



# Status of BINP collaboration with FAIR

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Budker INP, Novosibirsk

5<sup>th</sup> FAIR-BINP Meeting 9-13 November, 2020

# BINP-FAIR ongoing contracts

N	Contract N BRIEF	Contract N FULL	Sub-Project Leader (SPL)/ Work Package	Description
1	no	Collaboration Contract for design, production and delivery of vacuum chambers for dipole magnets for Work Package PSP 2.3.7.1.2.2 for the FAIR High Energy Beam Transport (HEBT) System	Alexander KRASNOV	design, production and delivery of vacuum chambers for dipole magnets for Work Package PSP 2.3.7.1.2.2 for the FAIR High Energy Beam Transport (HEBT) System
2	CC2.3.2-2	FAIR Contract No. CC2.3.2-2 (Magnets for HEBT System)	Ivan MOROZOV	Design, production, delivery, installation of magnets with resistive "warm" (nonsuperconducting) coils for the FAIR High Energy Beam Transport (HEBT) System (Batch 2)
3	no	FAIR Contract The design, production, delivery, assembly and testing of the Superconducting Solenoid Magnet of the PANDA Detector	Eugeny PYATA	Design, production, delivery, assembly and testing of the Superconducting Solenoid Magnet of the PANDA Detector
4	CC 2.5.2.1	FAIR Contract No. CC 2.5.2.1 (Dipole magnets)	Alexander STAROSTENKO	Design, production and delivery of Dipole Magnets for the FAIR Collector Ring (CR) System
5	CC 2.5.2.2.1	FAIR Contract No. CC 2.5.2.2.1 (CR Rest)	Ivan KOOP, Dmitry SHWARTZ	Design, production and delivery of Magnets, Power Supplies, Injection/Extraction, Beam Diagnostics, Vacuum for the FAIR Collector Ring (CR) System
6	CC CR.HOAI	FAIR Contract No. CC CR.HOAI	Dmitry SHWARTZ	Technical Coordination of the Construction of the Collector Ring to the Construction of the FAIR Facility
7	CC 2.4.2.1.1.2	FAIR Contract No. CC 2.4.2.1.1.2 on the in-kind Contribution (IKC) 2.4.2.1.1.2 Dipole 1 for Accelerator co-operation agreement,	Konstantin ZOLOTAREV	Dipole 1 for Super-FRS
8	no	Accelerator Implementing Agreement No. 1 to Addendum 1 to the Collaboration Contract	Konstantin ZOLOTAREV	Technological design of radiation-resistant multipole magnets for Super-FRS
9	no	dated 12.12.2016 As part of the Work Package PSP 1.1.1.7 For the CBM experiment	Nikolay MEZENTSEV	Design, prototyping, production, delivery, assembly and testing of the Dipole Magnet As part of the Work Package
10	no	Co-operation agreement, Implementing Agreement Addendum No 1 to the CO-OPERATION Agreement	Eugeny ANTOKHIN	Technological design of dipole magnet for HESR-PANDA
11	AFAA1 to CC 2.4.2.1.1.2 for 2.4.7.1.12.1	To the Collaboration Contract CC 2.4.2.1.1.2 Hereinafter referred to as "the Main Contract"	Alexander KRASNOV	Vacuum chambers and supports for beam diagnostics at the focal planes of SFRS; Diagnostic chamber Support (different sizes)
12	CC 2.3.7.1.2.3.2 as AFAA2 to CC 2.4.2.1.1.2	To the Collaboration Contract CC 2.4.2.1.1.2 Hereinafter referred to as "the Main Contract"	Alexander KRASNOV	Vacuum chambers for the FAIR High Energy Beam Transport (HEBT) System (HEBT Batch 2-3 Vacuum chambers)
13	CC 2.4.7.1.2.2.1 as AFAA3 to CC 2.4.2.1.1.2	To the Collaboration Contract CC 2.4.2.1.1.2 Hereinafter referred to as "the Main Contract"	Alexander KRASNOV	Vacuum chambers inside SC dipoles (SFRS)
14	CC 2.3.7.1.2.1 as AFAA4 to CC 2.4.2.1.1.2	To the Collaboration Contract CC 2.4.2.1.1.2 Hereinafter referred to as "the Main Contract"	Alexander KRASNOV	Vacuum chambers HEBT Batch 4
15	CC 2.9.2.2.1.1.1 as AFAA6 to CC 2.4.2.1.1.2	To the Collaboration Contract CC 2.4.2.1.1.2 Hereinafter referred to as "the Main Contract"	Petr SHATUNOV, Dmitry SHWARTZ	2.9.2.2.1.1.1 p-Bar Quadrupoles, CR-type, NC, wide apert. 2.9.3.2.1.1.1 p-Bar Power Part, Cabinet, Construction (pulsed op)

