Update LDC Hall, Assembly and Push-Pull

(Work is not finished. Sorry for confusing pictures)

- History
- General
- LDC/TESLA detector assumption
- Surface Assembly
  - A la CMS
  - A la GLD
- Shelf Shielding Detector/Shielding Wall
- Underground Cavern Size
  - Beam Position
  - Questions: Hall Width
  - Garage Position
    - Question: Electronic Location
    - Question: Shaft Position
- ILC MDI Engineering Forum at CERN 12.-13. Oct. 2006
- Task force: Technical feasibilitiy push-pull
  - Beam Pipe Breaking Point
  - QD0 Supply
  - Preliminary LDC position
- Summary

Norbert Meyners, MEA

History

1. Q: Surface assembly possible with the LDC detector?
   1. Q: Surface hall size?
   2. Q: Underground cavern size?
   3. Q: Second access shaft?
   4. Q: Crane capacities?
2. Q: Selfshielding detector or moveable shielding wall?
3. D: Garage position for beam commisioning
4. ILC MDI Engineering Forum at CERN 12.-13. Oct. 2006
5. Task force: Technical feasibilitiy push-pull
   1. Two phone conferences
   2. Paper: „Preliminary LDC position ...“

General

- 2000t parts are not easy to handle!

  CMS needs 1day to close one yoke ring! (Goal: ½ day)

- Do not forget:
  - Escape routes
  - Scaffolds, Lifts (scissor or cherry pickers)

  I assumed 3m space arround the open detector!
  - Cables and other supply lines
    (to the detector and at the walls)
  - Supports

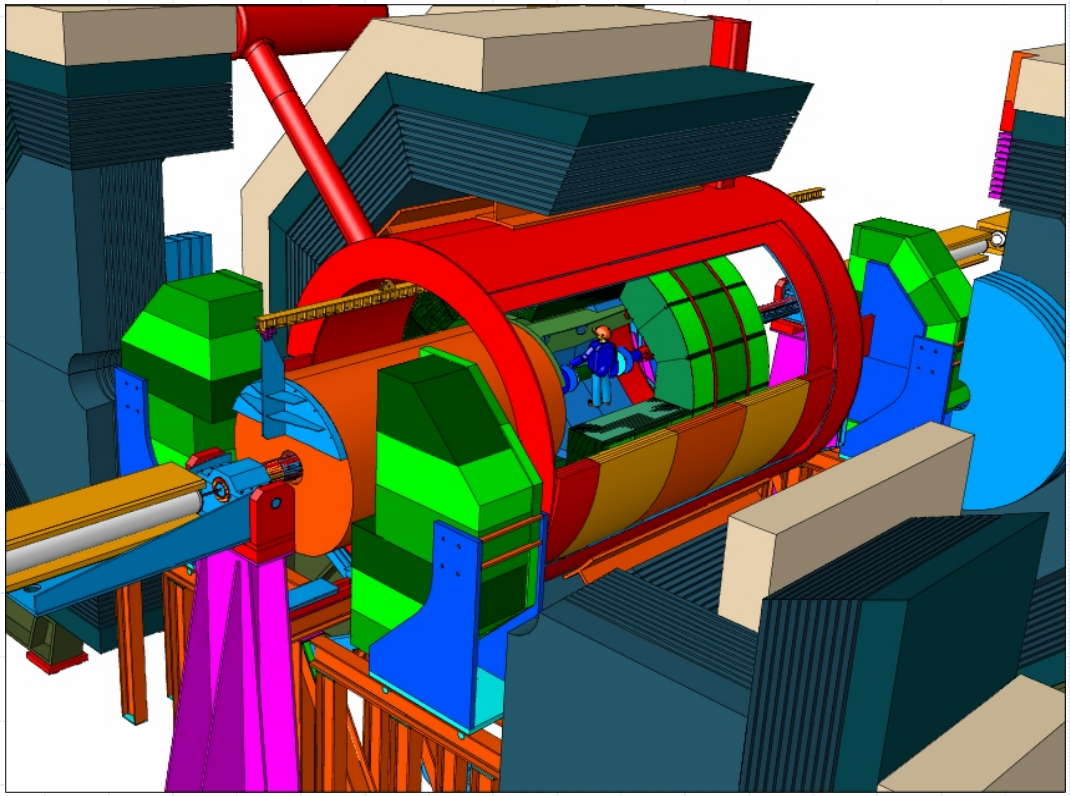
  Where are the cables and supply lines, fixtures etc.?

