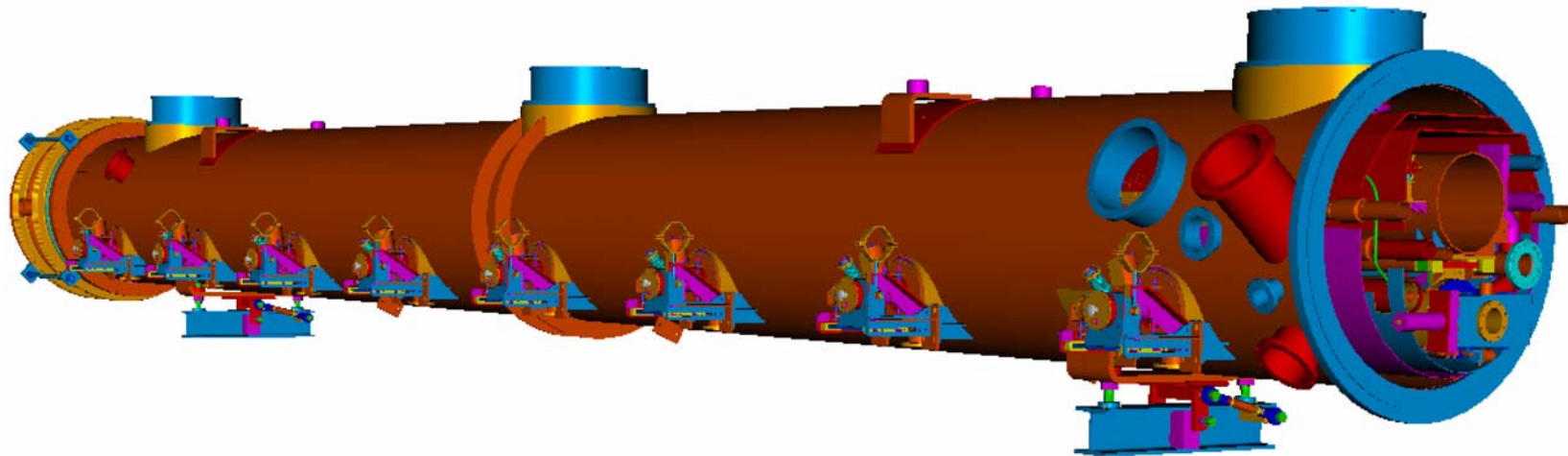


EIFast-XFEL Workshop 9/10 May



Cryo Module TypeIII Assembly outside
Clean Room



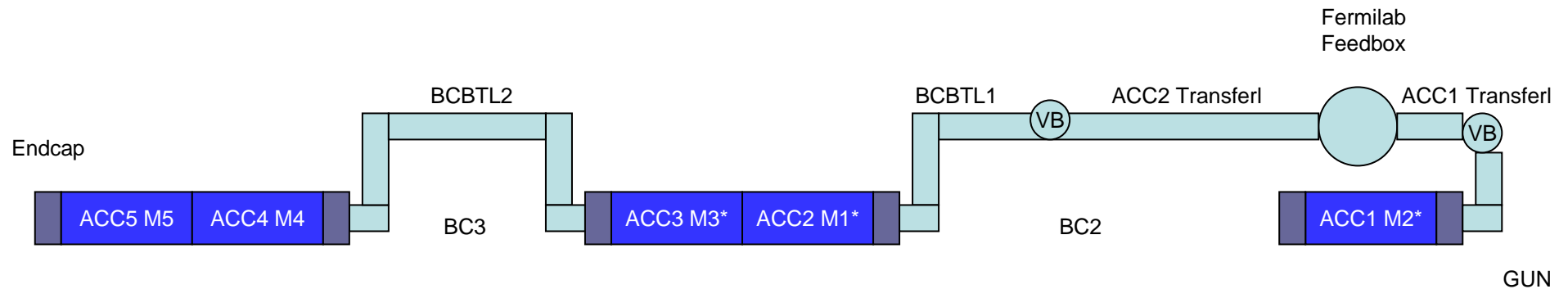
Assemblies, Installations and Cold Operation



Overview Assemblies and Cold Tests TTF-Cryomodules						
Status: 15-Feb-05 R. Lange DESY -MKS1-						
Module	Type	Assembly		Installation and Test		Therm. Cycles cold/warm
		Year	Days	in TTF-Linac		
Capture	Spec.	Saclay 1996		Oct-96	96→Sep-03	c/w 13
M1	I	1997	>>	Mar-97	97→Sep-97	c/w 2
M1 rep.	I	1997/98	>>	Jan-98	98→Mar-99	c/w 3
M2	II	1998	>>	Sep-98	98→May-02	c/w 3
M3	II	1999	35+15	Jun-99	99→May-02	c/w 1
M1*	II	2000	24	Jun-02	02→	c/w 3 +1
M4	III	2001	18+10	Apr-03	03→	c/w 1 +1
M5	III	2002	30	Apr-03	03→	c/w 1 +1
MSS	Spec.	2002	36	Jun-02	02→Sep-03	c/w 3
M3*	II	2003	18+6	Apr-03	03→	c/w 1 +1
M2*	II	2004	20	Feb-04	04→	c/w 1



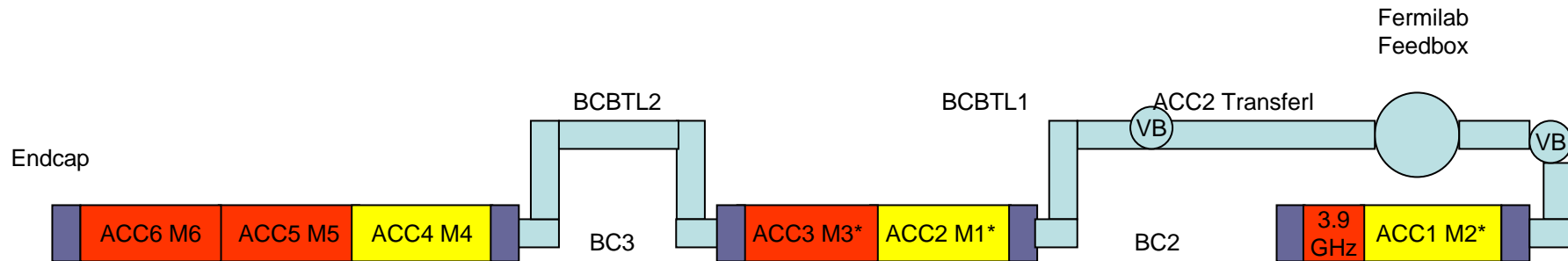
FLASH-Cryogenic operation



- 21.03.04 Start cool down
- 29.03.04 2 K / 31mbar
- Spring 07 Shut down / Warm up