≈87 MEuro

# BINP-FAIR contracts under discussion

16	AFFA5		Alexander KRASNOV	AFAA5 SFRS vacuum components (beam pipes and chambers) - Contract draft need acceptance.
17	AFFA7		Yury ROGOVSKY, Dmitry SHWARTZ	AFAA7 CR-like beam diagnostic BPMs, 100%-CR-like for HEBT and pbar. New big BPM for SFRS and pbar. Final technical clarification between BINP and FAIR. Contract preparation ongoing.
18	AFFA8			AFAA8 SFRS Local Cryogenic BINP's part of FAIR-WUST-BINP agreement. Waiting on GERMANY's finance agreement. Research
19	AFFA9		Alexander KRASNOV	AFAA9 SFRS branching dipole chamber contract – FAIR prepare contract. The price was misunderstood and costbook value is not
20	AFFA10			AFAA10 SFRS multipole magnets including vacuum chambers shall be tendered by FAIR. A consulting contract regarding BINPs radiation resistant multipole know-how shall be negotiated between FAIR and
21	AFFA11		Alexander STAROSTENKO	AFAA11 Dipole 3 (Connection box only difference to CR design) and Quadrupole 3 (100% CR-like) including vacuum – GSI provide draft of specification and FAIR IOP sent costbook8 info and price negotiations. Contract negotiation await CR Dipole FAT in Nov 2020
22	AFFA12		Alexander STAROSTENKO	AFAA12 pbar CR-identical lower yoke for dipole (radiation hard bending magnet). Contract negotiation await CR-Dipole FAT in Nov
23			Ivan KOOP, Dmitry SHWARTZ	Additional components at CR. The amendment to the CR rest contract will be prepared. The contract is under preparation.
24			Alexander STAROSTENKO	NMR (Nuclear magnet resonance) probe for magnetic field measurements in CR dipole magnet. The contract is under
25			Alexander STAROSTENKO	Decapole magnet for CR isochronous mode. The contract is under preparation.

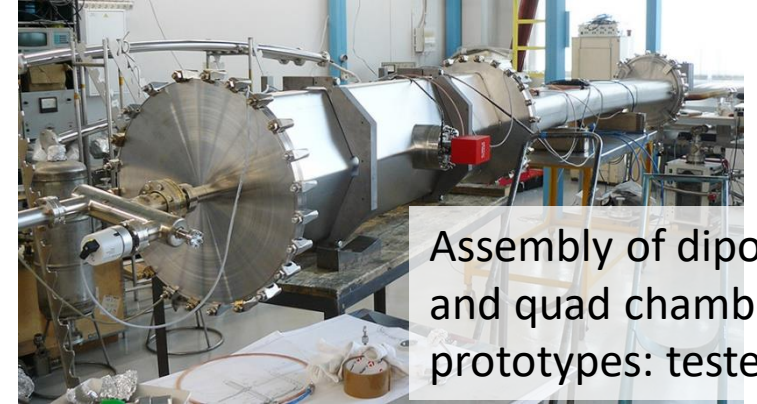
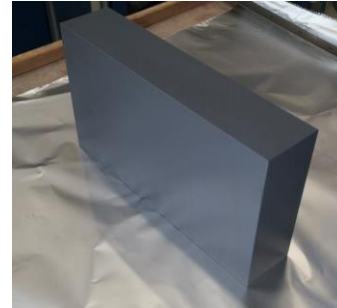
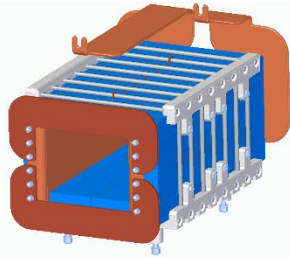
# Collector Ring

Contracts	Matter	Value	Signed
CC CR.HOAI	Technical coordination	8,495,805.00	19.08.2014
CC 2.5.2.2.1	<b>CR WPs:</b> magnets; PCs; vacuum; kickers; septa; diagnostics, TCR1 beamline	19,277,179.92	26.06.2018
CC 2.5.2.1	CR dipoles	13,688,016.19	12.10.2015



FoS dipole production: assembly

Kickers: ferrite blocks & vac. chamber tube

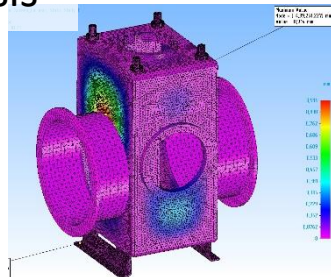


Assembly of dipole and quad chambers prototypes: tested.