  CMS has gaps, LDC has at the moment holes!?

  Are you aware that the end cap yoke has to have a 4mm gap filled with Aluminium. ...

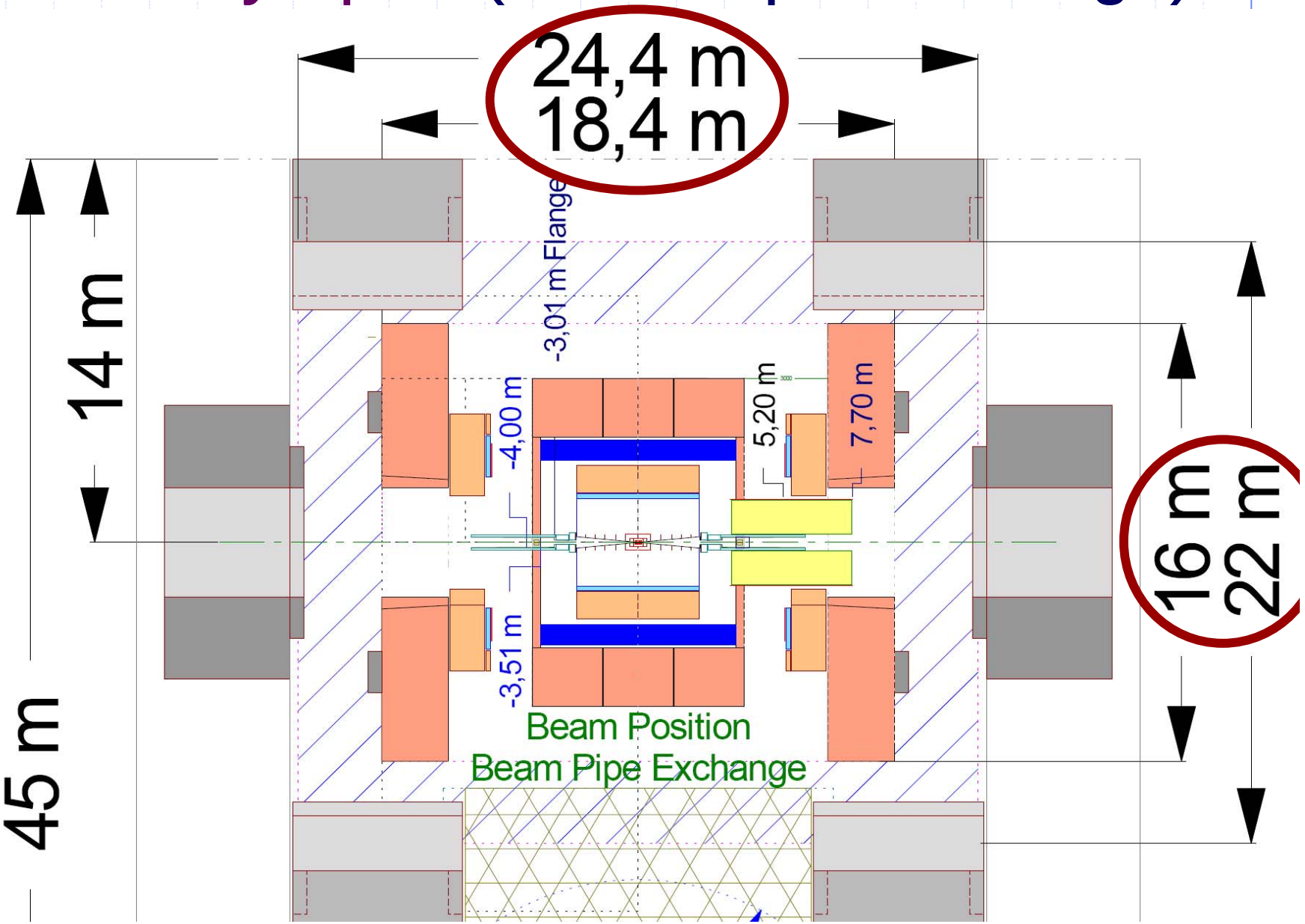
LDC/TESLA detector assumptions

- Reasonable fast access to the inner detector
- Access to the vertex detector without breaking the machine vaccum



