



Collector Ring Beam Diagnostics Status



Yury Rogovsky

on behalf of the Budker INP team

27 May 2020, Novosibirsk



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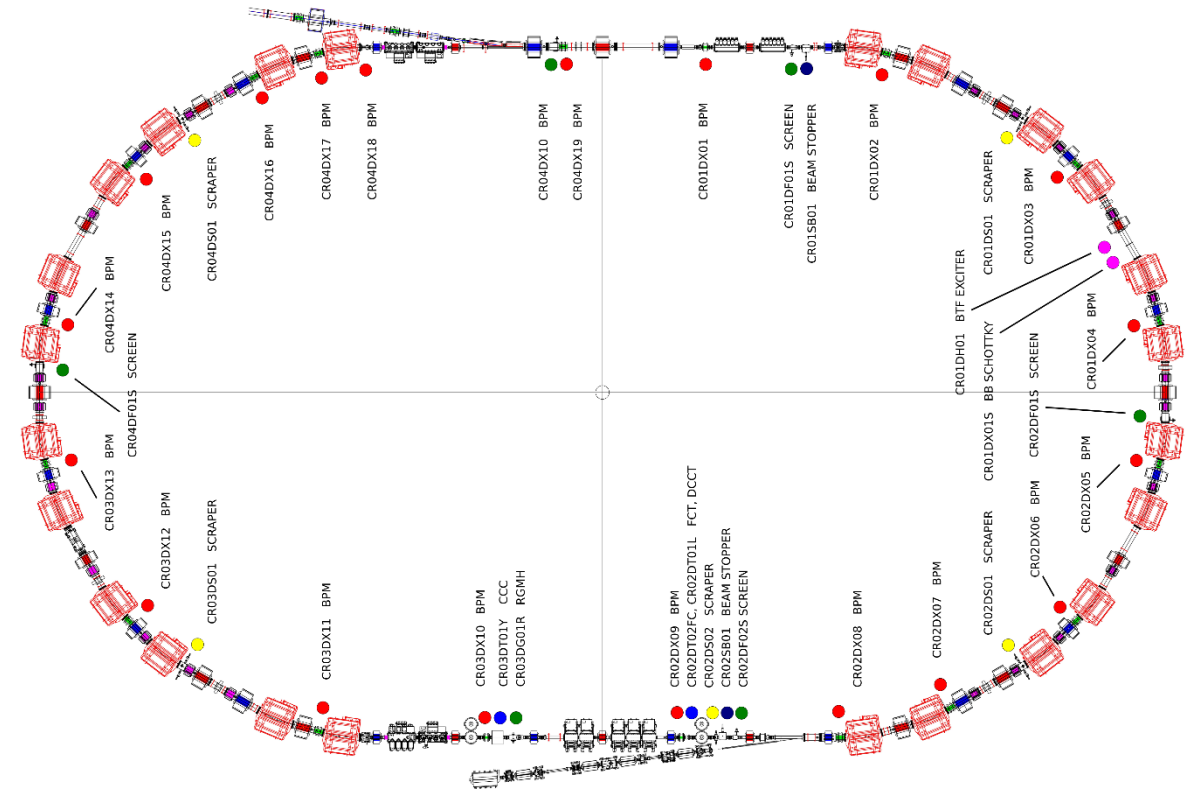
on behalf of the Budker INP team

27 May 2020, Novosibirsk

**The half a year progress
will be reported.**

Beam Instrumentations @ CR machine

Device	Qty	Parameter	Application
DC Transformer	1	DC current	Stored current, beam lifetime
Cryogenic Current Comparator	1	DC current	Stored current, beam lifetime
BPM	19	Beam center-of-mass	Closed orbit, turn-by-turn, K-modulation, lattice functions
BTF Exciter	1	Frequency of Schottky sidebands	Tune by BTF, tune by noise excitation, tune by Q-kick
Schottky pickup	1	Momentum distribution	$\Delta p/p$, tune, chromaticity
Fast Current Transformer	1	Broadband bunch structure	Longitudinal emittance, bunch gymnastics
Residual Gas Profile Monitor	2	Beam profile	Transverse emittance, injection matching
Beam Loss Monitor	Distributed	Beam loss	Mis-steering of magnets, halo detection at scrapers
Scintillating Screen	5	Beam profile	First turn diagnostics
Beam-Stopper	2	Stop the beam	First turn diagnostics
Scrapers	2x4 2x4	Beam size	Transverse beam size and beam alignment













- TCR1 beam instrumentation not covered by this talk, but has the same design mainly (except one BPM @ final part which is not developed fully).
- SFRS / Pbar “lost diagnostics” – words from another song.

3rd BINP-FAIR Workshop results

Conclusion / Progress 2019

- Most of all design work for all DB components was finished (or 90% ready)
- CDR for the BPM detector and mechanics, BPM amplifiers, FCT, DCCT, Scintillating Screen, Beam Scraper, Beam Stopper passed
- CDR for the RGM will be presented (not done)
- FDR for the BPM detector and mechanics, Beam scrapper ready (presented)
- FDR for other BD components will be presented soon (we do our best)
- Timelines for all BD components defined / corrected
- BTF, Schottky BPM (ITEP in-kind) in a good shape. Kick-Off @ October 2019 (presented)
- TCR1 diagnostics subsystems are now under design and we expect good progress in coming 2020 year. (has delay)
- We should keep close contact with FAIR-GSI colleagues (and subcontractors). (as planned)

28 Nov 2019	
09:30	--- BUS Hotel->BINP ---
15:00	CR diagnostics - Yury Rogovsky (BINP)  Dr Ivan Koop (BINP) Mr Oleksiy Dolinskyy (GSI, Darmstadt) Herbert Schwarz (GSI, Darmstadt) Dr Oleksii Gorda (GSI, Darmstadt) (until 17:00) (Vepp2000 Control Room)
15:00	Beam diagnostics overview - Yury Rogovsky (BINP) (Vepp2000 Control Room)   
15:40	FDR of BPM - Yury Rogovsky (BINP) (Vepp2000 Control Room)   
16:20	FDR for scrapers - Yury ROGOVSKY (Vepp2000 Control Room)   
17:00	--- Teabreak ---

Efforts in 2020 short overview

Spec	CDR	FDR	FoS	FAT	SAT
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- Pickups – FDR done in Nov-2019. Docs are in progress. Wide prototype is under intensive study. Small prototype manufacturing is ongoing. One TCR1 pickup in not designed yet.
- Scrapers – FDR done in Nov-2019. Docs are nearly ready. Wide type manufacturing is ongoing.
- Scintillators – CDR released. FDR coming soon. Scintillating plates partially produced. Optical components are purchased. Manufacturing has been started.
- Stoppers – CDR released. Design is finished. FDR upcoming.
- RGM – CDR docs are nearly finished, coming soon.
- FCT, DCCT – CDR,FDR released. Purchase via FAIR is assumed. Annoying item: TCR1 FCT is not contracted!