EWQ quads: design and FDR done



Scintillating screens: plates and chamber's stress analysis



FoS wide steerer with pickup prototype inside



Beam scrapers: stands and chambers



# FAIR Contract No. CC 2.5.2.1.



2.5.2.1 CR dipoles - 24 pieces  
2.9.2.1.2 TCR1-dipoles – 2 pieces

The first Dipole in assembling area.

Next step is the Dipole transportation to the magnetic measurement lab (“heavy” task).

We plan to start magnetic measurement on Nov 16.

# HEBT magnets batch 2-4 (CC2.3.2-2)

Dipole 4_0	2
Dipole 10_0	6
Dipole 13_0	2
Dipole 13_3	3
Dipole 19_0	4
Dipole 15_0	4
Dipole 15_1	1
Dipole 16_0	2
Dipole 17_0	1
Quadrupole 2	91
Quadrupole 2 long	4
Quadrupole 10	4
Quadrupole 11	70
Quadrupole 12	12
Steering 13	5
Steering 18	48
Steering 100	45
<b>Total magnets</b>	<b>304</b>

≈18 000 000 euro

October 2021 → December 2021 (covid19)

Delivered 60 magnets

Ready for delivery 12 magnets.

Produced 48 magnets.

# HEBT magnets batch 2-4 (CC2.3.2-2)

Quadrupole 11



Steering 100



Dipole 10\_0



Dipole 13\_0



# HEBT magnets batch 2-4 (CC2.3.2-2)

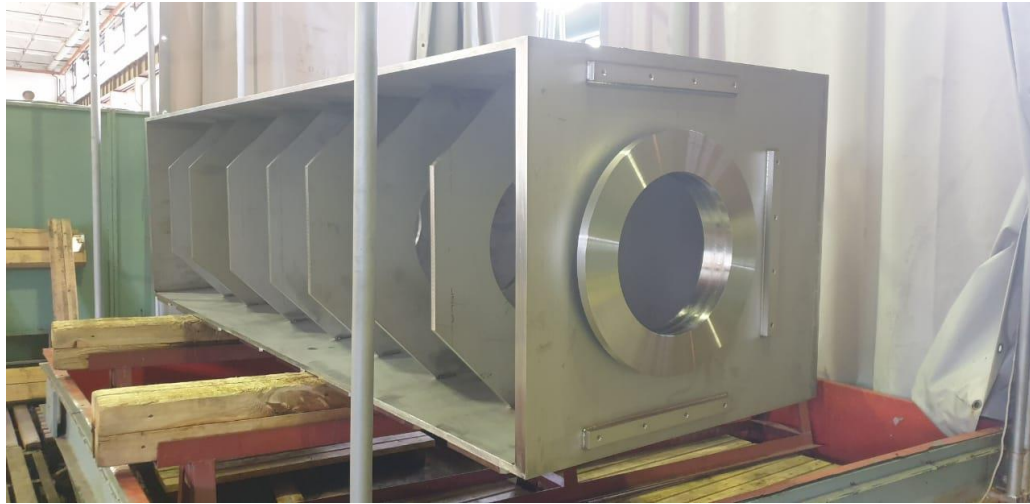
Production plan HEBT Magnets Batch 2, 3 & 4															06.11.2020
Magnets	Quantity	At FAIR	Prepares for shipment	Was produced	2020 months		2021 months								
					11	12	1	2	3	4	5	6	7	8	
dip4_0	2											1		1	
dip10_0	6	1		1		1		1		1		1			
dip13_0	2			1			1								
dip13_3	3							1		1		1			
dip19_0	4						1		1		1		1		
dip15_0	4	4													
dip15_1	1				1										
dip16_0	2					1					1				
dip17_0	1						1								
Quadrupole 2	91	32	1	12		8		10		10	8		5	5	
Quadrupole 2 long	4											2		2	
Quadrupole 10	4		4												
Quadrupole 11	70	5	1	11	12		12		12		10		7		
Quadrupole 12	12							1			5			6	
Steering 13	5											1		4	
Steering 18	48	8	6	8		5	5	2	10	4					
Steering 100	45	10		13		5	5	5	3		4				
<b>Total</b>	<b>304</b>	<b>60</b>	<b>12</b>	<b>46</b>	<b>13</b>	<b>20</b>	<b>25</b>	<b>20</b>	<b>26</b>	<b>16</b>	<b>29</b>	<b>6</b>	<b>13</b>	<b>18</b>	



