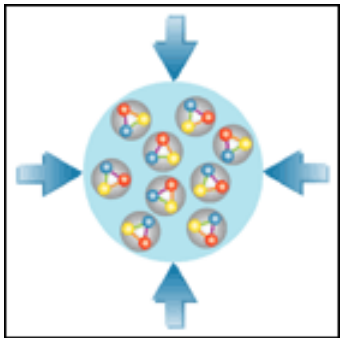
The Status of the CBM Experiment

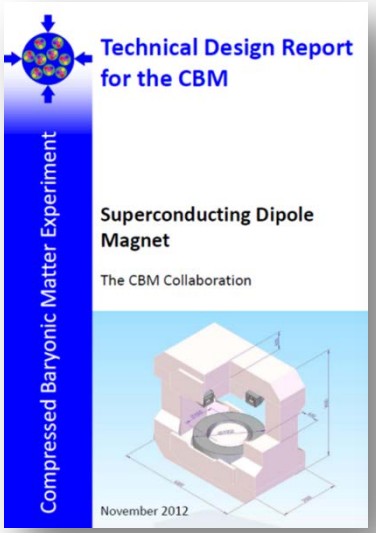


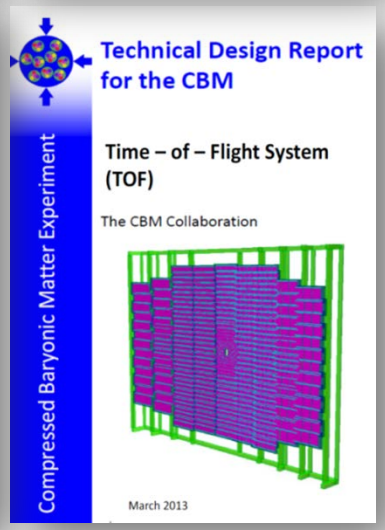
Walter F.J. Müller, FAIR, Darmstadt

CBM Magnet CDR
22-24 May 2017

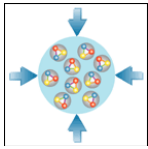
CBM Technical Design Report Status

#	Project	TDR Status
1	Magnet	approved
2	STS	approved
3	RICH	approved
4	TOF	approved
5	MuCh	approved
6	HADES ECAL	approved
7	PSD	approved
8	MVD	submission 2017
9	DAQ/FLES	submission 2017
10	TRD	submission 2017
11	ECAL	submission 2017





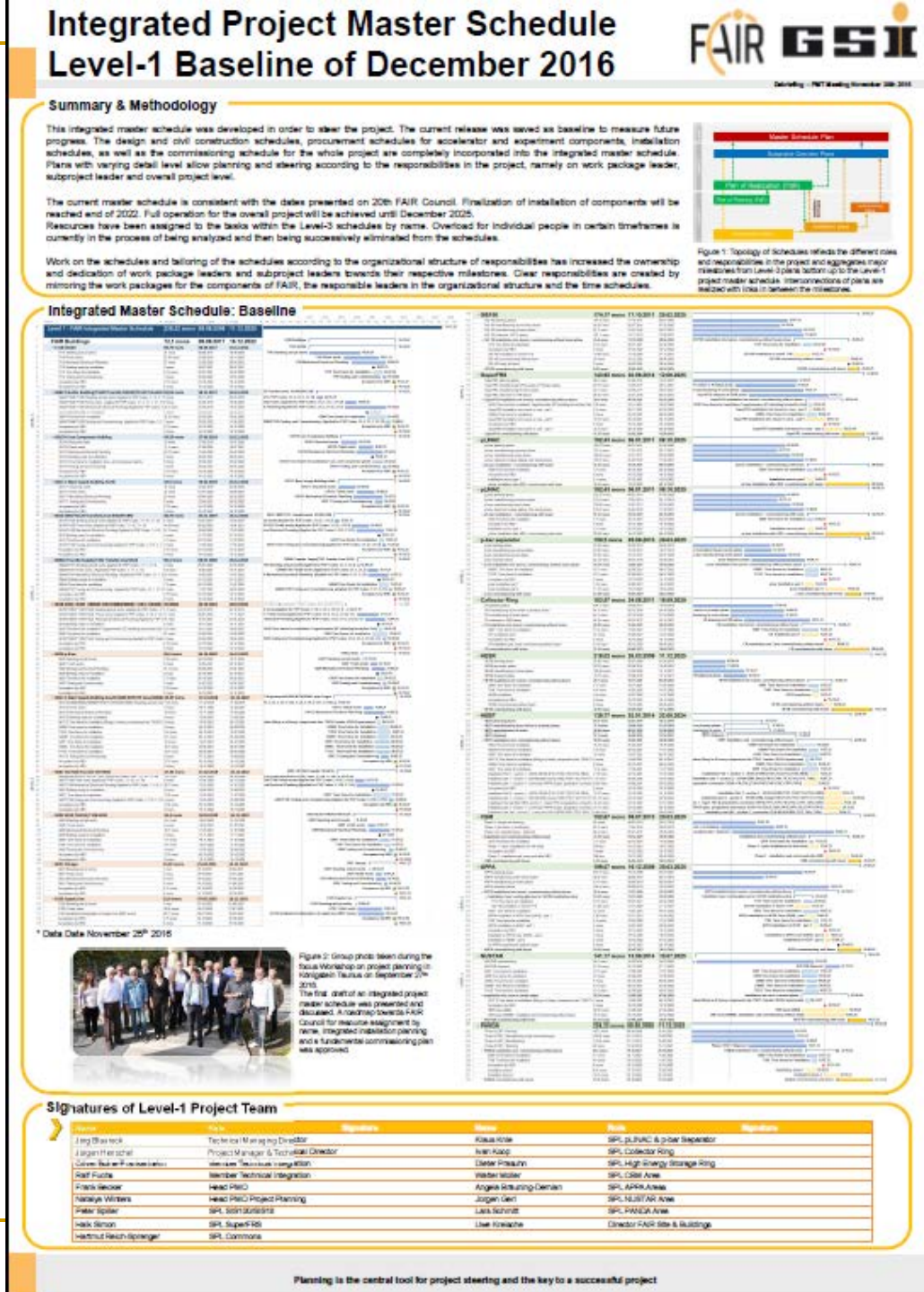
FAIR Integrated Schedule



- The integrated FAIR schedule
  - covers civil construction, accelerator and experiments
  - is based on a **conservative** planning (with buffers)
  - for GSI activities also **resource loaded**
  - serves as **baseline**
  - **key dates**
    - most building shells completed 2021
    - all buildings fully commissioned 2022 (incl. services)
    - FAIR operational 2025
- Installation vs. Commissioning
  - Installation window after building shell finished
    → only very basic services (crane ect)
  - Commissioning window after building fully commissioned
    → all HVAC services available (Cryo comes later!)

FAIR Schedule

- Major effort
- Presented to FAIR council on December 6th, 2016
- Very positive reception



Integrated Project Master Schedule
Level-1 Baseline of December 2016

FAIR GSI

Summary & Methodology

This integrated master schedule was developed in order to steer the project. The current release was saved as baseline to measure future progress. The design and civil construction schedules, procurement schedules for accelerator and experiment components, installation schedules, as well as the commissioning schedule for the whole project are completely incorporated into the integrated master schedule. Plans with varying detail level allow planning and steering according to the responsibilities in the project, namely on work package leader, subproject leader and overall project level.

The current master schedule is consistent with the dates presented on 20th FAIR Council. Finalization of installation of components will be reached end of 2022. Full operation for the overall project will be achieved until December 2025.
Resources have been assigned to the tasks within the Level-3 schedules by name. Overload for individual people in certain timeframes is currently in the process of being analyzed and then being successively eliminated from the schedules.

Work on the schedules and tailoring of the schedules according to the organizational structure of responsibilities has increased the ownership and dedication of work package leaders and subproject leaders towards their respective milestones. Clear responsibilities are created by mirroring the work packages for the components of FAIR, the responsible leaders in the organizational structure and the time schedules.

Figure 1: Topology of Schedules reflects the different roles and responsibilities in the project and aggregates major milestones from Level-3 plans bottom up to the Level-1 project master schedule. Interconnections of plans are realized with links in between the milestones.

Integrated Master Schedule: Baseline

* Data Date November 25th 2016

Figure 2: Group photo taken during the focus Workshop on project planning in Königstein Taunus on September 27th 2016.
The first draft of an integrated project master schedule was presented and discussed. A roadmap towards FAIR Council for resource assignment by name, integrated installation planning and a fundamental commissioning plan was approved.

