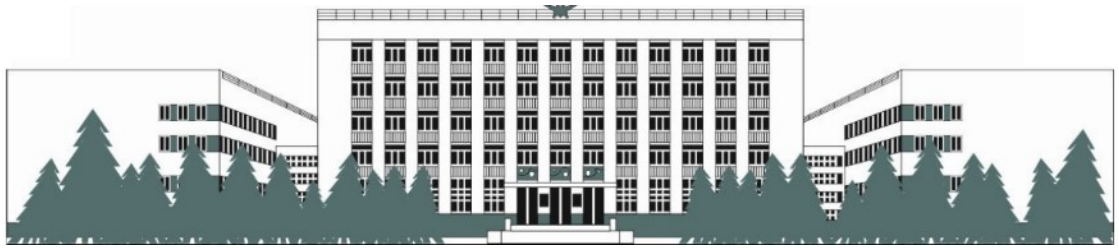
Collector Ring Beam Diagnostics Status



Yury Rogovsky

on behalf of the Budker INP team

11 November 2021, Novosibirsk

We are glad to see you here in a good health. We hope you and you families in a good shape during this COVID-19 time. Take care of yourself.

Yury Rogovsky

on behalf of the Budker INP team

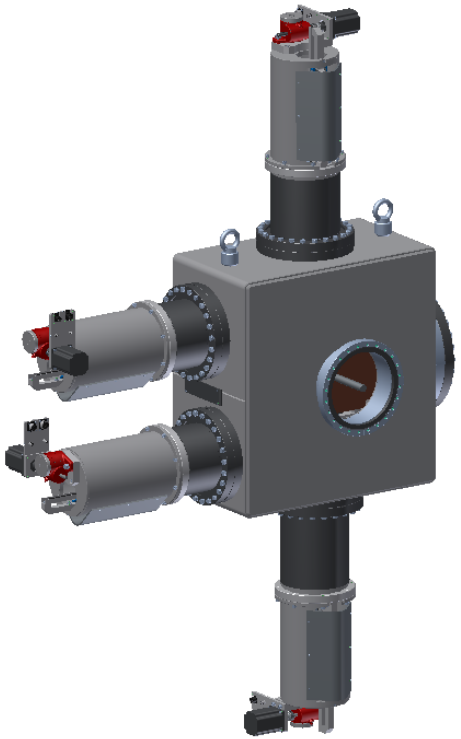
11 November 2021, Novosibirsk

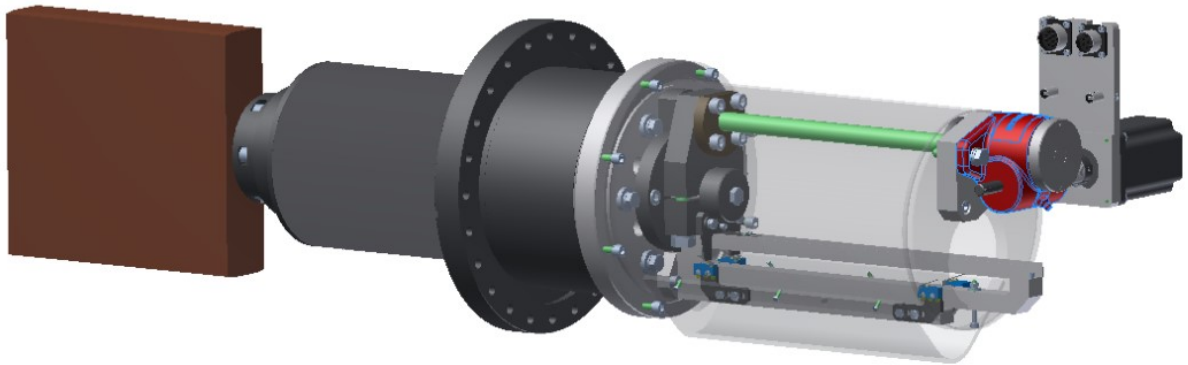
The half a year progress will be reported.

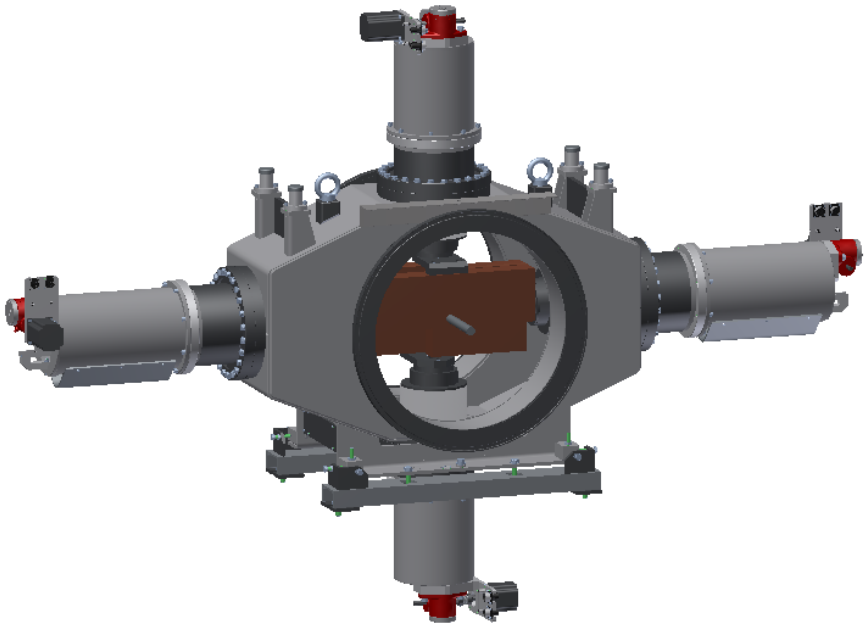
Beam Stopper for CR (I)

- CDR passed (protocol signed @ 2019) https://edms.cern.ch/document/2137461/1
- FDR passed (protocol signed @ 14 July 2021, documents in EDMS
- https://edms.cern.ch/document/2150197/1

- Production is ongoing.
- ~~Open questions:~~ MBOX PDC – 5pcs – not in 2nd Amendment for the "FAIR orders components for BINP". Purchase letter to FAIR will be prepared in November 2021.