# Vacuum component contracts

Name	Signed	End (expected)	Cost M€	Status
AFAA1 SFRS Diagnostic chambers	03.2019	12.2021 (12.2022)	1.11	FoS is produced. All documents for FDR are uploaded into EDMS. Waiting vacuum equipment for FAT. 2D drawings – 20%, CDR – 75%. All CF flanges are ordered.
AFAA2 HEBT Batch 2-3 Vacuum chambers	05.2019	07.2021 (02.2022)	1.71	CDR – 65%. FDR – 25% (but not paid), 2D drawings – 60%. High grade stainless steel are under purchasing. First FAT is expected in December 2020.
AFAA3 SFRS Vacuum chambers inside SC dipoles	10.2019	06.2022 (11.2022)	0.87	3D model of combined chamber with pumping port is created. <b>Waiting corrected 3D DMU from FAIR/GSI.</b> Conception of assembly into SC magnet is accepted (details are under consideration). FEM analysis for NC dipole wide chamber is going on.
AFAA4 HEBT Batch 4 Vacuum chambers	11.2019	12.2022 (12.2022)	4.18	2D drawings of the x-cross chamber are uploaded and under consideration. Prototyping of standard pumping port is going on at BINP workshop. <b>Waiting 3D and 2D drafts from FAIR/GSI</b>
AFAA5 SFRS vacuum components			1.5	Time schedule is agreed. Cost is fixed. Contract can be signed before detailed specification finalization.
SFRS branching chambers inside SC dipoles			<del>0.31</del> 0.1	The cost is too low for production the complex chambers

# Vacuum component contracts SFERS diagnostic chambers



FoS is produced.

All documents for FDR are uploaded into EDMS. Waiting vacuum equipment for FAT.

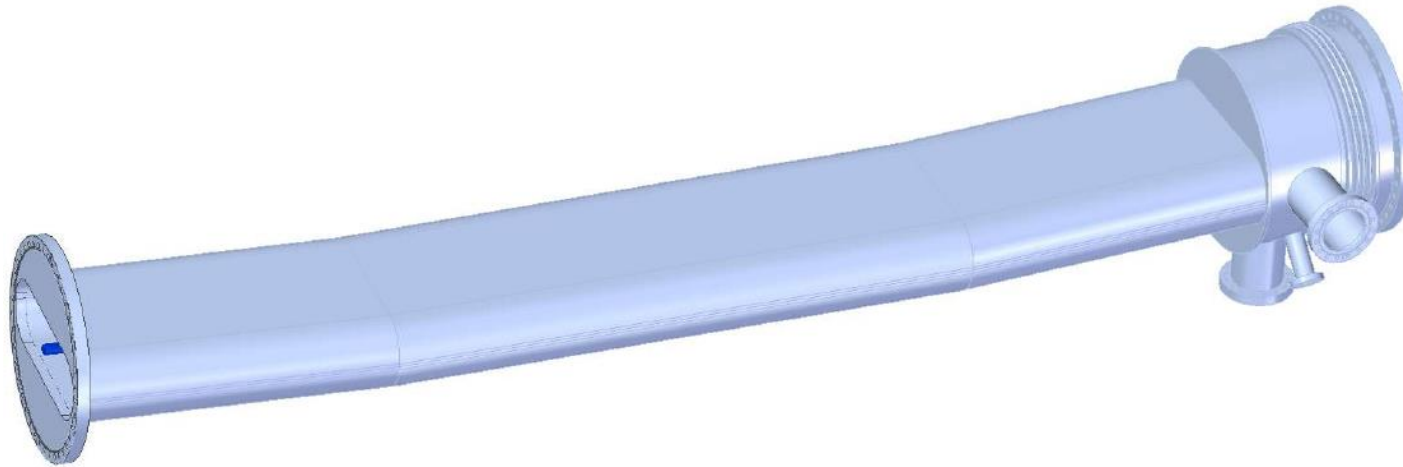
2D drawings – 20%,

CDR – 75%,

All CF flanges are ordered.