Picture from
"Mechanical Concept of the TESLA Detector"
(LC-DET-2001-045)

LDC fully open (Beam Pipe Exchange)



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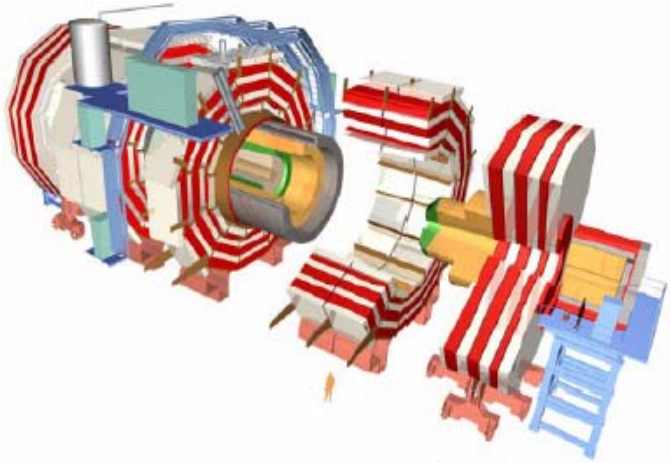
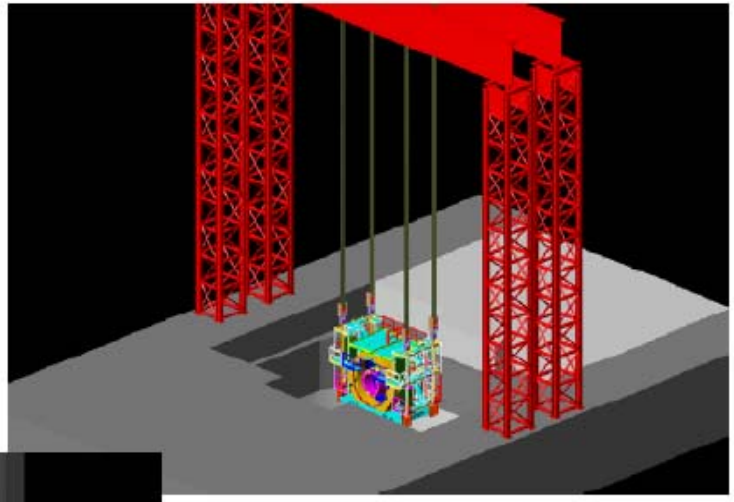
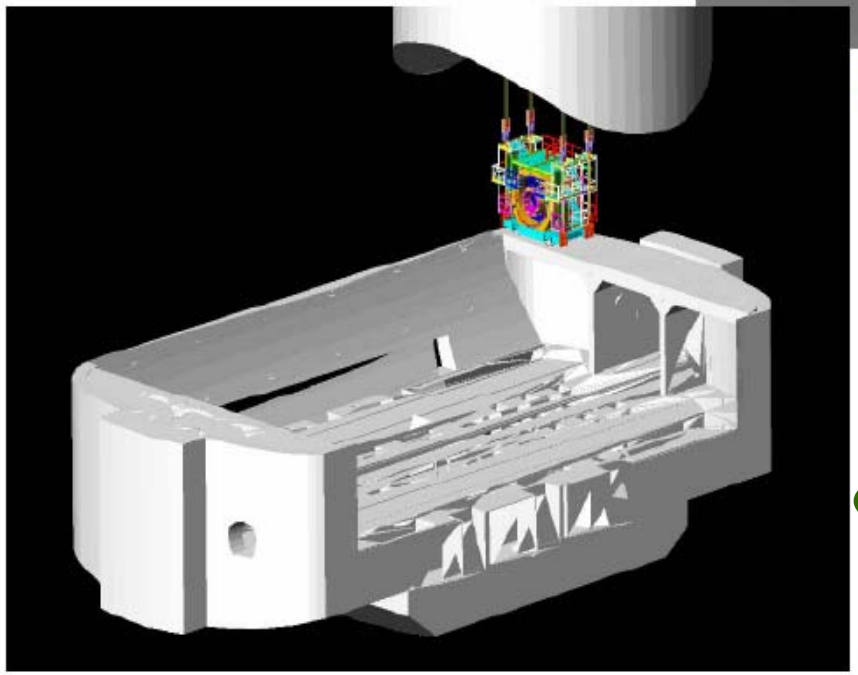
On-surface assembly : CMS approach