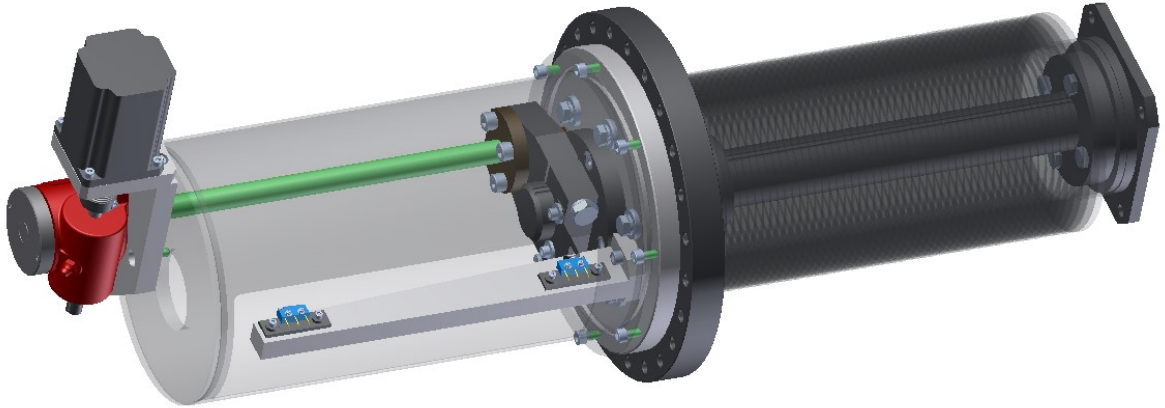


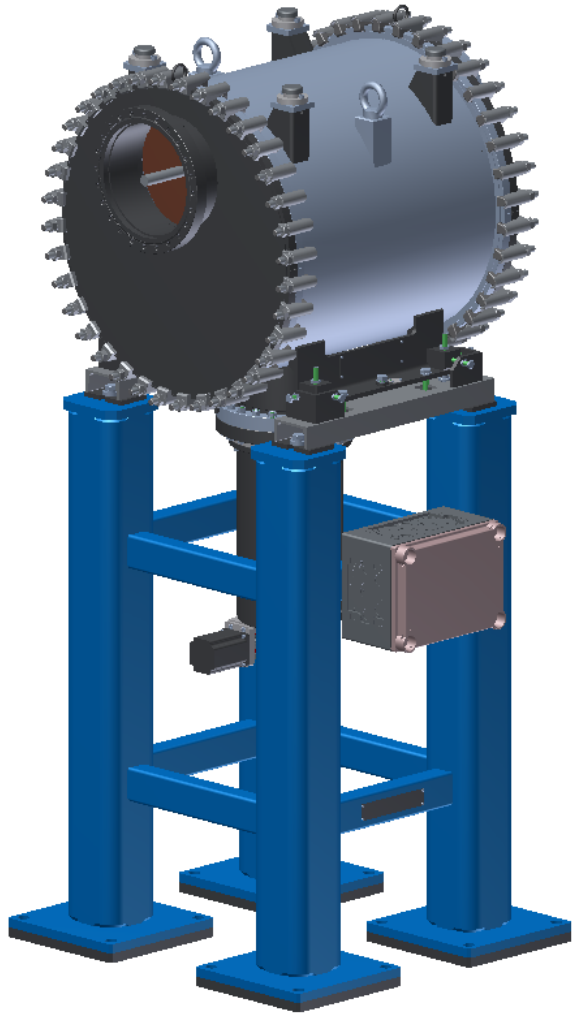


Beam Stopper for CR (I)

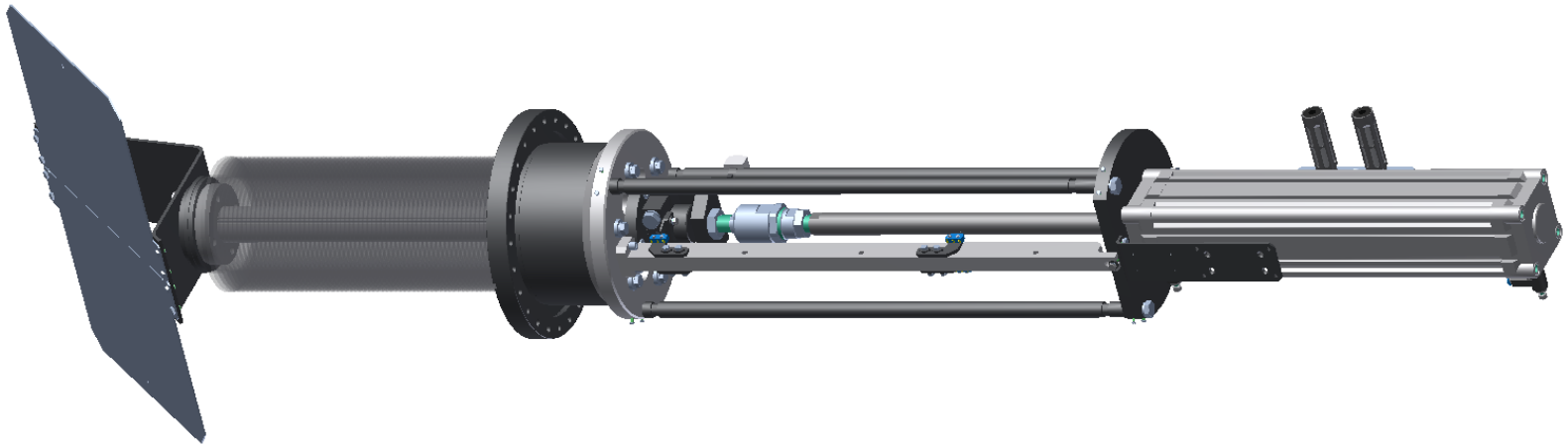
- CDR passed (protocol signed @ 2019) https://edms.cern.ch/document/2150433/1
- FDR passed (protocol signed @ 01 November 2021, documents in EDMS
- https://edms.cern.ch/document/2150333/1

