The CMS forward muon upgrade

Restore the TDR version of CMS ⇩ ME4 CSC's and RE4 RPC's on Yoke YE3
High eta part foreseen in Phase 2 (2017 ?)

- ❑ When ? — During first long shutdown (2013 ?)
- ❑ Who ? — CSC's US groups @ CERN
  RPC's China,Korea,Pakistan + Belgium,India,Italy…
- ❑ What ? — 144 chambers + 56 spares (also for stations 2 & 3)
  ⇩ Need to be backward compatible !
- ❑ Where ? — Ghent (~30),India (~30),CERN 904 (~140)

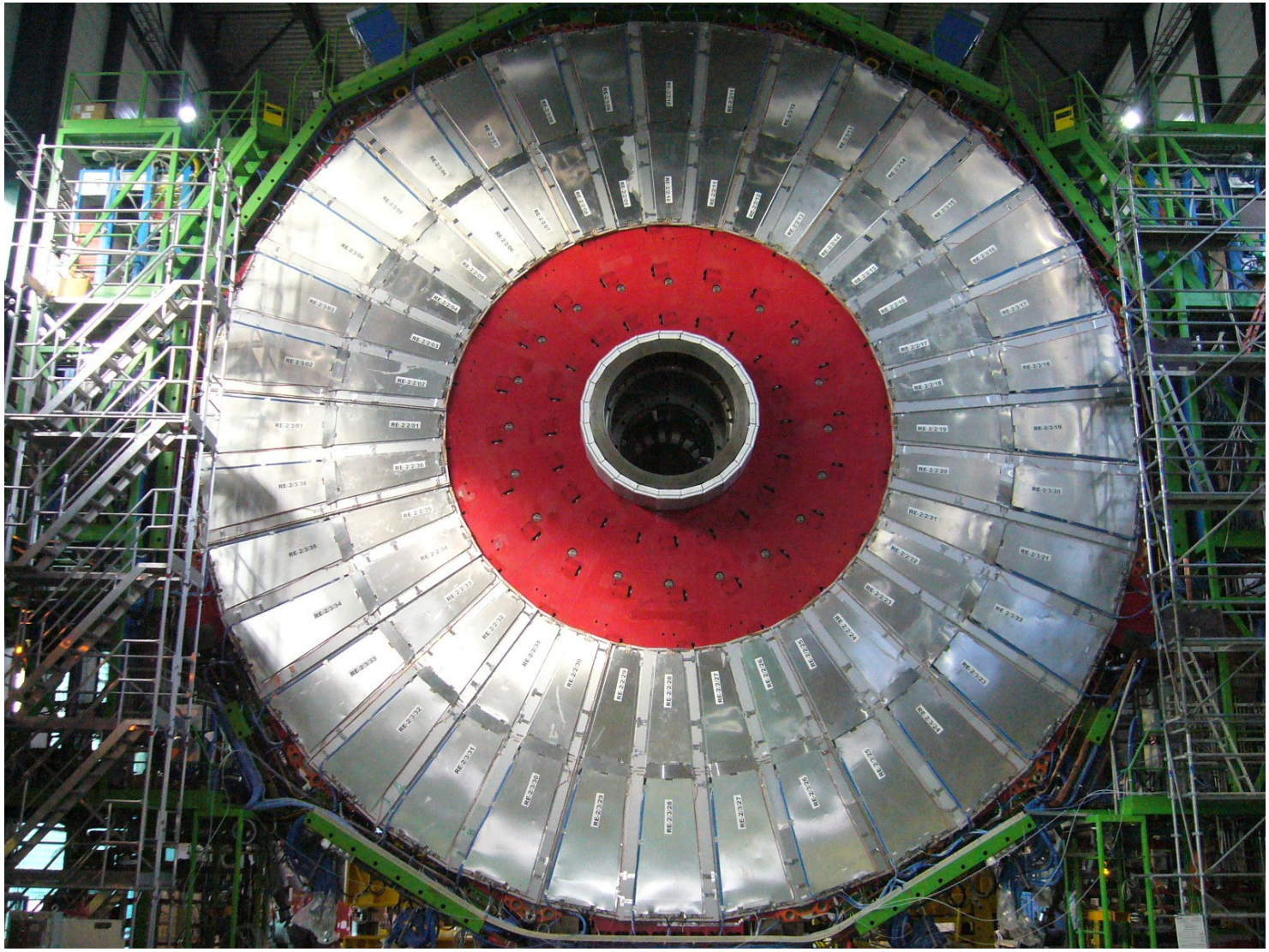
Restoring the TDR low η system

- Use identical chamber design ; modest integration required
- Build station RE4 i.e. 144 RPC of the low η type + spares (~56)
- Install on YE3 behind CSC's (off the CSC mounting posts)
- All services to the RE4 station (in UXC) ex.:
  - HV ombilical in YE1 cable chains
  - Extra Patch Panel space on YE1
  - Rackspace on YE3 and services in mini cable chains
  - Gas distribution rack on YE3
  - Cooling off YE3 manifold (modification) or extra manifold
  - Link system

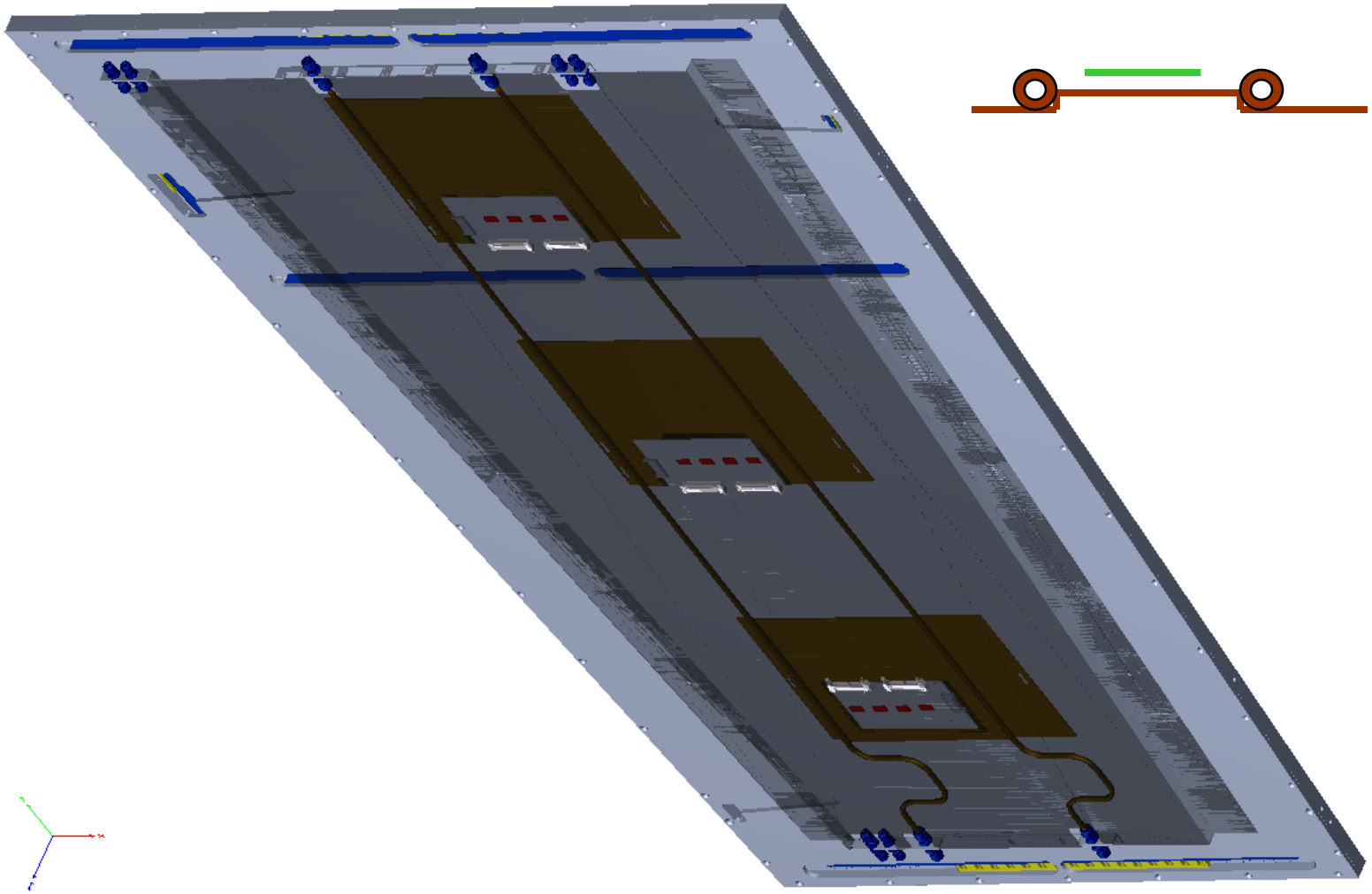
  ...

