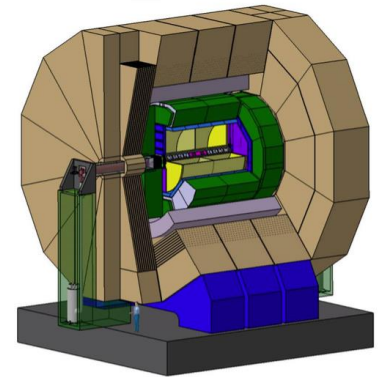


Ideas on TPC Assembly



Volker Prahl,
Thomas Schörner-Sadenius
Paris, 8/9 October 2015



Outline

Some basic considerations

Horizontal / vertical TPC assembly (in the AH?)

A first shot at the various possible TPC project plans

TPC insertion in the DH

Some basic assumptions – all to be argued

No (long) transport of full TPC, field cage or fully equipped end-plates → need to assemble TPC at IP campus

- Our assumption here: TPC assembly in the AH. Compatible with Yasuhiro's overall plan assuming realistic TPC time scales?
- Then space in AH necessary
- Do it in research office building? But then where full TPC system test (gas!)?
- No TPC assembly in DH.

No TPC assembly in DH – sufficient space and possibility to work in parallel with yoke construction, but probably bad timeslot?

Current scenario therefore:

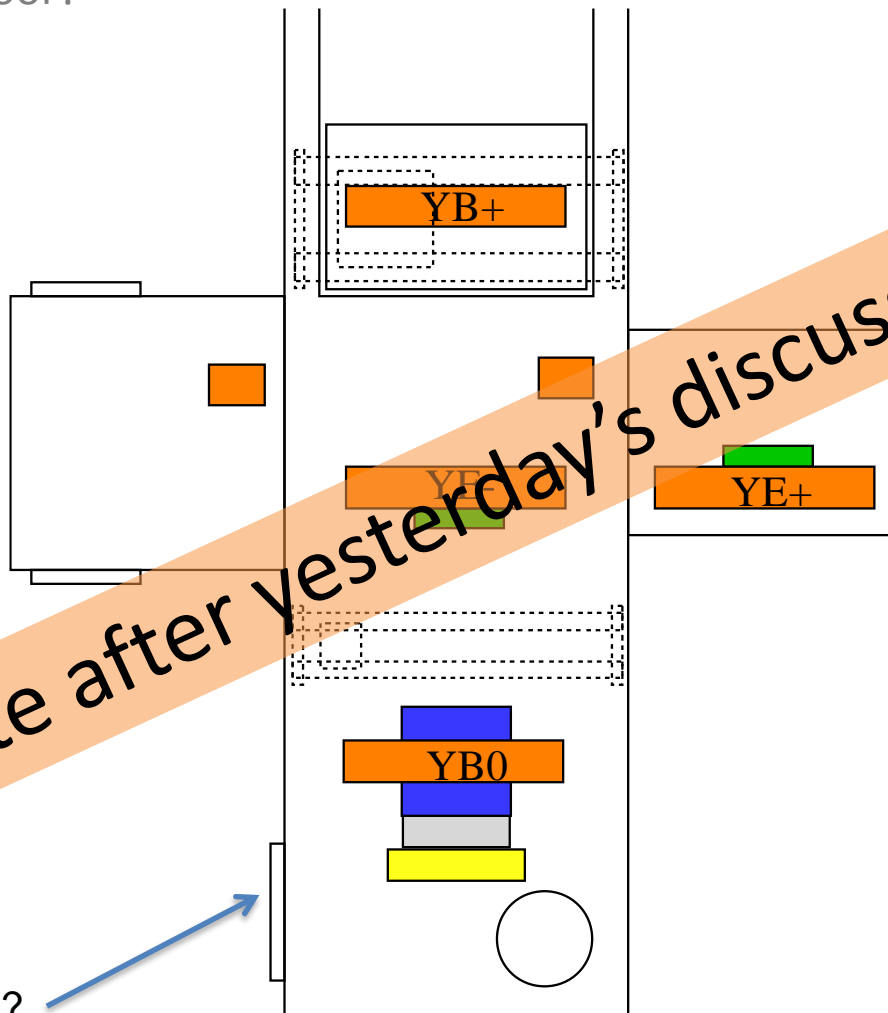
- Horizontal or vertical assembly in AH hall (exact position tbd)
- Space requirement: 100 m² (probably 60 m² enough, but some contingency), plus storage space (for modules) and test area for modules
- Field cage delivered in one or two big pieces and assembled in AH
- Necessity to create grey-room / ISO7 characteristics around TPC assembly place

Location in AH (from Yasuhiro's yoke assembly plan)

TPC Assembly
horizontal - long

Questions:

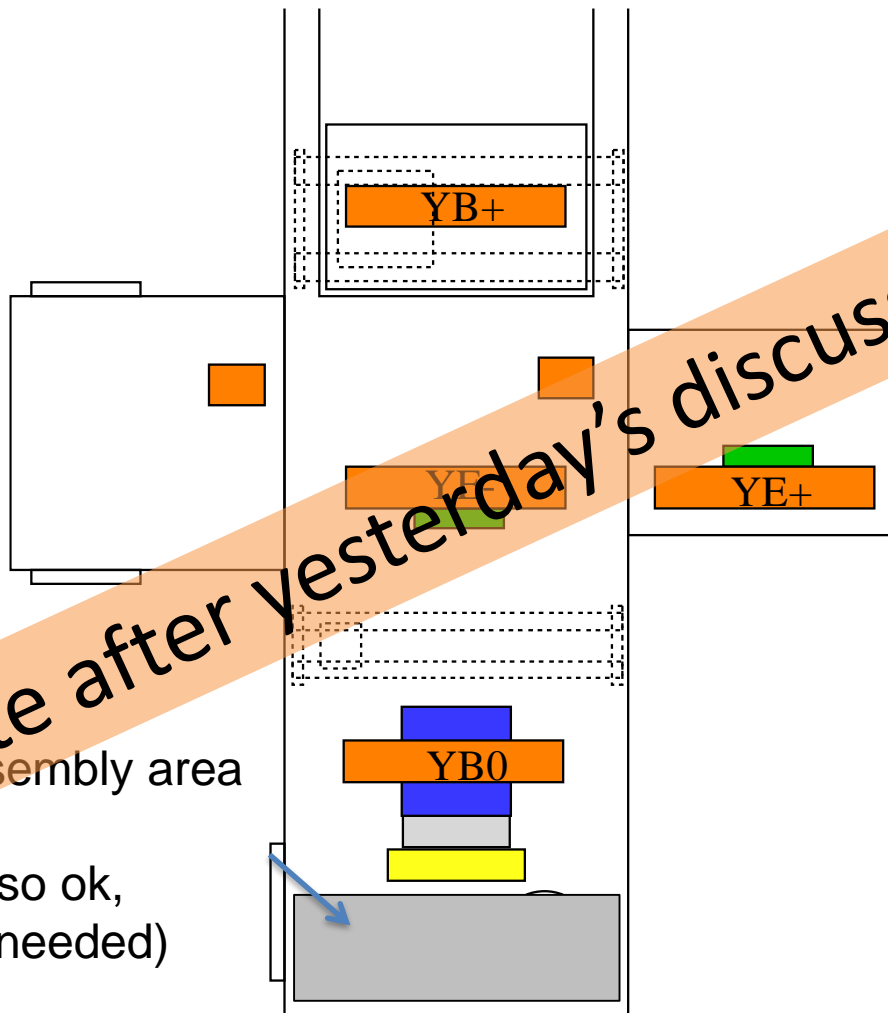
- Grey-room quality after delivery of field cage and mounted end-plates?
- Position of large door?



Door position?

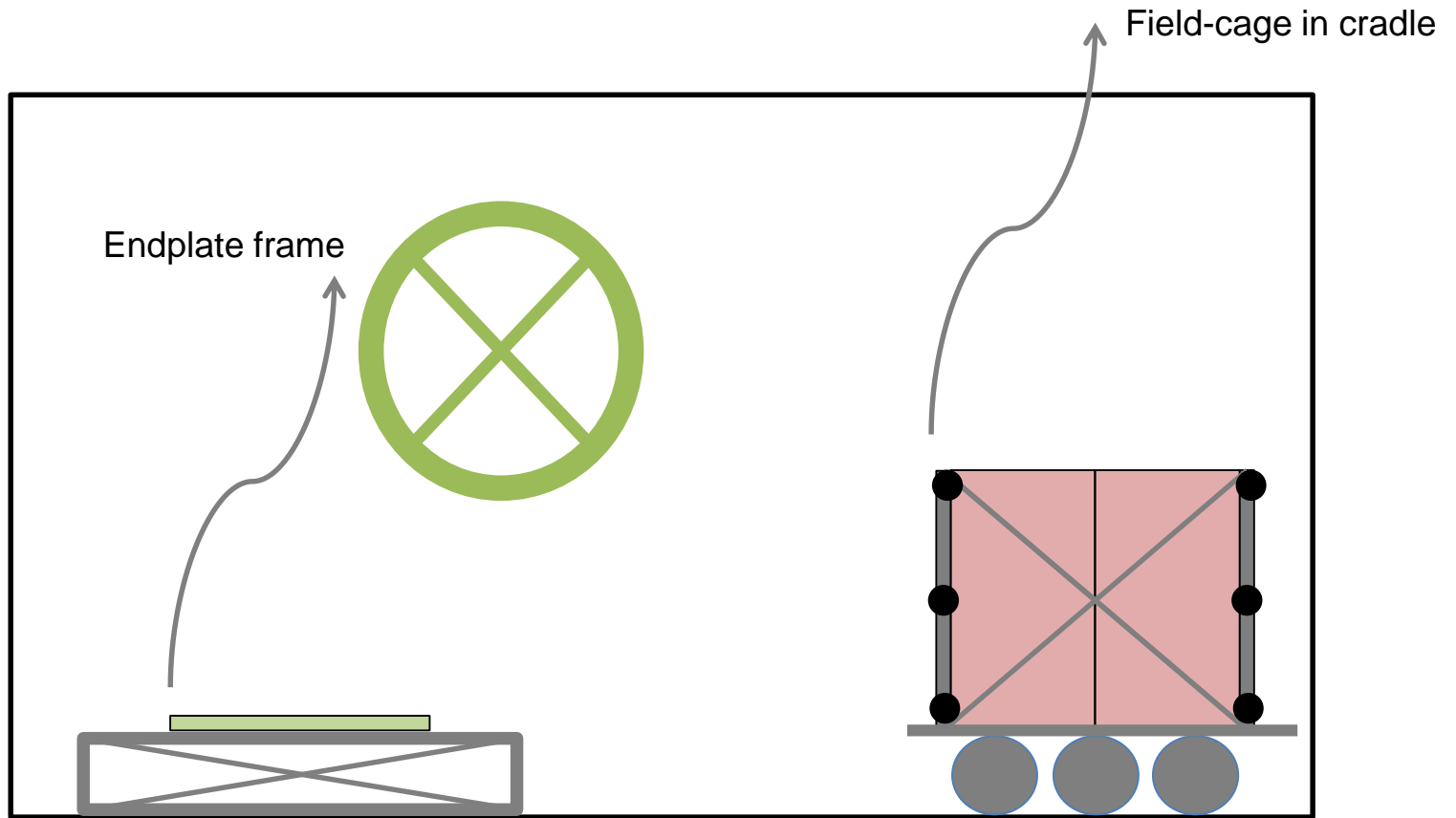
Location in AH (from Yasuhiro's yoke assembly plan)