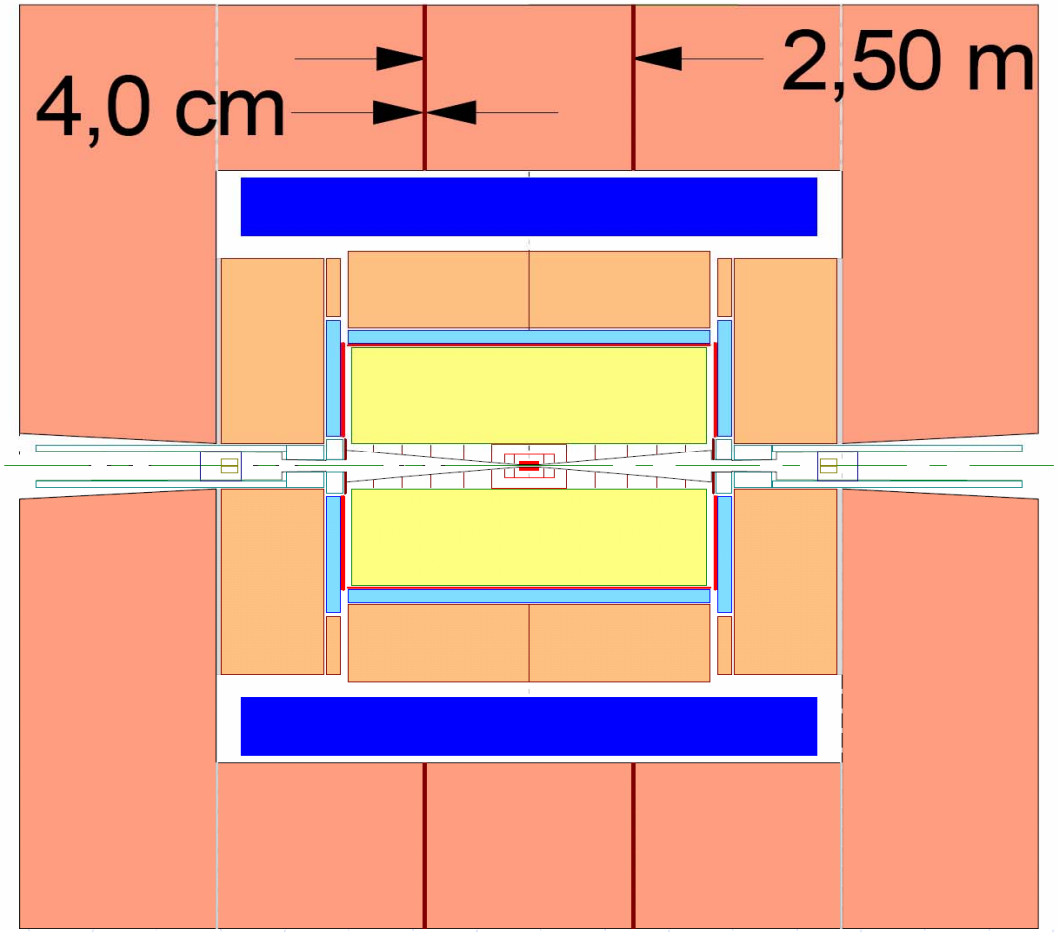
CMS assembly approach

- Assembled on the surface in parallel with underground work
- Allows pre-commissioning before lowering
- Lowering using dedicated heavy lifting equipment
- Potential for big time saving
- Reduces size of required underground hall

Q: Surface Assembly a la CMS

It would be possible!