Price tag ~ 4 Mio CHF

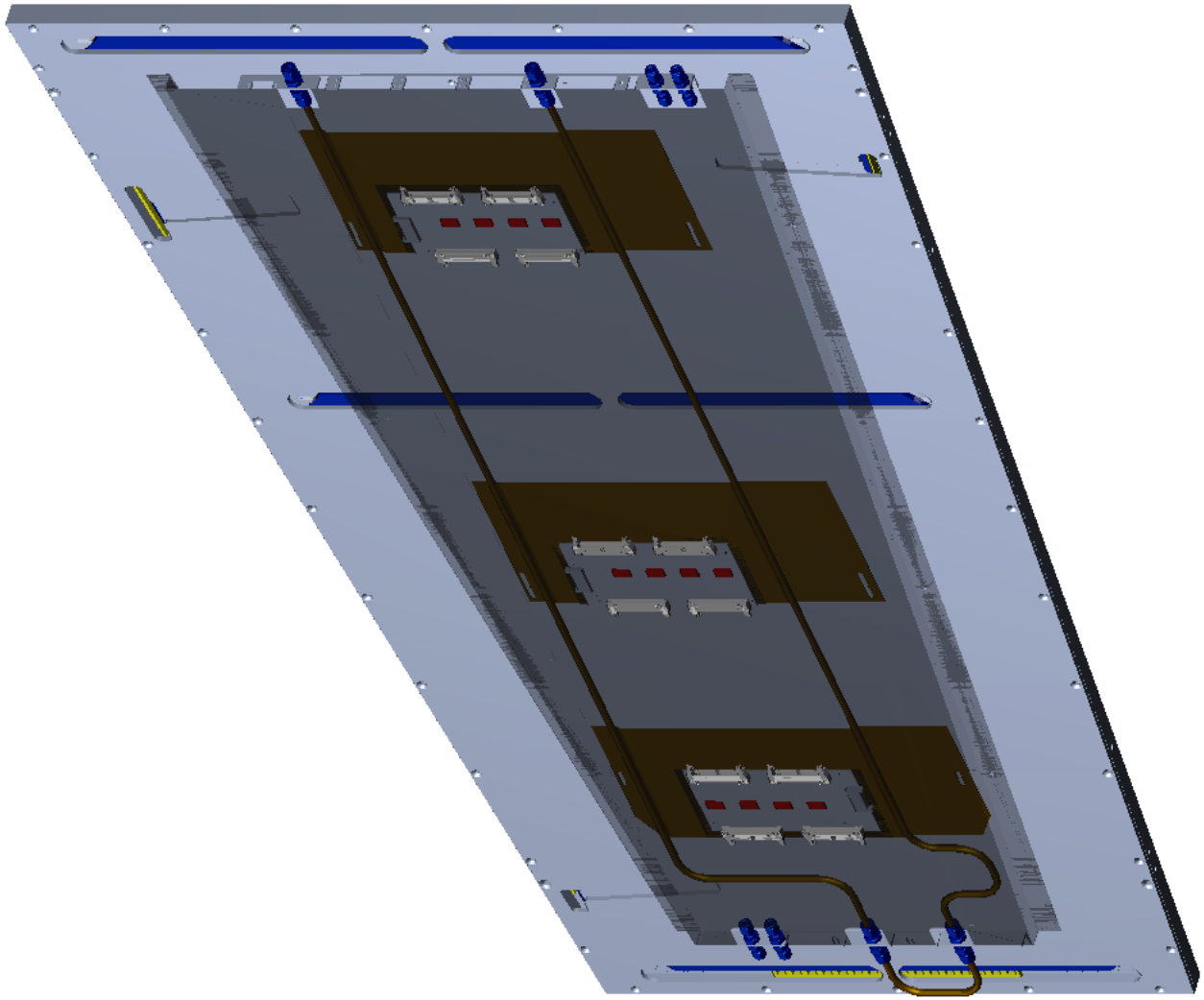
RE-2 station



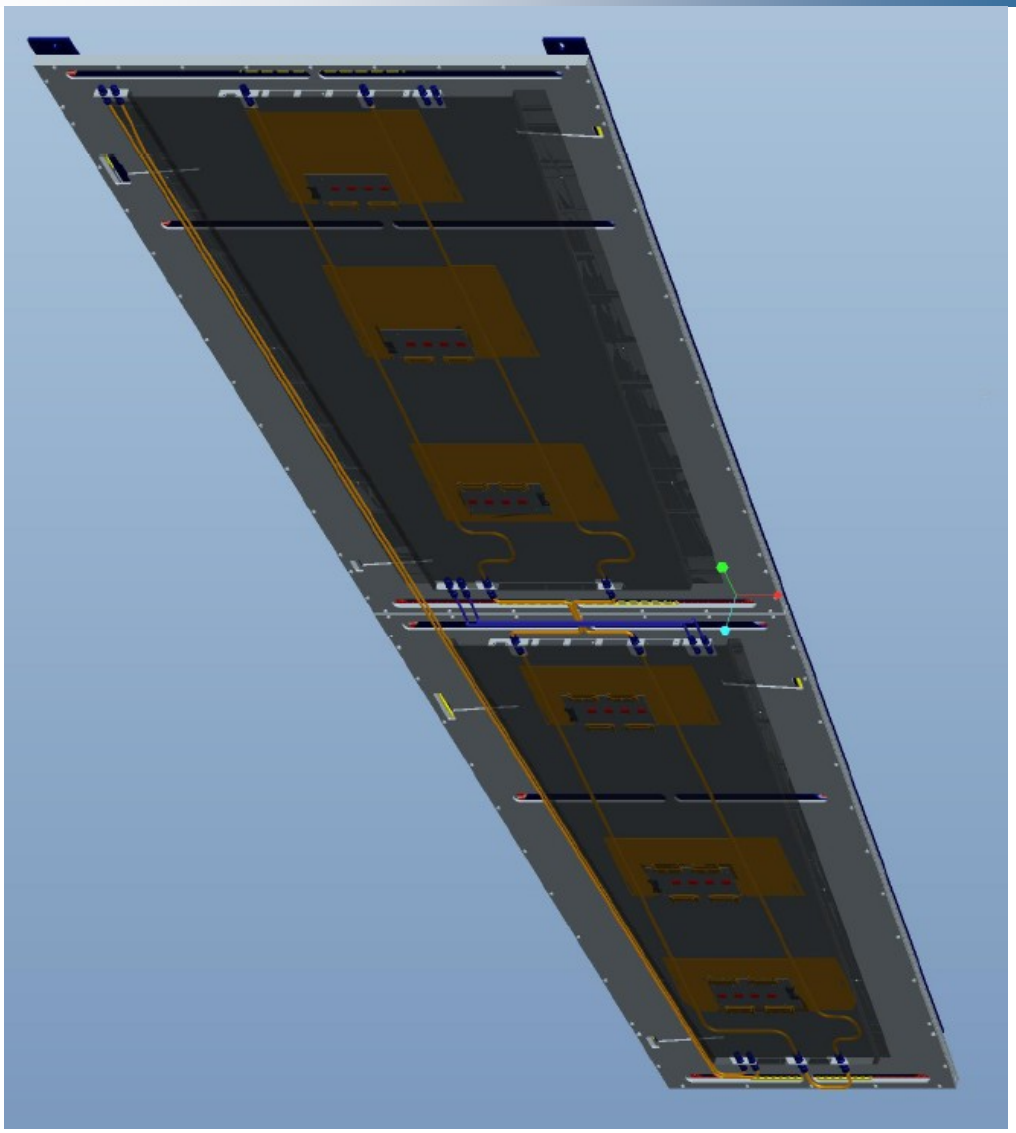
RE4/3



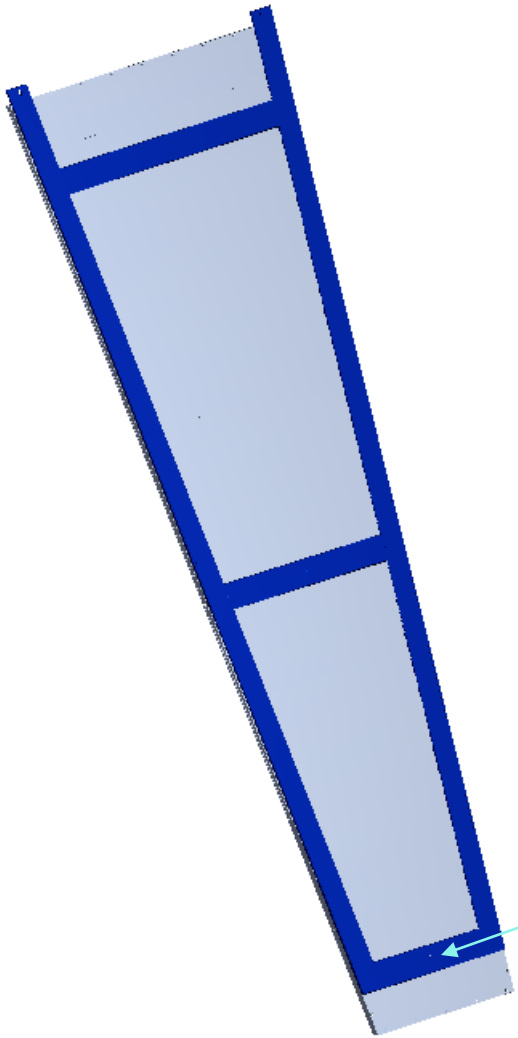
RE4/2



RE4: 10 degree preassembled module



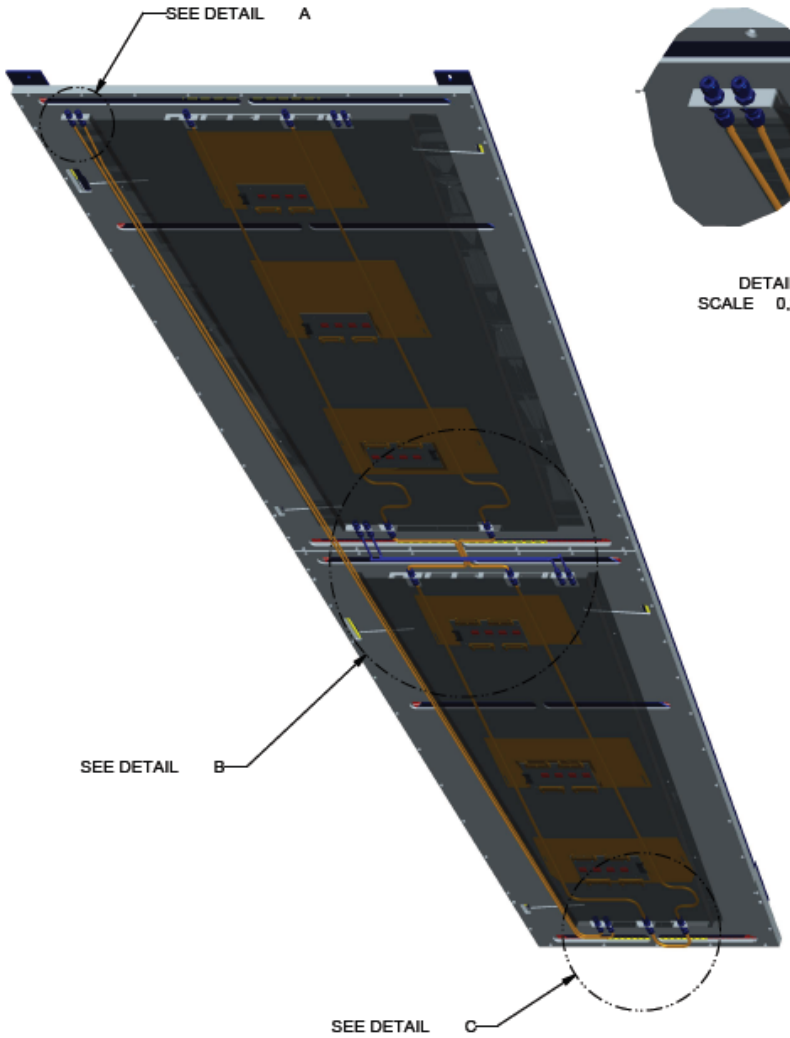
Interface frame



Spring loaded fixation

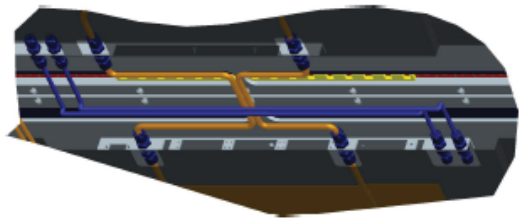
Full set of lr. Drawings @

https://rpc-cms-re4-upscope.web.cern.ch/rpc-cms-re4-upscope/RPC/Chamber%20production/Components/Mechanics/LucDrawings/REtype3/29April2011/