TPC Assembly
horizontal - long

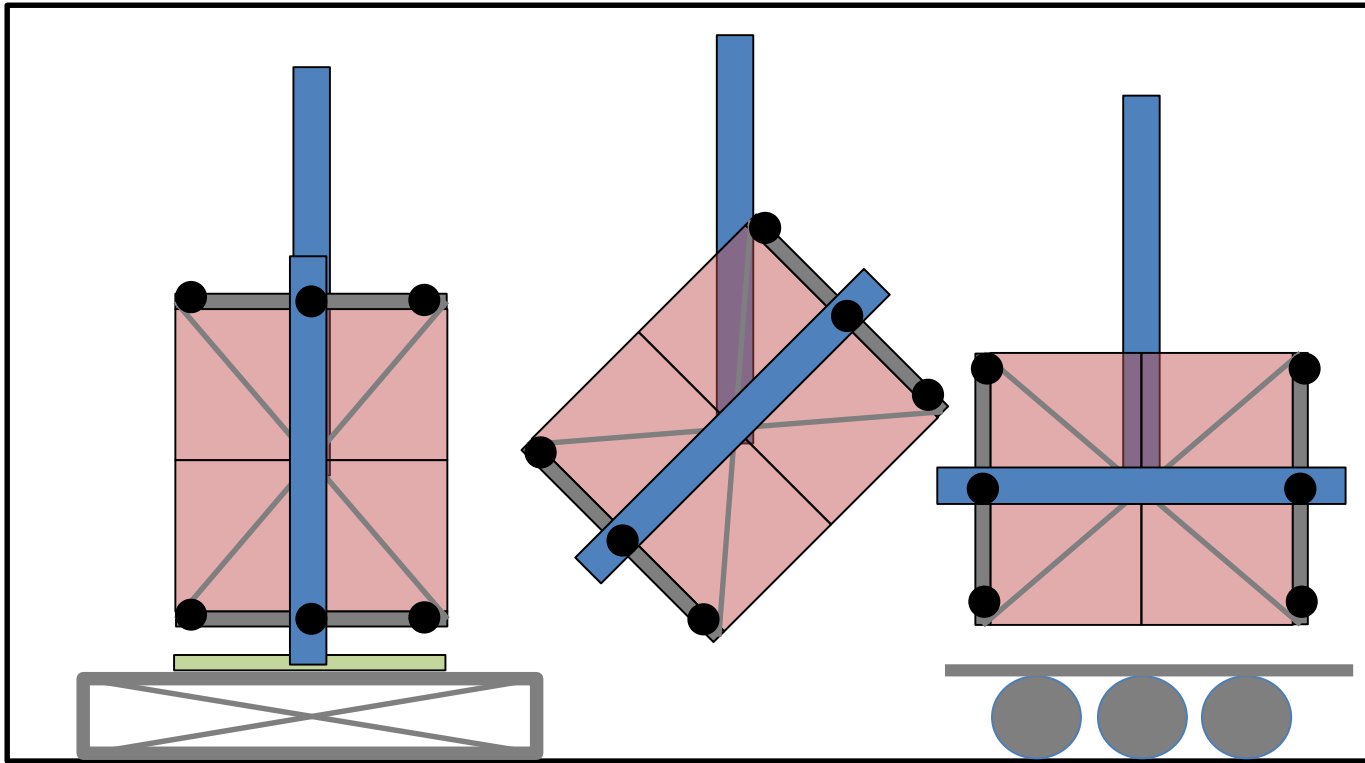


Possible TPC assembly area
approx 25x8 m²
(half the length also ok,
greyroom / ISO7 needed)