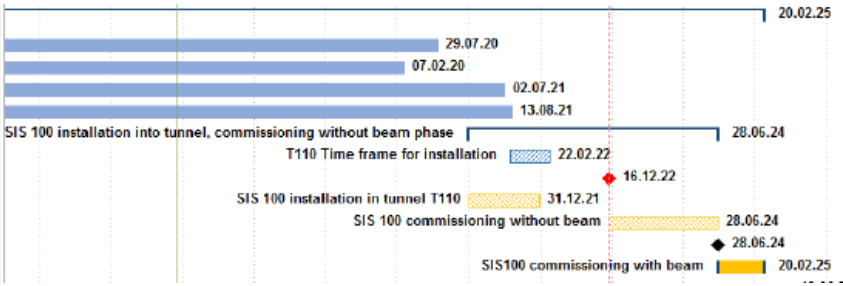
Signatures of Level-1 Project Team

Name	Role	Signature	Name	Role	Signature
Jörg Blaurock	Technical Managing Director		Klaus Knie	SPL pLINAC & p-bar Separator	
Jürgen Henschel	Project Manager & Technical Director		Ivan Kojo	SPL Collector Ring	
[illegible]	[illegible]		Dieter Prasuhn	SPL High Energy Storage Ring	
Ralf Fuchs	Member Technical Integration		Walter Müller	SPL CBM Area	
Frank Becker	Head PMO		Angela Breuning-Demian	SPL APPA Areas	
Natalya Winters	Head PMO Project Planning		Jürgen Gerl	SPL NUSTAR Area	
Peter Spiller	SPL Synchrotrons		Lars Schmitt	SPL PANDA Area	
Falk Simon	SPL SuperFRS		Uwe Kreische	Director FAIR Site & Buildings	
Hartmut Reich-Sprenger	SPL Commons				

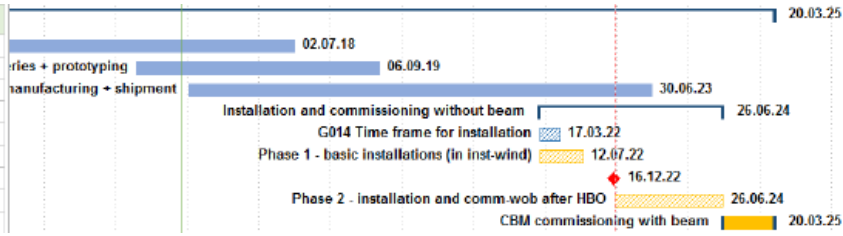
Planning is the central tool for project steering and the key to a successful project

FAIR Schedule: SIS100 and CBM

120	**SIS100**	**174,17 mons**	**17.10.2011**	**20.02.2025**
121	SIS 100 planning phase	114,6 mons	17.10.2011	29.07.2020
122	SIS 100 manufacturing of pre-series phase	99,25 mons	02.07.2012	07.02.2020
123	SIS 100 manufacturing of series phase	97,2 mons	21.01.2014	02.07.2021
124	SIS 100 shipment, SAT A phase	101,1 mons	14.11.2013	13.08.2021
125	**SIS 100 installation into tunnel, commissioning without beam phase**	**45,6 mons**	**31.12.2020**	**28.06.2024**
126	T110 Time frame for installation	6,75 mons	29.07.2021	22.02.2022
127	Acceptance by HBO	0 mons	16.12.2022	16.12.2022
128	SIS 100 installation in tunnel T110	13,06 mons	31.12.2020	31.12.2021
129	SIS 100 commissioning without beam	20 mons	19.12.2022	28.06.2024
130	SIS 100 ready for beam	0 mons	28.06.2024	28.06.2024
131	**SIS100 commissioning with beam**	**8,42 mons**	**28.06.2024**	**20.02.2025**



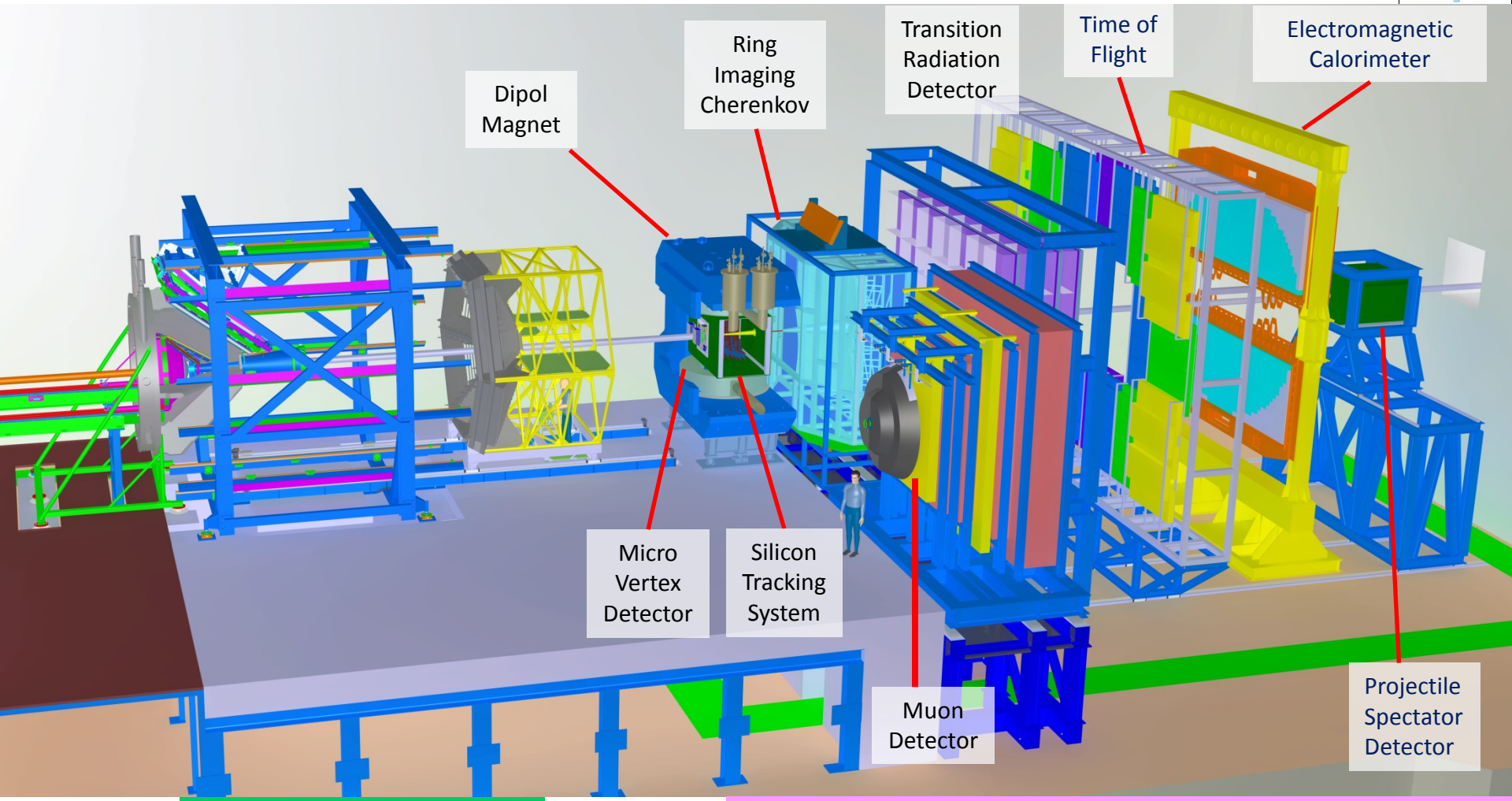
233	**CBM**	**152,67 mons**	**08.07.2013**	**20.03.2025**
234	Phase 2: design and planning	65 mons	08.07.2013	02.07.2018
235	Phase 4: pre-series + prototyping	44,5 mons	11.04.2016	06.09.2019
236	Phase 5+6: manufacturing + shipment	84,6 mons	05.01.2017	30.06.2023
237	**Installation and commissioning without beam**	**33,55 mons**	**01.12.2021**	**26.06.2024**
238	G014 Time frame for installation	3,1 mons	02.12.2021	17.03.2022
239	Phase 1 - basic installations (in inst-wind)	160 dys	01.12.2021	12.07.2022
240	Acceptance by HBO	0 mons	16.12.2022	16.12.2022
241	Phase 2 - installation and comm-wob after HBO	398 dys	19.12.2022	26.06.2024
242	**CBM commissioning with beam**	**9,52 mons**	**26.06.2024**	**20.03.2025**



- The CBM bottom line:
  - Dec '21 to Jul '22 — 1st installation window
  - Dec '22 — Building acceptance
  - Dec '22 to Jun '24 — Installation & commissioning w/o beam
  - Mar '23 — Cryo: DB2 cold; ready for cool down CBM
  - Jun '24 to Mar '25 — Commissioning beam from SIS100

G014 – Home for CBM and HADES

Full HADES+CBM Setup in CBM Cave



HADES
p+p, p+A
A+A (low mult.)