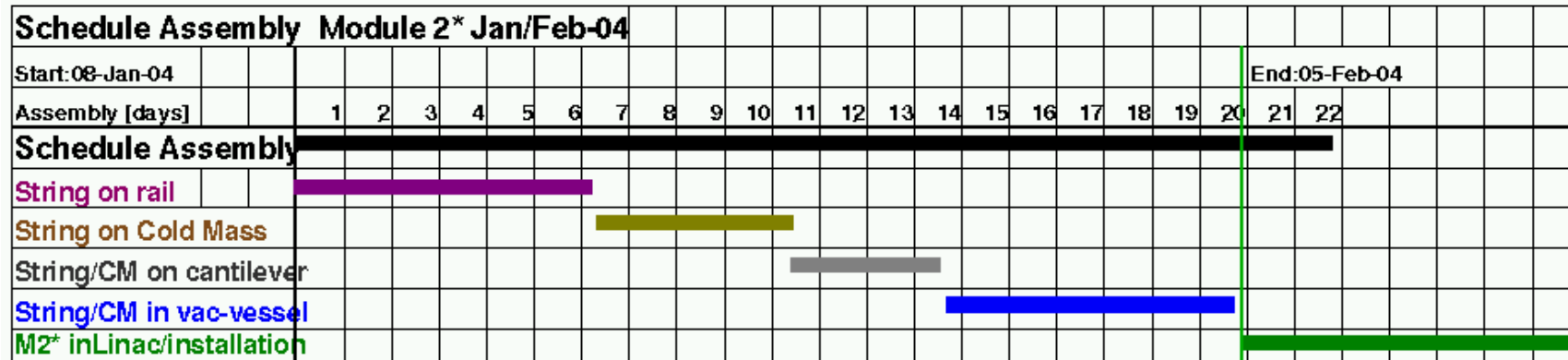
Plan for the FLASH-shut down spring 2007



- Module 5 -remove TTF, tuner motors repair, reassembly and reinstallation TTF
- Module 6 -8 x 35MV/m (Plan)
 - assembly spring 2006
 - cold test at the module test stand (CMTB)
 - installation position ACC6
- Module 7 -assembly earliest autumn 2006
 - cold test at the module test stand (CMTB)
 - installation position ACC3
- Module 3* -change with module 7
- 3.9 GHz (3rd harmonic cavity) FERMILAB
 - only behind ACC1
 - installation summer 2007



Schedule/manpower module assembly outside cleanroom



Total manpower for module assembly outside clean room:

4 experts(average) x 8 hours x 20 days = 640 man hours

640 man hours mean: Everything is included for complete module assembly

Aim for future module assemblies: <20 days assembly time

Even at DESY 15 days assembly seems possible



Very rough numbers for man hours/percentages
for module assemblies outside cleanroom



	<u>man hours</u>	<u>%</u>
RF experts (adjustments, RF cables etc.)	32	5
Coupler experts (warm main couplers)	32	5
Vacuum experts (beam tube, coupler vac)	32	5
Survey experts (align cav, mag, cold mass)	36	6
Crane driver (from clean room to cantilever)	6	1
Cryo experts (align, tubing, magnet, tuners, magn./cryo shields, sensors, etc.)	504	78
Total	640	100

Of big advantage: All experts are involved in module assemblies outside cleanroom are also involved in single component tests and linac installation/operation.

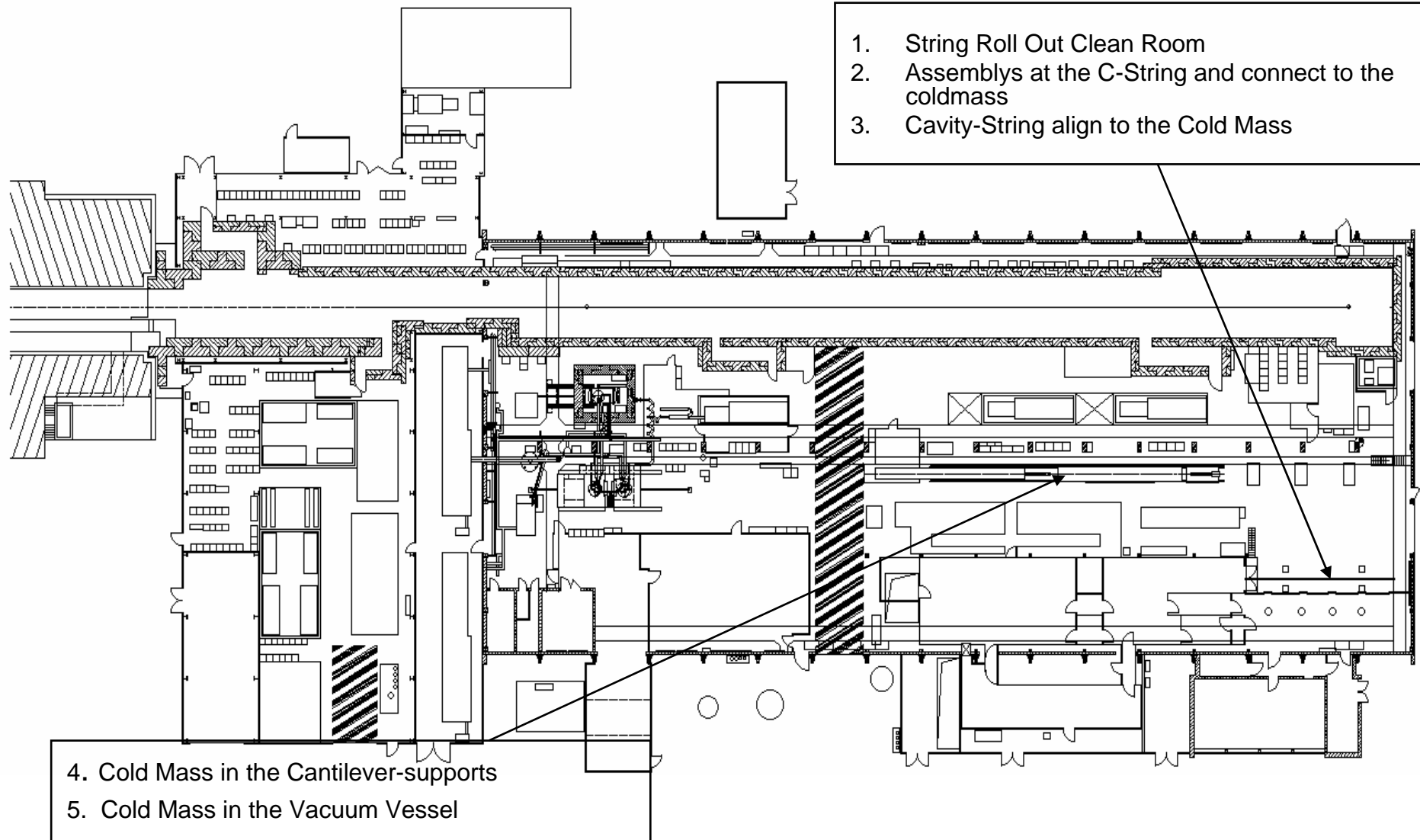
**Aim for future module assemblies: <20 days assembly time
Even at DESY 15 days assembly seems possible**