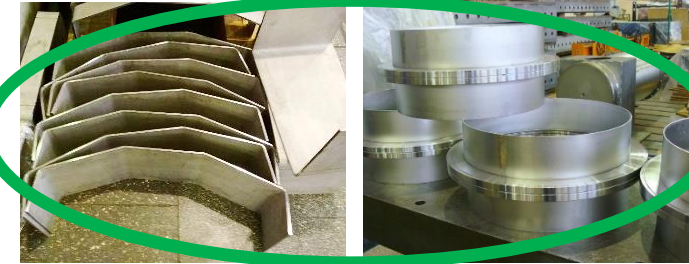


Wide pickup prototype

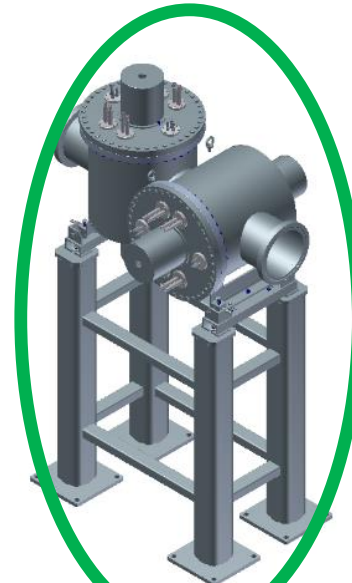


Pickup preamplifier prototype

Scrapers vacuum chamber parts



Scintillating screens: manufactured plates, purchased objectives & CCDs →



RGM 3D-model



Scraper 3D-model

Scrapers supports



Cryogenic Current Comparator for CR

PSP 2.5.6
WP CR Diagnostics
 WP-Leader Rogovsky Yury
 Report period April 2020

Qualitative rating:
 X done
 as planned
 critical, but reachable
 very critical, unreachable
 not applicable

Status for WP
 Deadlines
 Costs
 Resources



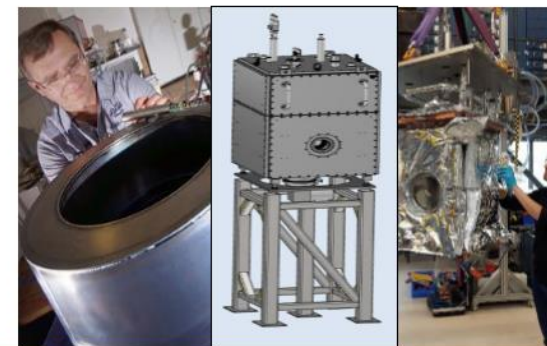
PSPSp	Subproject	Responsibility	S	CDR	FDR	PR FoS	FAT FoS	SAT FoS	SP	FAT SP	DL	SAT SP	IN	CO	Activities in reporting period / Risks
2.5.6.3.1	BTF	M. Schwickert O. Chorniy	X												GSI / ITEP resp. Kick-off October 2019. CDR preliminary February 2020. Draft 3d model.
2.5.6.3.2	Schottky Pickup	M. Schwickert O. Chorniy	X												GSI / ITEP resp. Kick-off October 2019. CDR preliminary February 2020. Draft 3d model.
2.5.6.1.3	CCC	M. Schwickert O. Chorniy													The specification should be ready until the middle of 2019 (according to plans).

Monthly report, April 2020

- Development of CCC for CR based on R&D process at GSI.
- High complicated work with many parameters caused by requirements.
- High sensitivity required at very low intensities (for commissioning at least) is the key feature of the device.
- Specification reasonable delayed => production delayed.
- Dummy placeholder vacuum pipe for commissioning (as an option)?
- Looking forward for the successful first test at CRYRING.

February 2020

After 10 years of R&D, First Cryogenic Current Comparator detector for absolute, highly accurate beam intensities measurements in collaboration with HI Jena, Uni. of Jena and the SPARC Collaboration, is ready for testing in CRYRING



Jörg Blaurock talk on May 25, 2020

Good Job!!!
 Congratulations!

BTF / Schottky Pickup for CR

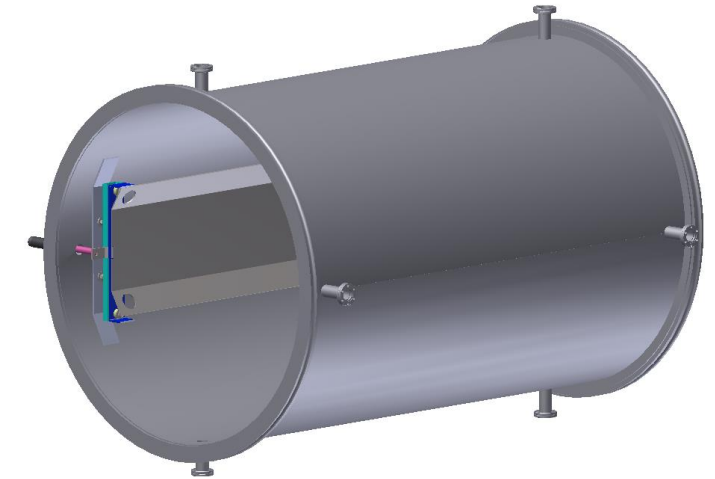
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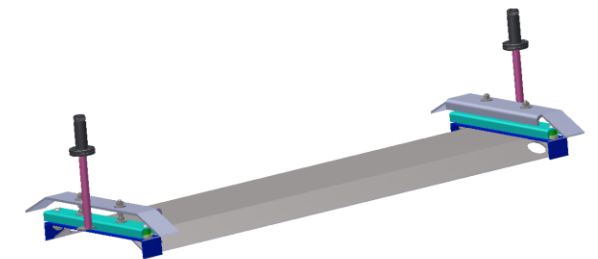
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Monthly report, April 2020



Dmitry Liakin, ITEP
 Private communications
 March 2020

- Development and production contracted with ITEP (Moscow, Russia).
- Kick-off meeting was in October 2020.
- Draft of CDR was discussed February-March (O. Chorniy, D. Liakin).
- Preliminary 3D model developed. Not discussed yet.
- Looking forward to the CDR procedure in nearest future.
- NB: Budker INP team must be involved in process (checking the interfaces).