We split the barrel yoke in three rings and do it like CMS

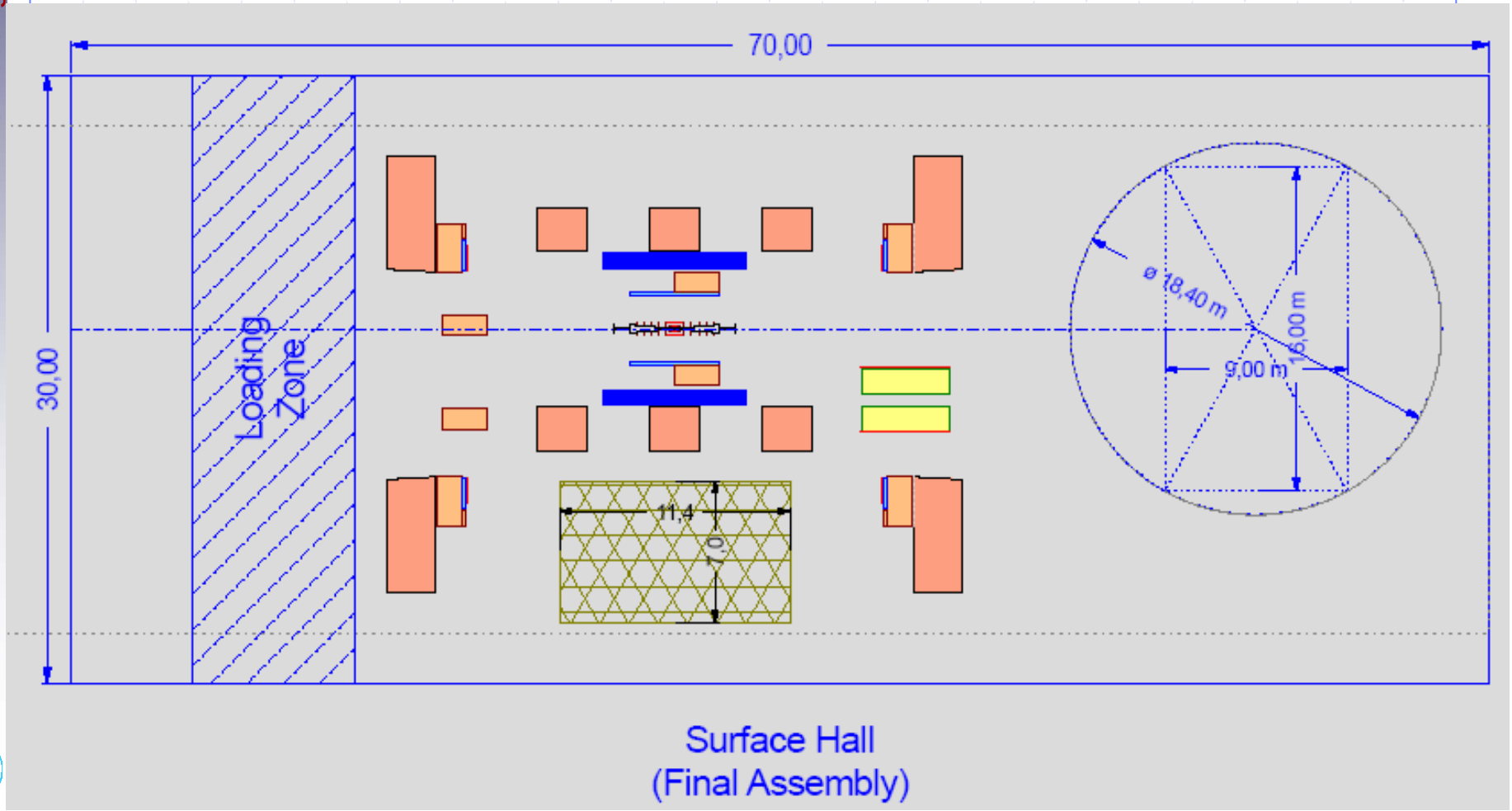


(In case of a shallow hall I would stick to the TESLA concept)

Surface Hall Size

50m (later 70m) x 30m; 2 x 80t crane; hook 19m above floor.