Tabelle3_2

Status: R.Lange-MKS-Modul3SMontageEng.sdr

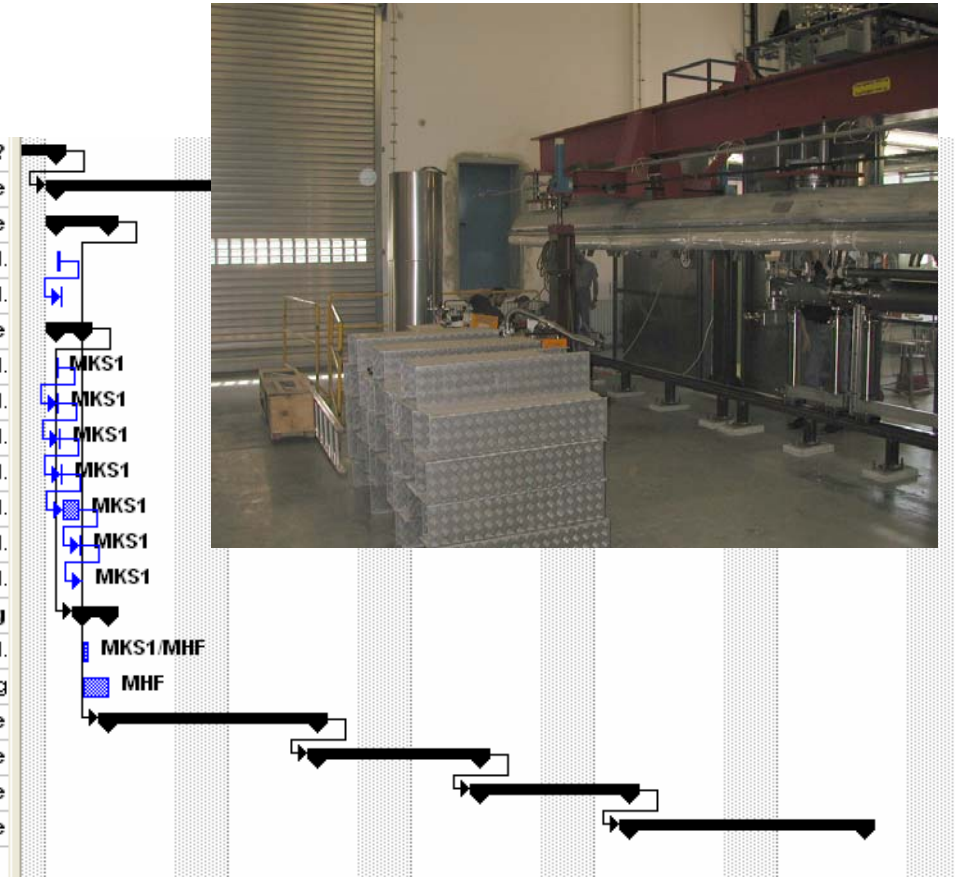
Module3* Assembly	Group(s)	Overview for involved groups																											
Assembly Manager Jensch/Lange	MKS1																												
Assembly duration working days	[days]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
3.000 Module- Assembly Duration	MKS1	[Blue bar from day 0 to 22]																											
3.001 String from cleanroom	MKS3	[Red bar from day 1 to 2, labeled '<- Start 30-Jan-03 day 2']																											
3.011 HOM- adjust,rf- measure/fr	MHF	[Red bar from day 2 to 4]																											
3.023 Connect RF- cable Cav./Checks	MHF/MKS1	[Red bar from day 3 to 5]																											
3.026 Disassemble cav- clamp/meas fr	MHF/MKS1	[Red bar from day 4 to 5]																											
3.027 Test tooling align/survey	MKS1/ZMEA2	[Red bar from day 5 to 6]																											
3.039 Lift cold mass and string	MKS1	[Red bar from day 8 to 9, labeled '<- o.K. 7- Feb-03 day 8']																											
3.041 Align/measure position quad	MKS1/ZMEA2	[Red bar from day 9 to 10]																											
3.042 Align/meas. Position C1- C8	MKS1/ZMEA2	[Red bar from day 10 to 11]																											
3.044 Final measure position string/real	MKS1/ZMEA2	[Red bar from day 11 to 12]																											
3.054 Connect cables BPMs	MHF/MKS1	[Red bar from day 12 to 13]																											
3.066 Preparation for transport	MKS1/ZMEA1	[Red bar from day 13 to 14]																											
3.067 Transport to Cantilevers	MKS1/ZMEA1	[Red bar from day 14 to 15, labeled '<- - 14- Feb day 13 (gain 1d)']																											
3.101 Take over cold mass to vac- vess	MKS1	[Red bar from day 17 to 18, labeled '<- - 20- Feb day 17']																											
3.103 Align cold- m beam/Taylor- Hob	ZMEA2/MKS1	[Red bar from day 18 to 19, labeled '(gain 1d)']																											
3.104 Mounting warm couplers	MHF	[Red bar from day 19 to 20]																											
3.105 Superisolation coupler ports	MHF/MKS1	[Red bar from day 19 to 20]																											
3.106 Leaktest warm couplers	MVP	[Red bar from day 19 to 20]																											
3.107 Wiring flanges coupler ports	MHF	[Red bar from day 19 to 20]																											
3.114 Assembly coupler pumping tube	MVP	[Red bar from day 20 to 21]																											
3.115 Leak test beam tube	MVP	[Red bar from day 20 to 21]																											
3.116 Measure fr/tuner test	MHF/MKS1	[Red bar from day 21 to 22]																											
3.121 Set vacuum caps posts/vac- vess	MKS1	[Red bar from day 21 to 22, labeled 'Stop Coupler Problem']																											
Transport into Linac to Pos. ACC3	MKS1/ZMEA1	[Red bar from day 26 to 27, labeled '26- Mar-03 Delay:17 days (Coupler problems)']																											
Assembly duration working days	[days]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		