CBM
p+A, A+A

CBM Cave – Cryogenic Distribution

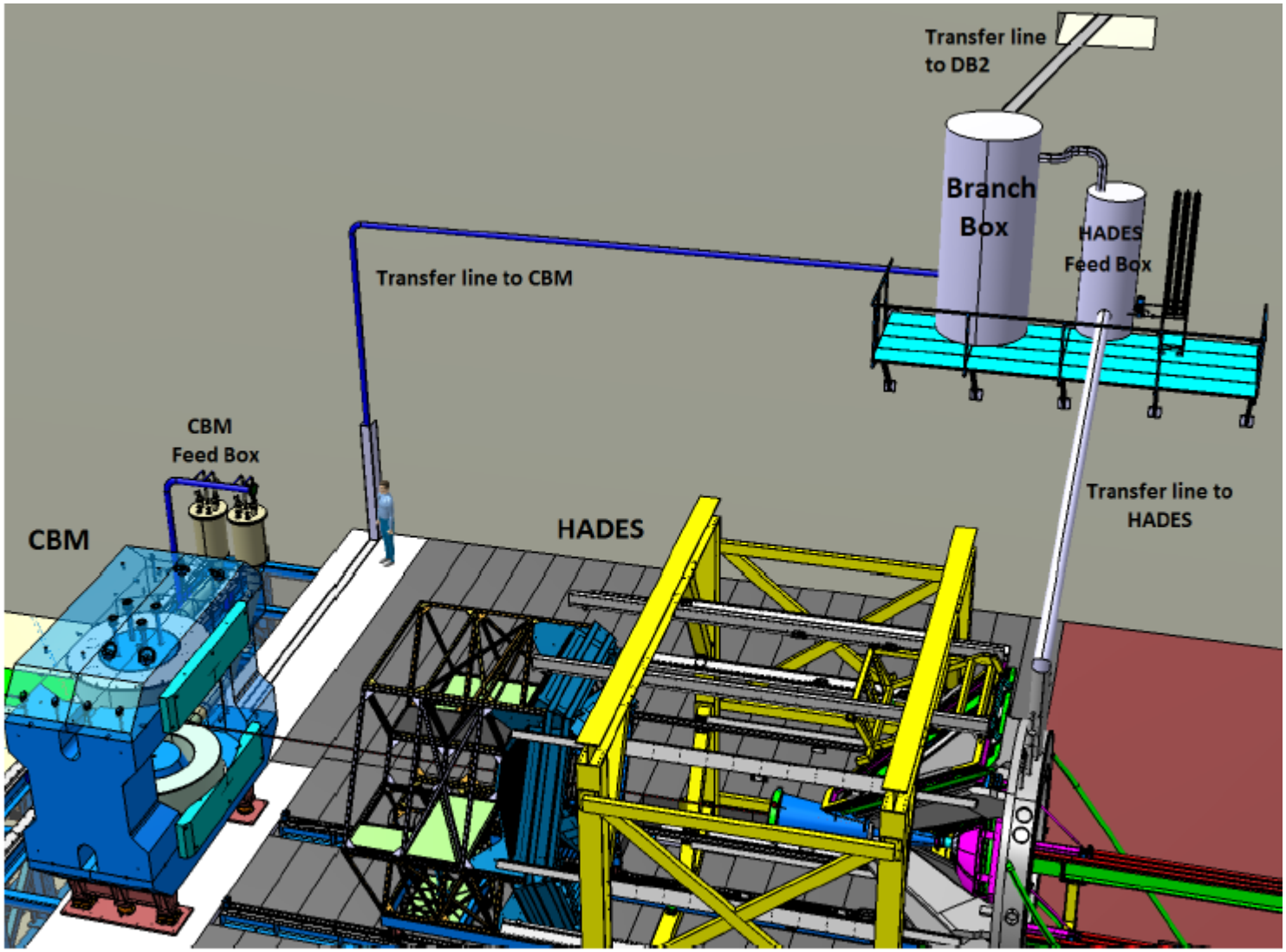
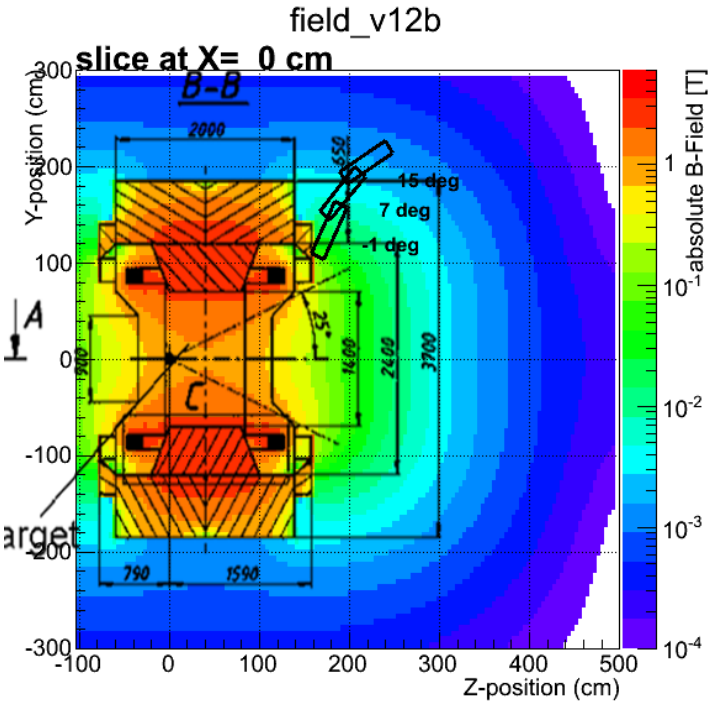


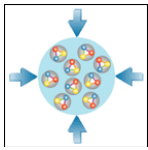
Figure 4: CBM cave: Cryogenic distribution for the experiments CBM and HADES

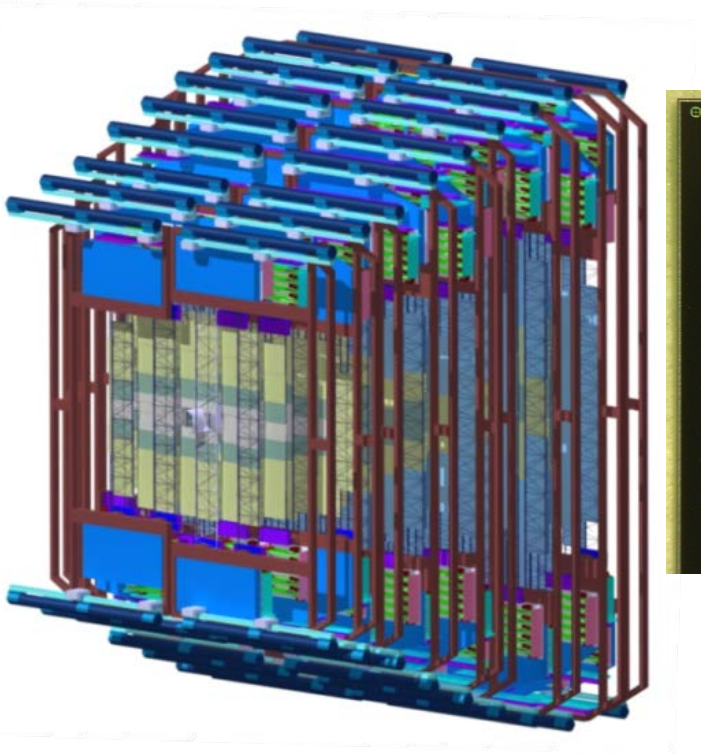
Superconducting Dipole Magnet

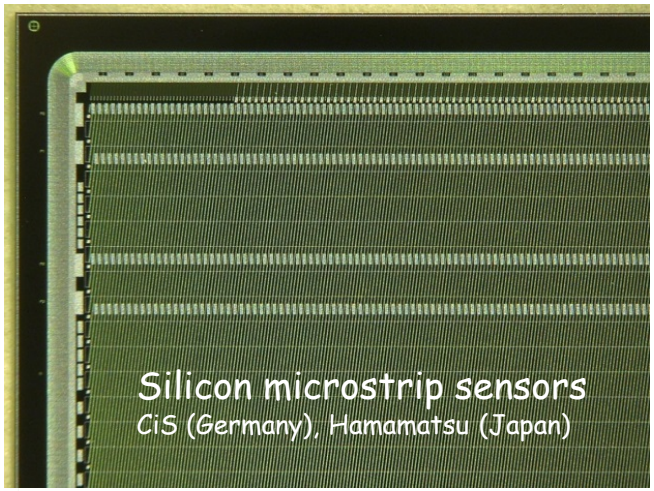


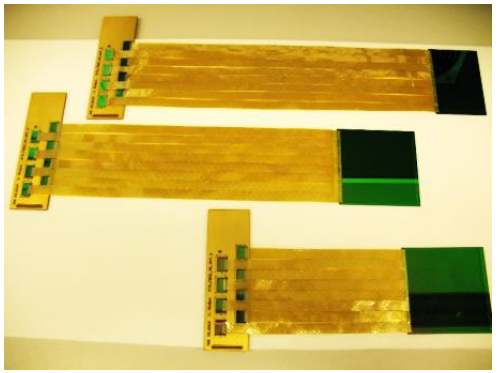
- Large-acceptance superconducting dipole magnet.
- The pole gap is 144 cm, the bending power 1 Tm.
- Participating institutes:
  JINR Dubna, BINP Novosibirsk, GSI Darmstadt