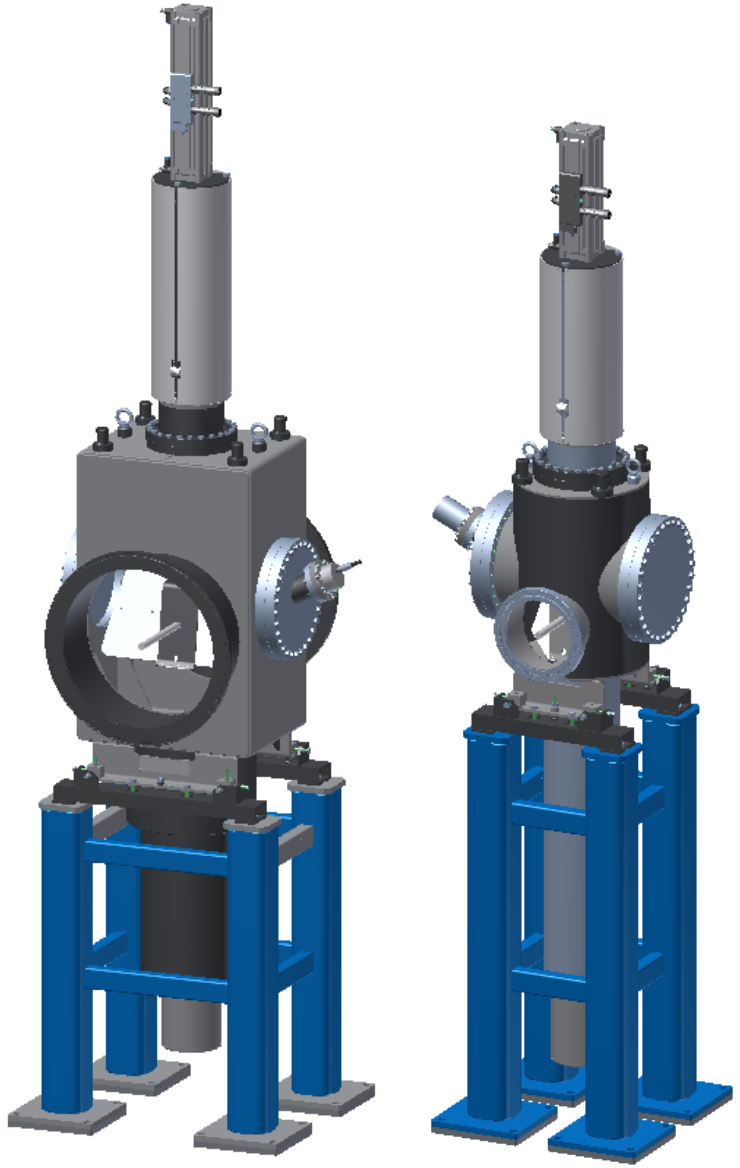
- Production is ongoing.
- ~~Open questions:~~ MBOX PDC – 2pcs – not in 2nd Amendment for the "FAIR orders components for BINP". Purchase letter to FAIR will be prepared in November 2021.





Scintillating Screen for CR (I)





- CDR passed @ 2020
- FDR presented and discussed with GSI colleagues. No significant deficiencies.
- One step required for finalization – detector vacuum tests.

  Vacuum quality Investigation of detector not finished.

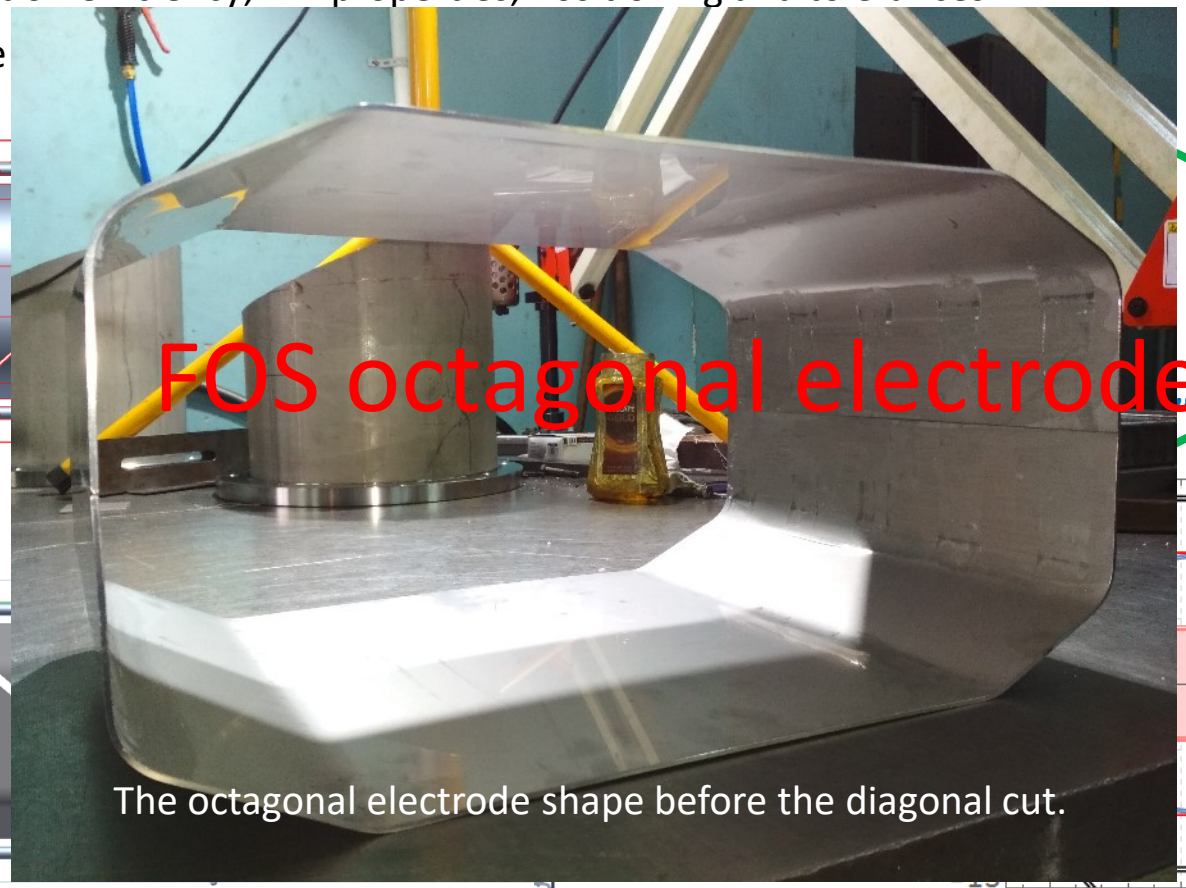
  Detector bake out (local, before installation) proposed and under tests.