Assembly Major Steps



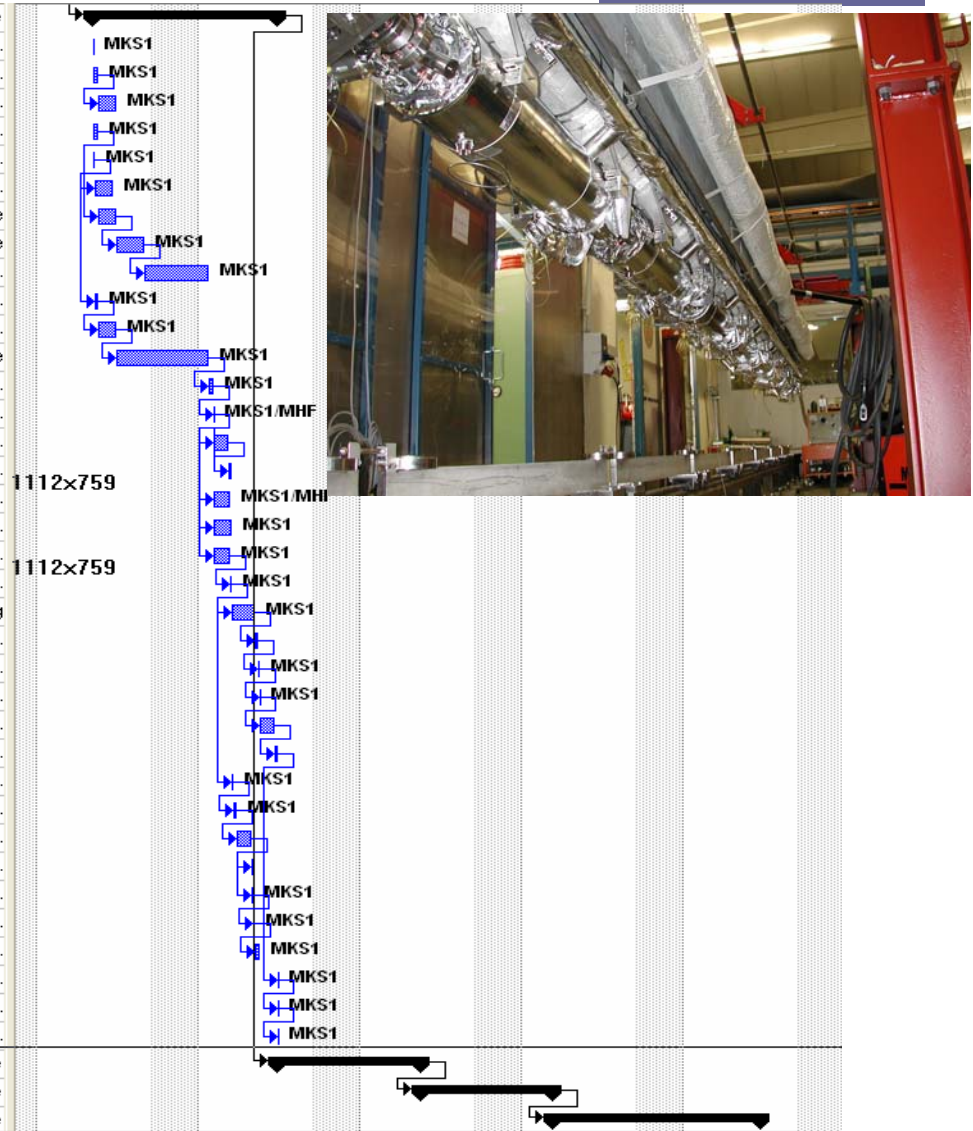
1. String Roll Out Clean Room

⊕ WP 0 Vorarbeiten u. Montageplatz einrichten	9,38 Tage?
⊖ Modul-Montage	22,84 Tage
⊖ WP 1 Roll Out u. Kontrolle	1,94 Tage
WP 1.00 (WP 1.00) Roll Out	2 Std.
WP 1.01 (WP 3.02) Cav.-String in z-Pos. Z. Kaltenm. Ausr. u. fixieren	2 Std.
⊖ Abnahme Kontrolle MKS1	0,94 Tage
WP 1.02 (WP 1.01) Kontrolle aller Flansche u. Schrauben	0,5 Std.
WP 1.03 (WP 1.03) Kontrolle Höhen-/Seitenlage	1 Std.
WP 1.04 (WP 1.04) Kontrolle Verdrehung Cav/Quad.	1 Std.
WP 1.05 (WP 1.05) Kontrolle Kopplerabstände	1 Std.
WP 1.06 (WP 1.06) Kontrolle Längenposition	2 Std.
WP 1.07 (WP 1.07) Ohm: HOM/Pickup/e-/Koppl./BPM	1 Std.
WP 1.08 (WP 1.08) Ohm: Quad/Dip-Doublet	1 Std.
⊖ Kontrollsteps MHF-SL	1 Tag
WP 1.09 (WP 1.09) Plan für evtl. Kurzschluß. Erstellen	4 Std.
WP1.10 (WP 1.10) HOM-Justierung/Cav. Messen/fr.	1 Tag
⊕ WP 2 Start Montagearbeiten	6,13 Tage
⊕ WP 3 Kaltenmasse mit Cavity-String	4,38 Tage
⊕ WP 4 Kaltenmasse in Cantilever	3,34 Tage
⊕ WP 5 Kaltenmasse im Vak.-Behälter	7,06 Tage



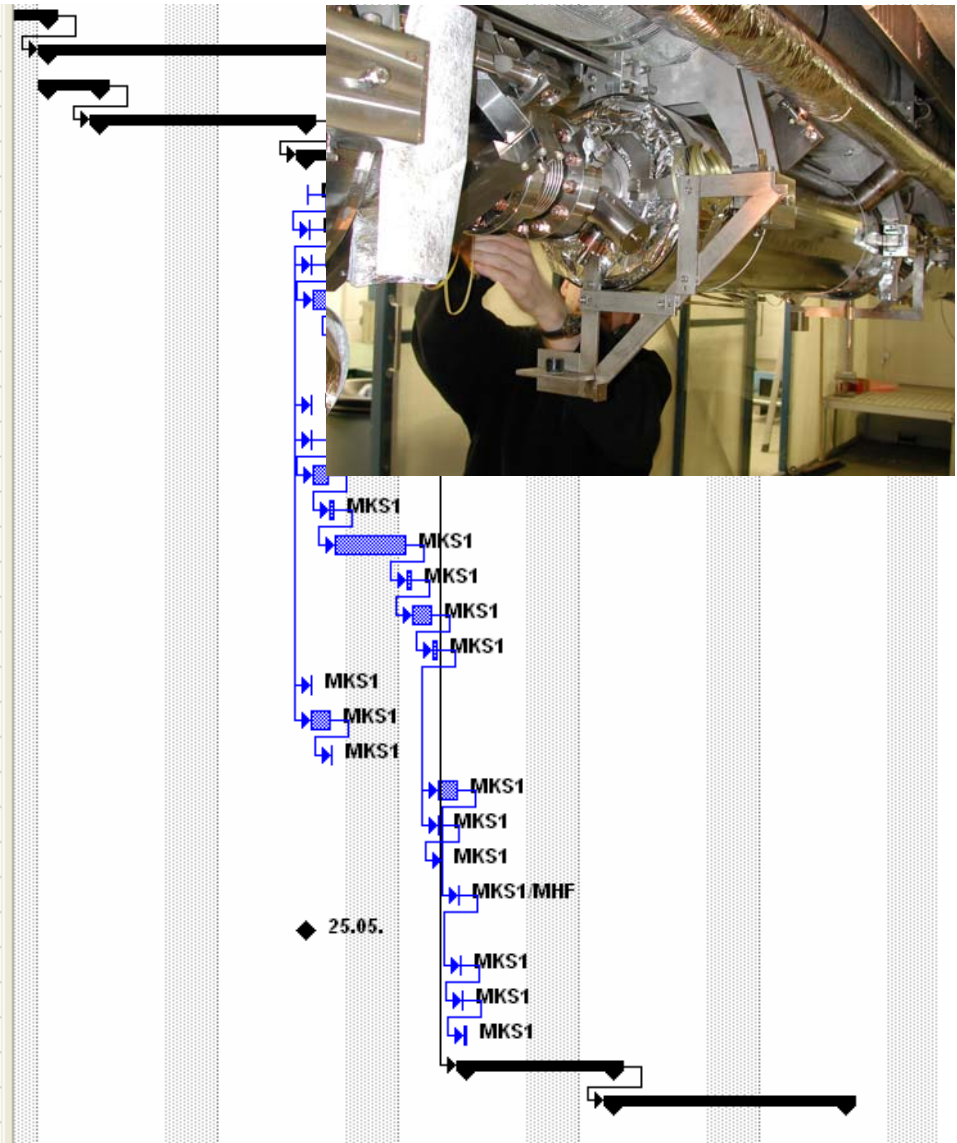
2. Assemblys at the C-String and connect to the cold mass