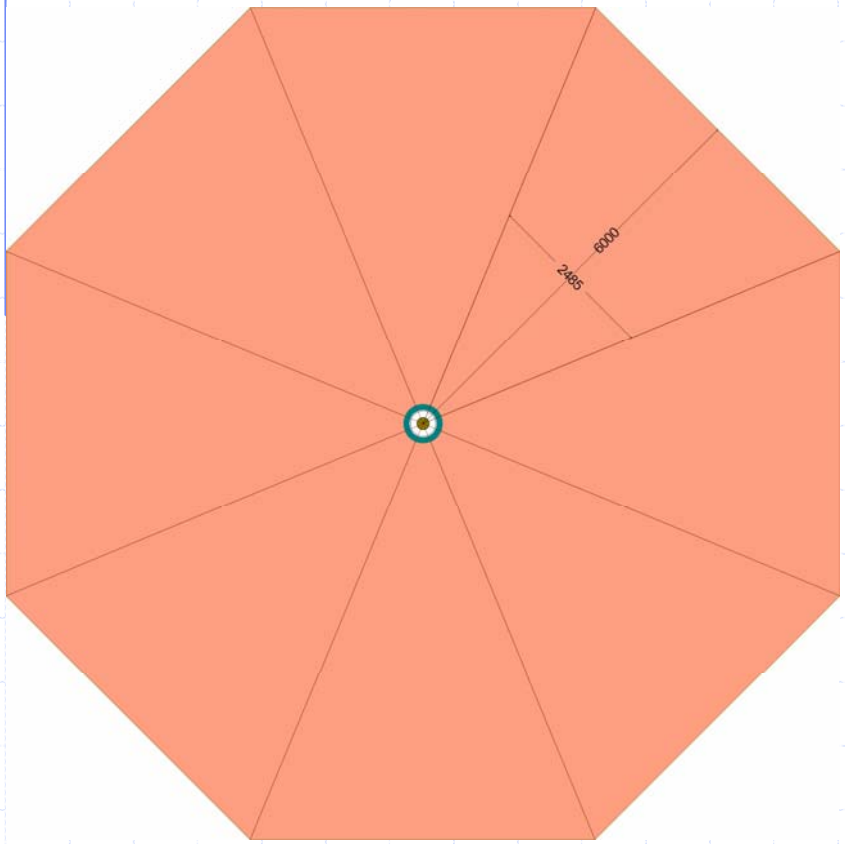
(For the costing MDI panel has chosen 100m x 25m.)