# Vacuum component contracts SFRS SC dipole chamber



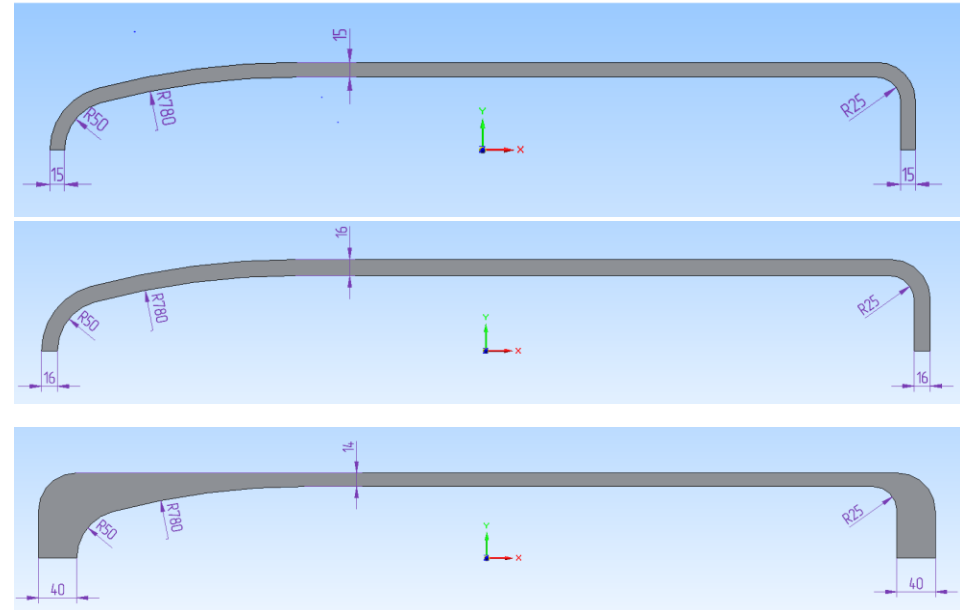
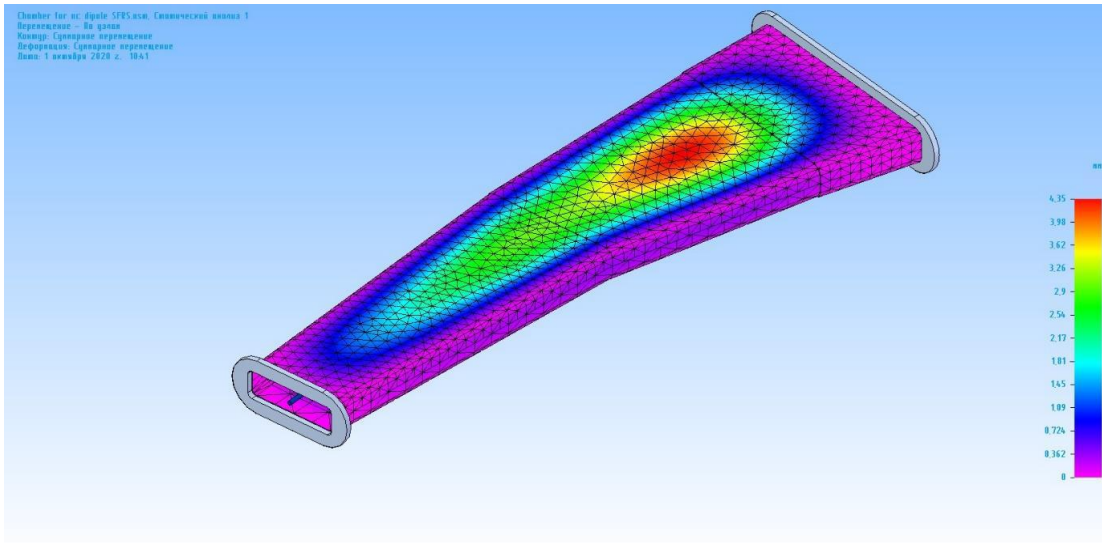
3D model of combined chamber with pumping port is created.

**Waiting for corrected 3D DMU from FAIR/GSI.**

Conception of assembly into SC magnet is accepted (details are under consideration).

Materials and bellows for Pre-serial production are ordered.

# Vacuum component contracts R&D for SFRS NC dipole chamber



FEM analysis for wide chamber (inside SFRS NC RR dipoles) is going on. Preliminary results show that the chamber can be made of Ti or Ti alloy.