Schottky Pickup 50 Ohm
 matched electrode

FCT and DCCT for CR

December 2019

~120 k€

NPCT-CF8"-147.6-120-UHV-	6"	DN160 NW150CF	147.6	120.0
NPCT-CF10"-198.4-120-UHV-	8"	DN200 NW200CF	198.4	120.0

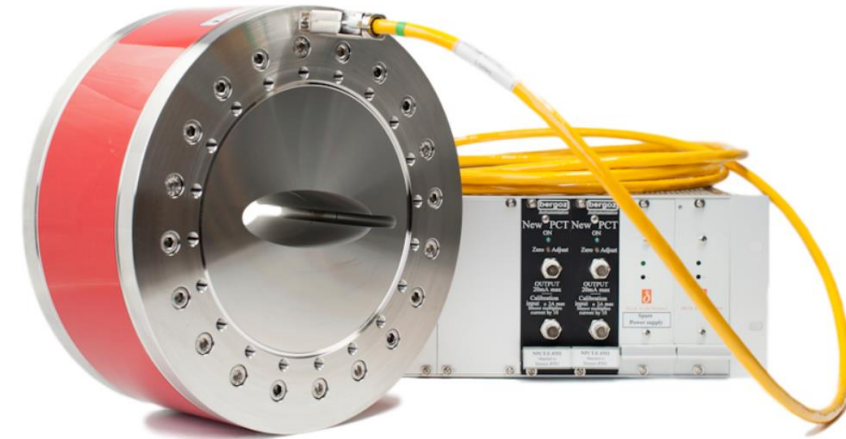
~40 k€

FCT-CF10"-147.6-40-UHV	6"	DN/NW200CF	147.6	
FCT-CF12"-198.4-40-UHV	8"	DN/NW250CF	198.4	
		Axial length H	40.0	

Now (Price List April 13th, 2020)

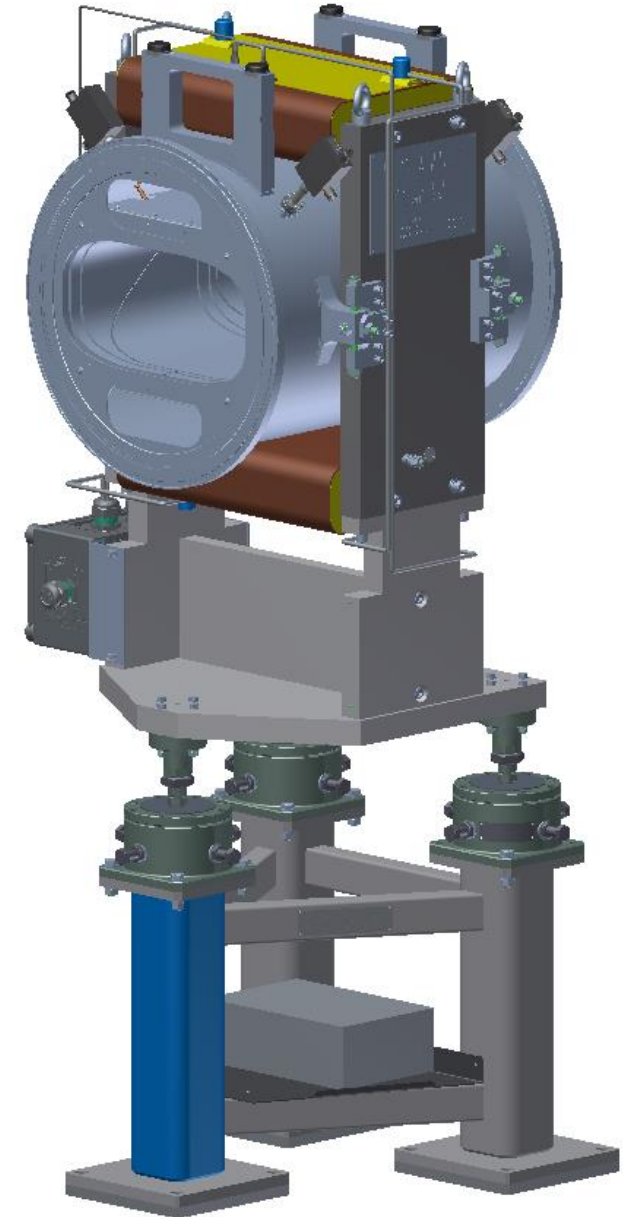
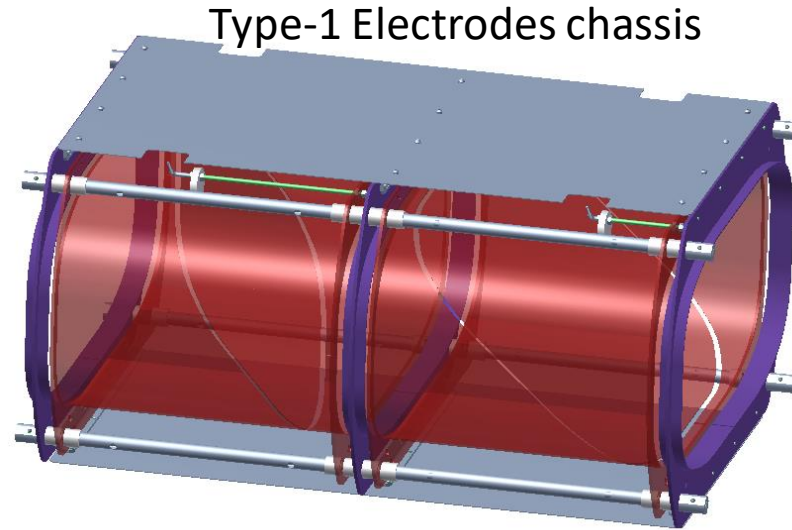
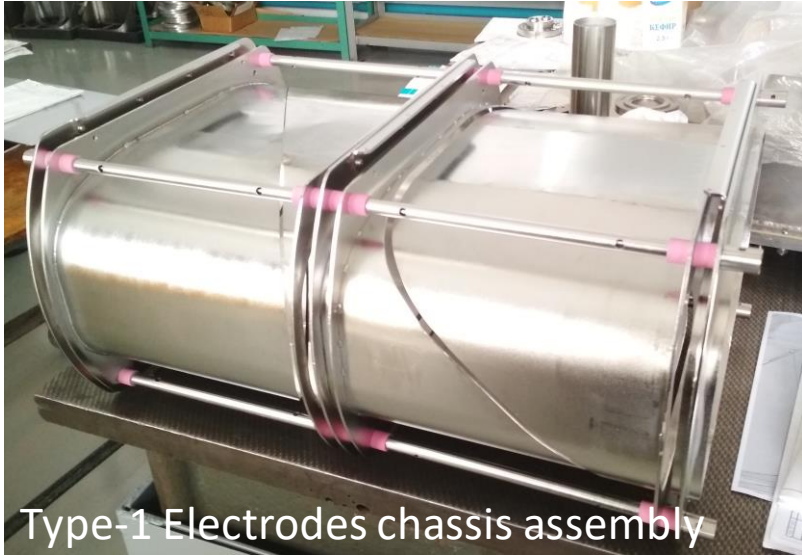
125 k€ and 42 k€

- CDR / FDR passed.
- Commercially available devices from BERGOZ (Genève). We keep contact.
- Purchase via FAIR is assumed. Looking forward for any news or procedure.
- NB: Budker INP team must be involved in process. Not all options still available from BERGOZ. (for an additional kE => NPCT with 2 mA range)
- Annoying item: TCR1 FCT is not contracted! Must be clarified this year.