WP 2 Start Montagearbeiten	6,13 Tage
WP 2.01 (WP 2.01) Cu-Kühlring BPM	1 Std.
WP 2.02 (WP 2.13) Kühlleitung HOM-Absorber	4 Std.
WP 2.03 (WP 2.14) Lecktest Kühlleitung HOM-Absorber	4 Std.
WP 2.04 (WP 2.07) Kühlleitung Quad/Dip-Doublet vorbereiten	4 Std.
WP 2.05 (WP 2.02) STC/He-Tank kleben	2 Std.
WP 2.06 (WP 2.03) Pt1000/Koppler 80K kleben	4 Std.
WP 2.07 (WP 2.04) Vorbereitung 2 Ph-Leitung schweißen	0,5 Tage
WP 2.08 (WP 2.05) Schweißung 70er Leitung	1,5 Tage
WP 2.09 (WP 2.06) Lecktest 70er Leitung	4 Std.
WP 2.10 (WP 2.08) Isolation 2K-Behälter	2 Std.
WP 2.11 (WP 2.09) Mittelteile magn. Abschirmung He-Tank	5 Std.
WP 2.12 (WP 2.10) Montage Cavity-Tuner	2 Tage
WP 2.13 (WP 2.10a) Montage gespiegelten Tuner	3 Std.
WP 2.14 (WP 2.11) Ausbau Pratzen, Cav/fr. messen	1 Std.
WP 2.15 (WP 2.06a) Montage Strahlrohrschieber-Halter Cavity 1-Seite	1 Std.
WP 2.16 (WP 3.04) Test Meßwerkzeug Cav/Quad-Axen	2 Std.
WP 2.17 (WP 2.12) Mont. HF-Kabel mit TDR /Check	2 Std.
WP 2.18 (WP 4.07) Anbau Cu-Litzen Tuner/HOM	4 Std.
WP 2.19 (WP 4.13) 2 K-Bereich Restisolation	2 Std.
WP 2.20 (WP 3.06) Absenken Kaltenmasse	2 Std.
WP 2.21 (WP 3.07) Montage der Cavity-Aufnahmen	1 Tag
WP 2.22 (WP 3.12) Quad. in die Aufnahme montieren	2 Std.
WP 2.23 (WP 3.08) Fixierung Rollenlager Cav5	1 Std.
WP 2.24 (WP 3.09) Kontrolle Schrauben Haltesystem	1 Std.
WP 2.25 Fixpunkt Invar-Stange montieren	1 Std.
WP 2.26 Verbindungen Cavity auf Invar-Stange montieren	2 Std.
WP 2.27 (WP 3.10) Koppler. Markierung z-Pos. Auf 80 K-Schild	1 Std.
WP 2.28 (WP 3.11) Bohrung . Prov. Koppler-Halter 80 K	2 Std.
WP 2.29 (WP 3.05) Einhängen 2K Kalt/Warm-Leit.	2 Std.
WP 2.30 (WP 3.16) Anbau prov. Koppler-Halterung	2 Std.
WP 2.31 (WP 3.14) Festpunkt 2 K K/W-Leitung	1 Std.
WP 2.32 (WP 3.15) 2 K K/W-Leitung an He-Tank anschließen	2 Std.
WP 2.33 (WP 4.08) Lecktest 2 K-Bereich	3 Std.
WP 2.34 (WP 3.17) Abbau Balgsicherungen Strahlrohr	0,5 Std.
WP 2.35 (WP 3.18) Seit/Dreh-Just. String wegklappen	0,25 Std.
WP 2.36 (WP 3.19) End-Kontrolle String-Halterung	0,25 Std.
WP 3 Kaltenmasse mit Cavity-String	4,38 Tage
WP 4 Kaltenmasse in Cantilever	3,34 Tage
WP 5 Kaltenmasse im Vak.-Behälter	7,06 Tage



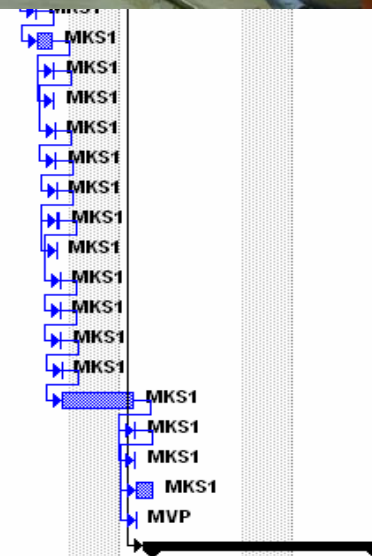
3. Cavity-String align to the Cold Mass

⊕ WP 0 Vorarbeiten u. Montageplatz einrichten	9,38 Tage ?
⊖ Modul-Montage	22,84 Tage
⊕ WP 1 Roll Out u. Kontrolle	1,94 Tage
⊕ WP 2 Start Montagearbeiten	6,13 Tage
⊖ WP 3 Kaltenmasse mit Cavity-String	4,38 Tage
WP 3.01 (WP 4.01) Anheben Kaltenmasse mit String	1 Std.
WP 3.02 (WP 4.02) Demontage Stützen/Halterungen Schiene	1 Std.
WP 3.03 (WP 4.03) Justieren Quad.	2 Std.
WP 3.04 (WP 4.04) Justieren C1 u. C8	1 Tag
WP 3.05 (WP 4.05) Fixierung Stellschrauben String	1 Std.
WP 3.06 (WP 4.06) Einmessen String ev. Nachjustierung	4 Std.
WP 3.07 (WP 4.09) Kabel BPMs u. Acc anbauen /TDR	1 Std.
WP 3.08 (WP 4.20) Anpassen Cu-Litzen 4K- u. 80K-Kones	2 Std.
WP 3.09 (WP 4.21) Anbauen Cu-Litzen 4K- u. 80K-Kones	1 Std.
WP 3.10 (WP 4.15) Abbau Balgsicherung Koppler	4 Std.
WP 3.11 (WP 4.16) Anbau 80 K-Kones	4 Std.
WP 3.12 (WP 4.17) Anbau 4 K-kones	4 Std.
WP 3.13 (WP 4.18) 4 Gewindestangen/Koppler in die Kones einschrauben	4 Std.
WP 3.14 (WP 4.19) Anbau End.Teile magn Abschirmung	4 Std.
WP 3.15 (WP 4.11) Anbau Tuner Rohr/Kabelb. mit Steckerverbindung	2 Std.
WP 3.16 (WP 4.10) 4K-Leitung mit Quad. verbinden	4 Std.
WP 3.17 (WP 4.14) Lecktest 4K-Bereich	2 Std.
WP 3.18 (WP 4.22) Therm./Führ. HF-Kabel auf magn. Abschirmung	4 Std.
WP 3.19 (WP 4.23) Therm. Führung Tunerkabel auf magn. Abschirmung	2 Std.
WP 3.20 (WP 4.12) Tuner-Testläufe vom Kabelende	1 Std.
WP 3.21 (WP 4.24) Ohm/TDR: HOM/Pickup/e-/BPM	1 Std.
WP 3.22 (WP 4.25) Ohm: T-Sensor>>>später	0 Tage
WP 3.23 (WP 4.26) Kabel für Transport sichern	2 Std.
WP 3.24 (WP 4.27) Kontrolle Balg-Freiheit Quad.	1 Std.
WP 3.25 (WP 4.28) Vorbereitung für Transport	2 Std.
⊕ WP 4 Kaltenmasse in Cantilever	3,34 Tage
⊕ WP 5 Kaltenmasse im Vak.-Behälter	7,06 Tage