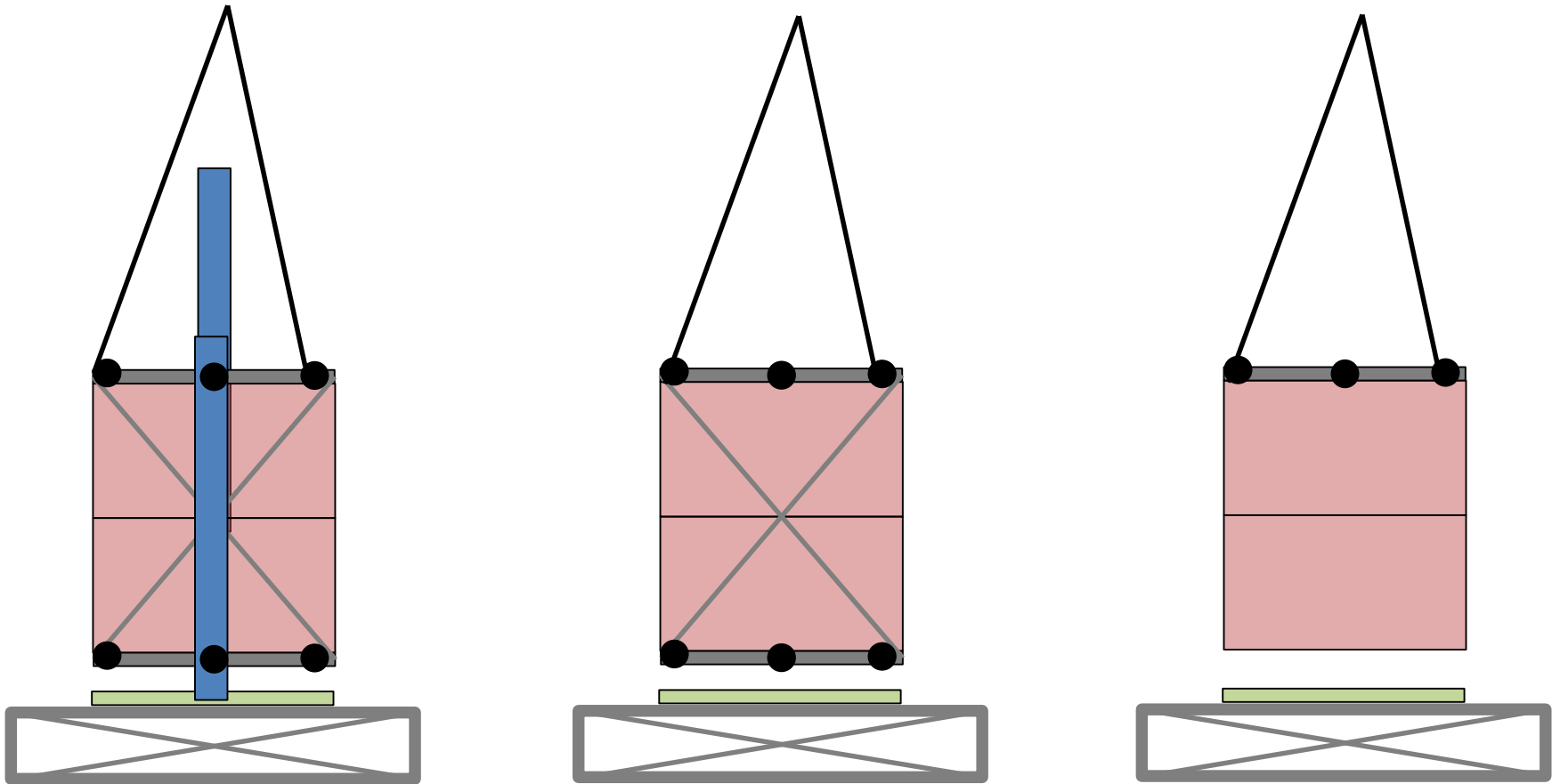
Vertical procedure in a few steps



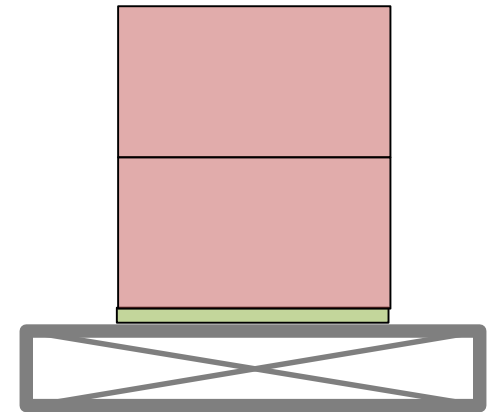
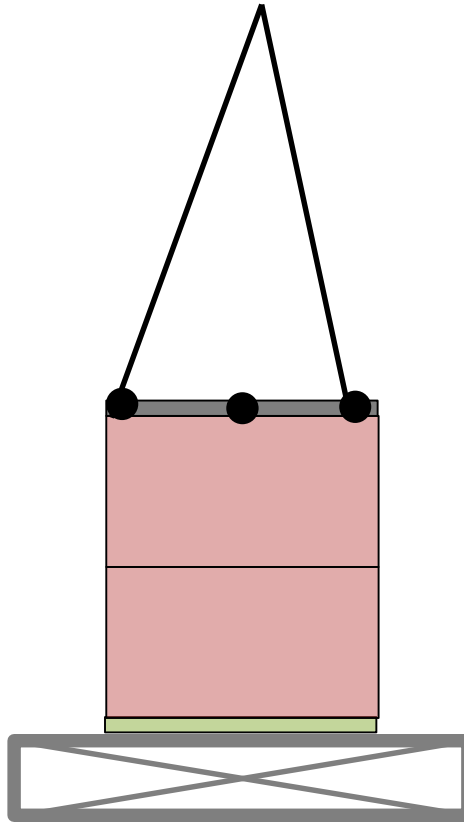
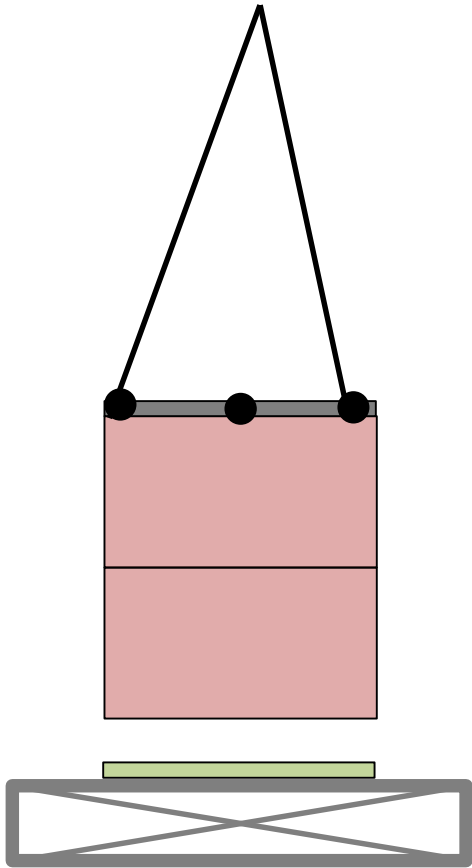
Vertical procedure in a few steps



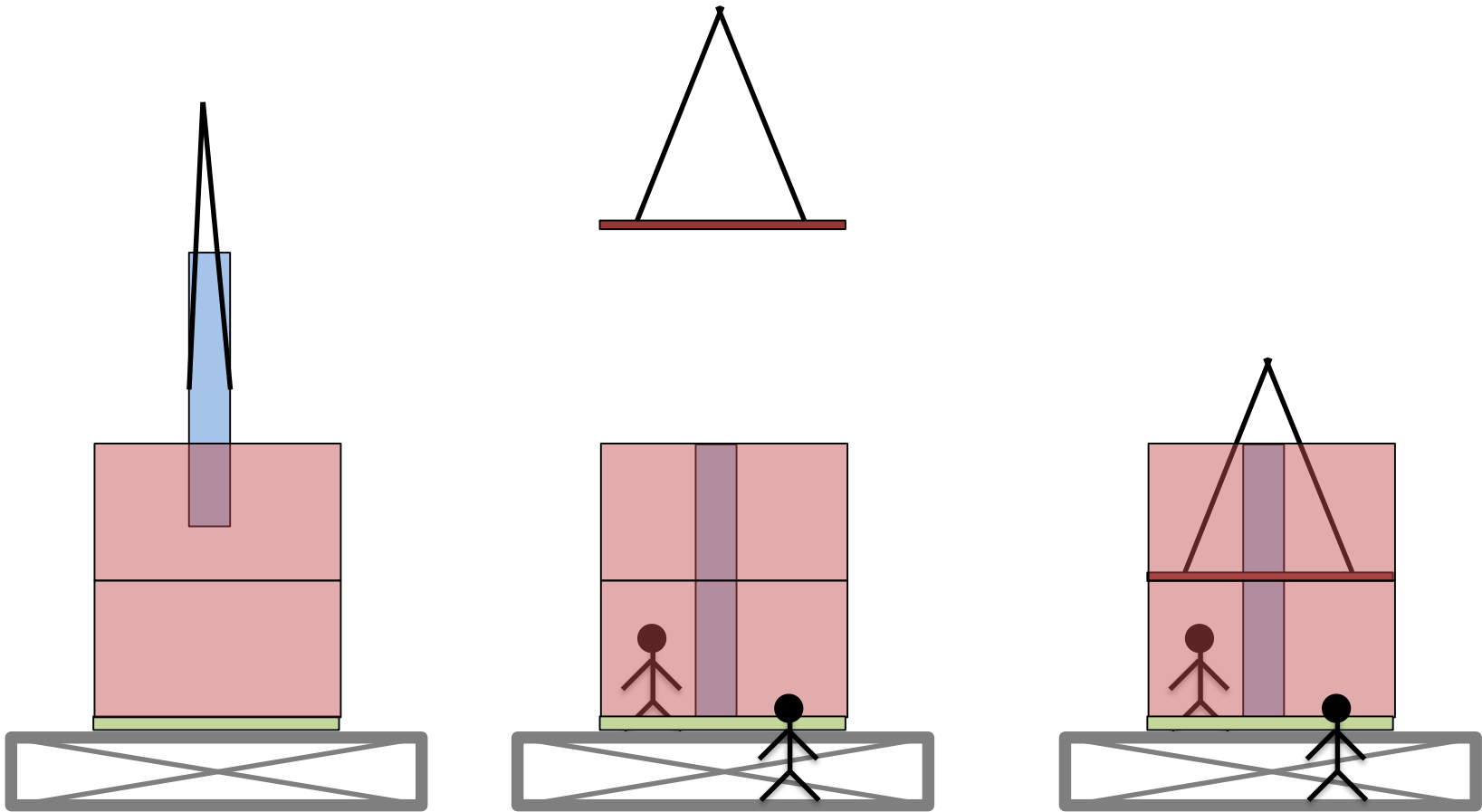
Vertical procedure in a few steps



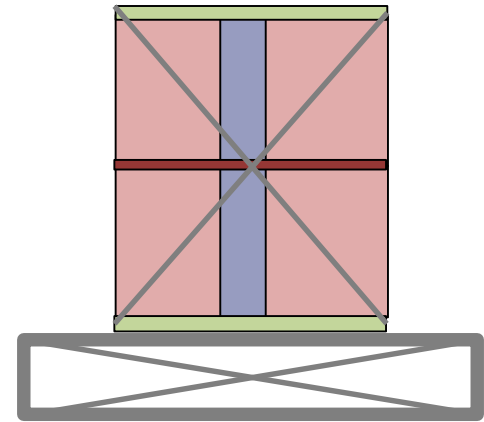
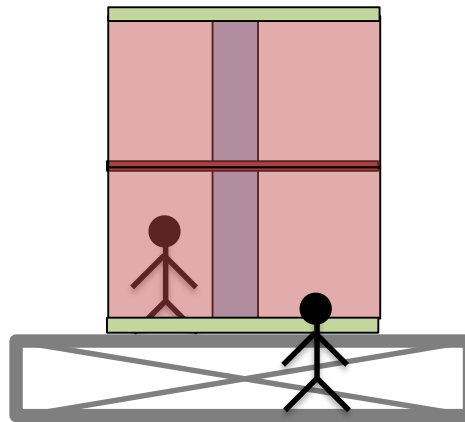
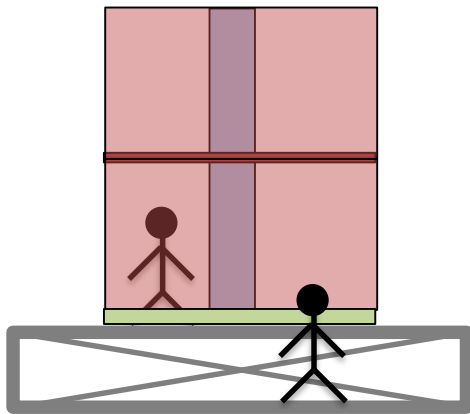
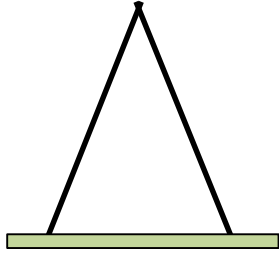
Vertical procedure in a few steps