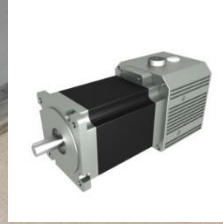
- DCCT: comes with electronics
- FCCT: amplifier required (selected one – DUPWA-1-70 by FEMTO)

Beam Position Monitor for CR

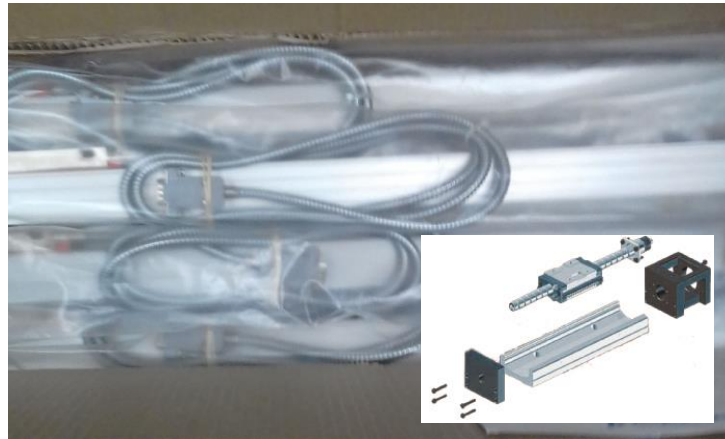


- Concept finished. Mechanical development was done. **No crucial changes last time. All changes done caused by optimization of production technology.**
- **Model / Drawings 95% ready.** Procurement of most components done. Wait.
- **FDR presented. FDR documents pack** – 1st internal review passed; **2nd internal review** – coming soon. Many discussions with GSI QA. **FEM analysis in progress.**
- **FoS production:** 90% of Type-1 BPM combined with vert. dipole corrector done.
- **Open questions:** Libera A110 – 19pcs – not in 2nd Ammendment for the "FAIR orders components for BINP". The same for TCR1 – 5pcs.
- **Minor changes in VGA control. Not finished with FZJ. Will be discussed later.**

Beam Position Monitor Test Stand



Interface to PC, RSI profile for whole stand, motors and LIR (with encoders).



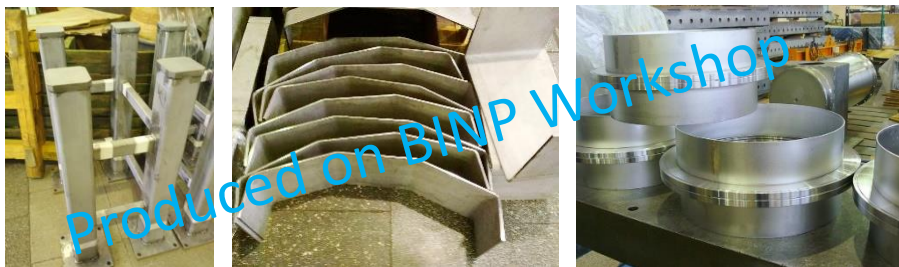
- Test stand development is going.
- Procurement of components done, 70% stuff delivered to BINP.
- Electrodes production technology takes much more efforts due to its complexity.

- **Open questions:** Draft Amendment on Temporal (2 years) import of one Libera Hadron Processor to BINP send to the FAIR in February 2020. To be corrected before signature.
- **LNA and VGA parts prototypes from FZJ delayed due to COVID.**



Beam Scraper for CR

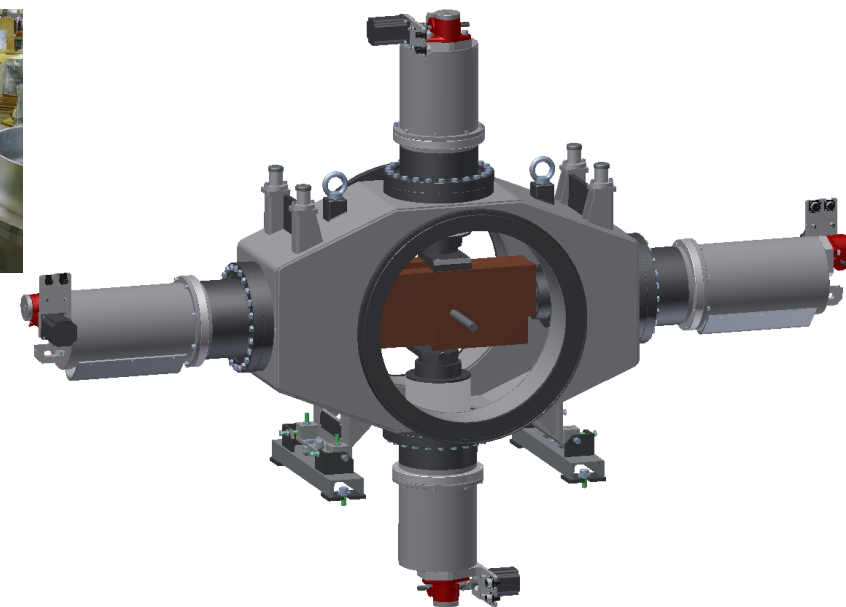
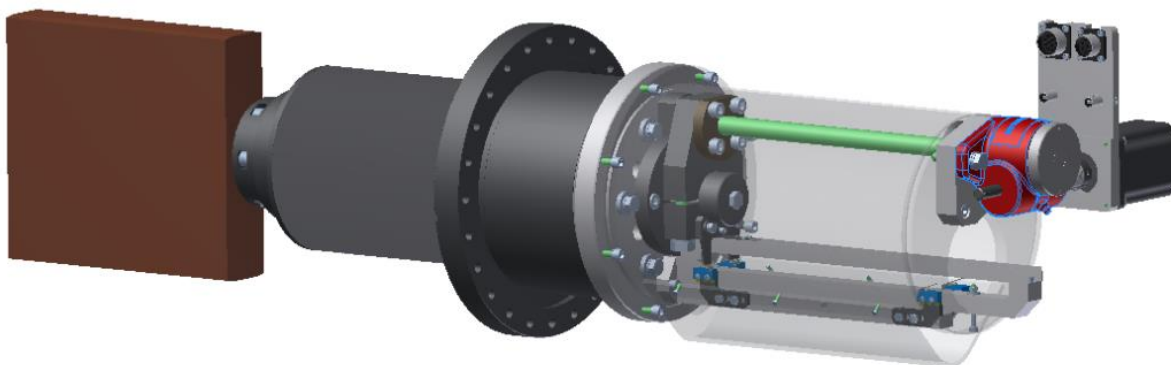
Received



Oriental 5-phase motor. Micro Switch.



