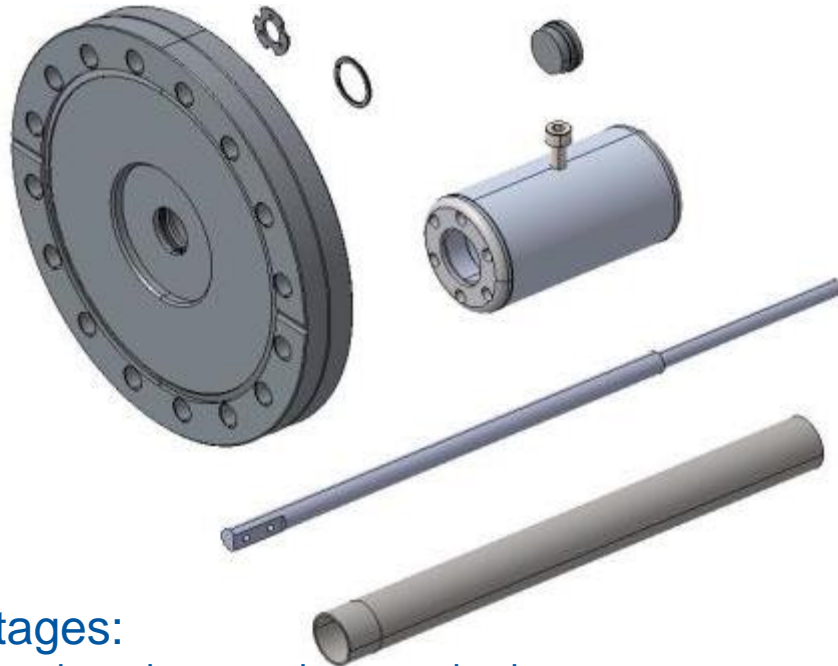
Note : Connection structure of Drive Thimble also serves as a Anti – Rotation tool and assures linear movement of inner Vacuum Shaft !



Device description:

- Provides linear motion of the vacuum shaft.
- Vacuum shaft and Drive Thimble are **magnetically coupled**.
- Both the driver and the follower consist of arrays of equal numbers of permanent magnets with poles.
- **Removes the need for edge-welded bellows ‘stacks’**, incorporated within traditional ‘push/pull’ designs - their elimination **maximises vacuum integrity!**
- Unlike a bellows-sealed device, the MPPL is not subject to the thrust due to vacuum, resulting in **smooth free-moving operation**.

Screen in/out system

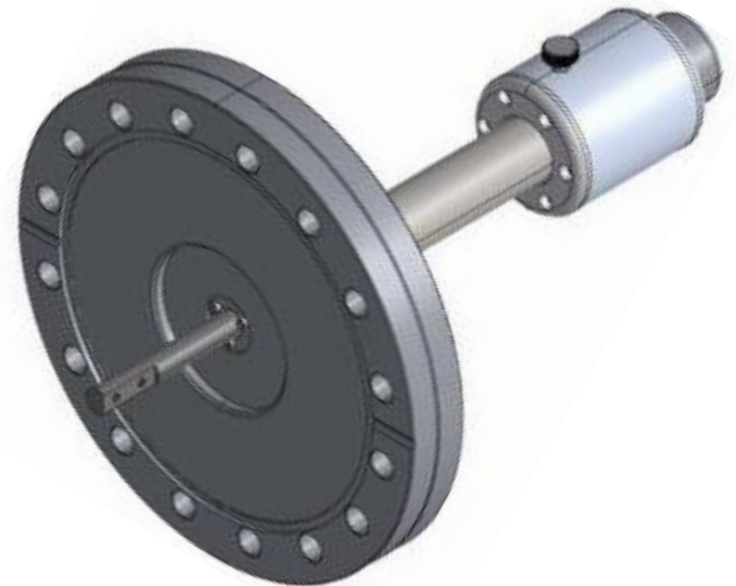


Assembly components:

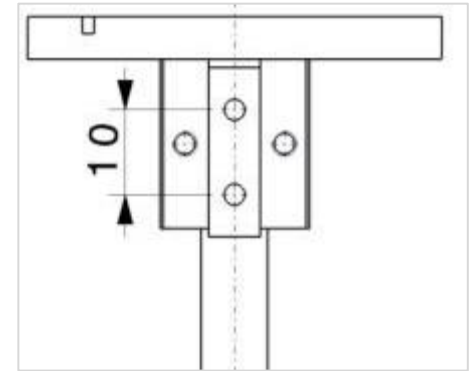
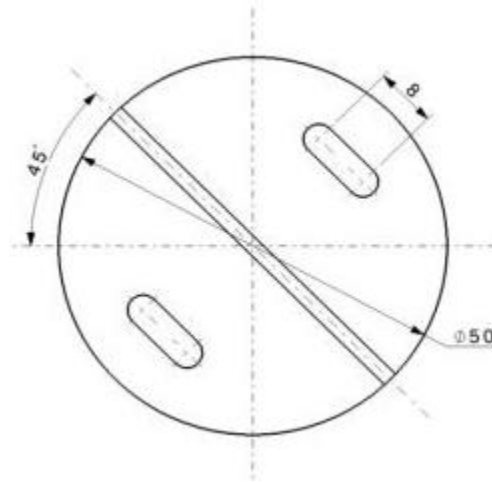
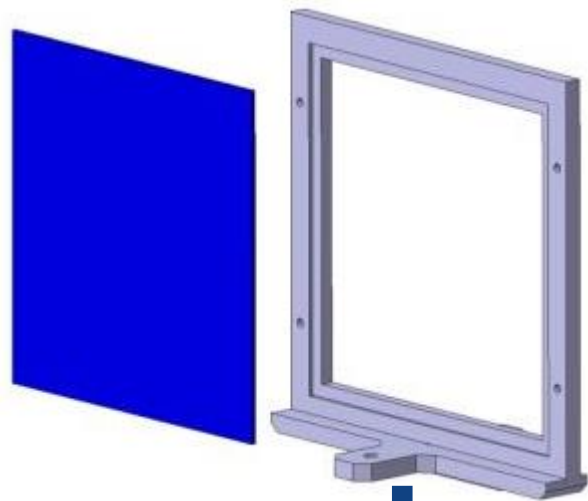
- Inner Vacuum shaft
- Drive Thimble
- Flange DN100 – 316LN
- End Cap
- Position Locking screw

Advantages:

- Extremely resistant to demagnetization
- No thrust due to vacuum
- Guaranteed linear motion
- Good temperature stability (maximum use temperatures between 250 °C (523 K) and 550 °C (823 K); Curie temperatures from 700 °C (973 K) to 800 °C (1,070 K))

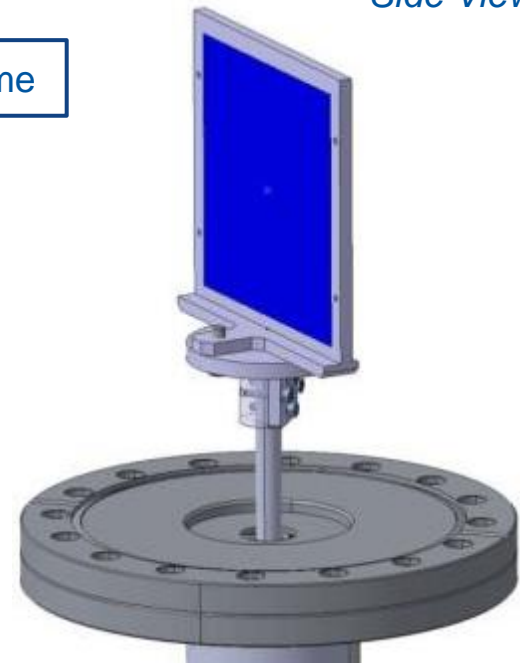


Screen support structure



Side View

Support for Screen frame



Conclusions

- Need of new instrumentation for the injection line optimization from AD to ELENA ring.
- Implementation of new technology for the mechanical systems – replacing bellow motioned devices by magnetically coupled ones.
- The tests to approve new technologies are under progress in framework of collaboration between GTU and CERN.

In collaboration with:

S.Burger (*CERN*) – project coordinator

R.Sautier (*CERN*) – *design and testing*

N.Sharmazanshvili (*GTU*) – *design and testing*