Silicon Tracking System



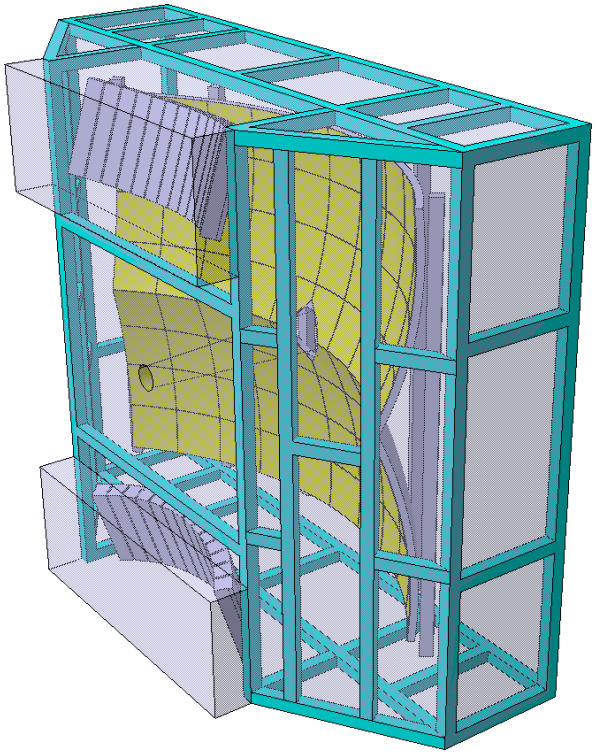


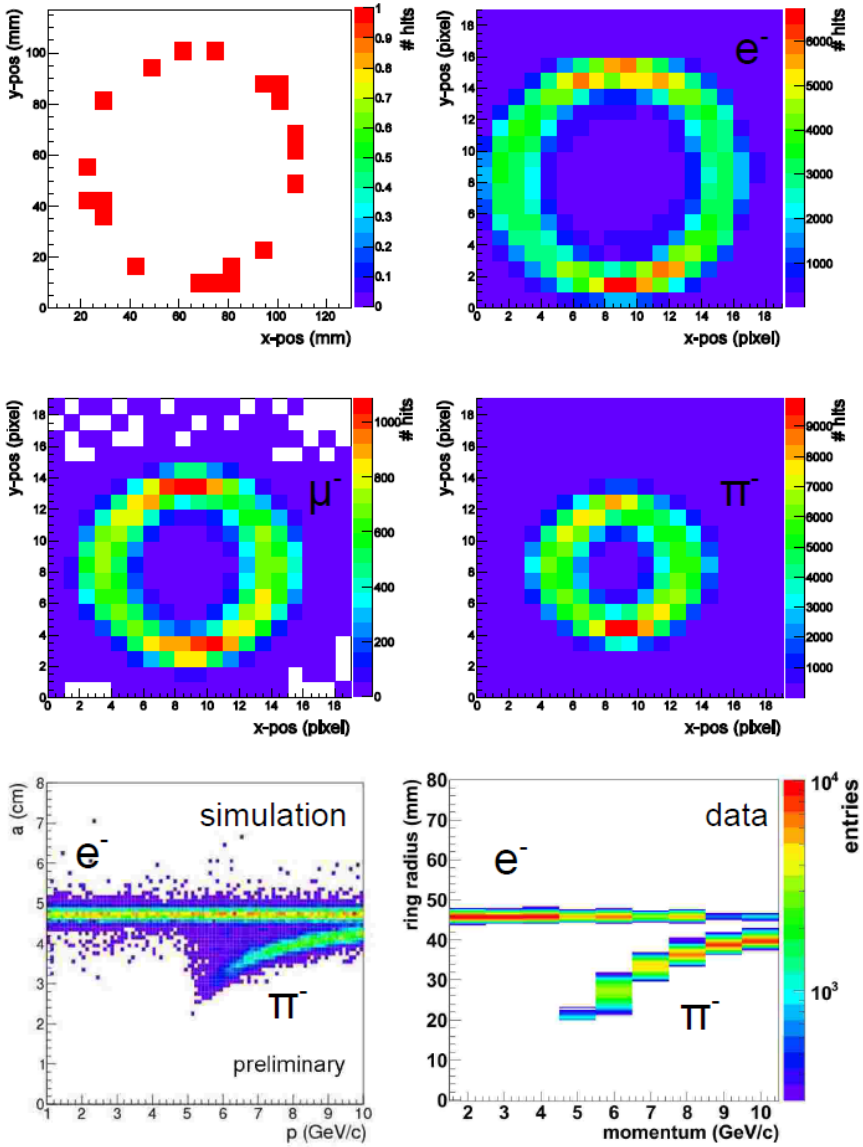




- The STS consists of about 1000 double-sided silicon micro-strip sensors arranged in 8 detector arrays located inside the dipole magnet. The detector provides track reconstruction and momentum determination for up to 1000 particles per event. The detector is operated at about -10°C, heat dissipation of the front-end electronics 40 kW, bi-phase CO2 cooling system
- Participating institutes: GSI, Darmstadt, JINR Dubna, KIT, INR Kiev, AGH and UJ Krakow, Univ. Tübingen, Warsaw UT

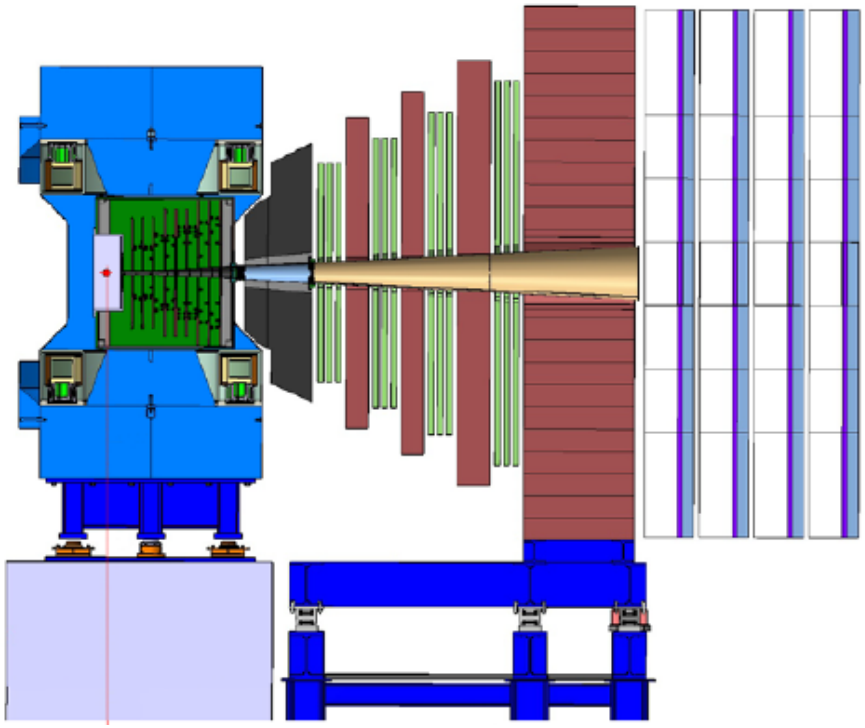
Ring-imaging Cherenkov (RICH) Detector





- The RICH is used for the identification of electrons with momenta below 8 GeV/c (pion suppression factor of > 500).
- Participating institutes: Gießen, Univ., Wuppertal, PNPI Gatchina