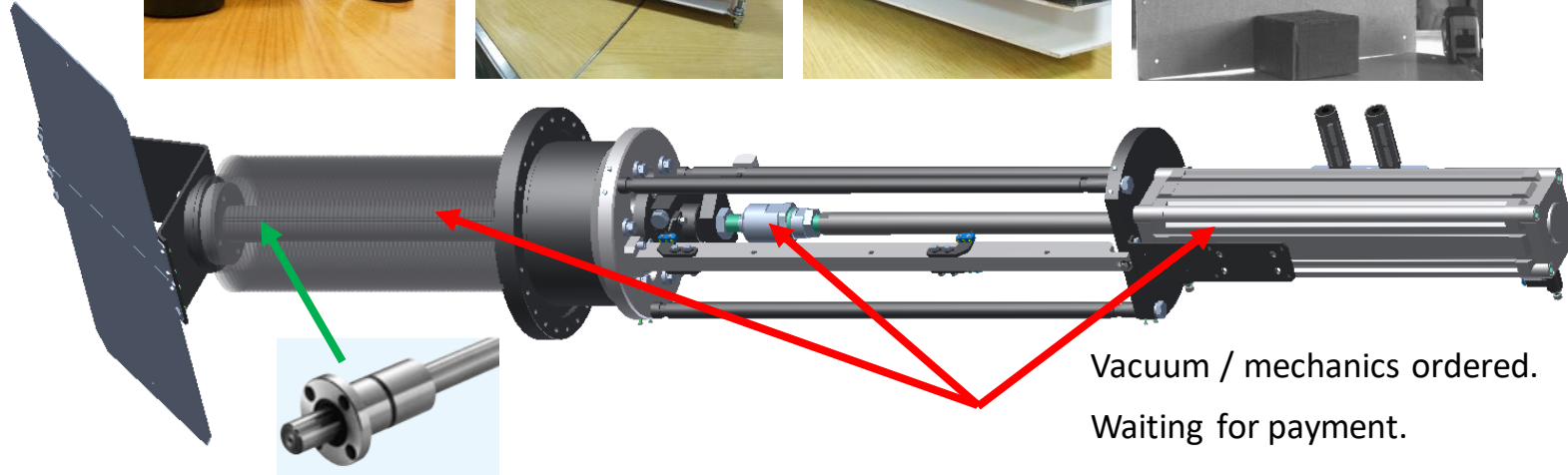
Ordered



- Concept finished. Mechanical development was done. **Minor changes last time.**
- **Model / Drawings 95% ready.** Procurement of most components done. Wait.
- **FDR presented. FDR documents pack – 1st / 2nd internal review passed; 3rd internal review – next week. Many discussions with GSI QA.**
- **FEM analysis: Fiducials shift less than 50 um. No valuable deformations.**
- **FoS production: 1490 of 2700 m.h. mech. drives, 1500 of 2700 m.h. other.**
- **Open questions: MBOX PDC – 5pcs – not in 2nd Ammendment for the "FAIR orders components for BINP".**

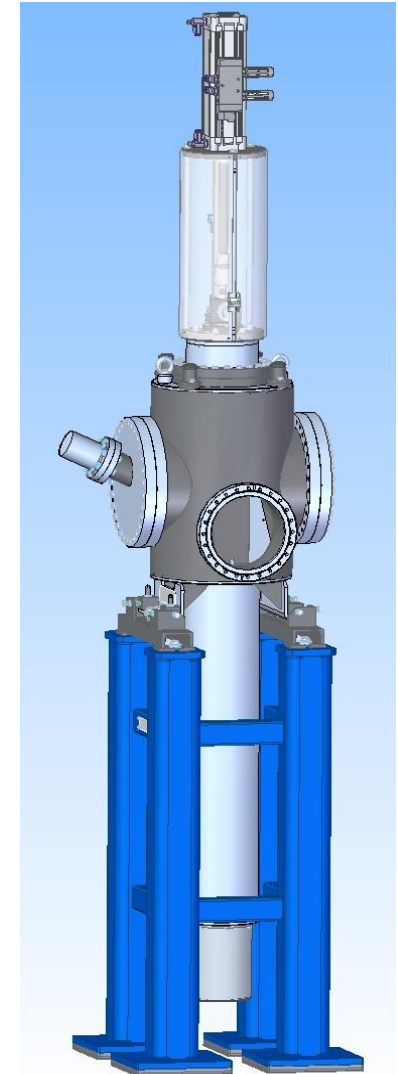
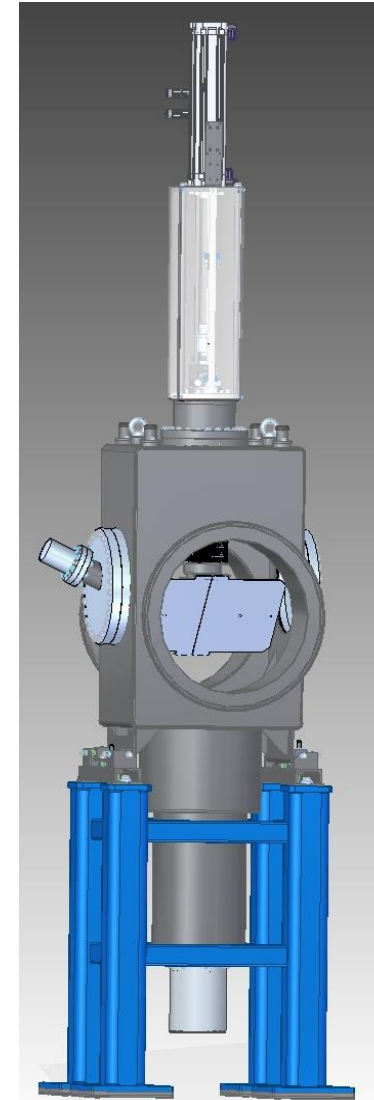
Item	#	Status
Standard Metric Inverted Rotating Screw Actuators: DE2626-0310, DE2626-0210, DE2626-0290	22	Contract is signed
Ball Splines SSPF Type: SSPF40A-1-430, SSPF40A-1-405, SPF40A-1-320	22	Order is in progress
Coupling): BKL/003/10/	22	Delivered
Stepper Motor: PKP569FN24A2	22	Delivered
Switch: S880W2G6k	150	Delivered
Linear Motion Conductive Plastic Potentiometers CFL300, CFL200	22	Order is in progress
Bellows Units DN102,5/150-35, DN102,5/150-50, DN102,5/150-55	22	Order is in progress
Connector Souriau Type UTG01412P 9.	22	Delivered
Pin Souriau Type RM16M23K	264	
Connector Souriau Type UTG0128P	22	
Pin Souriau Type RM24M9K	176	
Lemo Connector - Lemo PCA 0S 302 CLLC42	44	

Scintillating Screen for CR

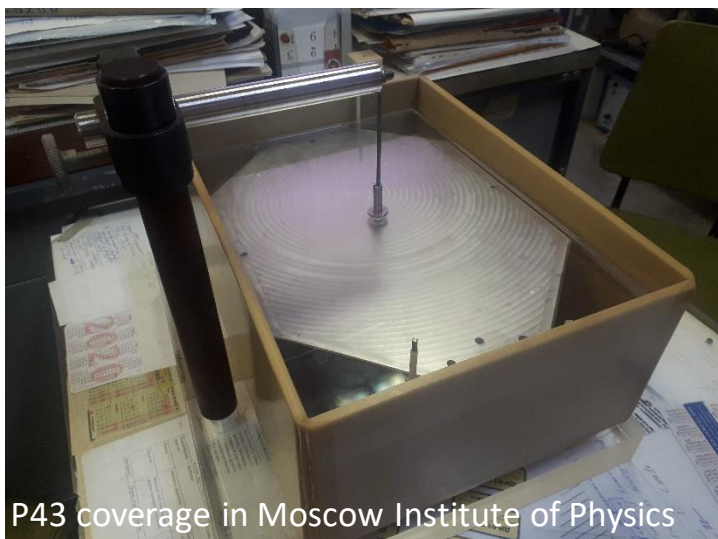


Vacuum / mechanics ordered.
Waiting for payment.