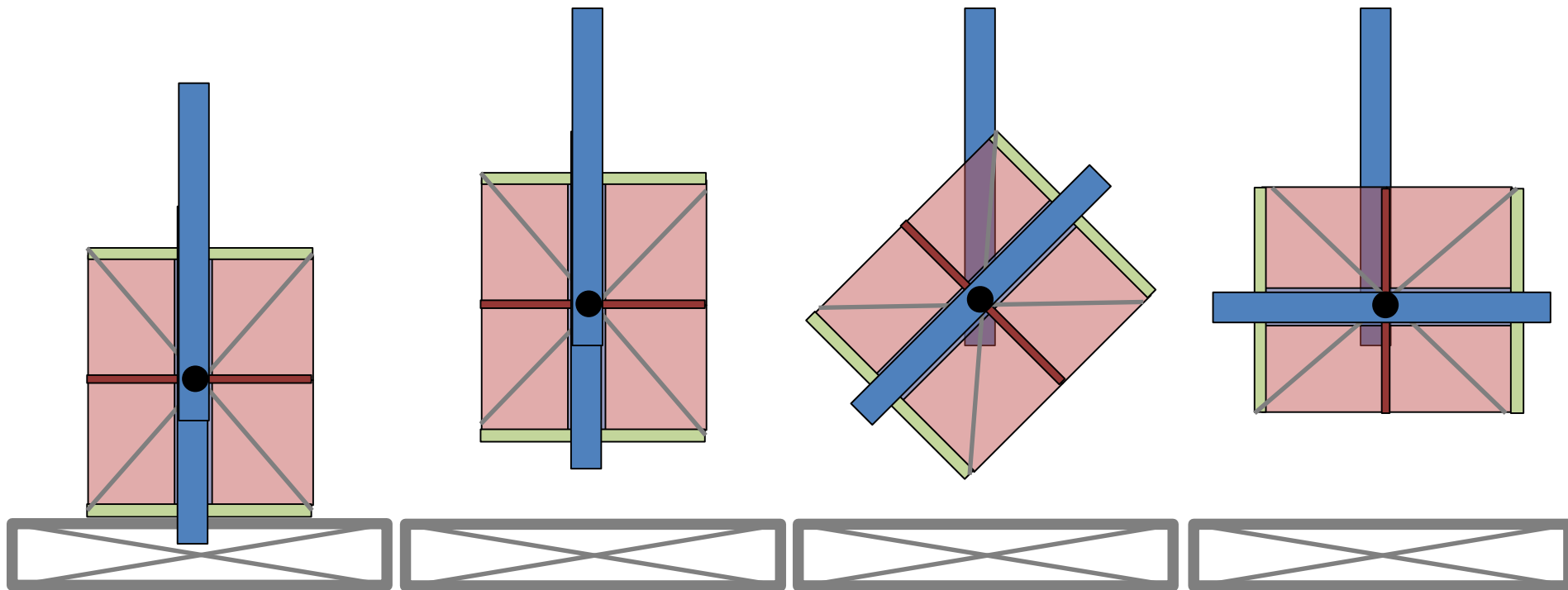
Vertical procedure in a few steps



Vertical procedure in a few steps



Vertical procedure in a few steps

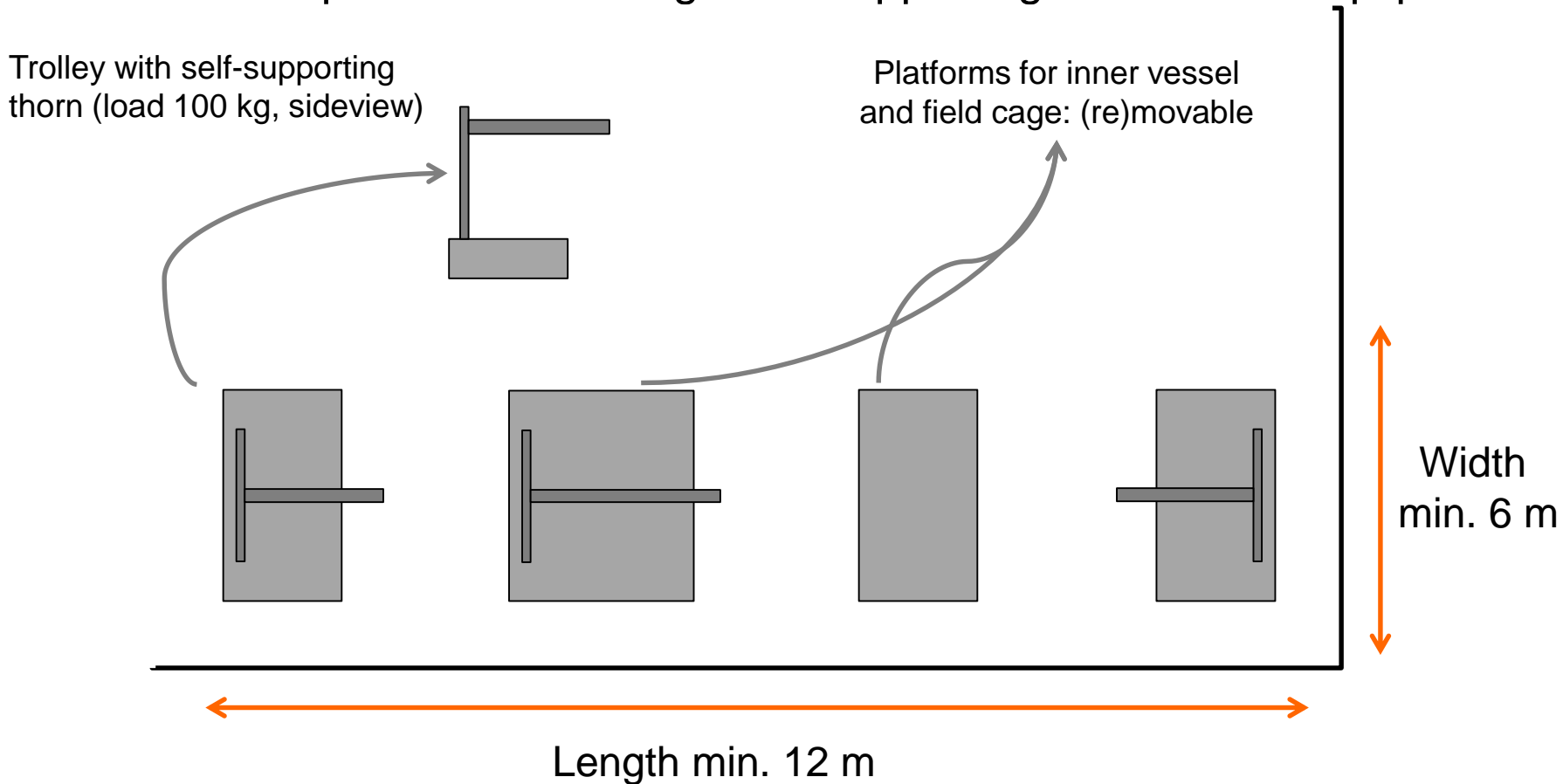


Then

- Cleaning of field cage
- Construction of grey/clean room around TPC field cage (ISO 7)
- Equipping of end-plates with tested modules using robot (petal-like structures in EP quadrant holes).
- System test (in AH)

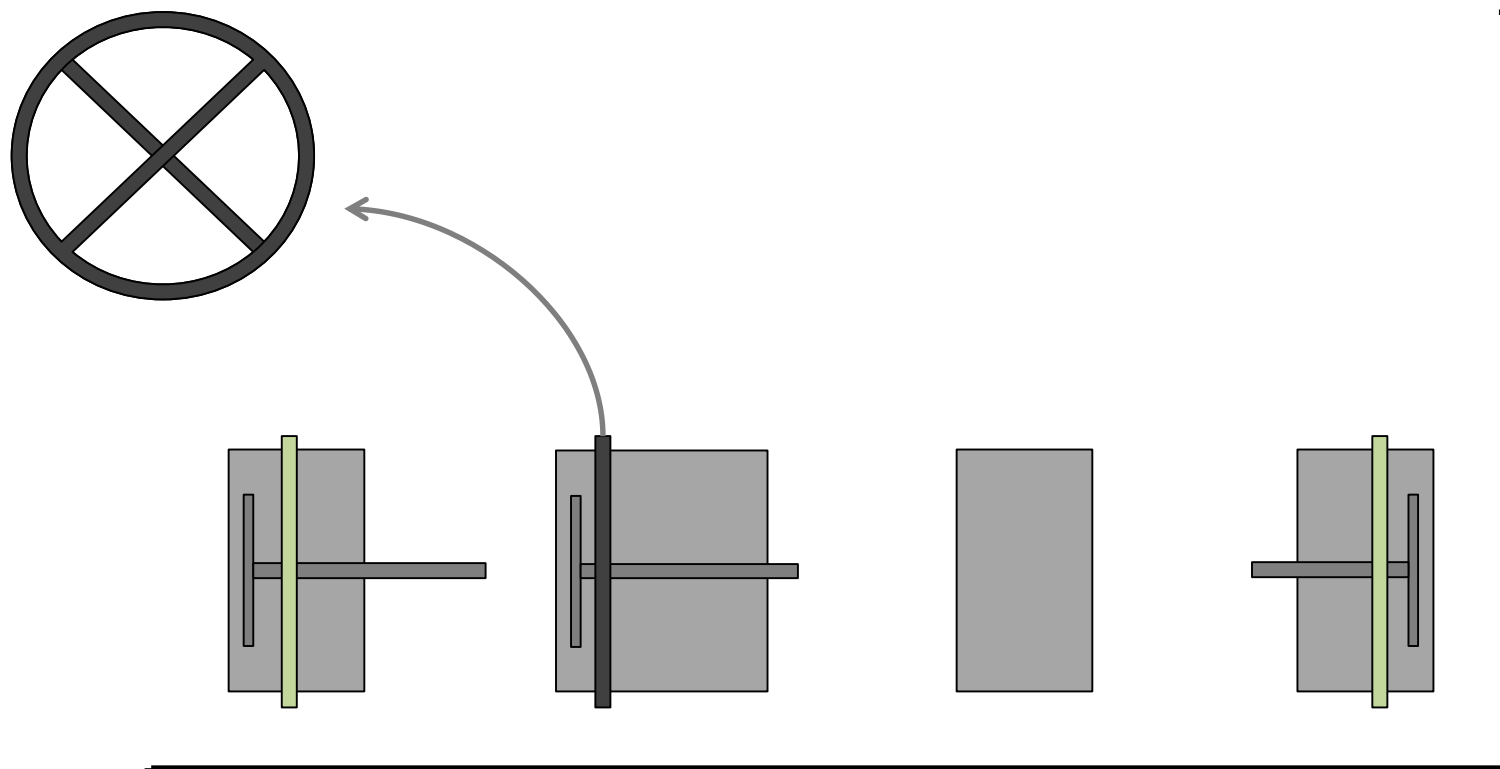
Horizontal procedure in a few steps

- Note:
- Greyroom / ISO7 with stable T and FFUs needed from start.
 - Access to greyroom through sliding gate with air lock
 - Assumption that field cage self-supporting and first EP equipment