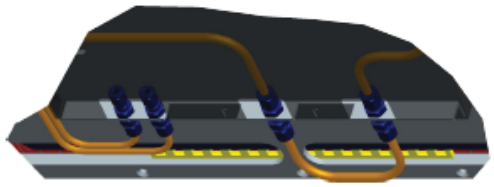


DETAIL A
SCALE 0,300

DETAIL B
SCALE 0,200

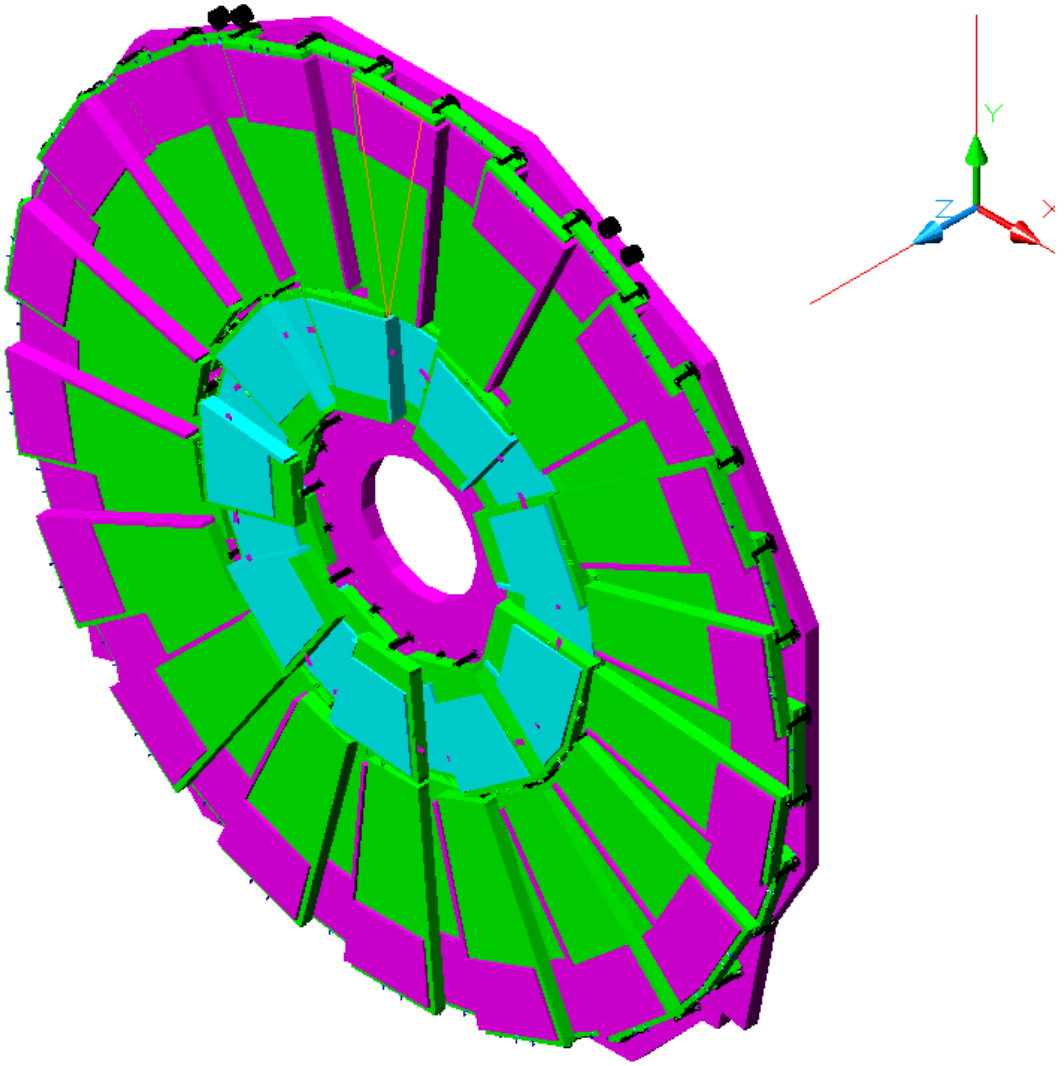


DETAIL C
SCALE 0,300

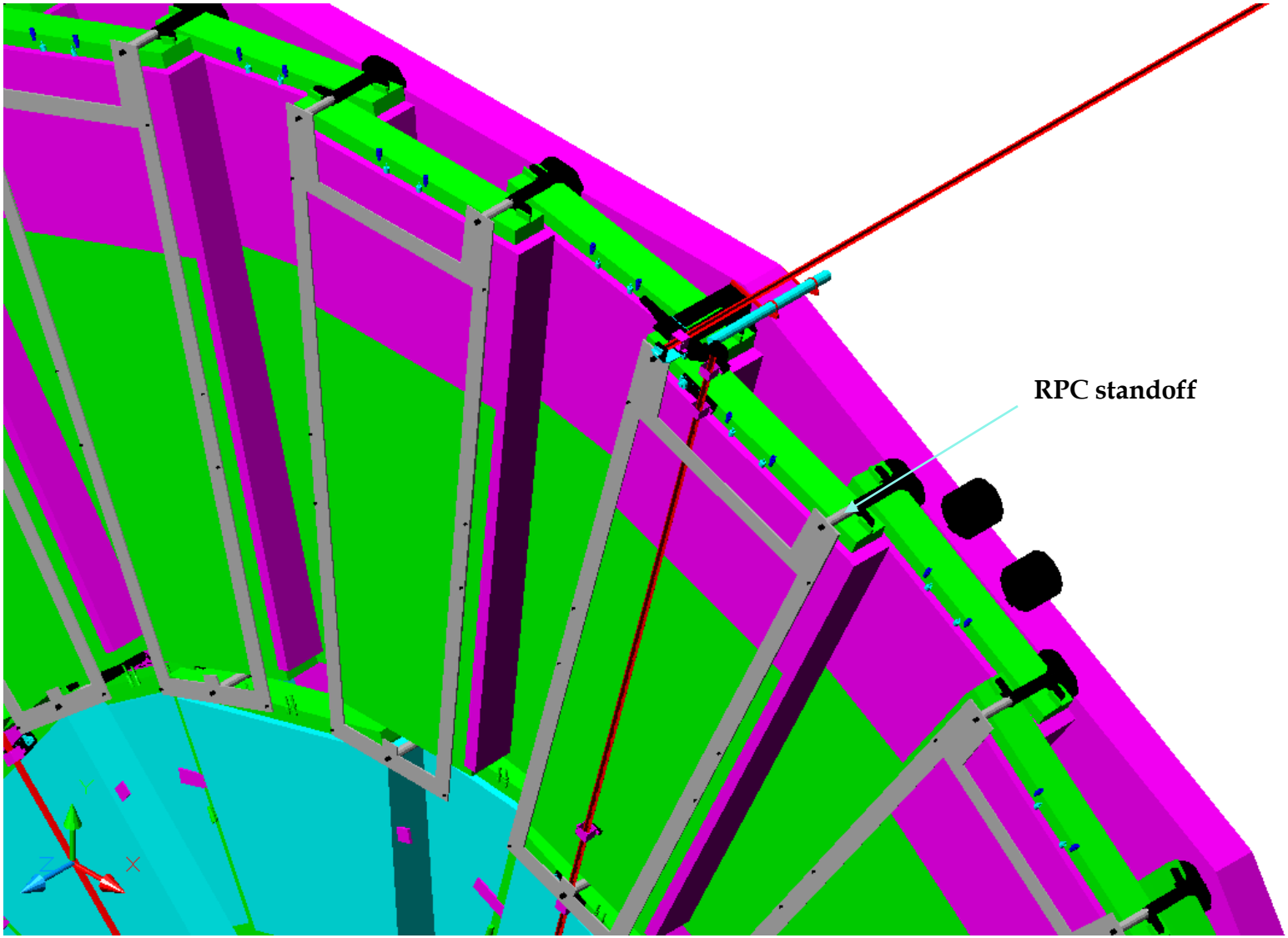


PLAN NR. RE4 -R2-R3- Frame - 001	REPLACE:	SCALE: 1/10
Design by: Luc Van Lancker	Verify by: LVL	Datum: 27-Oct-10
TITLE: RE4-R2-R3-Frame-piping	ASSEMBLY: RPC RE4 Frame	ISO-SYMBOL:
VUB DEPT:ELEM PLEINLAAN 2 - 1050 BRUSSEL TEL:32-2-6293231 FAX:00-32-2-6293816	Vrije Universiteit Brussel	