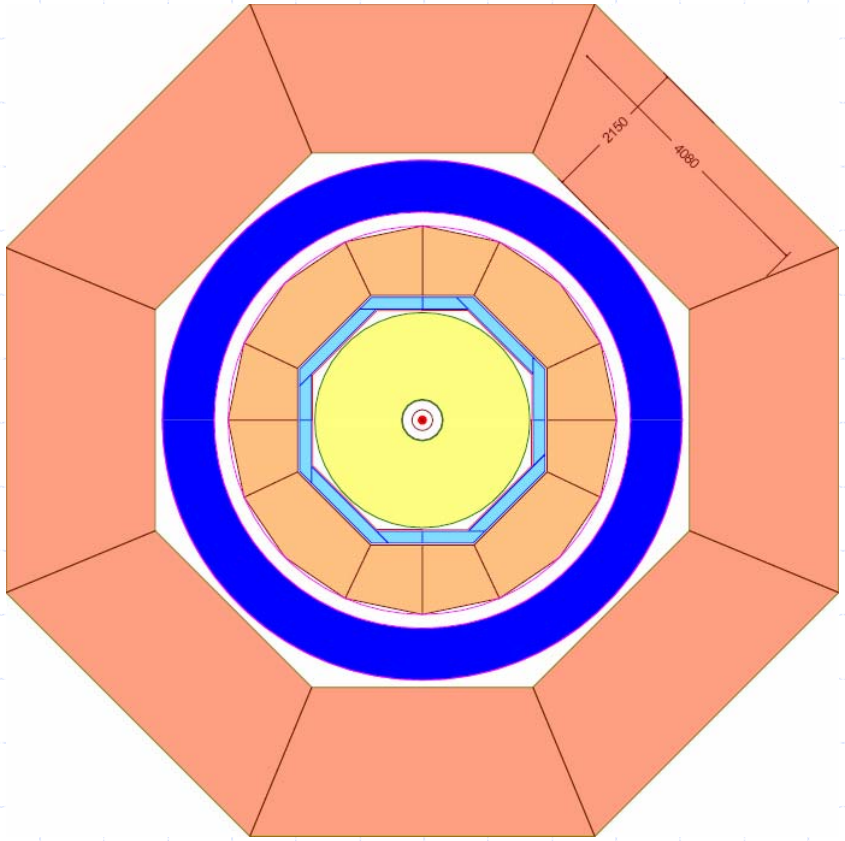


Q: Surface Assembly a la GLD

I now understood. It is possible too!.

- ➔ Split the instrumented yoke in its segments, lower them and the coil and reassembled underground.
- ➔ LDC 1/8 LDC Barrel yoke ~ 440t; 1/8 LDC End cap yoke ~240t; GLD 400t





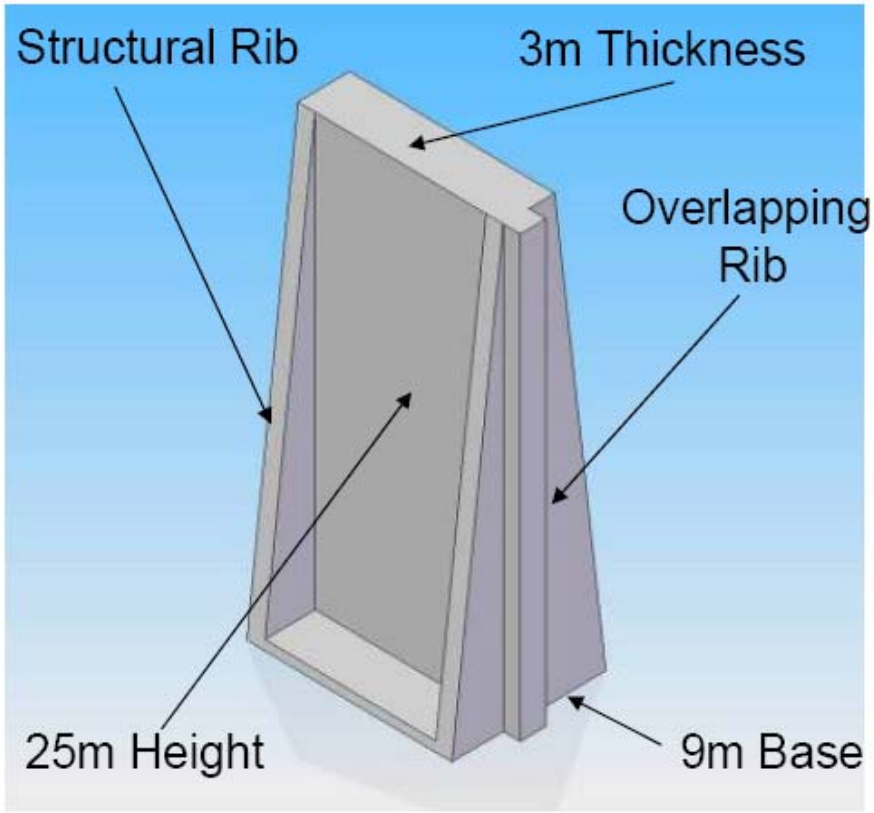
(I do not see an advantage over the CMS concept, beside the cracks in the barrel muon system)