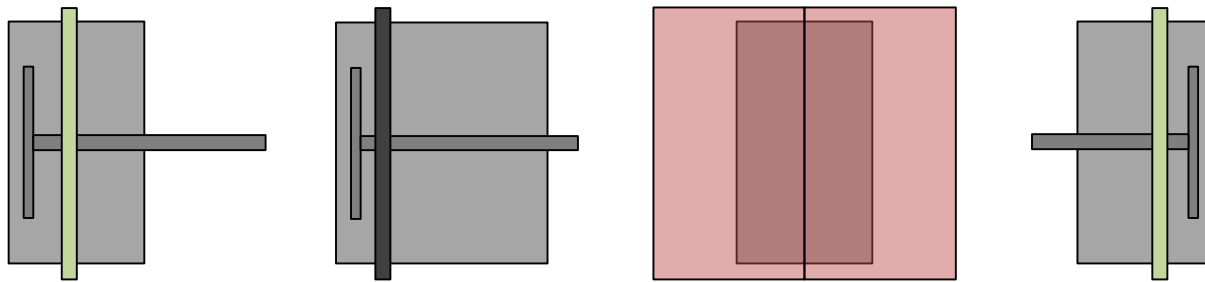
Horizontal procedure in a few steps

End-plate structures on trolleys and beginning of end-plate equipping (R); supporting star on inner-vessel platform



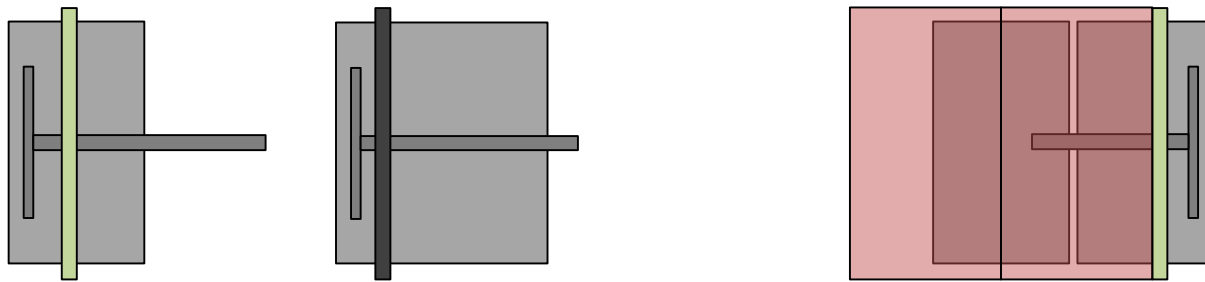
Horizontal procedure in a few steps

Field-cage assembly



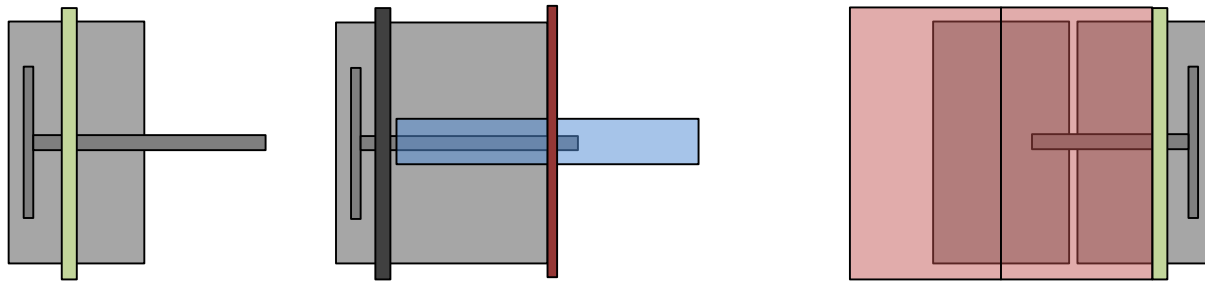
Horizontal procedure in a few steps

Marriage of field-cage and end-plate R



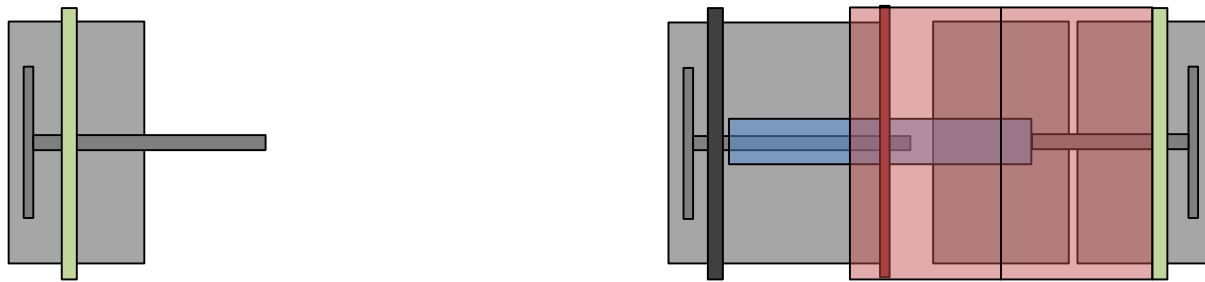
Horizontal procedure in a few steps

Set-up of inner vessel with cathode (“sail”)



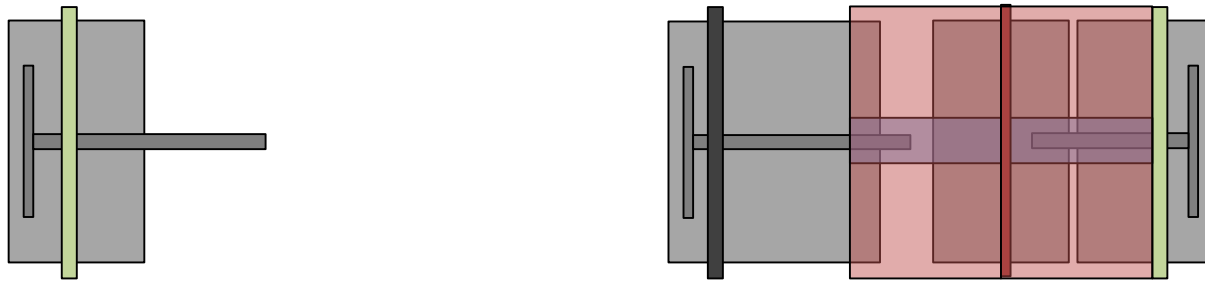
Horizontal procedure in a few steps

Marriage of inner vessel with cathode and field cage



Horizontal procedure in a few steps

Marriage of inner vessel with cathode and field cage

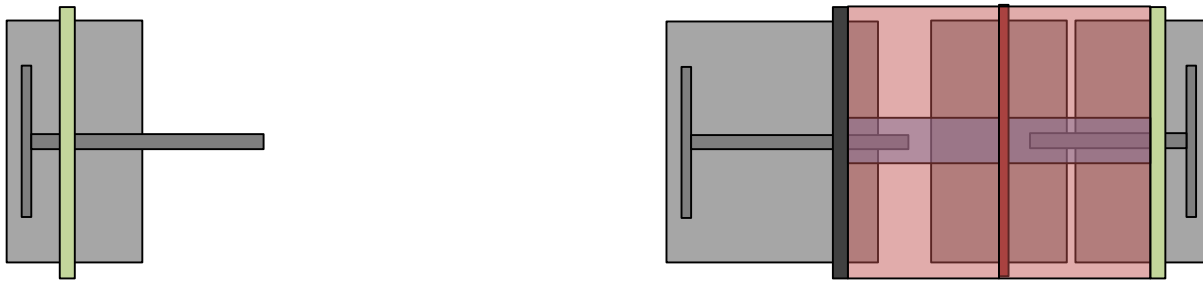


Alternative: First fixing of inner vessel in field cage,
then installation / spanning of cathode.

Horizontal procedure in a few steps

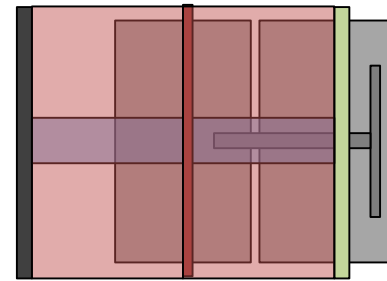
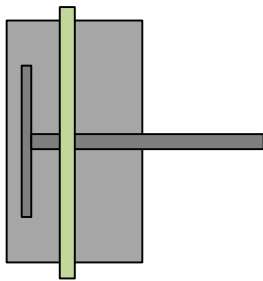
Marriage of inner vessel with cathode and field cage.

Fixing the supporting “star” supporting the inner vessel and the sail



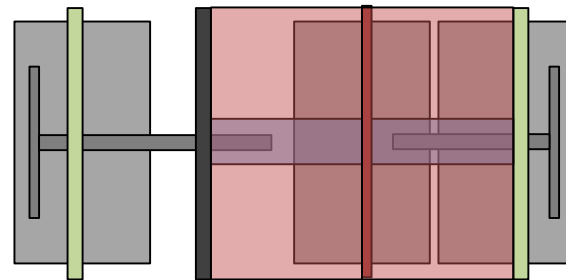
Horizontal procedure in a few steps

Removing inner-vessel platform and finalisation of end-plate L



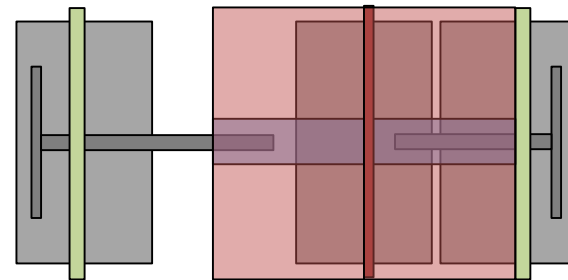
Horizontal procedure in a few steps

Inserting end-plate L: approaching the field cage ...