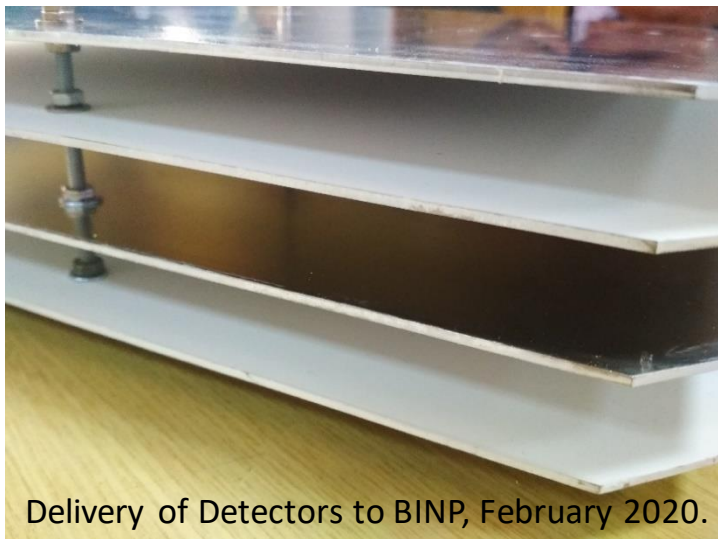
- Concept finished. Mechanical development was done. **Minor changes last time.**
- **Model / Drawings 95% ready.** Procurement of most components done. Wait.
- CDR presented. **FDR documents pack** – 1st / 2nd internal review passed; **3rd internal review** – next week.
- **Many discussions with GSI QA.**
- **FEM analysis in final stage (no problems).** Production formally not started.
- **Components: IDS UI-5240SE camera and Computar MG1616FC objective lens is “standard” solution for FAIR. FESTO pneumatic cylinder is well-known.**



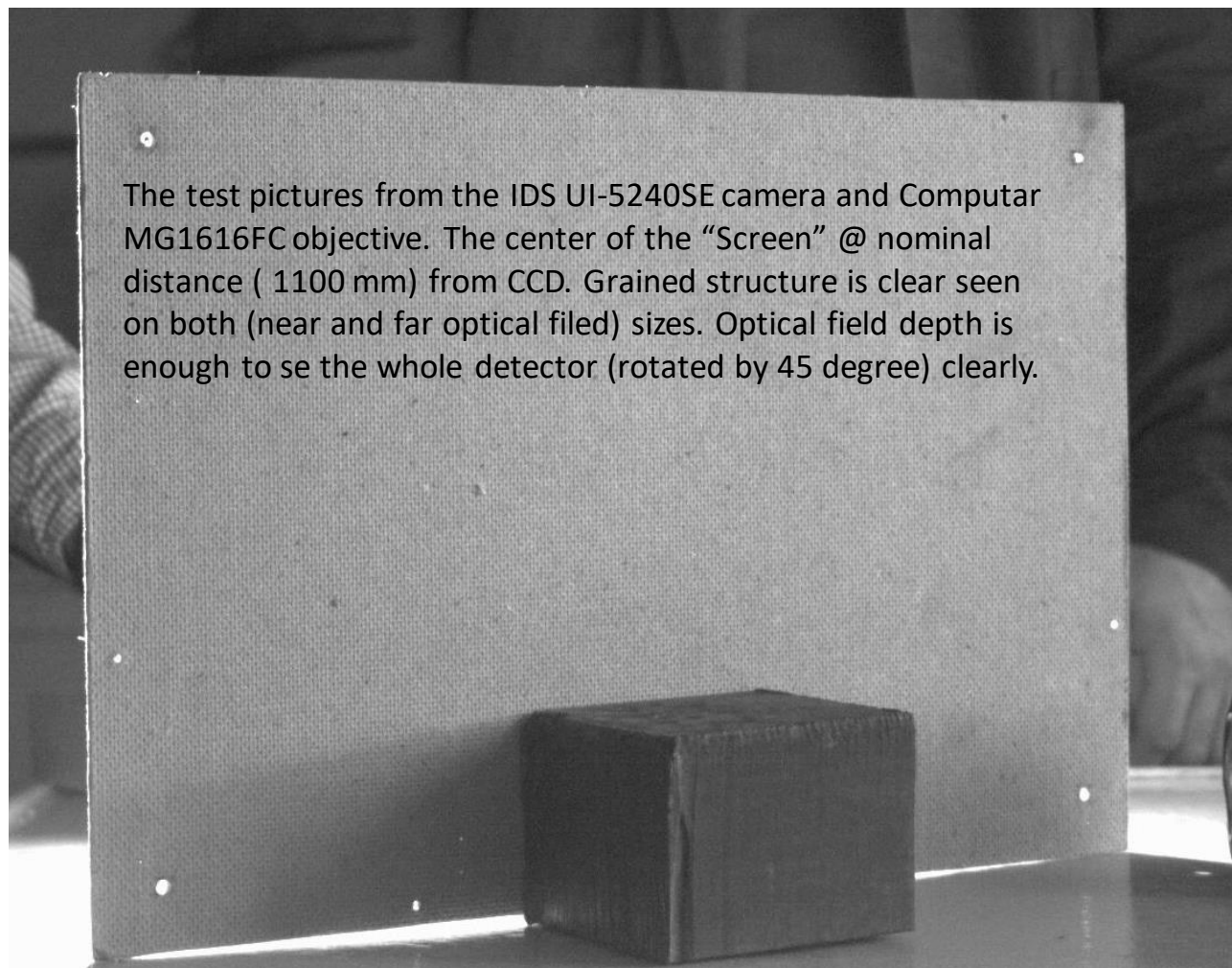
Scintillating Plates for CR



P43 coverage in Moscow Institute of Physics named after A.M. Prokhorov, December 2019.



Delivery of Detectors to BINP, February 2020.
First pack for Type-1. Delayed due to COVID.



The test pictures from the IDS UI-5240SE camera and Computar MG1616FC objective. The center of the "Screen" @ nominal distance (1100 mm) from CCD. Grained structure is clear seen on both (near and far optical filed) sizes. Optical field depth is enough to se the whole detector (rotated by 45 degree) clearly.