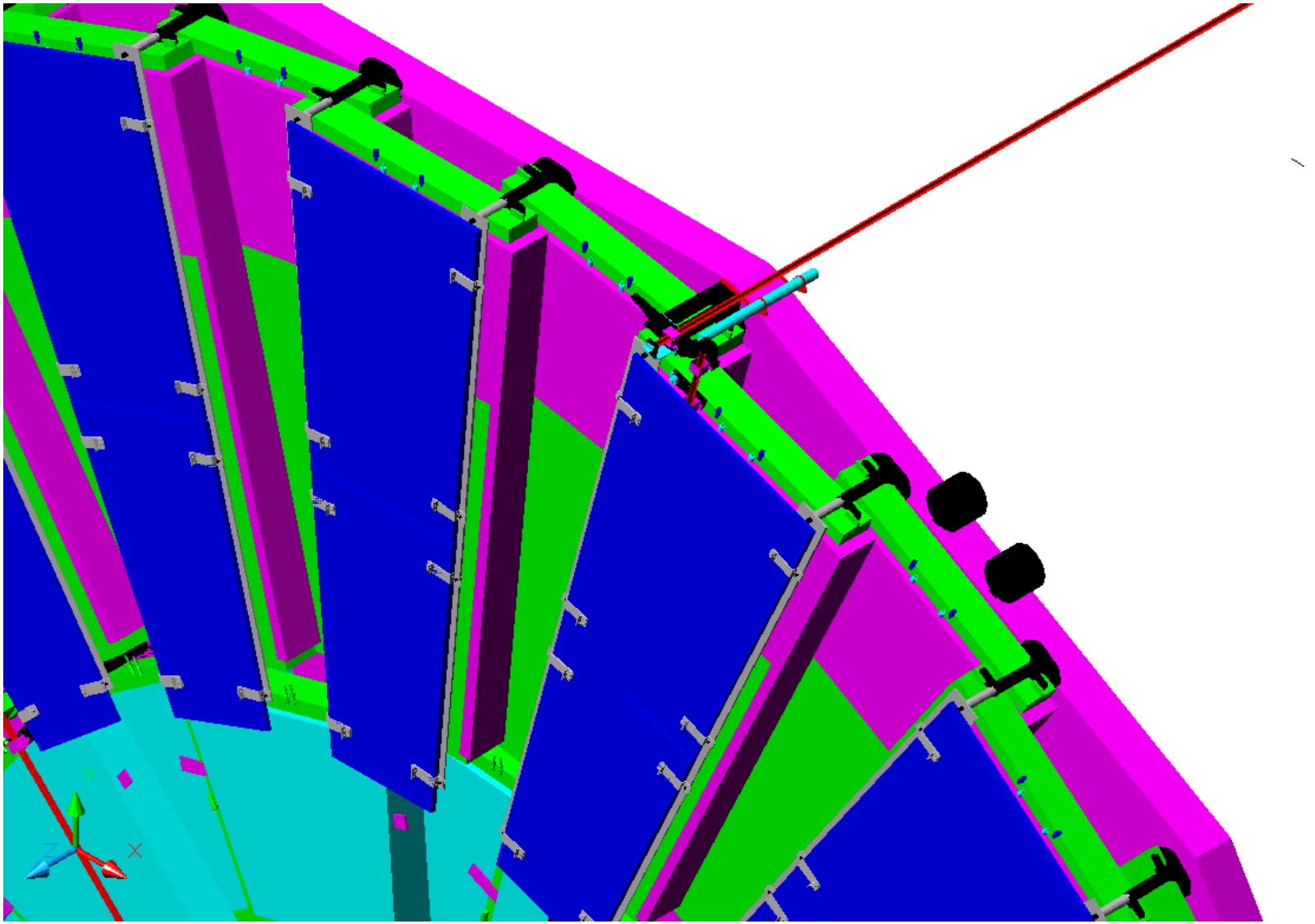
ME4 on Yoke YE3



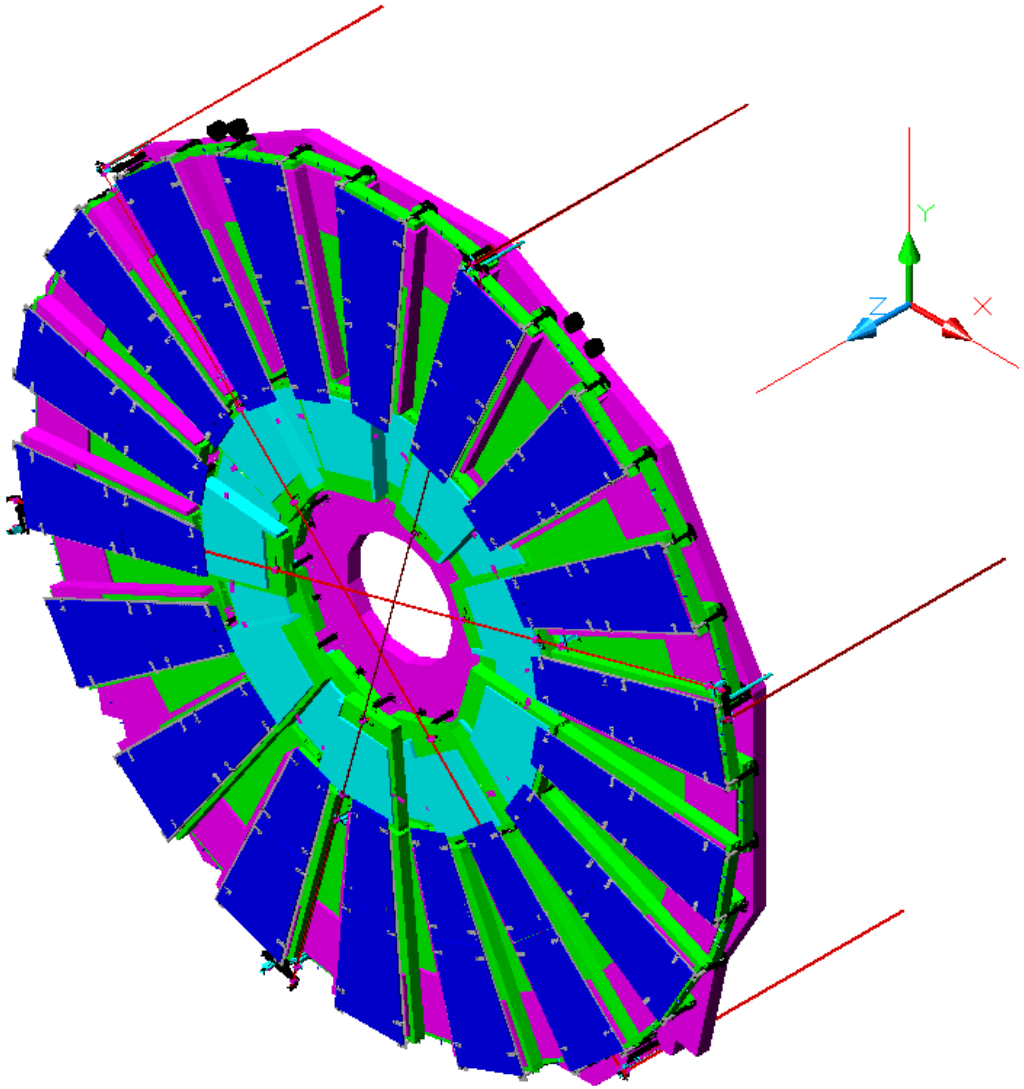
Interface RPC frame



RE4 near yoke



RE4 near yoke

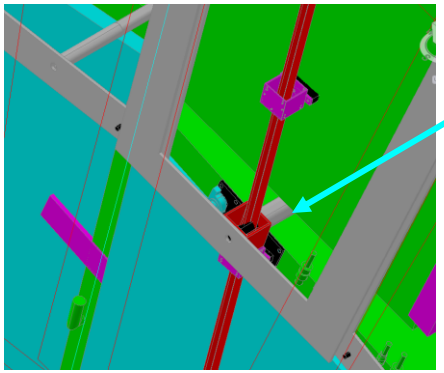


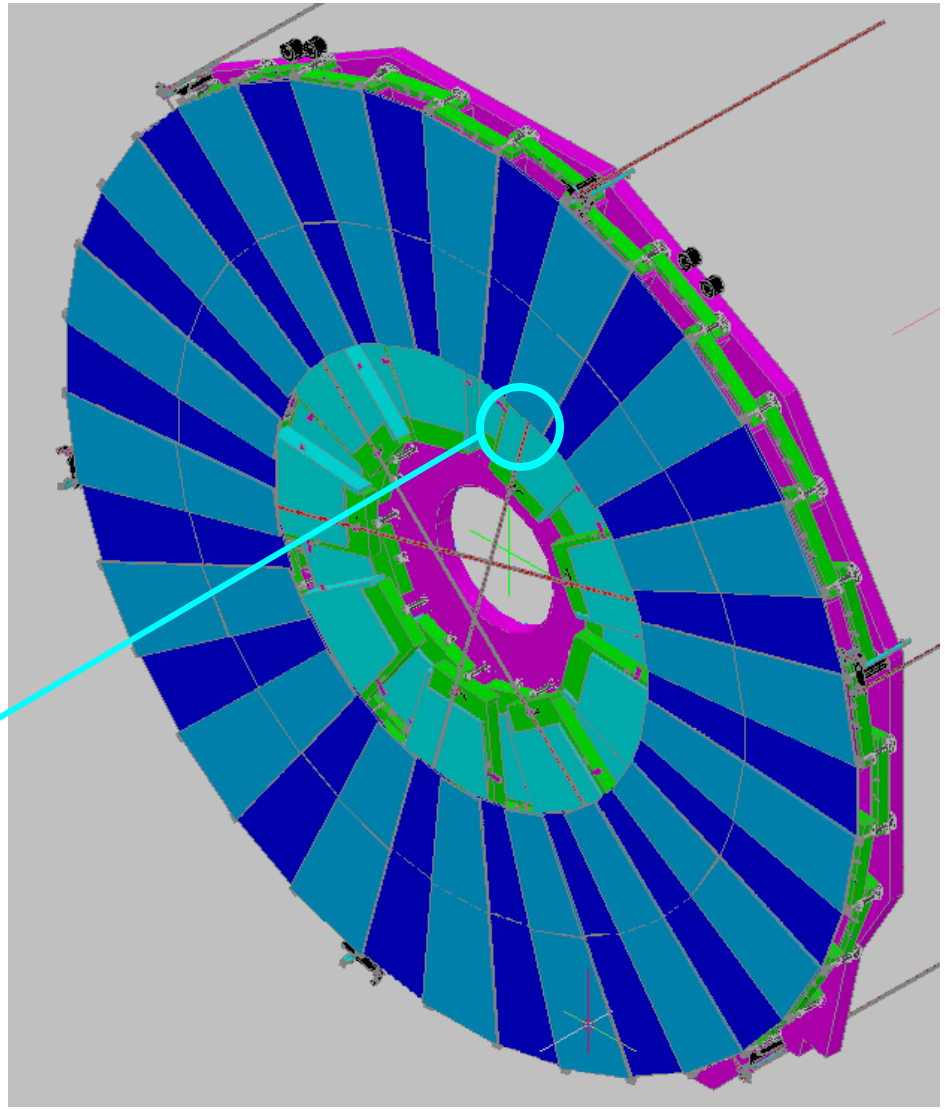
And "Off Yoke"

Clearance to YE4:

12 mm

Clearance alignement





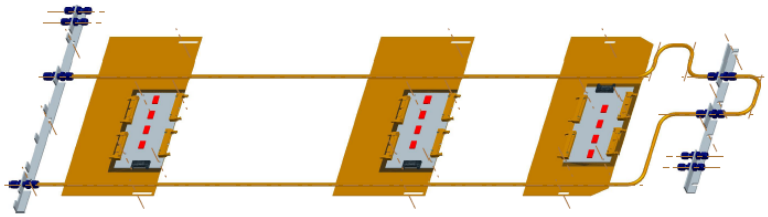
Integration issues: Gas

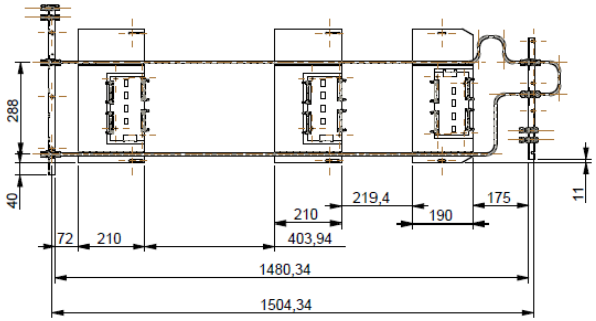
- New Gas rack being constructed (gas group) 36 Channels
- 2 Channels/10 degree sector (top & bottom; reverse flow)
  - 36 bulkheads with 2 channels in parallel