Muon Chamber (MuCh) System

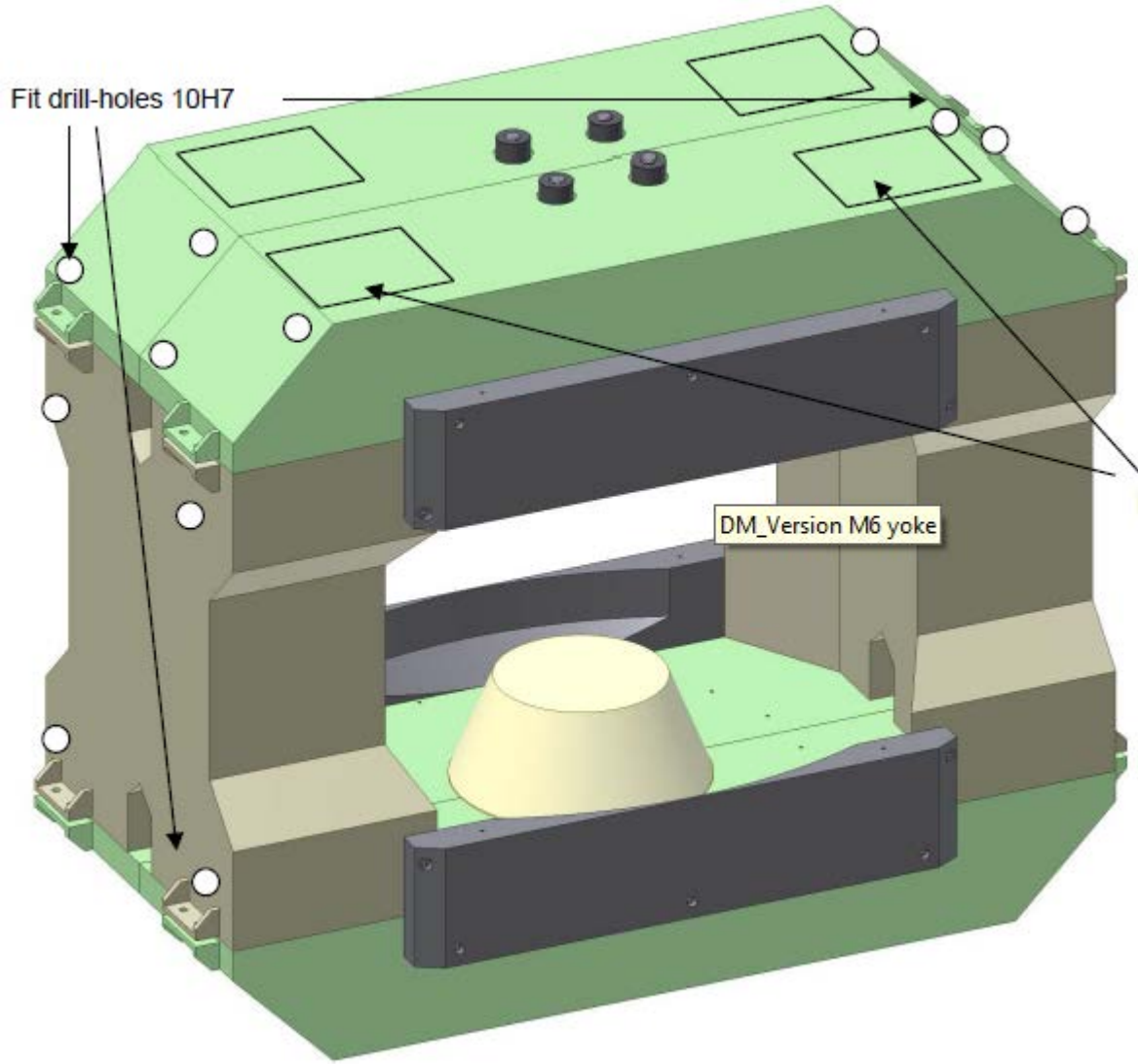


Full size GEM detectors tested with free-streaming read-out electronics at the CERN-SPS Nov.-Dec. 2016

- The MUCH consists of a combination of 15 detector stations sandwiched between one carbon and 4 iron absorber layers for hadron suppression. The MUCH provides the identification of muons with momenta above 1.5 GeV/c.
  - Tracking station 1+2: Two Gas-Electron-Multiplier (GEM) detector triplets
  - Tracking station 3+4: two low-resistivity trigger RPC triplets
  - Tracking station 5: four Transition Radiator Detectors (used only as trackers)
- Participating institutes: VECC Kolkata + 12 Indian Inst., PNPI Gatchina

CBM Geometry

- STS must fit in Magnet
  - height: 1440 mm
  - width: 3000 mm
  - support rails !!
- RICH
  - sensitive to stray field
  - → field clamps
- MUCH
  - very close to yoke
  - → field clamps must be removed