  Detector with improved P43 deposition technology waits for test as well.
- Production of vacuum chamber, support, pneumatic drive mechanics is ongoing step by step.

Beam Position Monitor for CR (I) 6th Workshop

Type-1 Electrodes was reviewed against: Mechanical stability and rigidity; Production efficiency; EM properties; Positioning and tolerances.

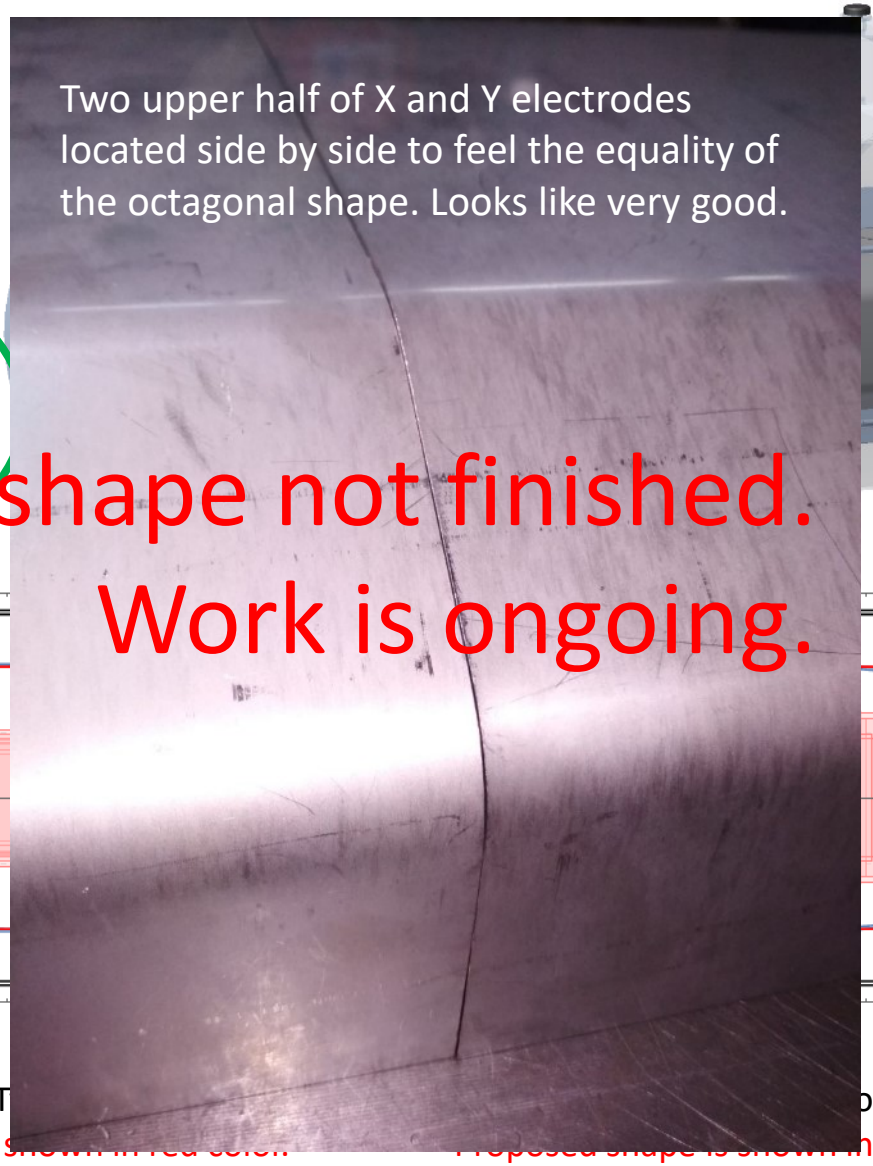
Change



The octagonal electrode shape before the diagonal cut.

FOS octagonal electrodes shape not finished.

Work is ongoing.



Two upper half of X and Y electrodes located side by side to feel the equality of the octagonal shape. Looks like very good.

All drawings for the octagonal electrodes are in production. Passed technical checks. Tooling produced. Waiting for materials.