# Vacuum component contracts HEBT Batch 2-3

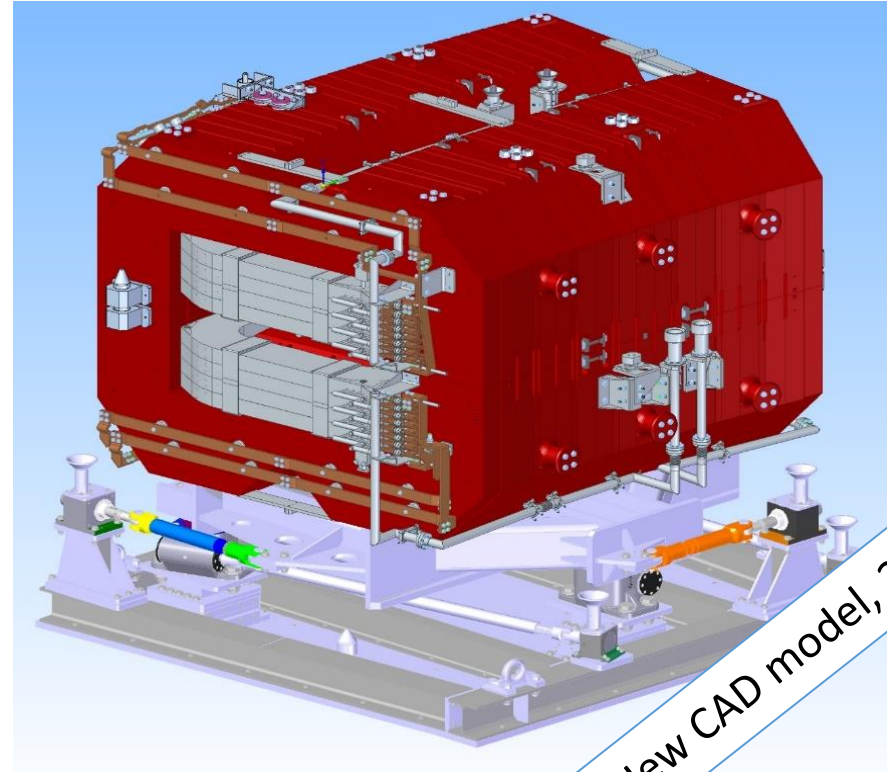
Q-ty	Types	CDR	FDR*	FAT	SAT Ab	October 2020, general info	
WP1	6 3	dip10 branch trapez 3.8m	12/2020	02/2021	10/2021	12/2021	design
WP2	5 1	dip13 (ch. 55 Batch 1)	paid	10/2020	11/2021	01/2022	material ordering, 3 chambers are produced
WP3	7 5	dip15-17 (like ch.120 Batch 1) 2 - 2.5m	paid	11/2020	12/2021	01/2022	material ordering
WP6	4 1	dip19 120x80 3,7m	10/2020	10/2020	12/2021	01/2022	material ordering
WP7	91 13	q1, q2, d120 some with bellow	paid	11/2020	05/2021	07/2021	design, material ordering
WP8	4 1	q10, d160, 2,8m	paid	10/2020	03/2021	05/2021	material ordering
WP9	69 19	q11, d100, oval 140x70, some with bellow	10/2020	11/2020	06/2021	10/2021	design
WP10	17 8	q12, some branch, oval, up to 2.1m, some with bellows	12/2020	02/2021	10/2021	12/2021	design, material ordering
WP11	63 35	s100, s18, d150, some with bellow	11/2020	12/2020	03/2021	06/2021	design
WP13	4 3	s13, d400	spec.?				
WP14	2 2	d4, 1 branch, 1 bend, 100x67	01/2021	03/2021	12/2021	02/2022	
272 91							
			done	close to be done	in process	delay more than - 8 months	

\*) Detailed description of main production and FAT procedures are uploaded into EDMS.

## CC 2.4.2.1.1.2 (03.2019 – 10.22)



PROTOTYPE, 2010



New CAD model, 2020

TOTAL: 3801092.00 EUR

FAIR supplies cable to BINP

TOTAL – Cable Cost = 2900720.00 EUR

Two radiation resistance magnets based on a design of the 2010 prototype.

## CC 2.4.2.1.1.2 (03.2019 – 10.22)

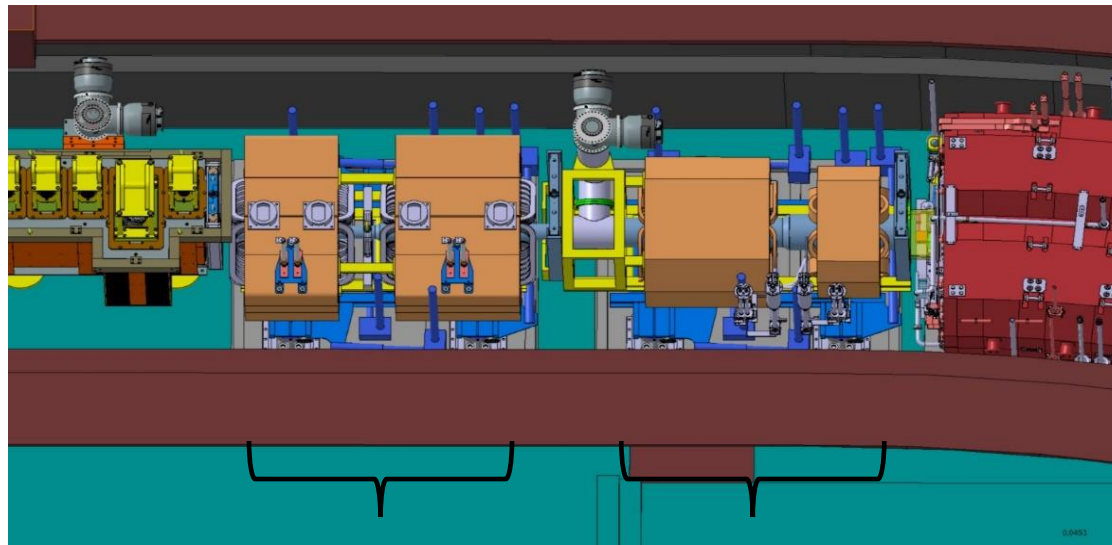
- 3D Model is almost finished (including remote water connections, remote current power connections, remote connections for thermal monitoring, current and water layout on the yoke).
- Some exceptions are left (grounding of magnet and layout of conductors for thermal monitoring in coils).
- The coils manufacturing drawings ongoing based on the 3D model. We plan to finish this work in December 2020.
- We plan to complete the yoke and stand drawings in the end of February 2021.