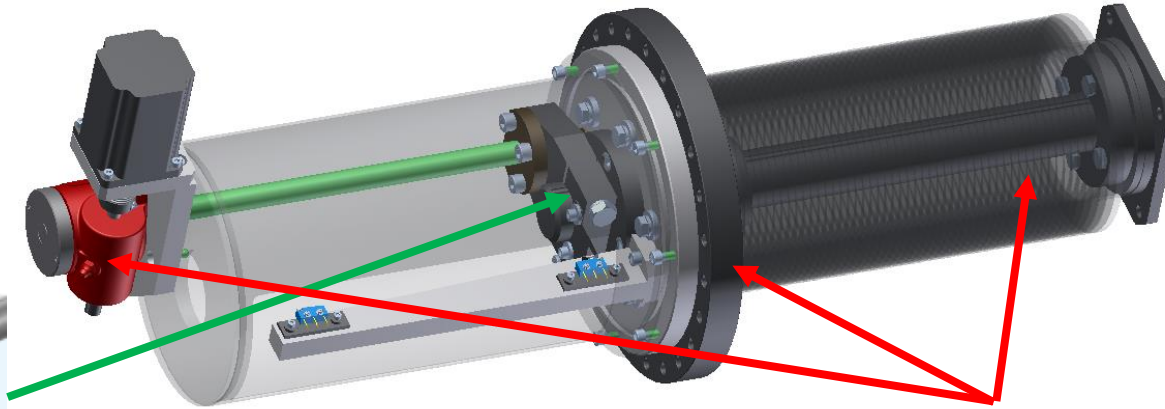
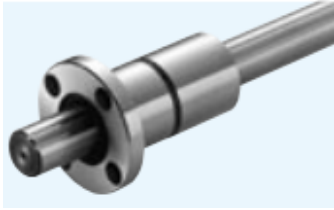
- Quality tests of the P43 coverage will be performed AFAP at BINP.
- Next pack of Detectors Type-2 will be delivered after COVID restrictions.

Beam Stopper for CR

Received



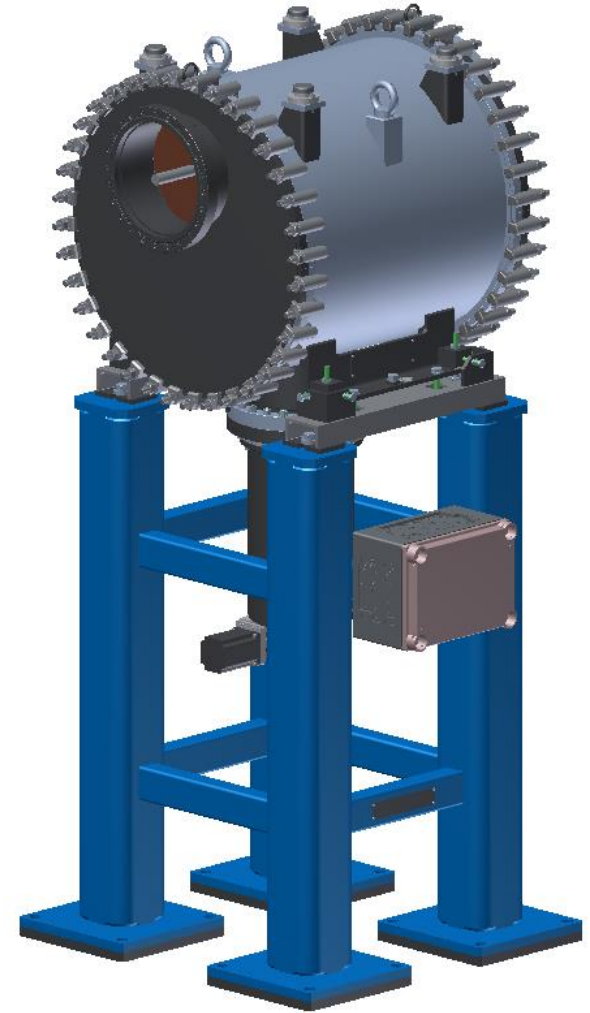
Oriental 5-phase motor.
Micro Switch. Ball Spline.
Potentiometer.



Vacuum / mechanics
components ordered

Delivery delayed due to COVID

- Concept finished. Mechanical development was done. **Minor changes last time.**
- **Model / Drawings 90% ready.** Procurement of most components done. Wait.
- **FDR documents pack** – 1st internal review passed; **2nd internal review next week.**
- **Features:** Sensitive to bunch charge (80 mV for 10^7 pBar @ 20 pF).
- Production formally not started.
- **Open questions:** MBOX PDC – 2pcs – not in 2nd Ammendement for the "FAIR orders components for BINP".



Residual Gas Monitor for CR

Camera
Calibration



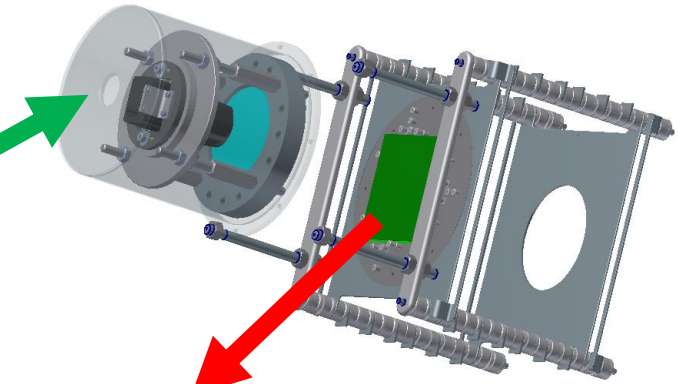
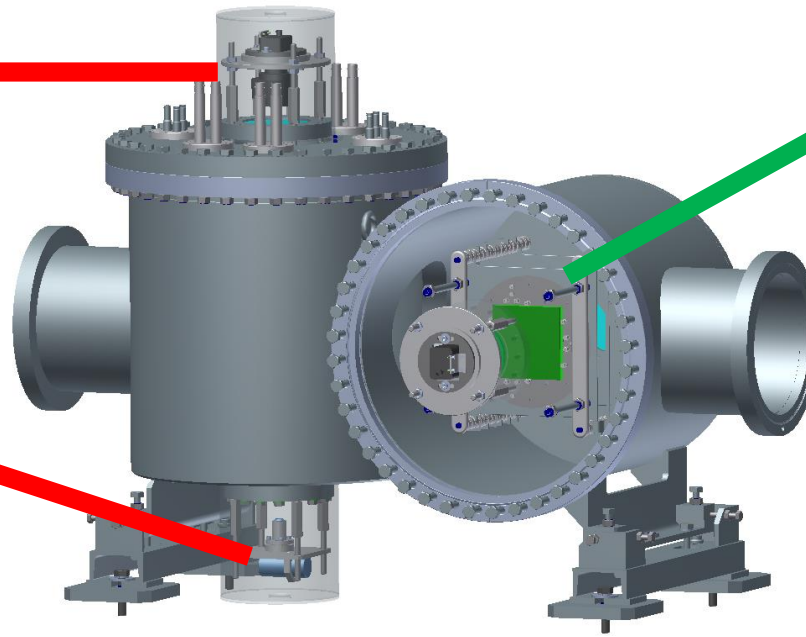
Prosilica GE680 CCD camera

HAMAMATSU PHOTON IS OUR BUSINESS **HAMAMATSU** PHOTON IS OUR BUSINESS



L7293 deuterium lamp (L2D2 lamp)

C9598 power supply deuterium UV lamp



MCP detector
100 x 100 mm

For Electric Field Box + Detector
8-channel High Voltage power supply is needed.