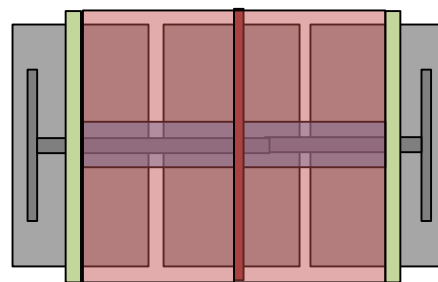
Horizontal procedure in a few steps

Inserting end-plate L: approaching the field cage, supporting the inner vessel and removing the supporting star, ...



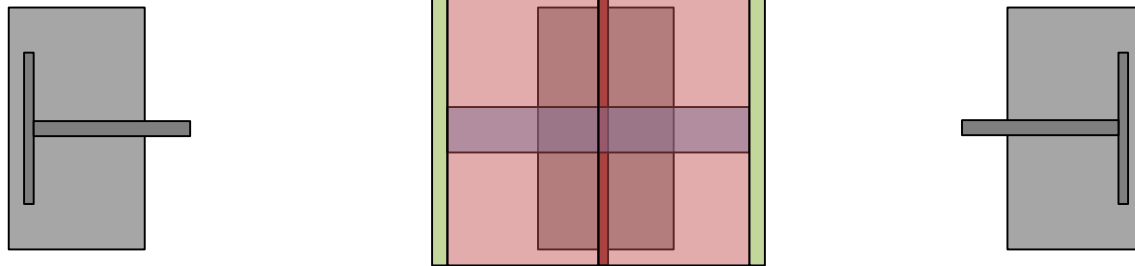
Horizontal procedure in a few steps

Inserting end-plate L: approaching the field cage, supporting the inner vessel + removing the supporting star, pushing in end-plate L



Horizontal procedure in a few steps

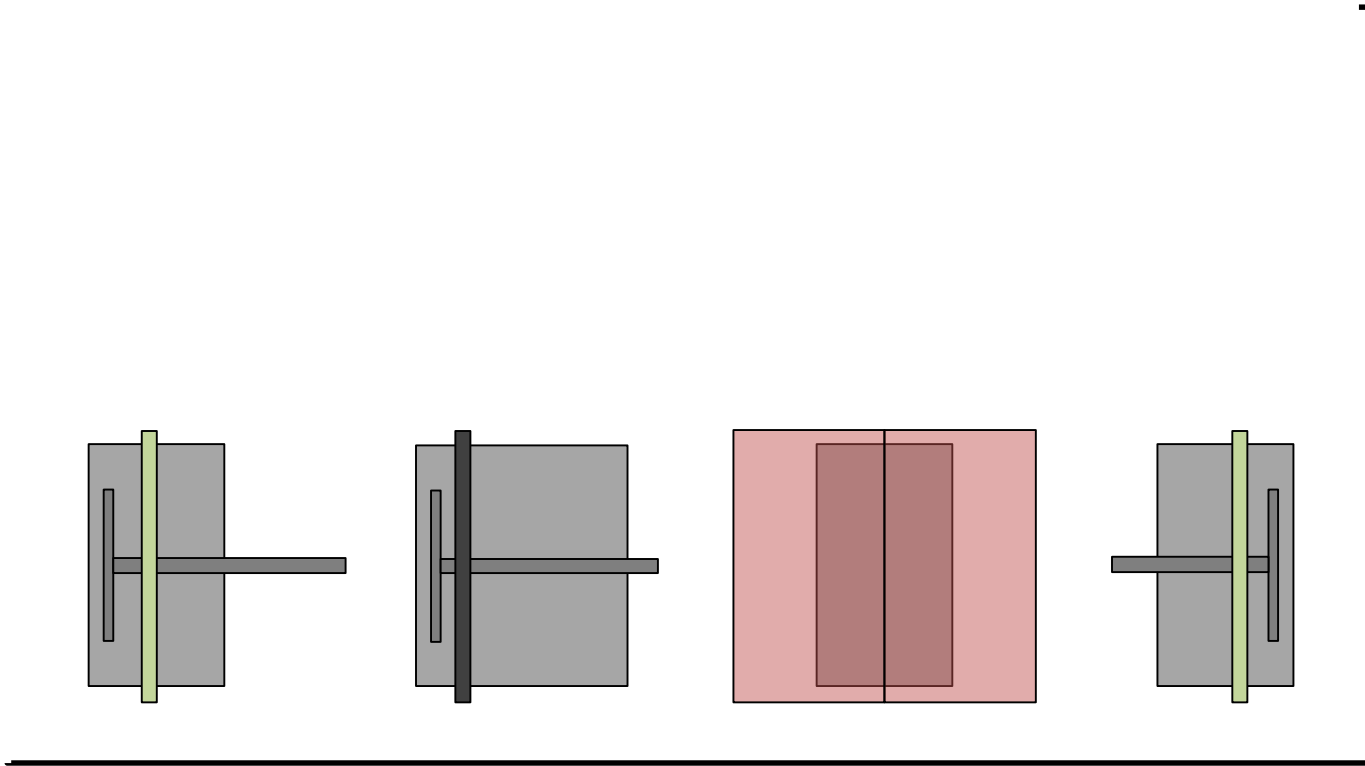
Ready



Alternative horizontal procedure

Assumptions: Similar as before, but ...

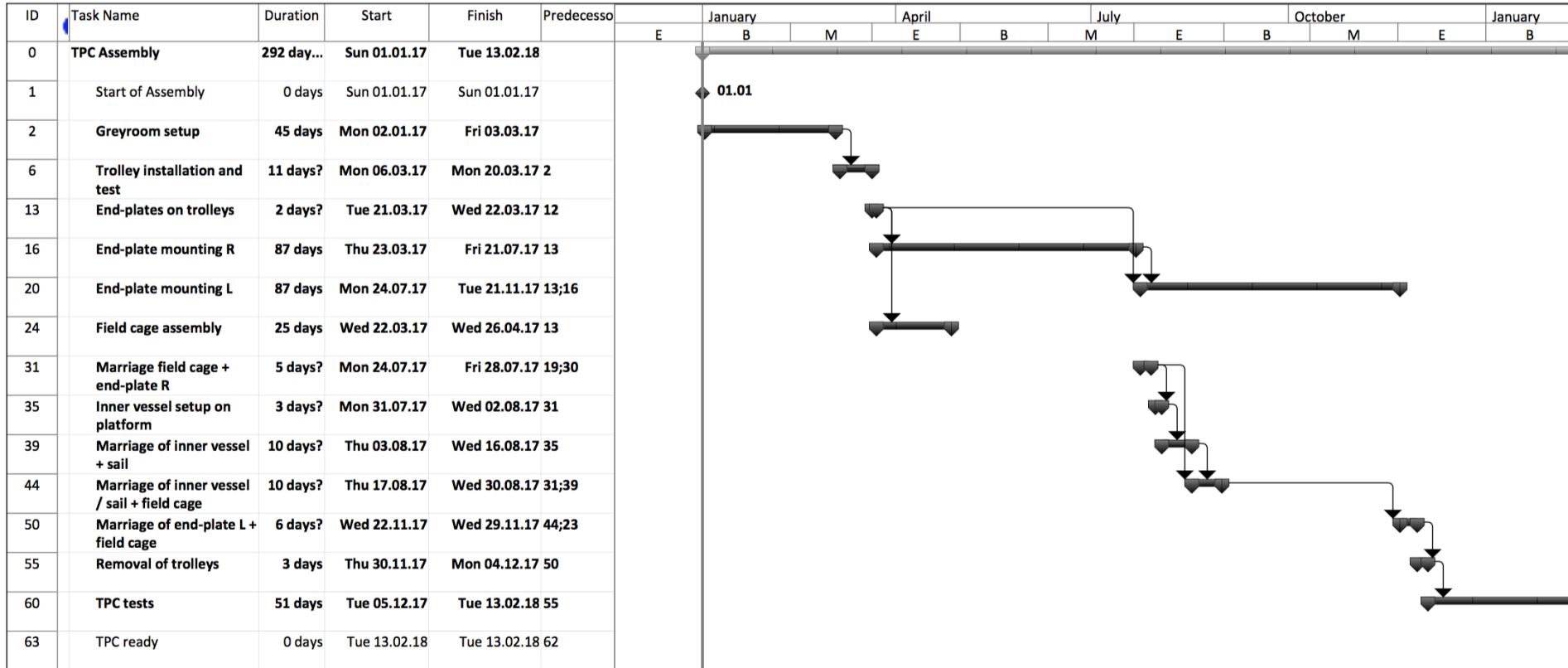
- EP equipment at the end with robot
- Question of overall time planning (end-plate equipment the most time-consuming item)