## 2.2.05.0121 Accelerator Implementing Agreement No. 1, GSI

Total: 75000.00 EUR

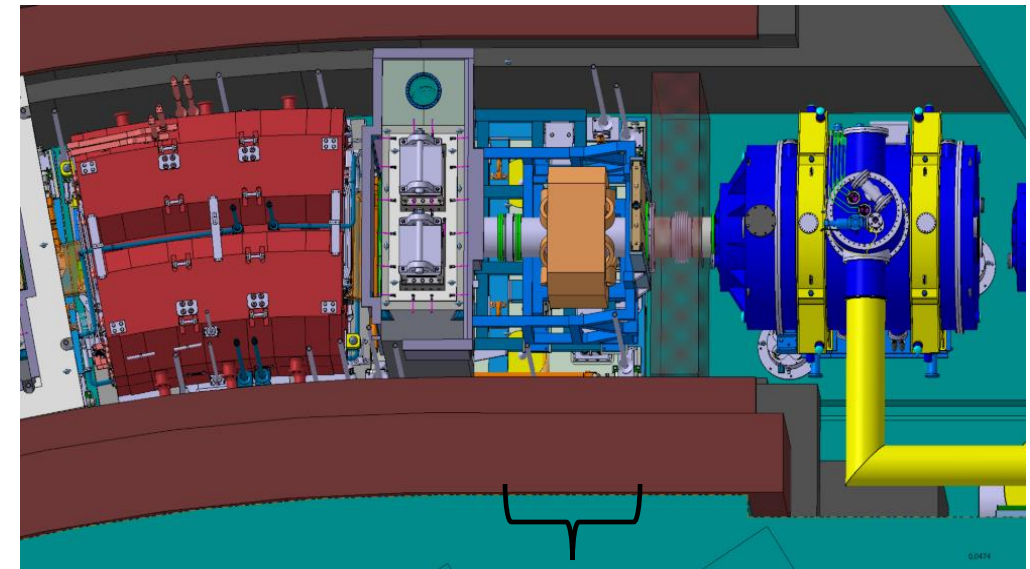
Development of 3 quadrupole and sextupole SFRS magnets.

3D magnetic field simulation has been done. 3D design is under completion.