Matsusada Precision

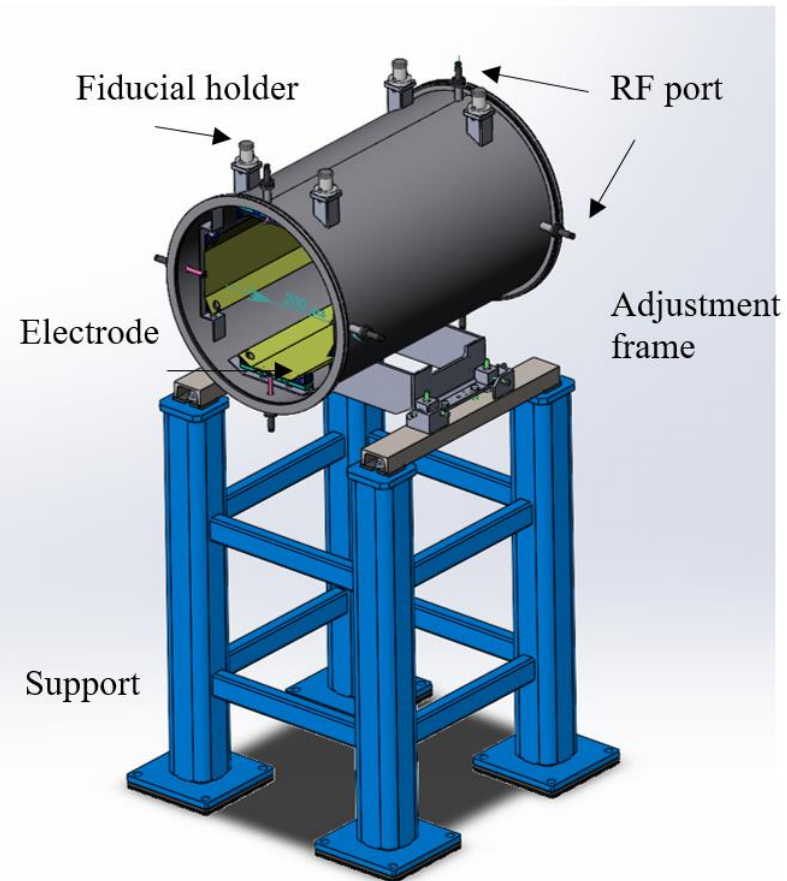


RA/RB series power supply modules up to 40 kV DC.

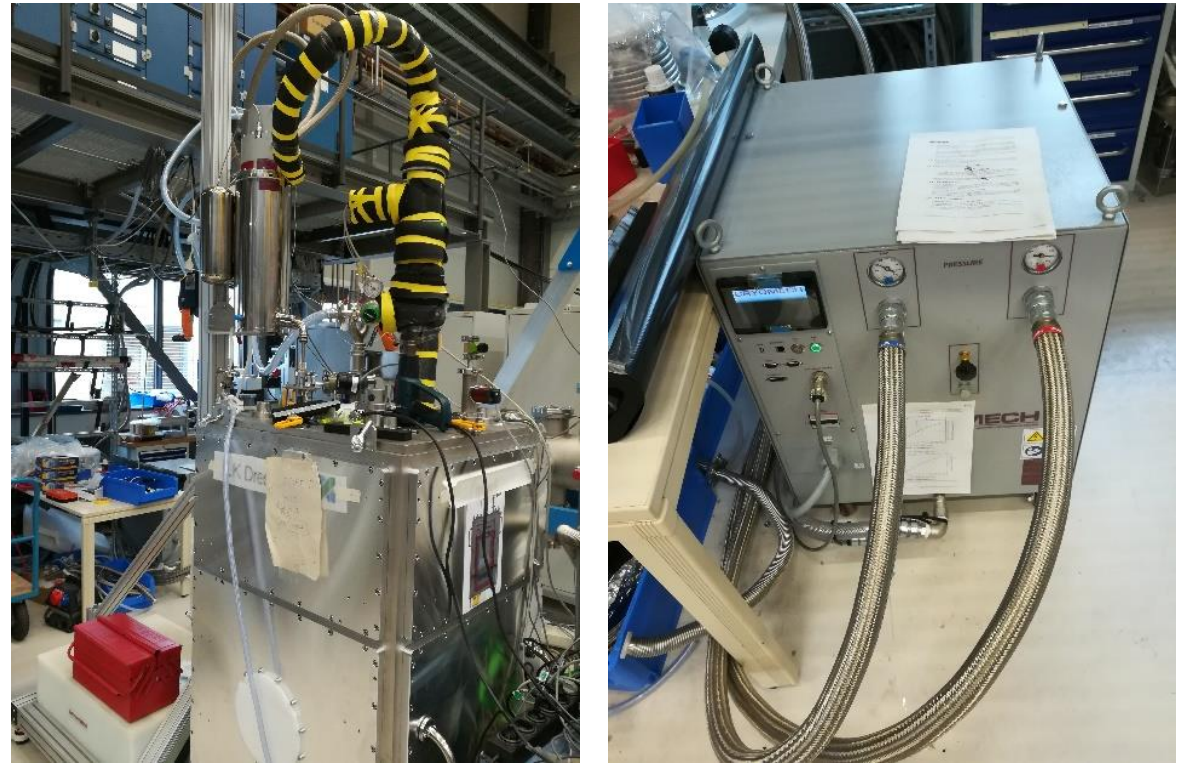
- Concept finished. Mechanical development was intensively for the last half year.
- CDR documents pack – 1st internal review passed; 2nd internal review next week.
- Model / Drawings 90% ready. Procurement of components – AFAP.
- **Restrictions:** Aperture 160 mm (chamber diameter), Bunch size 140 mm as in Specification, **Detector size (MCP + Scintillator) 100-110 mm** (biggest available on the shell). Negotiations not finished (stopped due to COVID).

CR beam instrumentation in tunnel by GSI / ITEP

Preparation to CDR of Schottky noise detector (ITEP, Russia InKind)



Temperature tests of FAIR CCC prototype (GSI InKind)



Reported by O. Chorniy, May 2020. Thanks.

Summary

- Subpackages CR Beam Instrumentation goes forward from design phase to the manufacturing phase.
- The documentation / models / drawings matching that are needed for milestones passage takes significantly more time than we expected.
- Various managing efforts done: contracts amendments; procurement via FAIR; temporary import; etc. **and still needed (not all done yet).**
- First CR BD component delivery (FoS Type-1 BPM, FoS Type-1 Scraper, FoS Type-1 Screen maybe) is expected @ FAIR site in Q1 2021.
- Thanks to all BINP BD team and BINP employers involved for a good job!
- **Many thanks to FAIR / GSI team for the constructive cooperation and discussions (very appreciated to O. Chorniy, A. Reiter, H. Schwarz and others).**

Thank you for your attention!