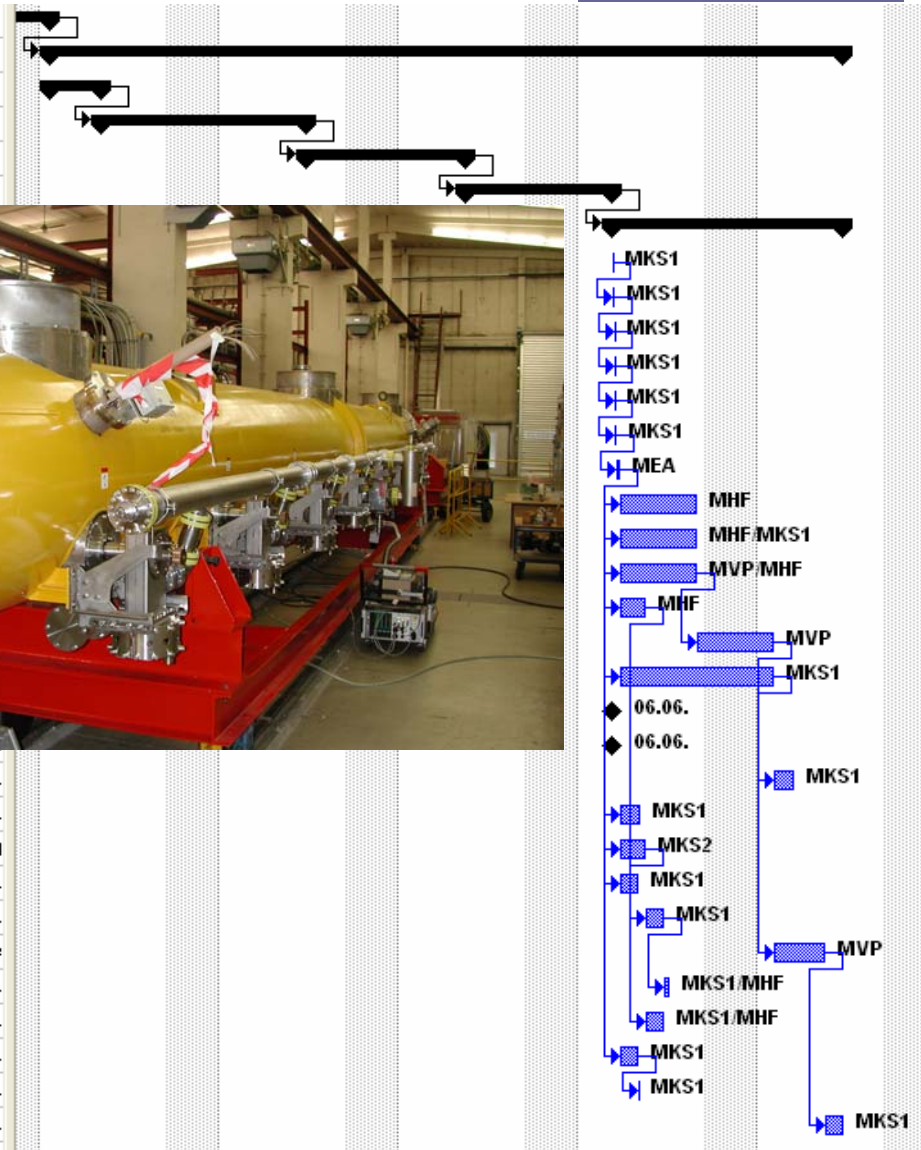
4. Cold Mass in the Cantilever

⊕ WP 0 Vorarbeiten u. Montageplatz einrichten	9,38 Tage ?
⊖ Modul-Montage	22,84 Tage
⊕ WP 1 Roll Out u. Kontrolle	1,94 Tage
⊕ WP 2 Start Montagearbeiten	6,13 Tage
⊕ WP 3 Kaltenmasse mit Cavity-String	4,38 Tage
⊖ WP 4 Kaltenmasse in Cantilever	3,34 Tage
WP 4.01 (WP 5.01) Transport Cantilever	1 Std.
WP 4.02 (WP 5.22) Abbau der Posts	1 Std.
WP 4.03 (WP 5.02) Aufbau der Abrollvorr. Isolation 80K	4 Std.
WP 4.04 (WP 5.03) Koppler-Pos. auf Hallenboden übertragen	0,5 Std.
WP 4.05 (WP 5.04) Abbau prov. Kopplerhalter	0,5 Std.
WP 4.06 (WP 5.05) Anpass. 4K-Schild Quad.-Bereich	0,5 Std.
WP 4.07 (WP 5.06) Anpass. 4K-Schild C1-Bereich	0,5 Std.
WP 4.08 (WP 5.07) Anbau 4K-Schildteile	1 Std.
WP 4.09 (WP 5.08) Kontrolle Freiheiten 4K-Schild	0,5 Std.
WP 4.10 (WP 5.10) Cu-Litzen 4K-Kones an 4K-Schild	1 Std.
WP 4.11 (WP 5.11) Cu-Kühlring BPM an 4K-Schild	0,5 Std.
WP 4.12 (WP 5.09) Schweißung 4K-Schild (Fingerschweißung)	1 Std.
WP 4.13 (WP 5.12) Therm./Führ. HF-Kabel auf 4K-Schild	2 Std.
WP 4.14 (WP 5.13) Kabel sichern	0,5 Std.
WP 4.15 (WP 5.14) Isolation 4K-Schild	2 Std.
WP 4.16 (WP 5.15) Ausschnitte 4K-Isolation	0,5 Std.
WP 4.17 (WP 5.16) Anbau 40K-Vorlaufleitung	0,25 Std.
WP 4.18 (WP 5.17) Anpass. 80K-Schildteile	0,5 Std.
WP 4.19 (WP 5.18) Anbau 80K-Schildteile	1 Std.
WP 4.20 (WP 5.19) Kontrolle Freiheiten 80K-Schild	0,25 Std.
WP 4.21 (WP 5.20) Schweißung 80K-Schild	2 Std.
WP 4.22 (WP 5.21) Cu-Litzen 80K-Kones an 80K-Schild	1 Std.
WP 4.23 (WP 5.24) Ohm: T-Sensor, Tuner	1 Std.
WP 4.24 (WP 5.25) Therm./Führ. HF-Kabel auf 80K-Schild	0,5 Std.
WP 4.25 (WP 5.23) Ohm: HOMPickup/e-/Koppl./BPM/Acc	0,5 Std.
WP 4.26 (WP 5.26) Kabel sichern	0,5 Std.
WP 4.27 (WP 5.27) Isolation 80K-Schild	6 Std.
WP 4.28 (WP 5.28) Aus-/Endschnitte 80K-Isolation	2 Std.
WP 4.29 (WP 5.29) Abbau Abrollvorr. Isolation	2 Std.
WP 4.30 (WP 5.30) Vorbereitung überrollen Vak.-Behälter	2 Std.
WP 4.31 (WP 5.31) Strahl.-Schieber C1 zu	0,5 Std.
⊕ WP 5 Kaltenmasse im Vak.-Behälter	7,06 Tage