  - 2 chambers in desy chain instead of 6

Integration issues: Cooling
New circuit

- Improved circuit to ALSO cool RPC chamber
- Keep backward compatibility !

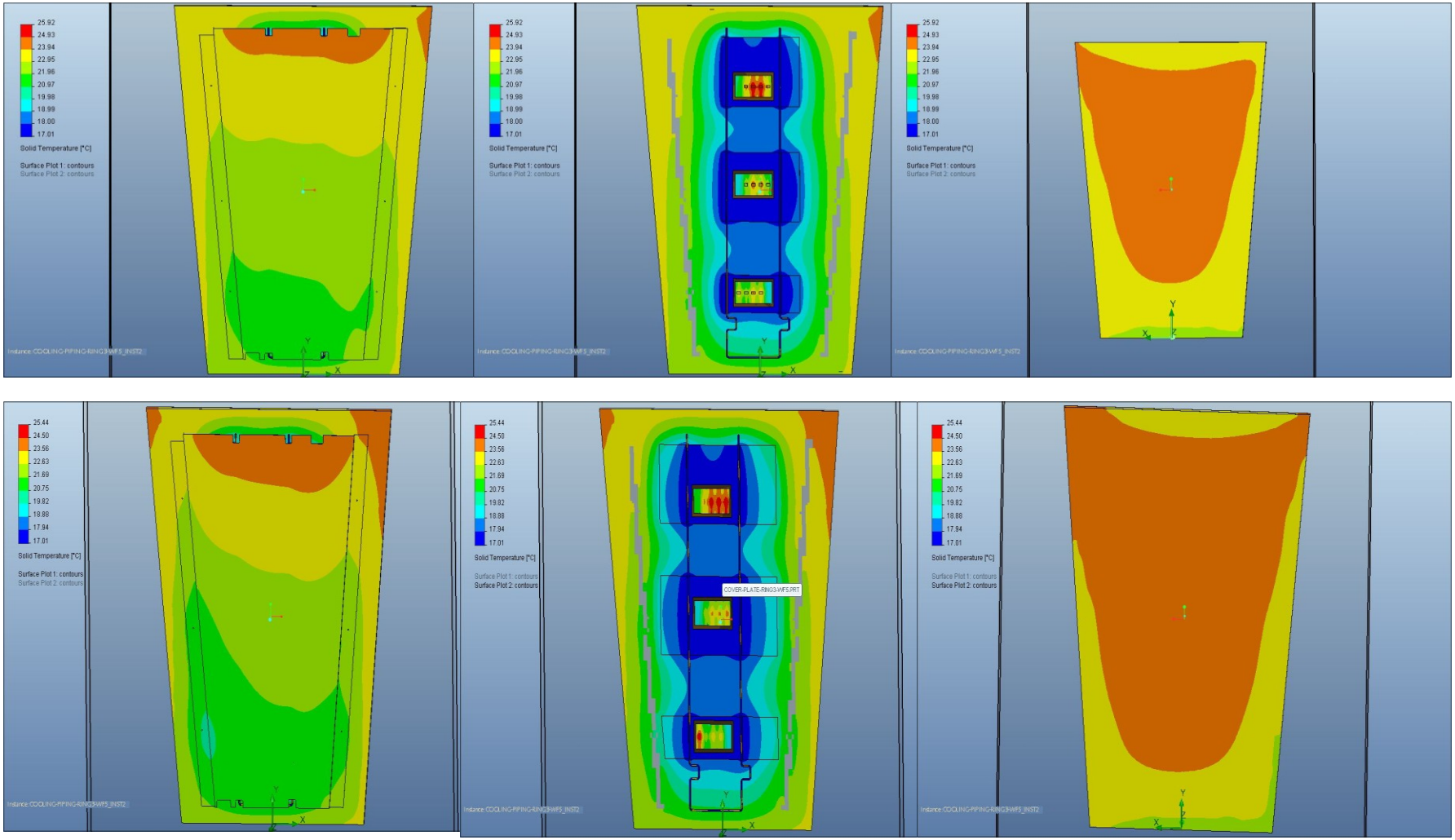
Assembly first the bulkhead union Sagana -tube 8 - on the L profiles
See that the flat surface of this bulkhead union is parallel with L profiles
Mont tubes on both L profiles
Fix assembly of L profiles on Cover-Honeycomb plate
Position the 3 cu plates coresponding with the holes on the Cover-Honeycomb plate
Solder the 3 cu plates on cooling tubes