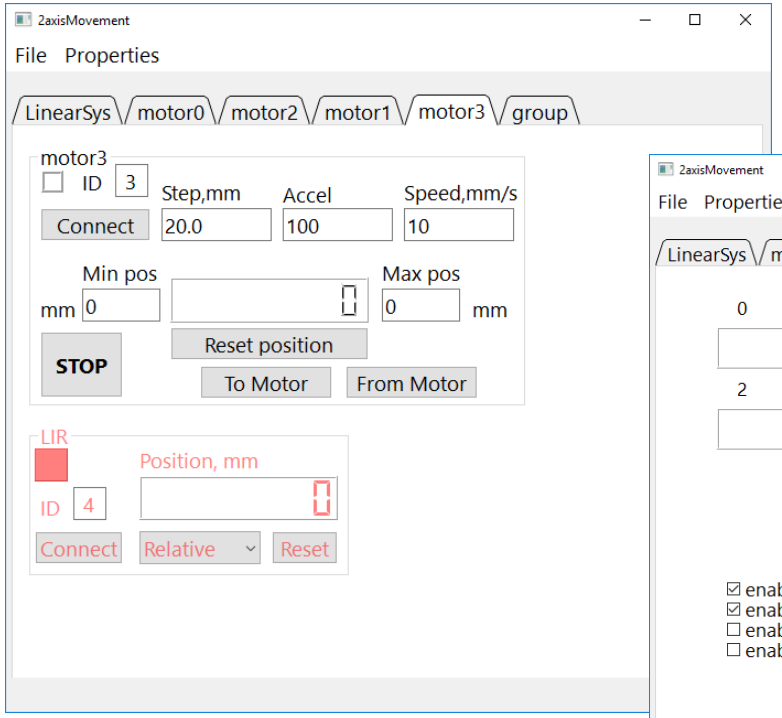
Beam shape @ BPM T … or RIB optics.

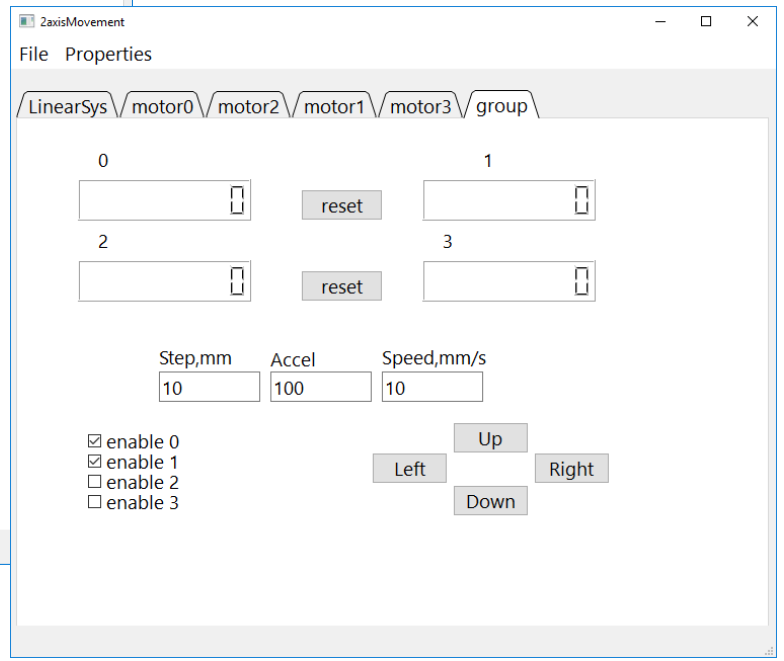
Proposed shape is … red color.

Beam shape in different BPMs shown as pink. We still fit the requirements.

Beam Position Monitor Test Stand (I)

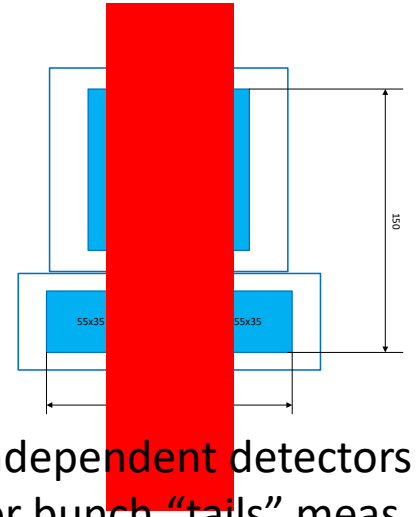
- Stand software development is ongoing
- Individual motor movement => Group movement
- Linear position readout shows ~50 um accurecy
- Waiting for LIBERA Hadron to start electrodes readout development



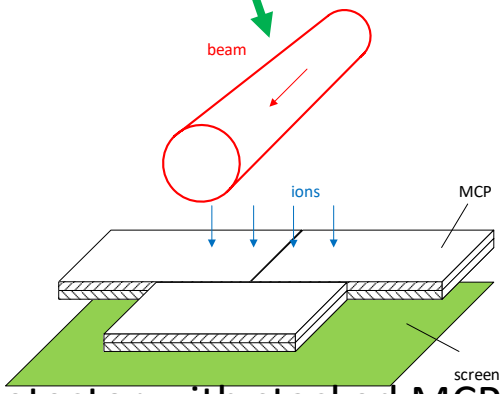


Residual Gas Monitor for CR (I) Concept

Another way is combining of several MCP. There are two ways: 1) stacked MCPs in one detector and 2) several detectors



Independent detectors for bunch "tails" meas.



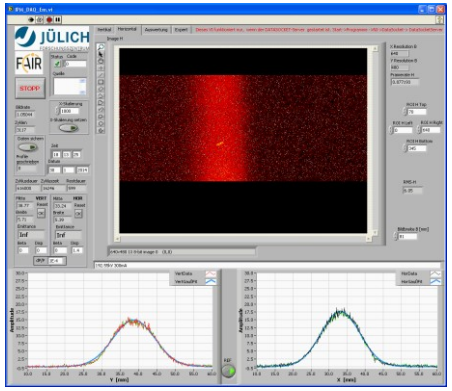
Detector with stacked MCPs

Restrictions: Aperture 160 mm (chamber diameter), Bunch size 85 x 120 mm as in Specification. Detector size ~140 mm requested in Specification.