CBM Magnet – Geo to STS I

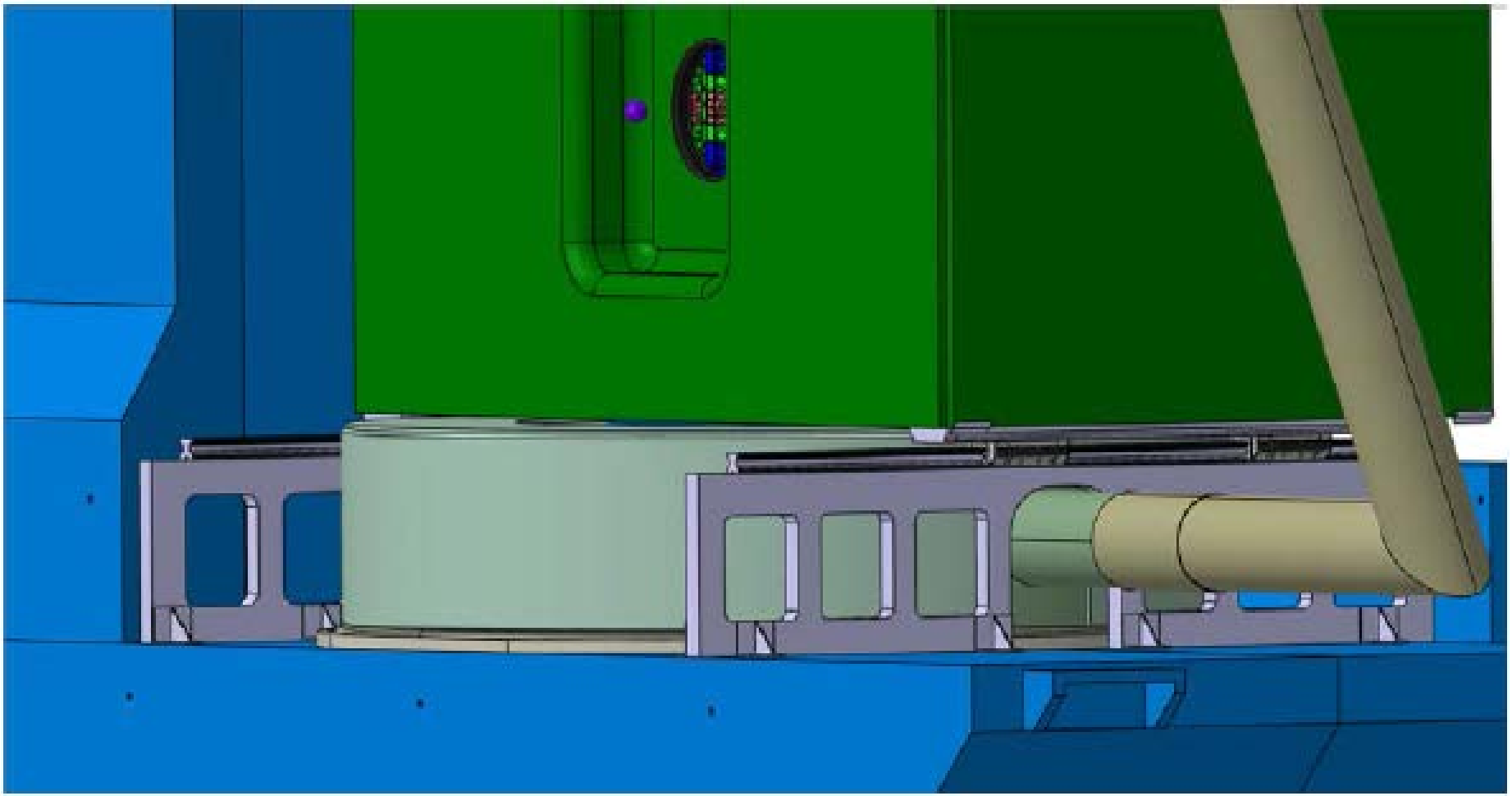


Figure 15: STS box, rail system and carrier structure

CBM Magnet – Geo to STS II

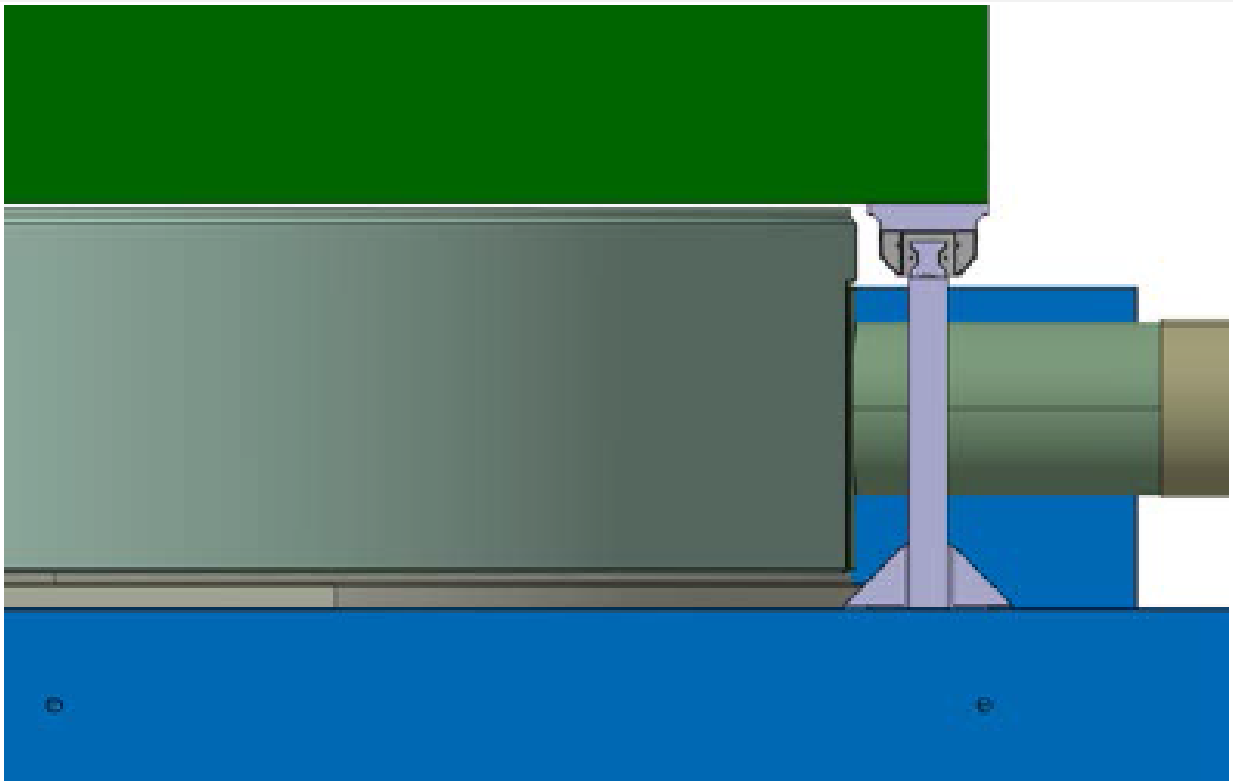
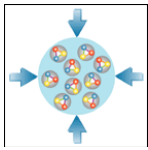
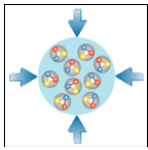