PLAN NR. RE4-Cooling-Ring2-002--V2	REPLACE: RE4-Cooling-Ring2-002 - V1	SCALE: 0.1
Design by: Luc Van Lancker	Verify by: LVL	Datum: 11-April-2011
TITLE: Piping-Cooling-Ring2	ASSEMBLY: RPC RE4 Ring2	ISO-SYMBOL:
VUB DEPT:ELEM PLEINLAAN 2 - 1050 BRUSSEL TEL:32-2-6293231 FAX:00-32-2-6293816	Vrije Universiteit Brussel	

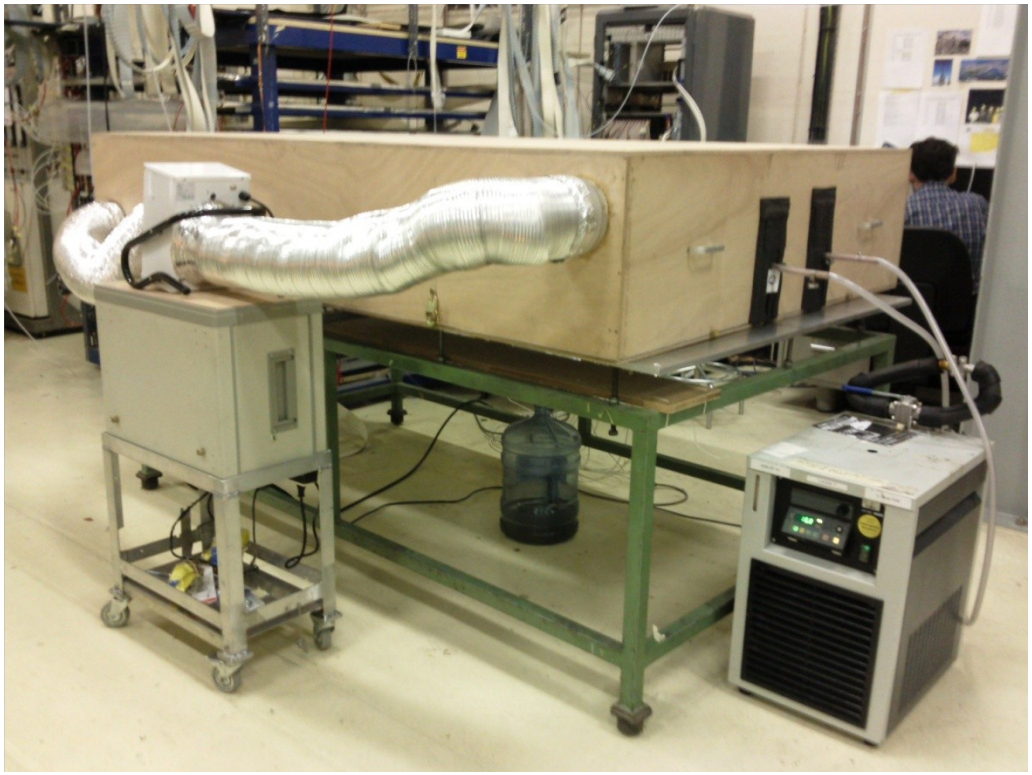
Integration issues: Cooling %
FE analysis (Luc Van Lancker)



Rule of tumb: T inside ~ average between ambient and coolant

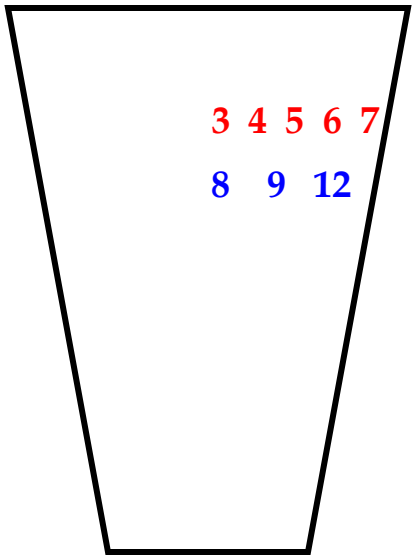
Integration issues: Cooling % Measurements