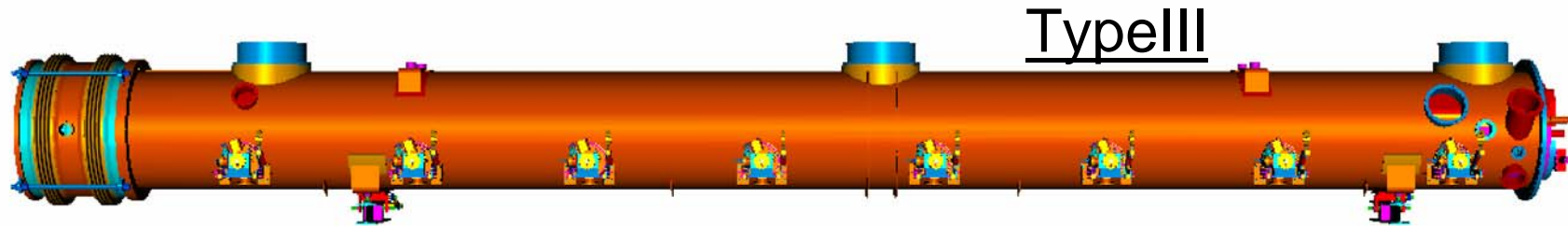


5. Cold Mass in the Vacuum Vessel

⊕ WP 0 Vorarbeiten u. Montageplatz einrichten	9,38 Tage?
⊖ Modul-Montage	22,84 Tage
⊕ WP 1 Roll Out u. Kontrolle	1,94 Tage
⊕ WP 2 Start Montagearbeiten	6,13 Tage
⊕ WP 3 Kaltenmasse mit Cavity-String	4,38 Tage
⊕ WP 4 Kaltenmasse in Cantilever	3,34 Tage
⊖ WP 5 Kaltenmasse im Vak.-Behälter	
WP 5.01 (WP 6.01) Überrollen Vak.-Behälter u. in z zur Kaltenmasse fixieren	
WP 5.02 (WP 6.02) Einbau Posts	
WP 5.03 (WP 6.03) Vak.-Behälter in z- u. x-Pos zur Kaltem. ausrichten/fixieren	
WP 5.04 (WP 6.04) Seidl. Stellschr. Vak/Eisenbahn lösen	
WP 5.05 (WP 6.05) Übernahme Kaltenmasse auf Vak.-Behälter	
WP 5.06 (WP 6.06) Justierung grob Kaltenmasse in Vak.-Behälter	
WP 5.07 (WP 6.07) Justierung/Einmessung Kaltenm. In Vak.-Behälter	
WP 5.08 (WP 6.08) Einbau warme Koppler	
WP 5.09 (WP 6.09) Isolation warme Koppler	
WP 5.10 (WP 6.10) Lecktest warme Koppler	
WP 5.11 (WP 6.11) Verdrahtung Kopplerports	
WP 5.12 (WP 6.20) Anbau Koppler-Vakuumsleitung	
WP 5.13 (WP 6.12) Einbau Stromzuf. Quad/Dip	
WP 5.14 (WP 6.16)	
WP 5.15 (WP 6.18)	
WP 5.16 (WP 6.19) Lecktest 4K-Bereich mit Quad/Dip/Diag-Flansch	4 Std.
WP 5.17 (WP 6.13) Aufkleben STC-Sensoren 4K/HOM-Leitung	3 Std.
WP 5.18 (WP 6.14) Verdrahtung Tuner, (T-Sensoren)	1 Tag
WP 5.19 (WP 6.15) Anschließen der BPM u. Acc-Kabel an E-Flansch	1 Std.
WP 5.20 (WP 6.17) Ohm: Tuner, (T-Sensoren)	2 Std.
WP 5.21 (WP 6.21) Lecktest Strahlrohr	2 Tage
WP 5.22 (WP 6.22) fr-Messung Cavities / Tunertest	4 Std.
WP 5.23 (WP 6.23) Ohm: HOM/Pickup/e-/BPM/Acc	1 Std.
WP 5.24 (WP 6.24) Isolation Postöffnungen	1 Std.
WP 5.25 (WP 6.25) Aufsetzen Vak.-Kappen	1 Std.
WP 5.26 (WP 6.26) Aufsetzen der Vakuum-Schiebemuffe	2 Std.



Next Steps to XFEL-Prototype TypeIII to TypeIII+



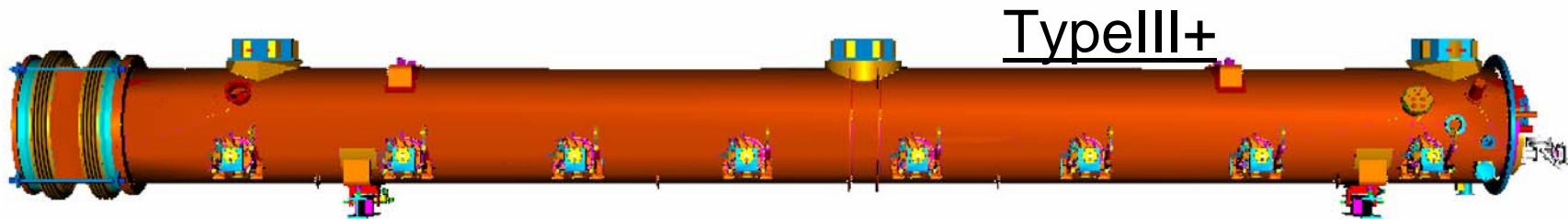
TypeIII

Identical:

- Overall length 12.2m
- Pipe diameter (all)
- Supports and posts
- Cavities
- Couplers

Differences:

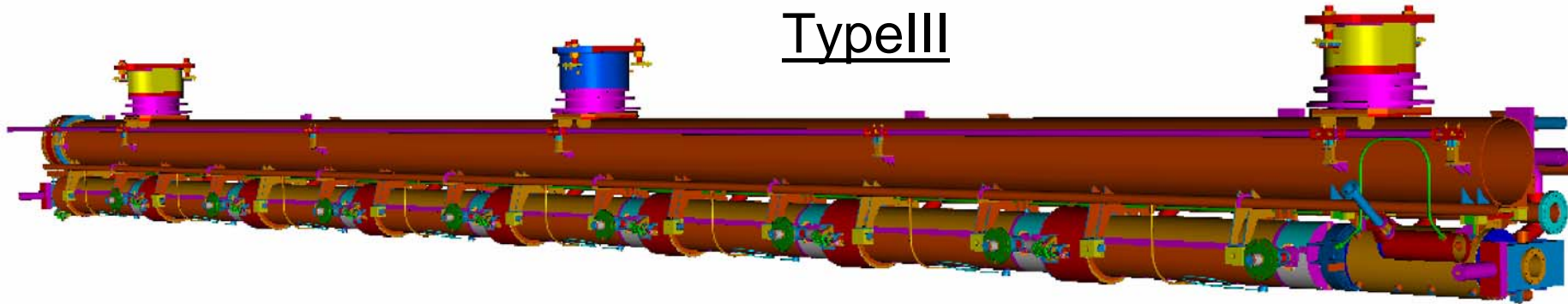
- Cavity spacing from 1380mm to 1383.6mm (coupler to coupler)
- Magnet package with 2 K cooling
- current leads
- BPM
- HOM-Absorber
- Tuner systems