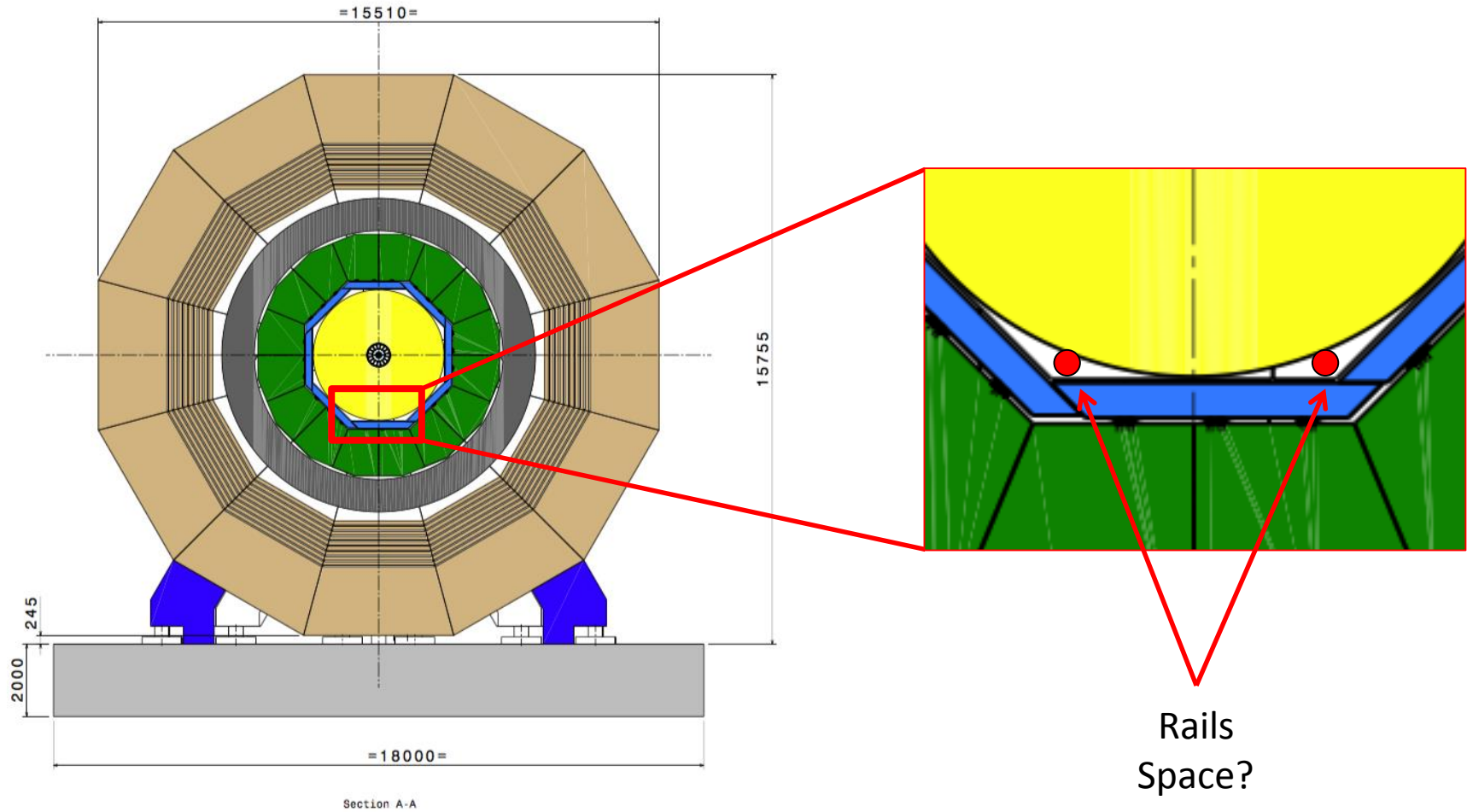
Vertical procedure – time estimate

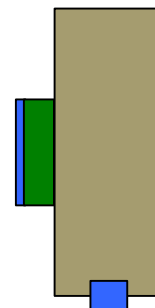
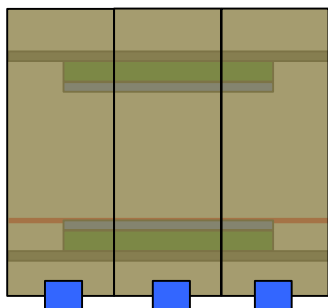
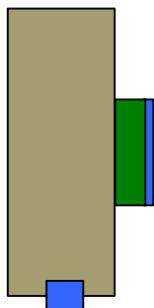
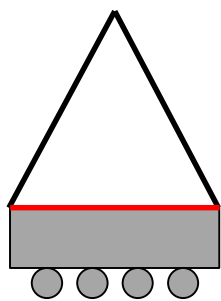
ID	Task Name	Duration	Start	Finish	Predecessor	Resource Names	Timeline											
							January	April	July	October								
							E	B	M	E	B	M	E	B	M	E		
0	TPC Assembly	254 day...	Sun 01.01.17	Thu 21.12.17			[Gantt bar spanning from Sun 01.01.17 to Thu 21.12.17]											
1	Platform setup	0 days	Sun 01.01.17	Sun 01.01.17			[Task bar from Sun 01.01.17 to Sun 01.01.17]											
2	End-plate delivery	0 days	Sun 01.01.17	Sun 01.01.17			[Task bar from Sun 01.01.17 to Sun 01.01.17]											
3	Inner vessel delivery	0 days	Sun 01.01.17	Sun 01.01.17			[Task bar from Sun 01.01.17 to Sun 01.01.17]											
4	Field cage delivery to hall	0 days	Sun 01.01.17	Sun 01.01.17			[Task bar from Sun 01.01.17 to Sun 01.01.17]											
5	Module testing	70 days	Mon 02.01.17	Fri 07.04.17			[Gantt bar from Mon 02.01.17 to Fri 07.04.17]											
8	Placing field cage on end-plate	5 days?	Mon 02.01.17	Fri 06.01.17	1;2;4		[Task bar from Mon 02.01.17 to Fri 06.01.17]											
14	Installation of inner vessel	1 day?	Mon 09.01.17	Mon 09.01.17	8		[Task bar from Mon 09.01.17 to Mon 09.01.17]											
16	Installation of cathode	1 day?	Tue 10.01.17	Tue 10.01.17	14		[Task bar from Tue 10.01.17 to Tue 10.01.17]											
18	Installation of top end-plate	3 days?	Wed 11.01.17	Fri 13.01.17	16		[Task bar from Wed 11.01.17 to Fri 13.01.17]											
22	Cleaning and greyroom installation	21 days	Mon 16.01.17	Mon 13.02.17	18		[Task bar from Mon 16.01.17 to Mon 13.02.17]											
25	Cabling of field cage, inner vessel and cathode	12 days	Tue 14.02.17	Wed 01.03.17	22		[Task bar from Tue 14.02.17 to Wed 01.03.17]											
28	Installation of Modules	160 days	Thu 02.03.17	Wed 11.10.17	25;6		[Gantt bar from Thu 02.03.17 to Wed 11.10.17]											
31	Final test of TPC	51 days	Thu 12.10.17	Thu 21.12.17	28		[Task bar from Thu 12.10.17 to Thu 21.12.17]											
34	TPC ready	0 days	Thu 21.12.17	Thu 21.12.17	31		[Task bar from Thu 21.12.17 to Thu 21.12.17]											

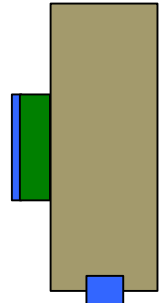
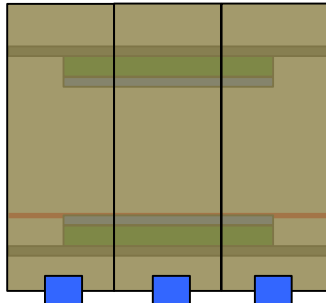
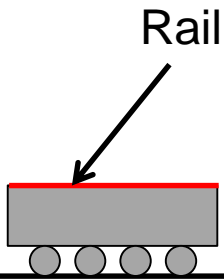
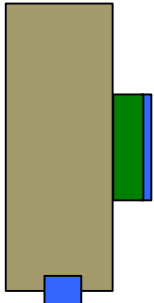
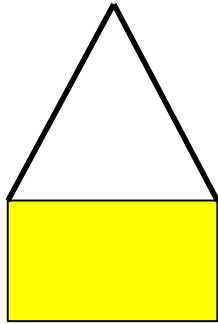
Horizontal procedure – time estimate

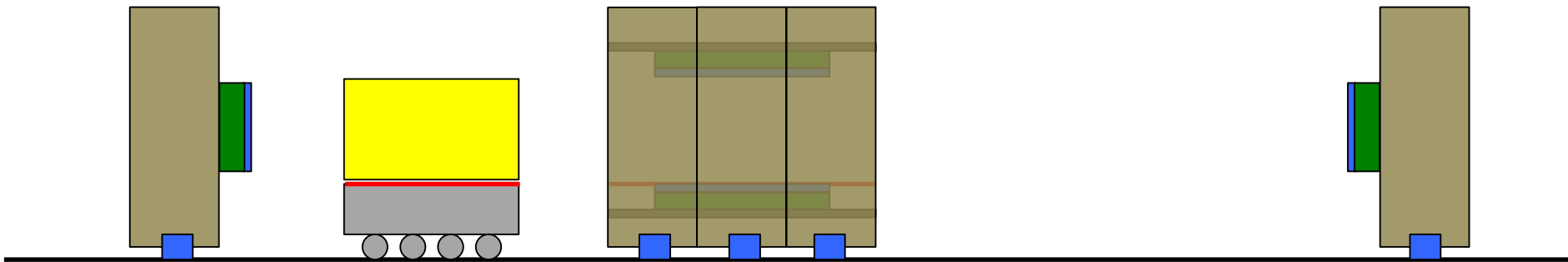


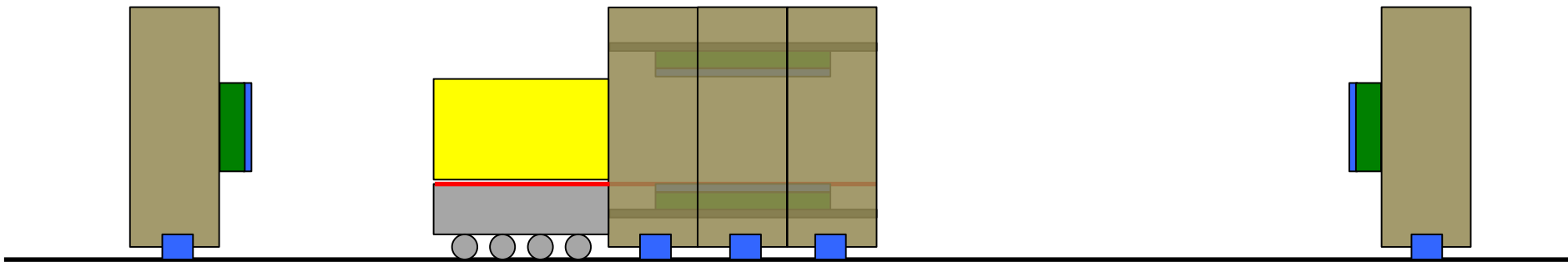
TPC insertion – mechanism?