Enviromental box @ ISR lab.
Water @ 17.5 ^{0}C



Courtesy Yasser Assran

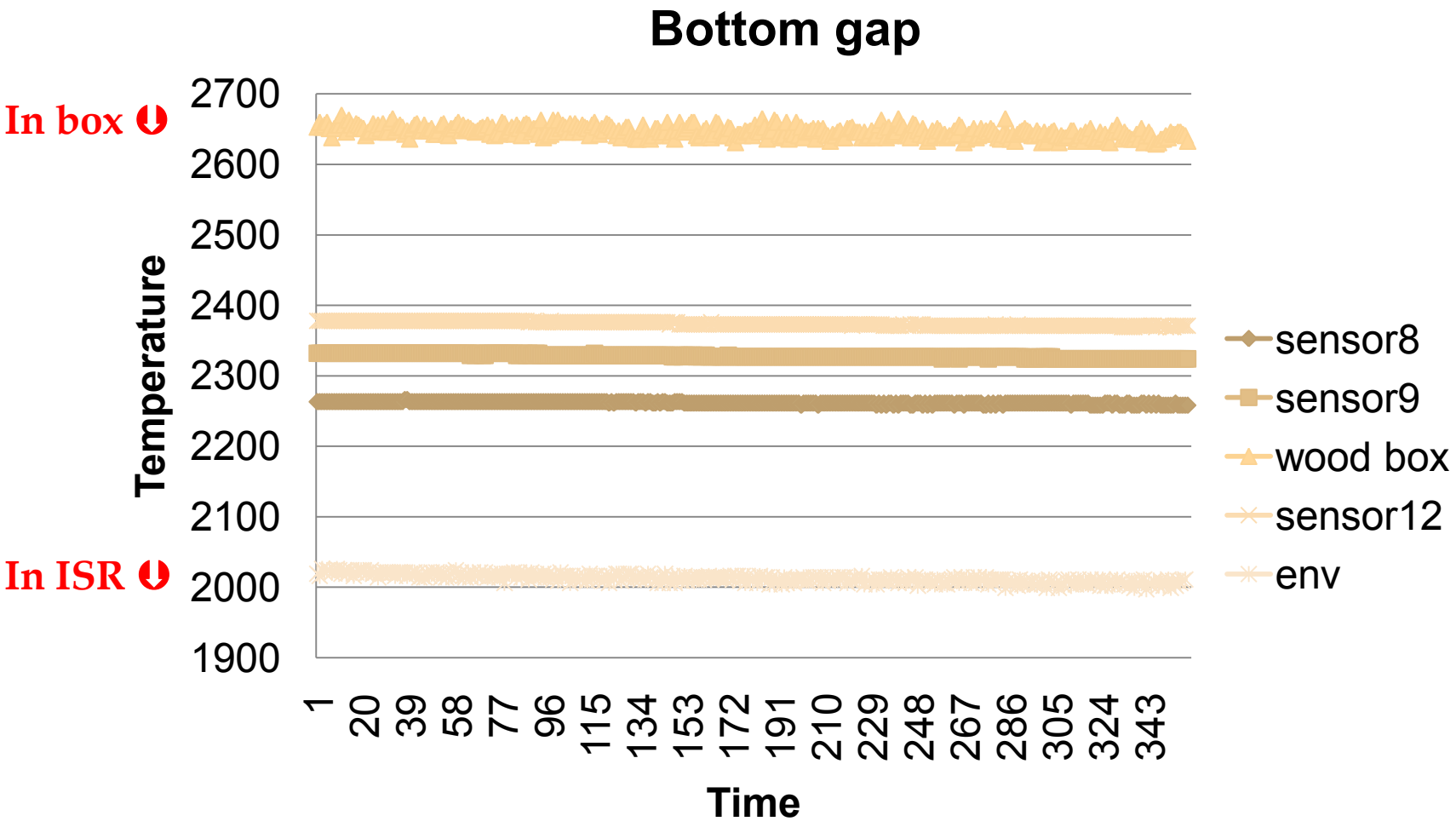
T sensor locations inside chamber



On top gap

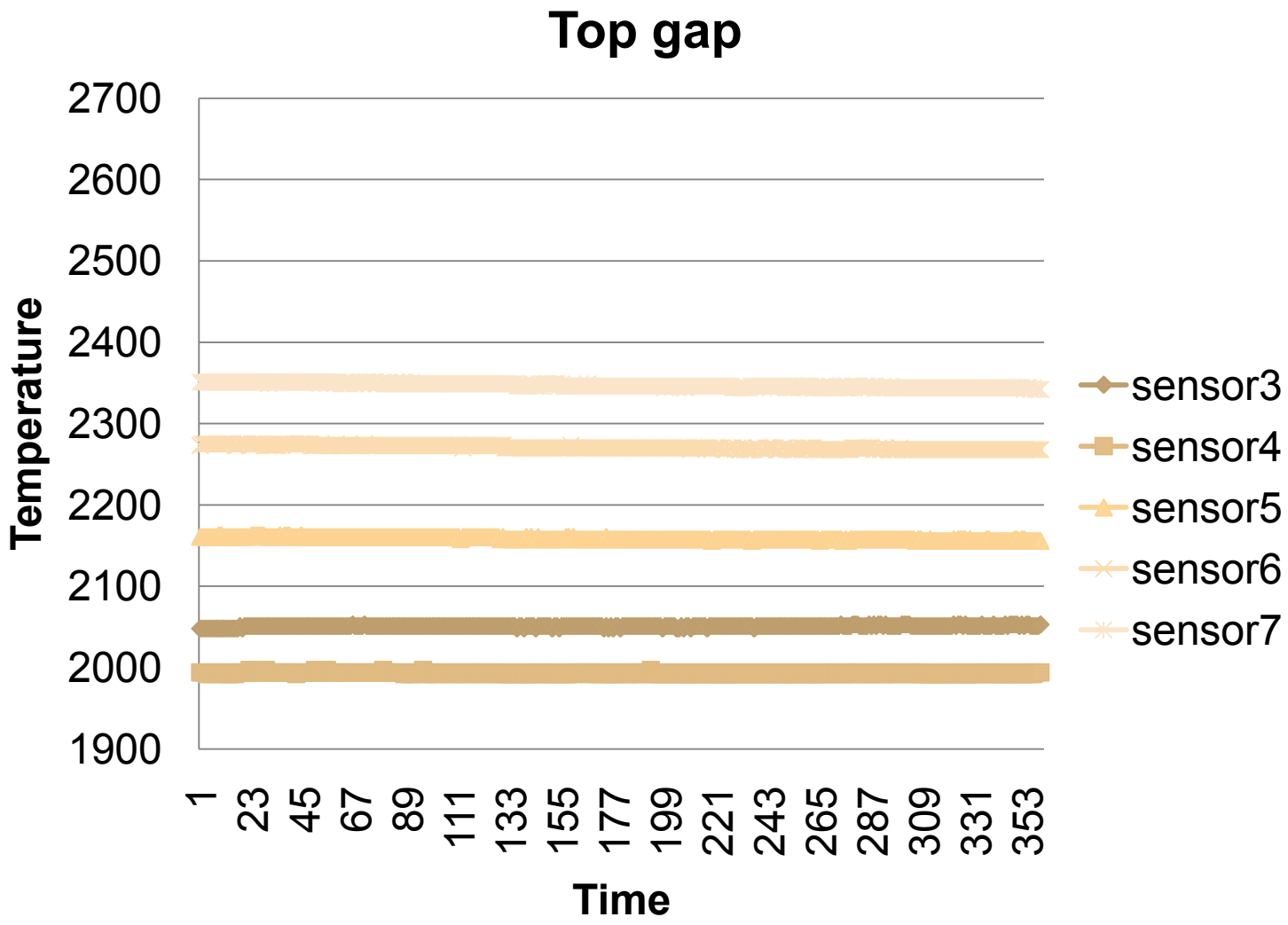
On bottom gap

Integration issues: Cooling % Results



Courtesy Yasser Assran

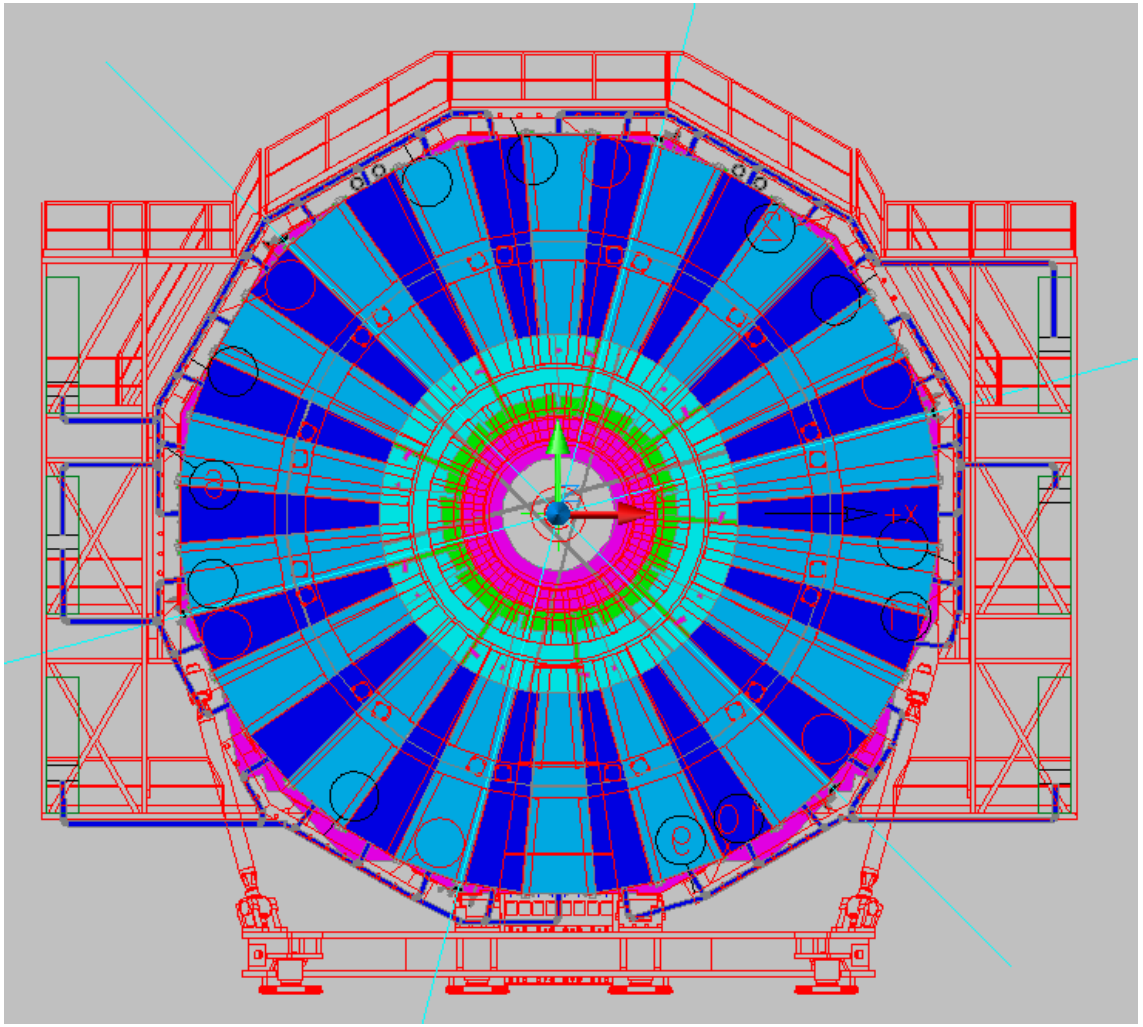
Integration issues: Cooling % Results



Courtesy Yasser Assran

Integration issues: Cabling Signal

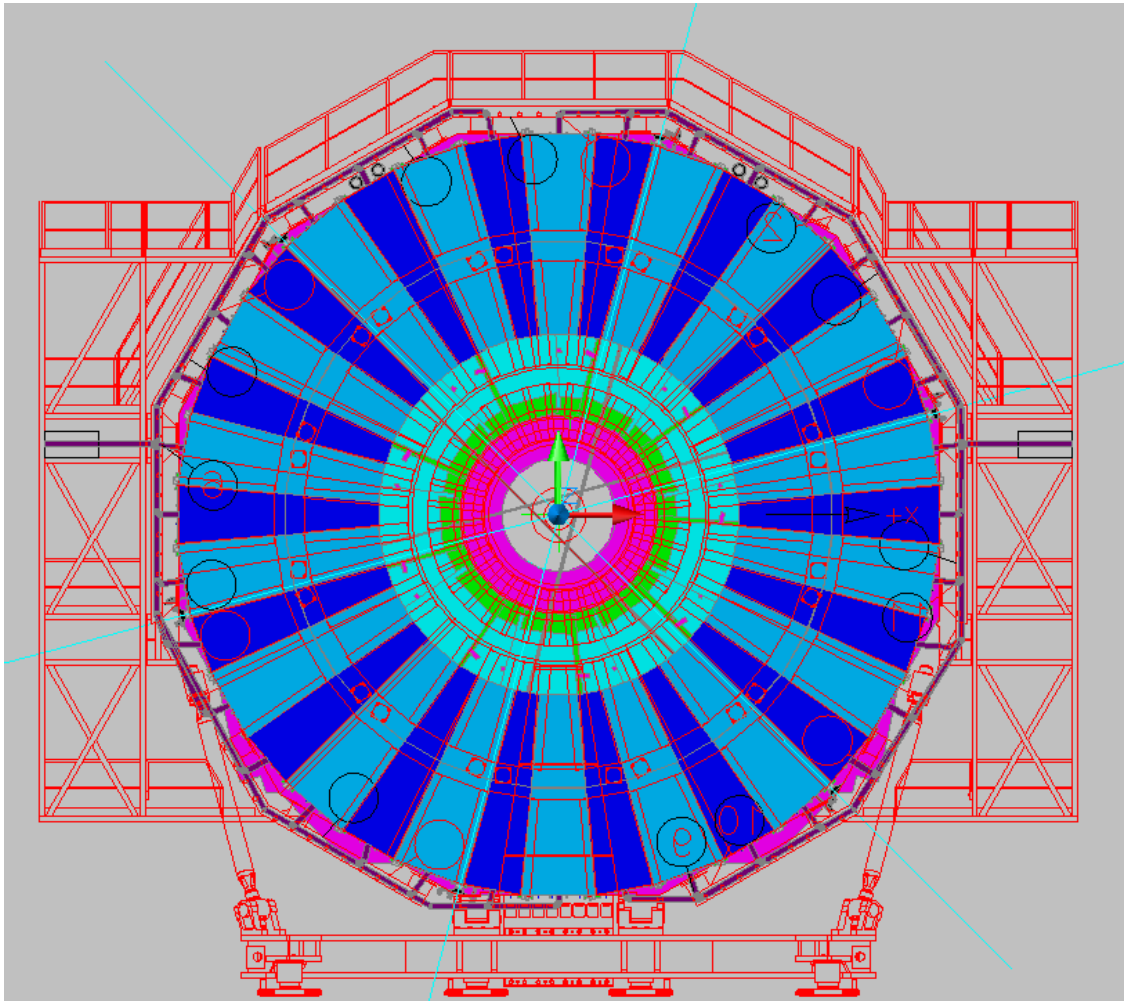
Position LBB to be agreed with CSC



Integration issues: Cabling
Signal cable lengths

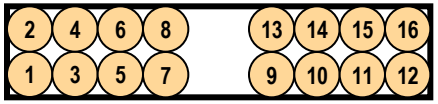
	A	B	C	D	E	F
1	**Chamber +end R3**	**L polyline**	**Xtra Z**	**Chamber +end R2**	**Xtra 2500**	
2						
3	RE4/3 1	3365	6365	RE4/2 1	8865	
4	RE4/3 2	2945	5945	RE4/2 2	8445	
5	RE4/3 3	4355	7355	RE4/2 3	9855	
6	RE4/3 4	5485	8485	RE4/2 4	10985	
7	RE4/3 5	5215	8215	RE4/2 5	10715	
8	RE4/3 6	6620	9620	RE4/2 6	12120	
9	RE4/3 7	7810	10810	RE4/2 7	13310	
10	RE4/3 8	9165	12165	RE4/2 8	14665	
11	RE4/3 9	10560	13560	RE4/2 9	16060	
12	RE4/3 10	11715	14715	RE4/2 10	17215	
13	RE4/3 11	11430	14430	RE4/2 11	16930	
14	RE4/3 12	10060	13060	RE4/2 12	15560	
15	RE4/3 13	8655	11655	RE4/2 13	14155	
16	RE4/3 14	7515	10515	RE4/2 14	13015	**Attention:**
17	RE4/3 15	6090	9090	RE4/2 15	11590	**Lengths are given for roll C**
18	RE4/3 16	4690	7690	RE4/2 16	10190	**Xtra required for roll B and A**
19	RE4/3 17	5190	8190	RE4/2 17	10690	
20	RE4/3 18	3800	6800	RE4/2 18	9300	
21	RE4/3 19	4200	7200	RE4/2 19	9700	
22	RE4/3 20	4165	7165	RE4/2 20	9665	
23	RE4/3 21	4235	7235	RE4/2 21	9735	
24	RE4/3 22	5410	8410	RE4/2 22	10910	
25	RE4/3 23	5910	8910	RE4/2 23	11410	
26	RE4/3 24	5600	8600	RE4/2 24	11100	
27	RE4/3 25	6790	9790	RE4/2 25	12290	
28	RE4/3 26	8155	11155	RE4/2 26	13655	