Figure 14: STS box (green) and rail system

The End

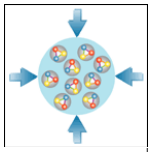


Thanks for your attention

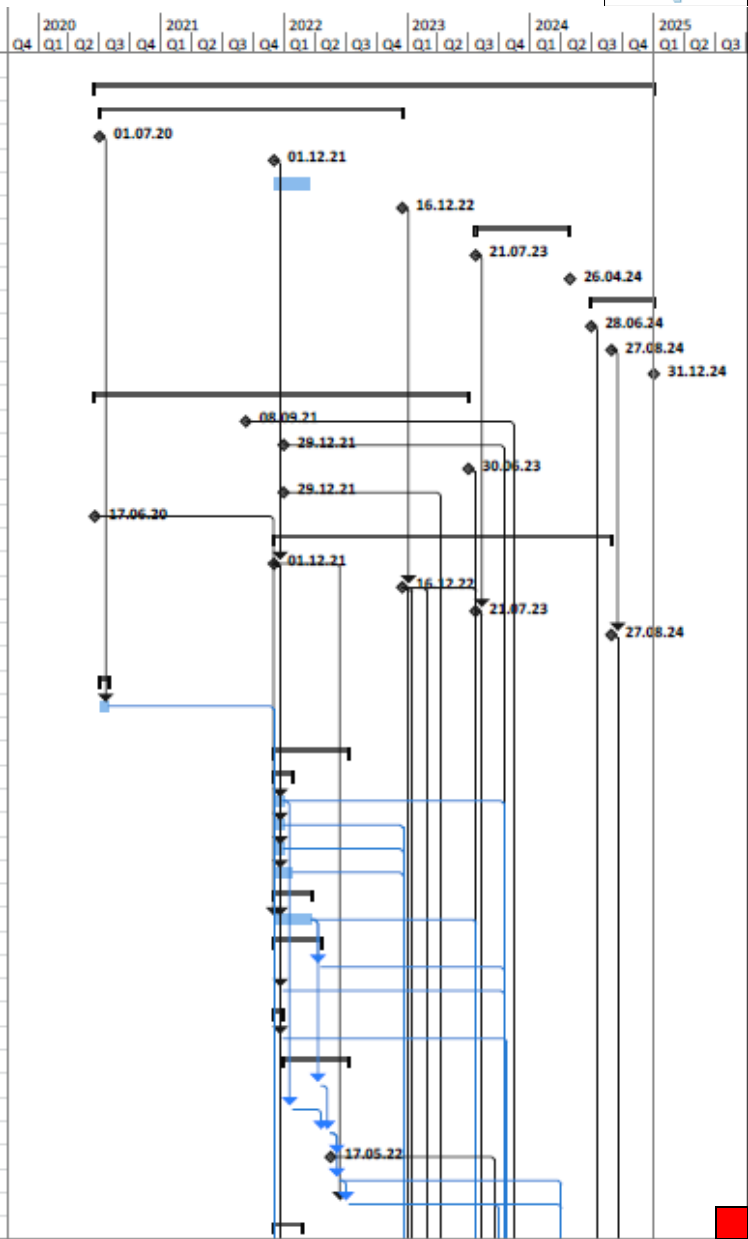


Backup Slides

CBM: Installation Plan I

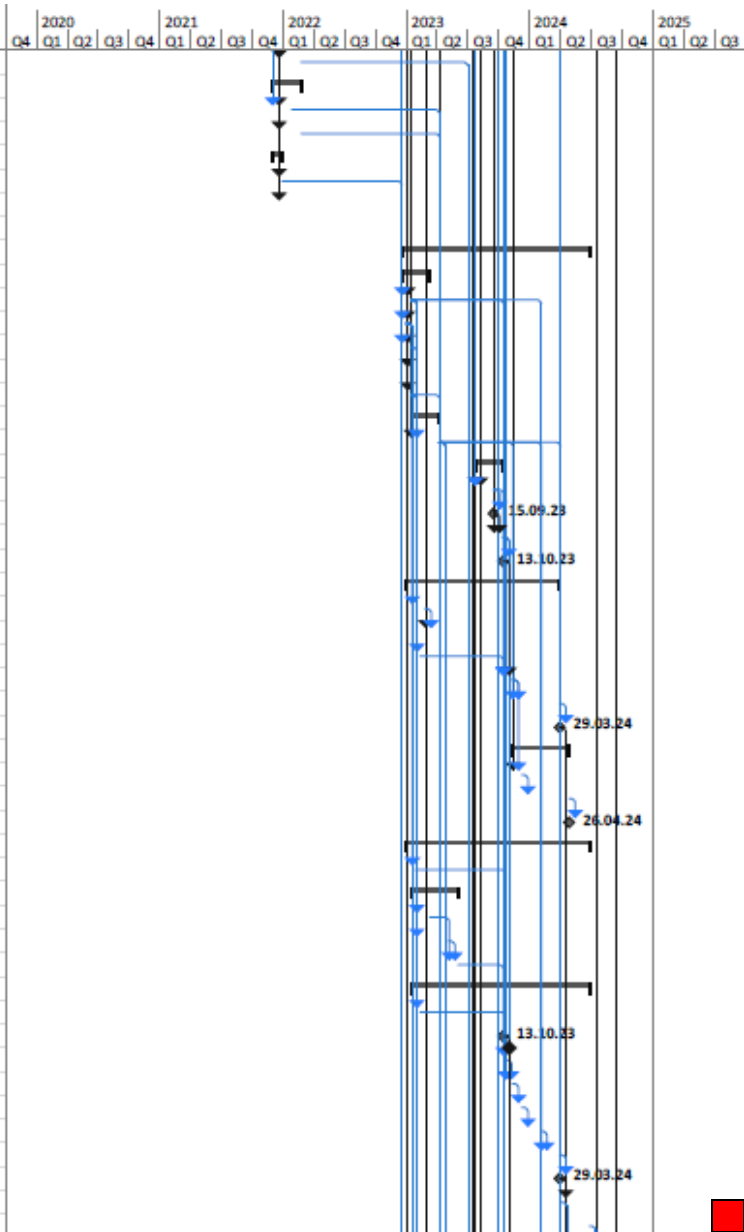


1								
2				External Milestones (from links)	236,8 wks?	17.06.20	31.12.24	
3				G014 Building milestones	128,4 wks?	01.07.20	16.12.22	
4		3.1.13	SCC3.MCC130-MB0	Building shell completed	0 days?	01.07.20	01.07.20	
5		3.1.13	SCC3.MB10	G014 Building ready for installation	0 days?	01.12.21	01.12.21	
6		3.1.13	SCC3.ACC10	G014 Time frame for installation	62 days?	01.12.21	17.03.22	
7		3.1.0	SCC4.MCC170-MB1	Acceptance by HBO	0 days?	16.12.22	16.12.22	
8				Cryogenics milestones	40 wks?	21.07.23	26.04.24	
9		2.14.8.1.2	S006.M10	Start of commissioning with local cryogenics anc	0 days?	21.07.23	21.07.23	
10		2.14.8.1.2	S007.M11	component accepted without beam (M11)	0 days?	26.04.24	26.04.24	
11				Accelerator milestones	26,4 wks?	28.06.24	31.12.24	
12		2.8		SIS100 bereit für Strahlbetrieb	0 wks?	28.06.24	28.06.24	
13		2.8		SIS100 First 'Splash Event'	0 wks?	27.08.24	27.08.24	
14		2.8	S008.M12	SIS100 ready for 'pilot beam' operation (single u	0 wks?	31.12.24	31.12.24	
15				CBM construction milestones	158,4 wks?	17.06.20	30.06.23	
16		1.1.1.1	S006.M10	MVD - ready for installation [M10]	0 wks?	08.09.21	08.09.21	
17		1.1.1.2	S006.M10	STS - ready for installation [M10]	0 mons?	29.12.21	29.12.21	
18		1.1.1.4	S006.M10	TRD - ready for installation [M10]	0 wks?	30.06.23	30.06.23	
19		1.1.1.5	S006.M10	TOF - ready for installation [M10]	0 wks?	29.12.21	29.12.21	
20		1.1.1.7	S006.M10	Magnet - ready for installation [M10]	0 mons?	17.06.20	17.06.20	
21				Key External Milestones - recollected	143 wks	01.12.21	27.08.24	
22				Building ready for installation	0 days	01.12.21	01.12.21	5
23				Building ready for usage (HBO done)	0 days	16.12.22	16.12.22	7
24				Cryo available in G014 (assume same as SIS100)	0 days	21.07.23	21.07.23	9
25				SIS100 first beam for detector commissioning	0 days	27.08.24	27.08.24	13
26								
27				Phase 0 - installations during civil construction	4 wks	02.07.20	29.07.20	
28				E10 - install rail system	4 wks	02.07.20	29.07.20	4
29								
30				Phase 1 - basic installations (in inst-wind)	32 wks	01.12.21	12.07.22	
31				General Infrastructure	8 wks	01.12.21	25.01.22	
32				E10 - install RICH/MUCH base	4 wks	01.12.21	28.12.21	22
33				E10-SA - install racks+power+cooling	4 wks	01.12.21	28.12.21	22
34				E30-GCR - install racks+power+cooling	4 wks	01.12.21	28.12.21	22
35				E40-ER - install racks+power+cooling	2 mons	01.12.21	25.01.22	22
36				Magnet	16 wks	01.12.21	22.03.22	
37				Magnet - install yoke+coil+power+bb+fb	4 mons	01.12.21	22.03.22	22,20
38				STS	20 wks	01.12.21	19.04.22	
39				STS - install STS mounting rails in magnet	4 wks	23.03.22	19.04.22	37
40				STS - install service lines	4 wks	01.12.21	28.12.21	22
41				RICH	4 wks	01.12.21	28.12.21	
42				RICH - install service lines	4 wks	01.12.21	28.12.21	22
43				MUCH	28 wks	29.12.21	12.07.22	
44				MUCH - install Carbon absorber	4 wks	23.03.22	19.04.22	37
45				MUCH - install platform + displacement system	4 wks	29.12.21	25.01.22	32
46				MUCH - install Iron absorbers	4 wks	20.04.22	17.05.22	45,44
47				MUCH - ready for upstream mapping	0 days	17.05.22	17.05.22	46
48				MUCH - install main frame	4 wks	18.05.22	14.06.22	46
49				MUCH - install service lines	4 wks	15.06.22	12.07.22	22,48
50				TRD	12 wks	01.12.21	22.02.22	

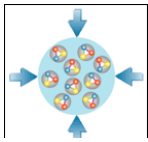


CBM: Installation Plan II

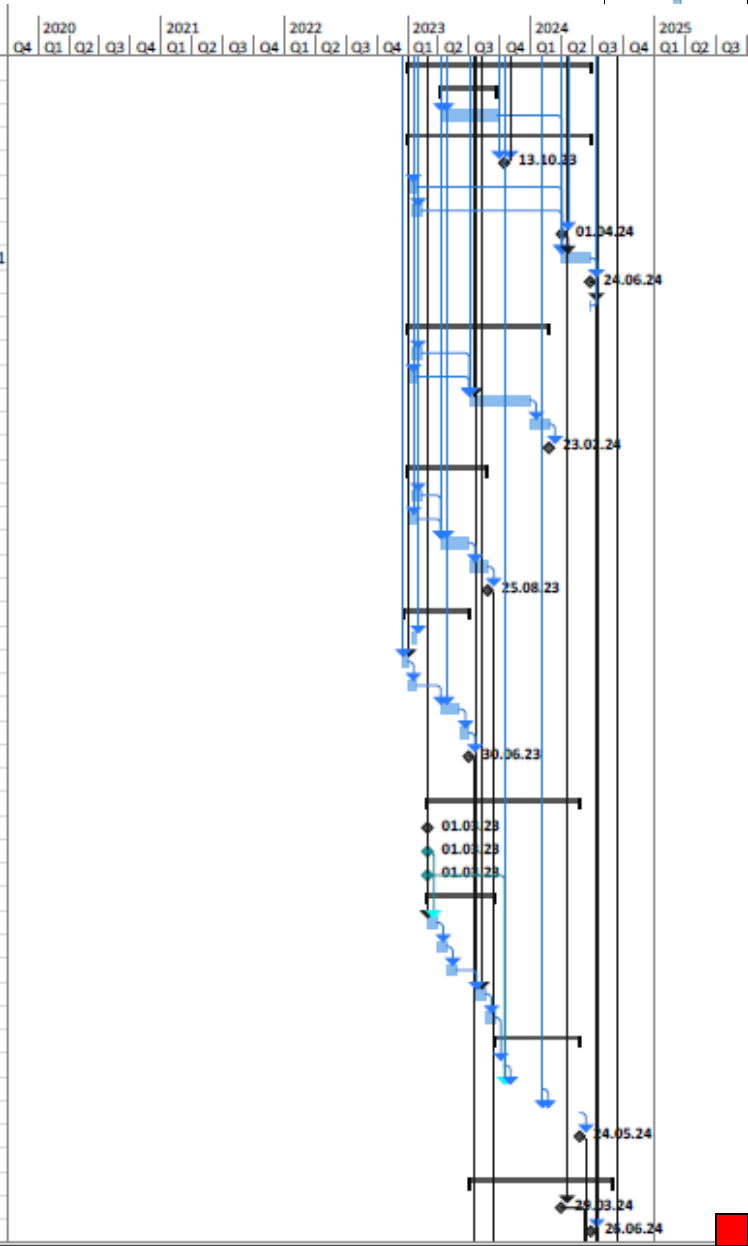
51				TRD - install service lines	3 mons	01.12.21	22.02.22	22
52				**TOF**	**12 wks**	**01.12.21**	**22.02.22**	
53				TOF - install main frame	2 mons	01.12.21	25.01.22	22,28
54				TOF - install service lines	3 mons	01.12.21	22.02.22	22
55				**PSD**	**4 wks**	**01.12.21**	**28.12.21**	
56				PSD - install support	4 wks	01.12.21	28.12.21	22
57				PSD - install service lines	2 wks	01.12.21	14.12.21	22
58								
59				**Phase 2 - installation and comm-wob after HBO**	**79,6 wks?**	**19.12.22**	**26.06.24**	
60				**General Infrastructure**	**12 wks**	**19.12.22**	**10.03.23**	
61				E10-SA - comm racks+power+cooling	4 wks	19.12.22	13.01.23	23,33
62				E30-GCR - comm racks+power+cooling	2 wks	19.12.22	30.12.22	23,34
63				E40-ER - comm racks+power+cooling	4 wks	19.12.22	13.01.23	23,35
64				E40-CR - setup control room	3 mons	19.12.22	10.03.23	23
65				E40-PA - setup preparation area	4 wks	19.12.22	13.01.23	23
66				**DAQ/FLES**	**12 wks**	**16.01.23**	**07.04.23**	
67				DAQ - install+comm entry nodes	3 mons	16.01.23	07.04.23	23,63
68				**Magnet**	**12 wks**	**24.07.23**	**13.10.23**	
69		1.1..1.7	S007.A119	Magnet - commissioning	2 mons	24.07.23	15.09.23	23,37,24
70		1.1.1.7	S007.M11	Magnet - ready for operation [M11]	0 days	15.09.23	15.09.23	69
71				Magnet - upstream mapping (wo+w MUCH)	4 wks	18.09.23	13.10.23	70,47
72				Magnet - ready for general use	0 days	13.10.23	13.10.23	71
73				**STS**	**65 wks**	**02.01.23**	**29.03.24**	
74				STS - install CO2 cooling plant (in E30-GCR)	2 mons	02.01.23	24.02.23	62
75				STS - re-comm CO2 cooling plant	4 wks	27.02.23	24.03.23	23,74
76				STS - install power supplies (E10-SA)	4 wks	16.01.23	10.02.23	61
77				STS - install STS box in magnet	4 wks	16.10.23	10.11.23	17,39,69,40,76,72
78		1.1.1.2	S007.A119	STS - comm-wob	5 mons	13.11.23	29.03.24	67,77
79		1.1.1.2	S007.M11	STS - ready for beam [M11]	0 days	29.03.24	29.03.24	78
80				**MVD**	**24 wks**	**13.11.23**	**26.04.24**	
81		1.1.1.1		MVD - install (after STS is mounted in magnet)	4 wks	13.11.23	08.12.23	77,16
82		1.1.1.1	S007.A119	MVD - comm-wob	5 mons	11.12.23	26.04.24	81
83		1.1.1.1	S007.M11	MVD - ready for beam [M11]	0 days	26.04.24	26.04.24	82
84				**RICH**	**77,6 wks?**	**02.01.23**	**26.06.24**	
85				RICH - install gas system (E30-GCR)	4 wks	02.01.23	27.01.23	62
86				**pre-installation in E40-PA**	**20 wks**	**16.01.23**	**02.06.23**	
87				RICH - setup box	8 wks	16.01.23	10.03.23	65
88				RICH - mount+align mirrors on mirror wall	4 mons	16.01.23	05.05.23	65
89				RICH - mount mirror wall in box	4 wks	08.05.23	02.06.23	87,88
90				**installation in cave**	**75,6 wks?**	**16.01.23**	**26.06.24**	
91				RICH - install power supplies (E10-SA)	4 wks	16.01.23	10.02.23	61
92				RICH - MUCH is in park position	0 days	13.10.23	13.10.23	105
93				RICH - move box to cave	1 wk	16.10.23	20.10.23	32,89,92
94				RICH - connect box service lines	3 wks	23.10.23	10.11.23	42,85,91,93
95				RICH - re-align and check mirrors	4 wks	13.11.23	08.12.23	94
96				RICH - install+comm photon detector	2 mons	11.12.23	02.02.24	95
97				RICH - comm-wob RICH	2 mons	05.02.24	29.03.24	96,67
98		1.1.1.3.1	S007.M11	RICH - ready for beam [M11]	0 days	29.03.24	29.03.24	97
99				RICH - moved to park position	1 day	01.04.24	01.04.24	98
100				RICH - moved from park to beam position	1 day?	26.06.24	26.06.24	111