TypeIII+

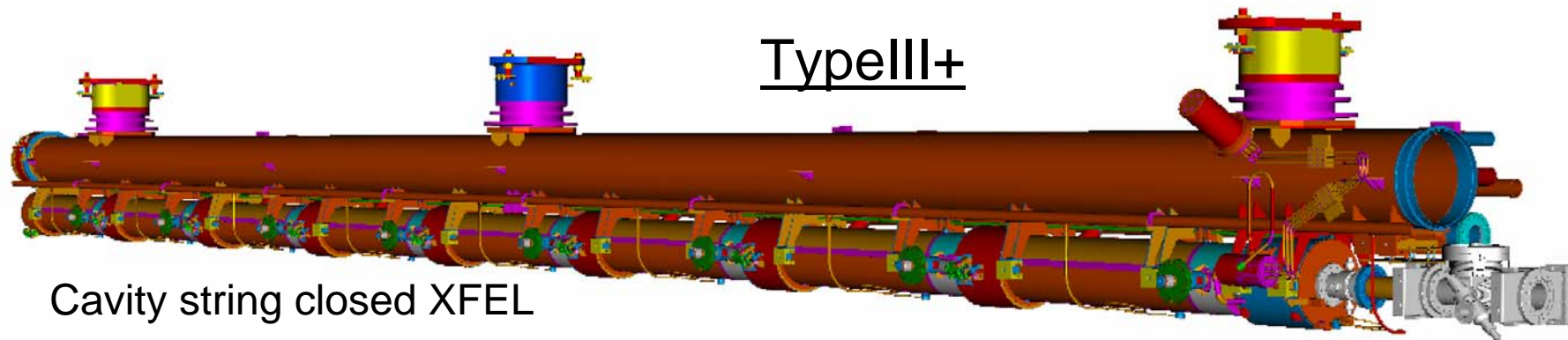
- Assembly early summer 07
- Industrial involved, part of the Assembly Study?

TypeIII



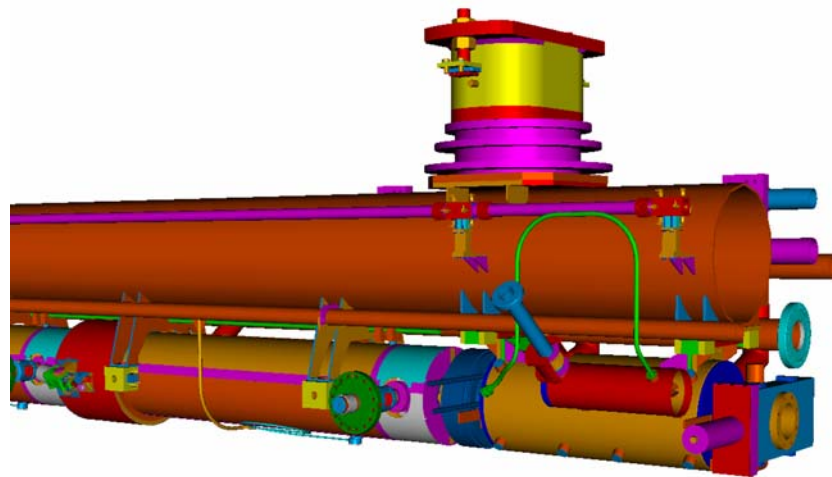
- Coldmass / Vacuum vessel Order Jan-06, delivery Oct-06

TypeIII+

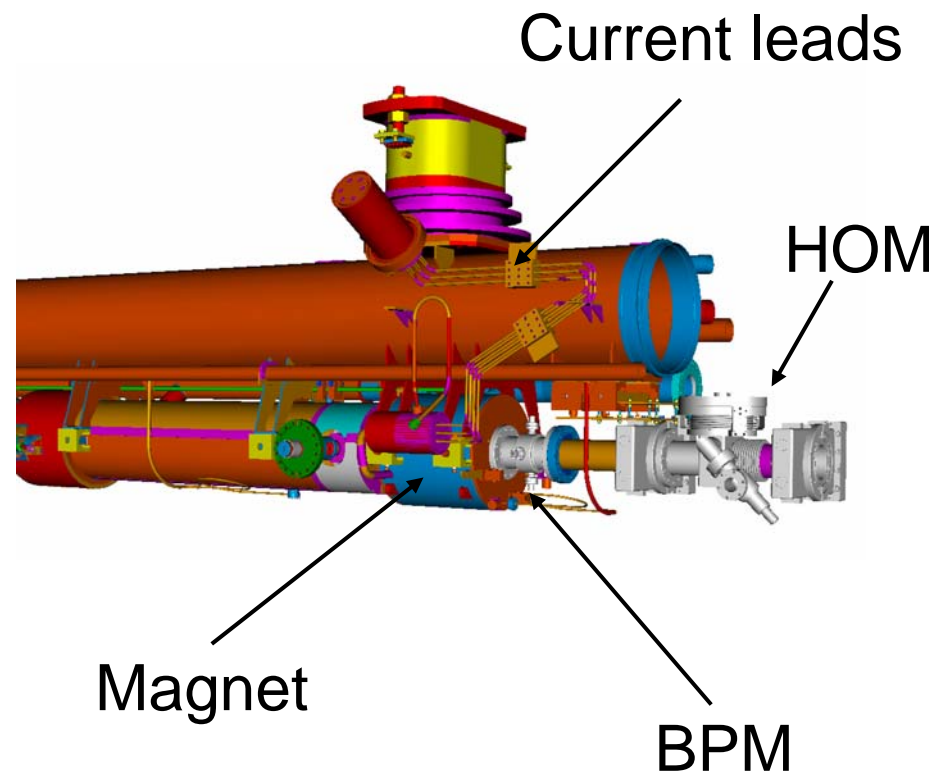


Cavity string closed XFEL

TypeIII



TypeIII+





Typelll+ to XFEL-Prototype



- Design task list for XFEL-Prototype :
 - Cryomodule must be hanging in the XFEL-Tunnel, new supports.
 - Structure investigation Vacuum vessel
 - To shorten the Cryomodule (~210mm)
 - Post position change
 - Structure investigation HeGRP to optimize the post position
 - Structure investigation Vacuum vessel
 - Possible road transport
 - Transportation lock
 - Vibration / maximum shock peaks (acceleration)
 - Piping
 - 40/80 K diameter (pressure drop)
 - 4 K and 2 Phase ?
 - According to PED 97/23/EC (DGRL 97/23/EG)
 - EN13445
 - AD2000