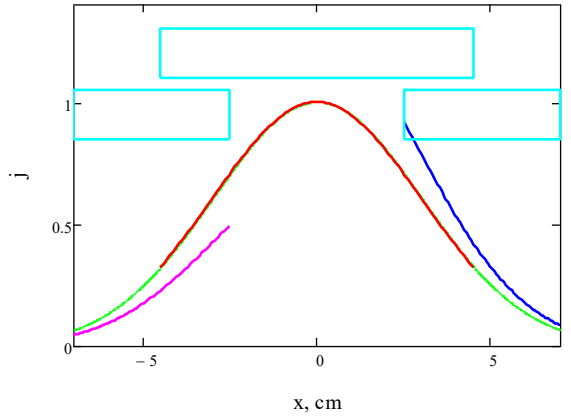
The base variant is several (3) detectors (variant 2):

- Cost: 1 detector 100x100 mm (chevron stack of MCP + phosphor screen K67 (analog of P43)) is about 4.5 k€ / pcs (3 required)
- Cost: 1 detector 43x63 mm is about 2 k€ / pcs (6 required)

Three measured curves may independently change in time due to HV PS imperfection. In order to eliminate this effect online fit can be made.



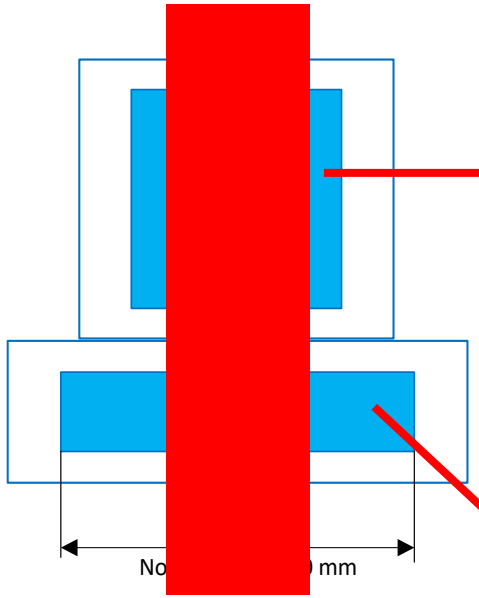
Measurement from COSY RGM

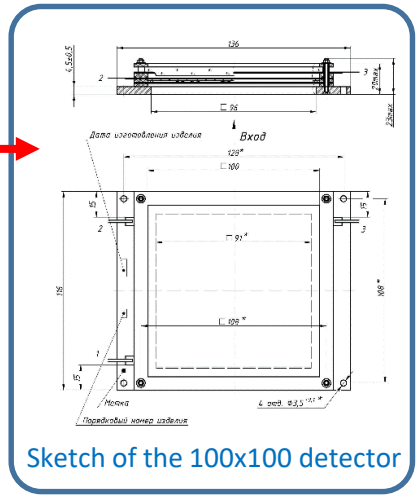


Model result of measurement with 3 independent detectors

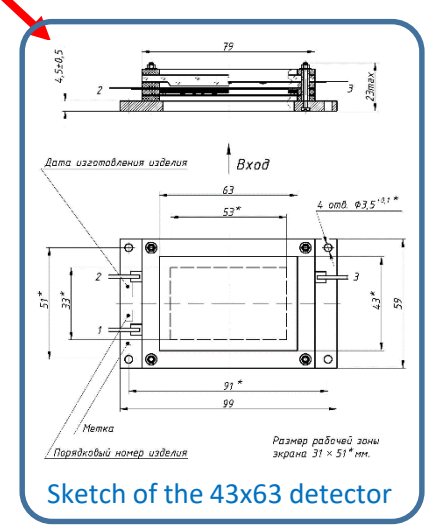
Residual Gas Monitor for CR (II) MCP detector

Another way is combining of several MCP. There are ONE ways: ~~1) stacked MCPs in one detector and~~ 2) several detectors

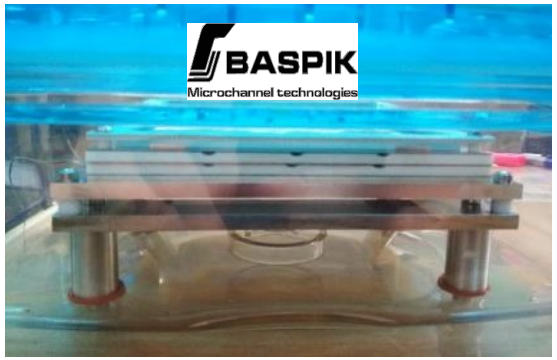




Sketch of the 100x100 detector



Sketch of the 43x63 detector

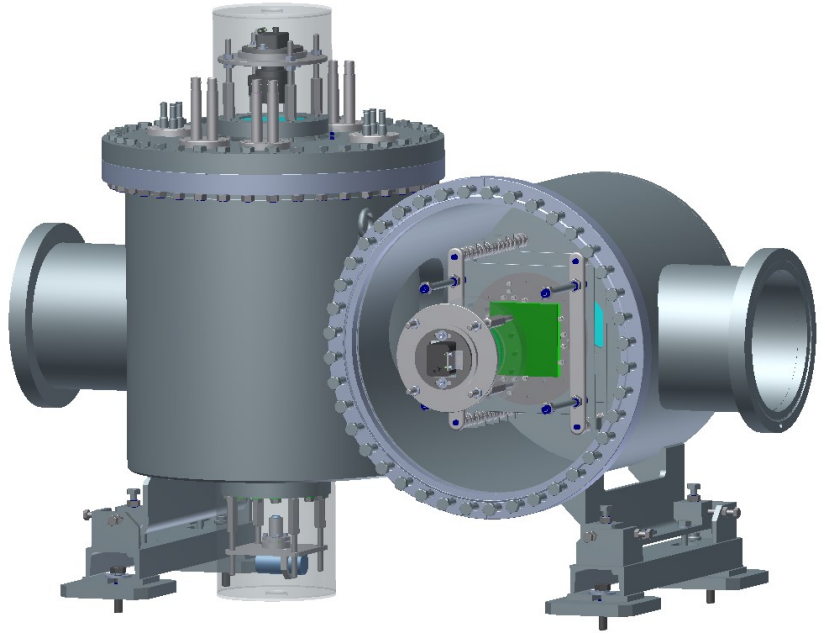


100x100 mm detector (chevron stack MCPs + phosphor screen).