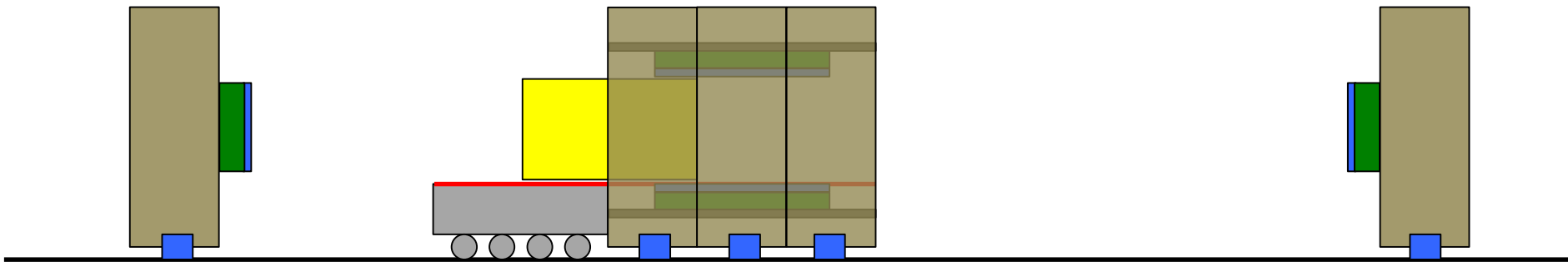


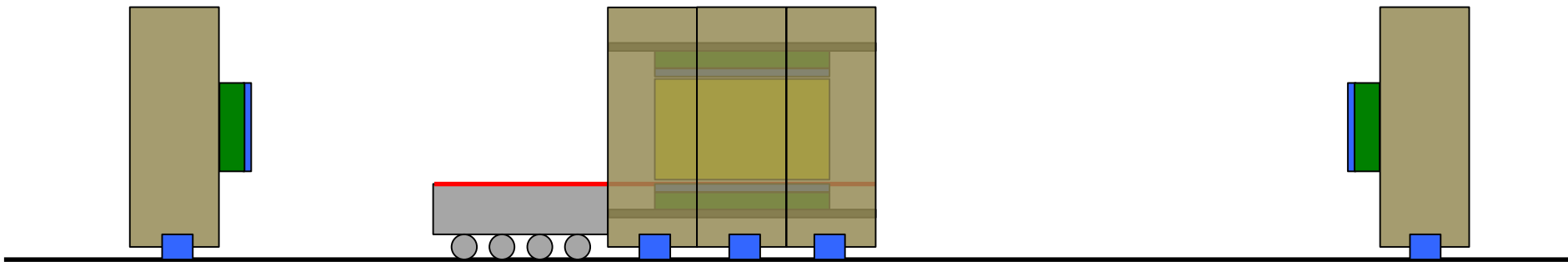




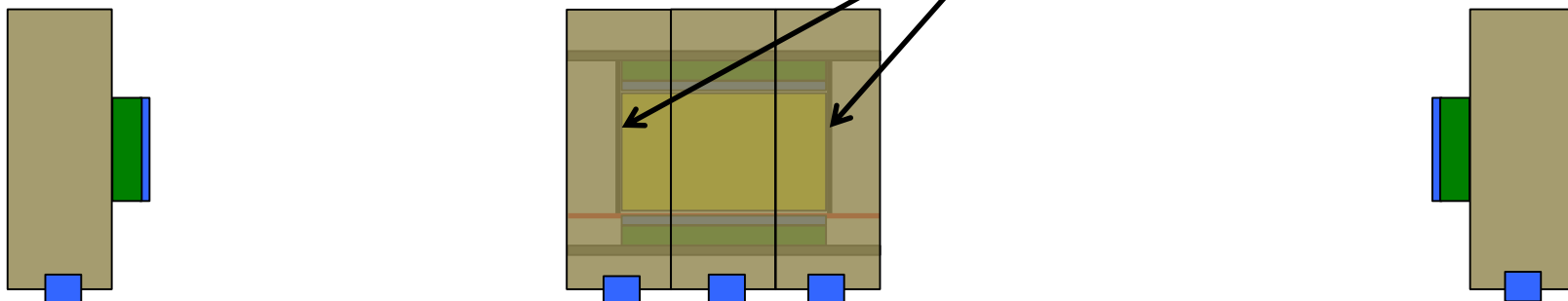






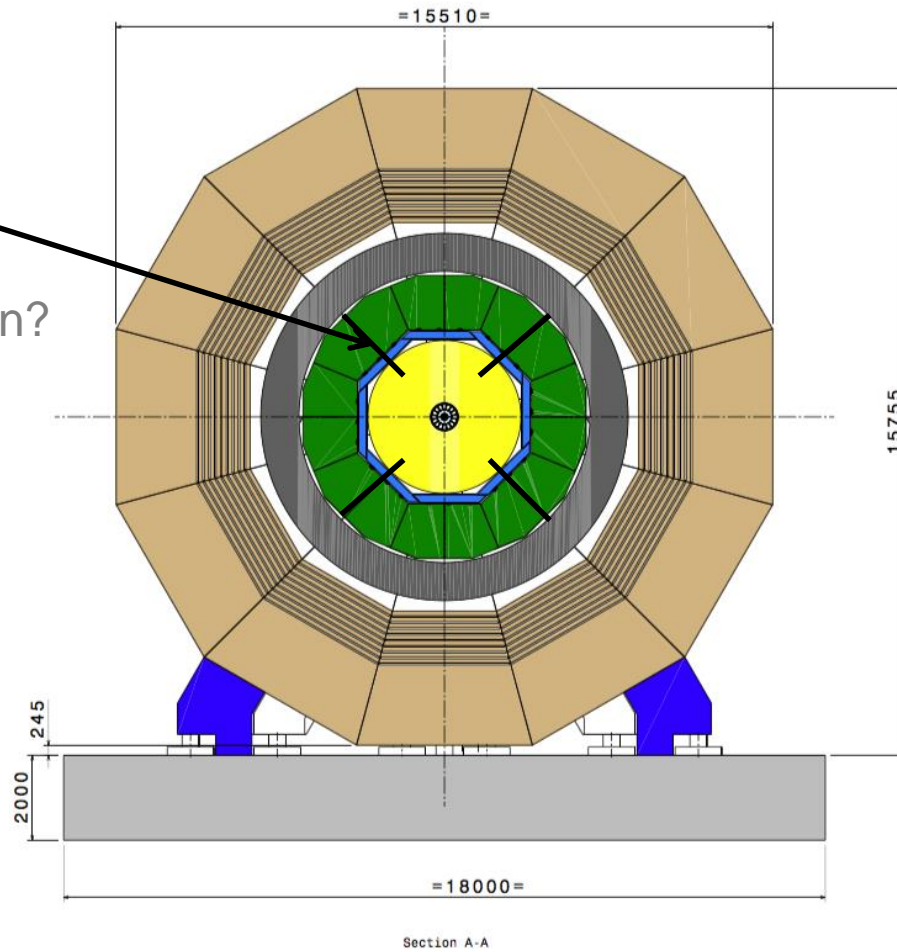


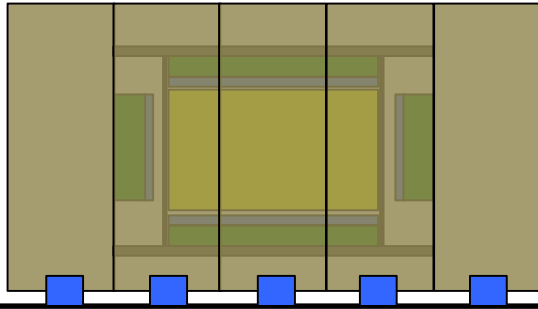
Carbon bands



Carbon bands

- How many?
- Size?
- How about longitudinal strain?





Veeeeery preliminary conclusions

Currently, more in favour of vertical assembly:

- Space requirements
- Time requirements
- Ease of access / logistics
- ...

But many steps need thorough planning, and many engineering solutions are still missing.

- Also for insertion of TPC into ILD, and for mounting and suspension

Nevertheless – best current guess:

- Assembly requires one year after delivery of field cage
- Space requirements: 100 m² (ISO 7 / greyroom quality)
- Plus space for module storage and testing, plus services

Some near-future steps

Continue to work on the models, assumptions and their consequences

- Principal procedures, needs and requirements
- Some important topics:
 - Support of TPC in ILC?
 - Prevention of longitudinal movement?
 - Cathode design?
 - End-plate design?
 - Space and infrastructure in DH (gas, power, electronic hut etc.)

To be decided soon: Where to assemble TPC?

- AH or research office building?
- If research office building, then still full TPC system test before lowering in AH?

Draw on previous experience

- Specifically ALICE → meeting in November at CERN

Get in touch with global integration efforts

- Hope to intensify contact to Yasuhiro