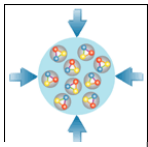
CBM: Installation Plan III



101				**MUCH**	**77,4 wks**	**02.01.23**	**25.06.24**	
102				**pre-installation in E40-PA**	**24 wks**	**10.04.23**	**22.09.23**	
103				MUCH - install+comm half-station	6 mons	10.04.23	22.09.23	65,67
104				**installation in cave**	**77,4 wks**	**02.01.23**	**25.06.24**	
105				MUCH - move to park position	0 days	13.10.23	13.10.23	49,71
106				MUCH - install gas system (E30-GCR)	4 wks	02.01.23	27.01.23	62
107				MUCH - install power supplies (E10-SA)	4 wks	16.01.23	10.02.23	61
108				MUCH - move back to operating position	0 days	01.04.24	01.04.24	99
109				MUCH - install+comm-wob st 1-4 chambers	3 mons	02.04.24	24.06.24	48,67,49,106,107,108,1
110		1.1.1.3.2	S007.M11	MUCH - ready for beam [M11]	0 days	24.06.24	24.06.24	109
111				MUCH - move to park position	1 day	25.06.24	25.06.24	110
112				**TRD**	**60 wks**	**02.01.23**	**23.02.24**	
113				TRD - install power supplies (E10-SA)	4 wks	16.01.23	10.02.23	61
114				TRD - install gas system (E30-GCR)	4 wks	02.01.23	27.01.23	62
115				TRD - install_comm modules	26 wks	03.07.23	29.12.23	51,114,113,18
116		1.1.1.4	S007.A119	TRD - comm-wob	8 wks	01.01.24	23.02.24	115
117		1.1.1.4	S007.M11	TRD - ready for beam [M11]	0 days	23.02.24	23.02.24	116
118				**TOF**	**34 wks**	**02.01.23**	**25.08.23**	
119				TOF - install power supplies (E10-SA)	4 wks	16.01.23	10.02.23	61
120				TOF - install gas system (E30-GCR)	4 wks	02.01.23	27.01.23	62
121				TOF - install+comm modules	12 wks	10.04.23	30.06.23	19,53,54,120,119,67
122		1.1.1.5	S007.A119	TOF - comm-wob	8 wks	03.07.23	25.08.23	121
123		1.1.1.5	S007.M11	TOF - ready for beam [M11]	0 days	25.08.23	25.08.23	122
124				**PSD**	**28 wks**	**19.12.22**	**30.06.23**	
125				PSD - install power supplies (E10-SA)	2 wks	16.01.23	27.01.23	61
126				PSD - comm support movement	2 wks	19.12.22	30.12.22	23,56
127				PSD - install modules	4 wks	02.01.23	27.01.23	126
128				PSD - install electronics	8 wks	10.04.23	02.06.23	127,67
129		1.1.1.6.2	S007.A119	PSD - comm-wob	4 wks	05.06.23	30.06.23	128
130		1.1.1.6.2	S007.M11	PSD - ready for beam [M11]	0 days	30.06.23	30.06.23	129
131								
132				**HADES major installation phases**	**64,6 wks**	**01.03.23**	**24.05.24**	
133				**HADES external milestones**	**0 wks**	**01.03.23**	**01.03.23**	
134				HADES magnet ready for installation [M10]	0 days	01.03.23	01.03.23	
135				HADES detectors ready for installation [M10]	0 days	01.03.23	01.03.23	
136				**HADES magnet**	**28,6 wks**	**01.03.23**	**15.09.23**	
137				HADES magnet installation	4 wks	01.03.23	28.03.23	23,134
138				HADES magnet alignment	4 wks	29.03.23	25.04.23	137
139				HADES magnet QA	4 wks	26.04.23	23.05.23	138
140				HADES magnet re-commissioning	4 wks	24.07.23	18.08.23	23,139,24
141				HADES magnet field mapping	4 wks	21.08.23	15.09.23	140
142				**HADES detectors**	**36 wks**	**18.09.23**	**24.05.24**	
143				HADES mainframe installation	4 wks	18.09.23	13.10.23	141
144				HADES all sub-systems install+comm-wob	4 mons	16.10.23	02.02.24	135,143,61
145				HADES ECAL install+comm-wob	4 mons	05.02.24	24.05.24	144,61
146		1.1.2	S007.M11	HADES ready for beam [M11]	0 days	24.05.24	24.05.24	145
147								
148				**Ready for beam summary**	**60,4 wks**	**30.06.23**	**27.08.24**	
149				STS ready for beam	0 days	29.03.24	29.03.24	79
150				RICH ready for beam	0 days	26.06.24	26.06.24	100



CBM: Installation Plan IV



151				MUCH ready for beam	0 days	24.06.24	24.06.24	110
152				TOF ready for beam	0 days	25.08.23	25.08.23	123
153				PSD ready for beam	0 days	30.06.23	30.06.23	130
154		1.1.1	S007.M11	CBM h+e (STS+RICH+TOF+PSD) ready for beam	0 days	26.06.24	26.06.24	149,150,152,153
155		1.1.1	S007.M11	CBM mu (STS+MUCH+TOF+PSD) ready for bean	0 days	24.06.24	24.06.24	149,151,152,153
156				HADES ready for beam	0 days	24.05.24	24.05.24	146
157				SIS100 ready for beam operation	0 days	28.06.24	28.06.24	12
158				SIS100 First 'Splash Event'	0 days	27.08.24	27.08.24	25