29	RE4/3 27	9605	12605	RE4/2 27	15105	
30	RE4/3 28	10800	13800	RE4/2 28	16300	
31	RE4/3 29	9420	12420	RE4/2 29	14920	
32	RE4/3 30	7975	10975	RE4/2 30	13475	
33	RE4/3 31	6720	9720	RE4/2 31	12220	
34	RE4/3 32	5480	8480	RE4/2 32	10980	
35	RE4/3 33	5780	8780	RE4/2 33	11280	
36	RE4/3 34	6835	9835	RE4/2 34	12335	
37	RE4/3 35	6055	9055	RE4/2 35	11555	
38	RE4/3 36	4745	7745	RE4/2 36	10245	
39						
40	**Total**	242545	350545		440545	
41	**Required length(*6)**		2103270		2643270	
42						
43	**Total + end**				**4746540**	
44						

Integration issues: Cabling HV

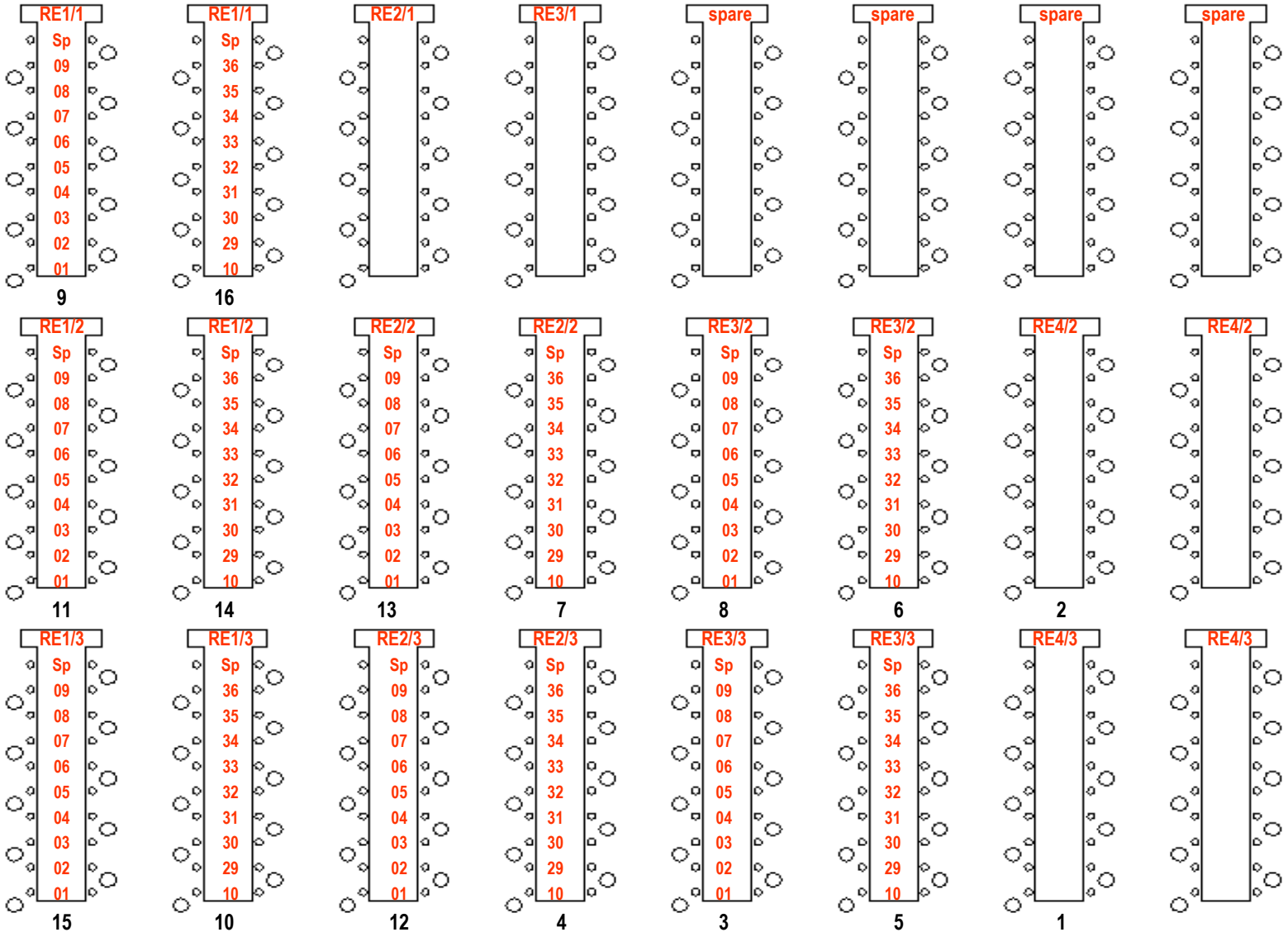


RE YE+1 Near (+x) HV PP as seen from IP

Cables in back of rack



PP in UXC



Integration issues: Cabling HV

- HV patch panels on YE1 includes ENTIRE TDR system (hi+lo η)
- HV ombilical include high eta ⇩ enough for RE4 low eta

⇩

No need to open YE1 main cable chains !

Summary and conclusions

- RE4 low eta chamber design ready
- PTY assembly exercise done in ISR with all teams involved
  - Mechanics validated and being produced (China)
  - Assembly procedures established
- Full set of signed off drawings on web sides:

https://rpc-cms-re4-upscope.web.cern.ch/rpc-cms-re4-upscope/RPC/Chamber%20production/Components/Mechanics/LucDrawings/REtype3/29April2011/

https://rpc-cms-re4-upscope.web.cern.ch/rpc-cms-re4-upscope/RPC/Chamber%20production/Components/Mechanics/LucDrawings/REtype2/29April2011/

- Only 2 chambers in gas desy chain (instead of 6)
- Improved cooling circuit to ALSO cool the chamber itself
- Backward compatibility stations 2 & 3 maintained (spares!)
- Cabling layout and lengths being determined
- Assembly sites (India,Ghent) ready by summer; CERN 904 by fall ?

The RE4 upgrade project is well on its way
Mainly awaiting the order of the Bakelite