1 pcs delivered to BINP

The base variant is several (3) detectors (variant 2):

- Cost: 1 detector 100x100 mm (chevron stack of MCP + phosphor screen K67 (analog of P43)) is about 4.5 k€ / pcs (3 required)
- Cost: 1 detector 43x63 mm is about 2 k€ / pcs (6 required)



The 3D model reworked for the final concept.

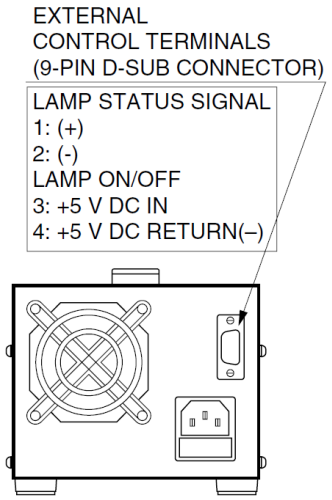
Residual Gas Monitor for CR (I) Readout Electronics

For MCP calibration and its quality control a UV lamp will be used: the Hamamatsu L2D2 lamp (L7293) with Hamamatsu C9598 power supply.

HAMAMATSU
PHOTON IS OUR BUSINESS

L7293 deuterium lamp (L2D2 lamp)

C9598 power supply deuterium UV lamp (left)



REAR VIEW

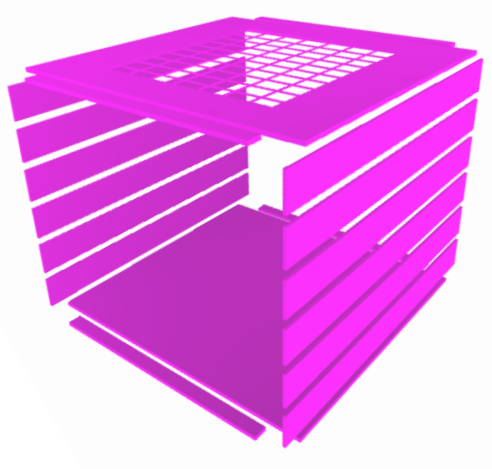
The UV lamp is controlled via 9-pin D-SUB connector. For one direction of the RGM 1 DO is needed for lamp ON/OFF and 1 DI is needed for status control.

Allied Vision

Prosilica GE680 CCD camera

- Camera will be connected to control computer via Ethernet. The connection provides both camera control and image receiving.
- Image processing will be made by the control computer
- Camera can work permanently. If remote ON/OFF of the camera needed, special electronic block is needed.

Residual Gas Monitor for CR (II) Detector Powering

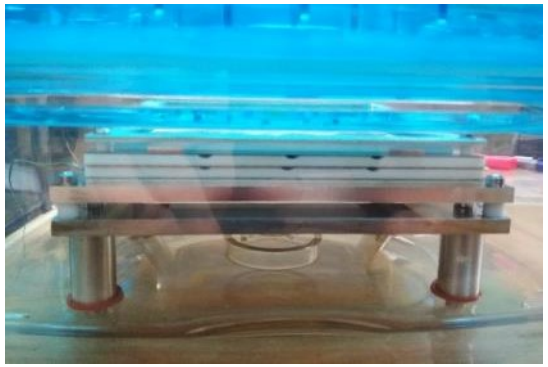


Electric filed box

The Matsusada HV PS will be used, which shown high quality and reliability.

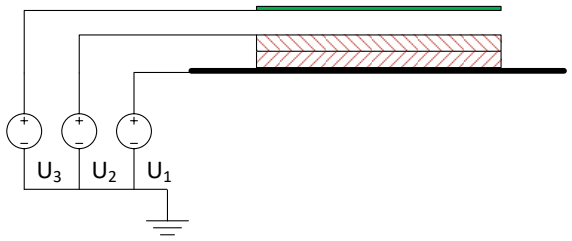
For one direction / one detector of RGM

1) EFB requires 4 HV power supplies (0 ÷ -5 kV, 0 ÷ +5 kV, 0 ÷ -10 kV, 0 ÷ -10 kV)
2) 3 detectors require 6 HV PS. In sum: 10 independent HV PS are needed for one direction.
3) Question of detectors safety.

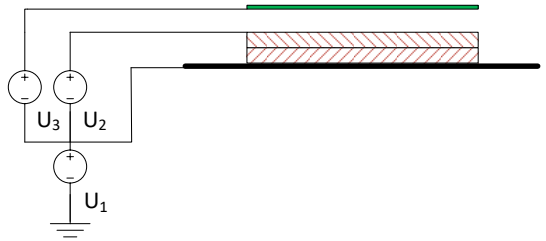


100x100 mm detector (chevron stack MCPs + phosphor screen).

a)



b)