Quad-Quad  
Assembly

Quad-Sext  
Assembly

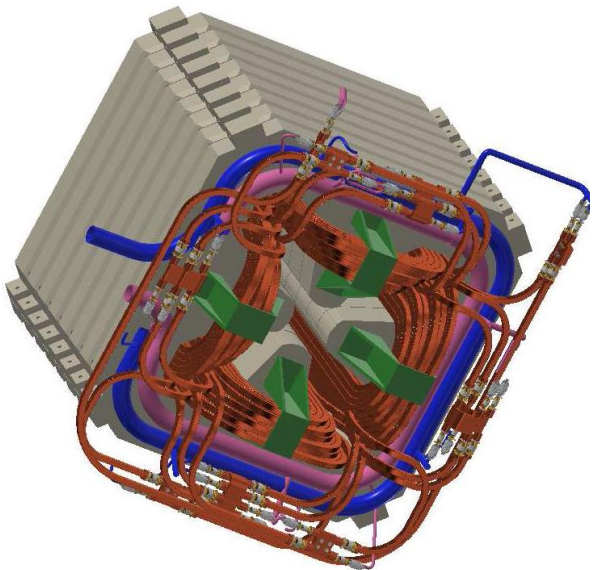


Single  
sextupole

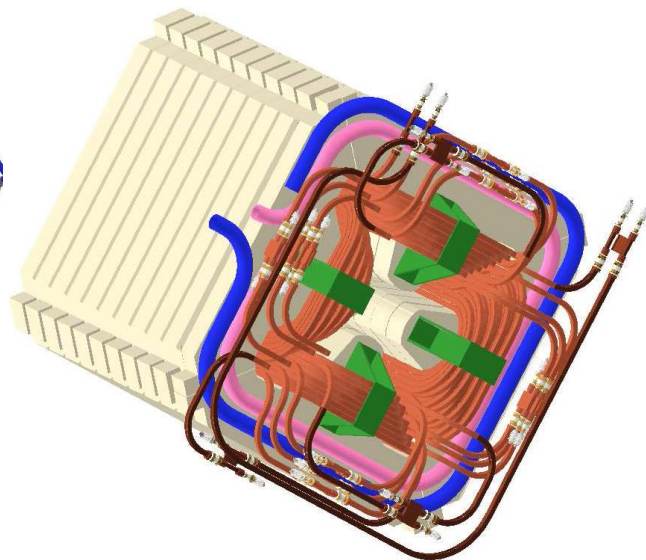


## 2.2.05.0121 Accelerator Implementing Agreement No. 1, GSI

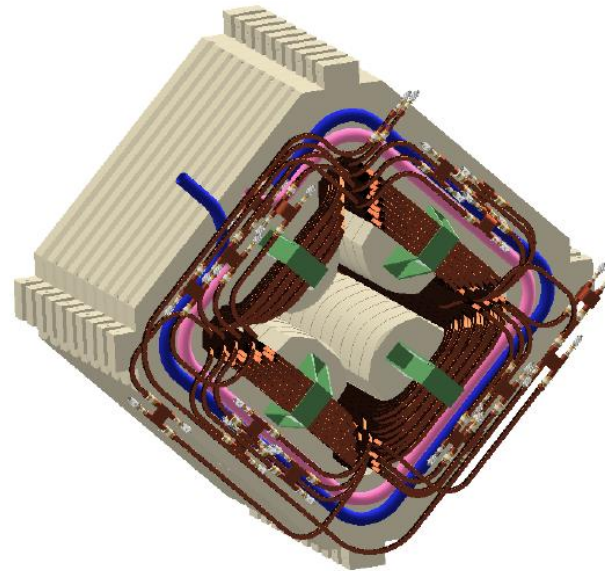
- 3D field simulation performed for multipole magnets (three Qs and 1 S).
- A design was optimized to reach good field quality in the whole operation range.
- General design of the yoke, coils, water and current commutation in ready.
- General 3D CAD models for all multipoles are ready.
- Possible production technology is presented.
- R&D contract is completed 08.07.2020.



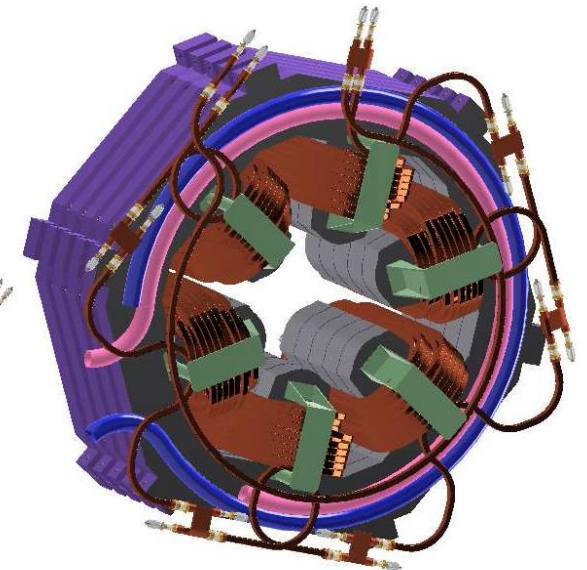
quadrupole-1a



quadrupole-1b



Quadrupole-2



sextupole17

# CC 2.9.2.2.1.1.1 as AFAA6 to CC 2.4.2.1.1.2 PBAR Wide Qs



Authorized to sign on behalf of the **Company**:

Name: Mr. Jörg Blaurock  
 Position: Technical Managing Director  
 Date: 29.4.20  
 Signature: 

Name: Dr. Ulrich Breuer  
 Position: Administrative Managing Director  
 Date: 30.4.2020  
 Signature: 

Authorized to sign on behalf of the **Contractor/Provider**:

Name: Mr. Pavel Logachev  
 Position: BINP Director  
 Date: 27.05.2020  
 Signature: 

Name: Mr. Eugene Levichev  
 Position: BINP Deputy Director  
 Date: 27.05.2020  
 Signature: 



Subject of the contract <i>Signed</i>	8 p-Bar Quadrupoles, CR-type, NC, wide apert.
	5 Power source, pulsed option.
	4 p-Bar Quad Chamber wide
Total payment	1.450.402,23 Euro (2024)
Contract signed	27.05.2020
First payment received	07.09.2020
Goal	04.2024
Additional option <i>Under consideration by FAIR till 12.2020</i>	3 Power source, pulsed option.
	4 p-Bar Quad Chamber wide
Total payment for the option	19394,88 Euro

# Summary

- Covid19 has “spoiled the party” very much. Personal contacts and live discussions are very important for effective coordination. In spite,...
- The FAIR activity at BINP moves forward and this direction is very important for the BINP management.
- According to the decision of the 4<sup>th</sup> BINP-FAIR meeting, a coordination group is established and operates now.
- New contract AFAA6 has signed since the previous meeting and several more are under discussion.

Take care and stay safe!