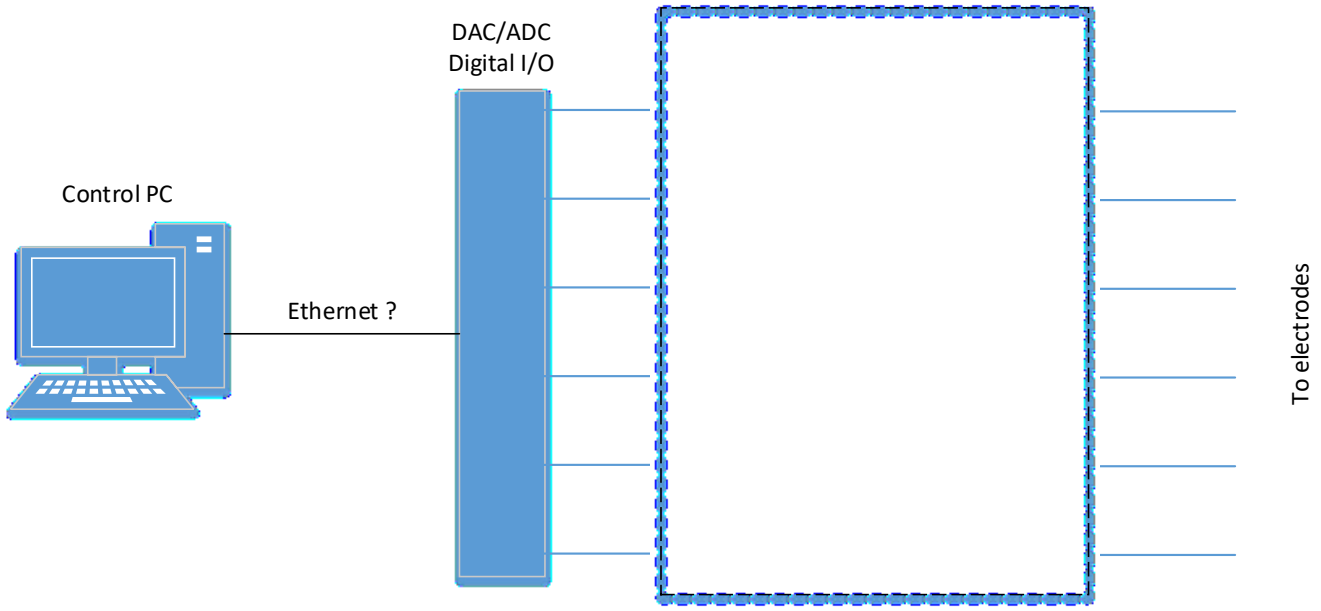
In variant (a) in case of drop down of voltage in PS U1, the detector will “see” full voltage of U2, that can result in discharge in the detector and damage it. Variant (b) is more safe from this point of view, but more complicated.

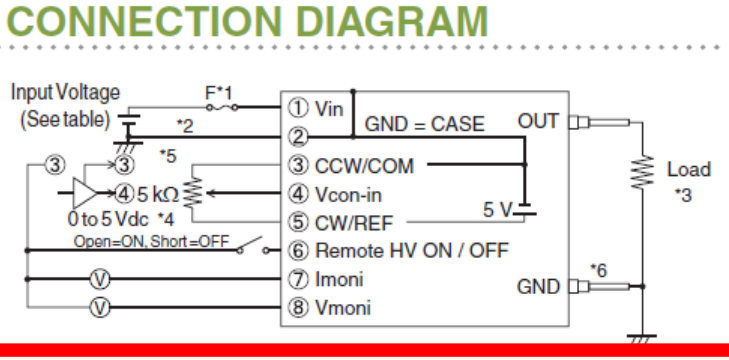
Matsusada Precision

RA/RB series power supply modules up to 40 kV DC.

Residual Gas Monitor for CR (III) Control

Operation with the Matsusada PS requires of 1 DAC (~ 12 bit) channel (control), 2 ADC (~ 16 bit) channels (measurements) and 1 DO for HV ON/OFF. Both ADC and DAC inputs (0 ÷ 5 V). Digital inputs and outputs are needed as well.



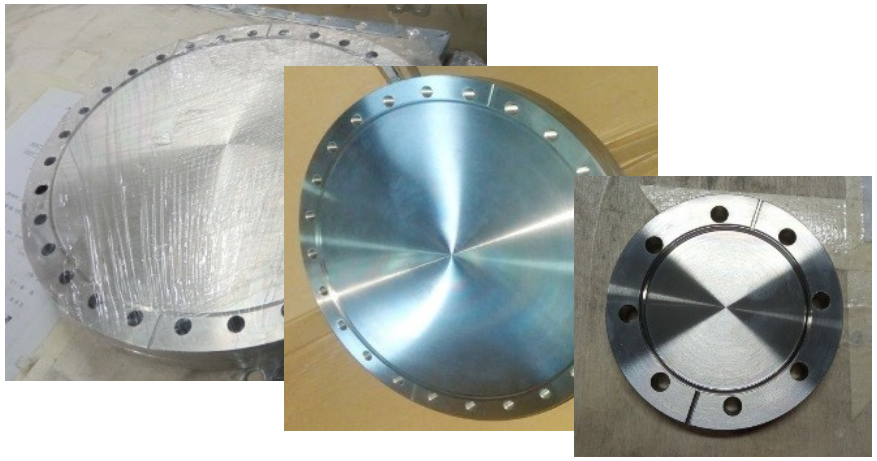


	ADC	DAC	DI	D0
EFB	4	8	-	4
Detector	6	12	-	6
UV lamp	-	-	1	1
Total	10	20	1	11

Number of channels fro one detector

- For such scheme we need DAC / ADC(s) (we assume there is universal solution at FAIR)
- Protection / interlock required (BINP in house development??). Provide protection of HV PS and ADC and proper system response to overcurrent due to spark discharge in HV system. Also it response for external interlock signals can be added (for example for personal safety).

Procurements: different equipment delivered /produced step by step



Summary

- Sub-packages for CR Beam Instrumentation one by one goes forward from design phase to the manufacturing phase.
- Beam Stopper and Beam Scrapper FDRs are passed.
- BPM test stand mechanics under tests. Software design moving forward. Looking forward of receiving of Libera Hadron fast to continue development.
- BPM octagonal electrodes production is ongoing. We expect a result in the end of Q1 2022.
- Rest Gas monitor CDR in a good shape. Needs GSI feedback on CS integration.
- Thanks to all BINP BD team and BINP employers involved for a good job!
- Thanks to FAIR / GSI colleagues (Ritscher O., Chorniy O., Schurig I. and others) for fast response and discussions.

Thank you for your attention!