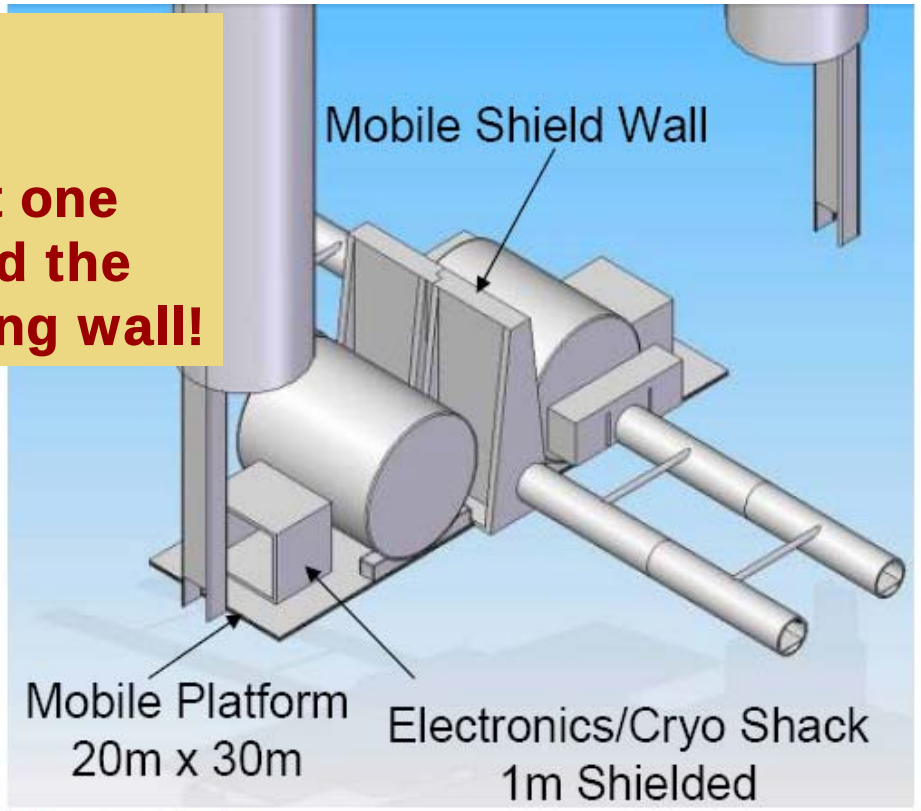
Shelf Shielding Detector/Shielding Wall

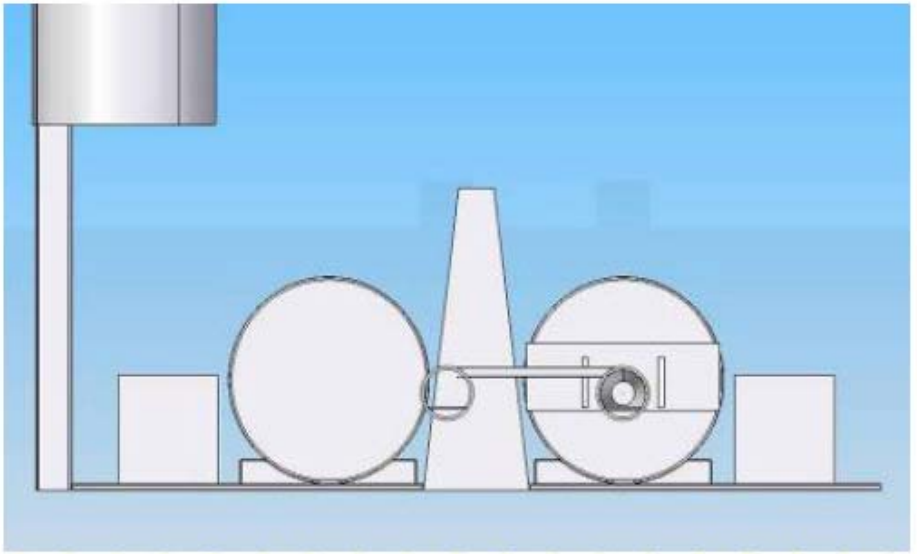
- If the detector is shelf shielding, the beam line needs 3m iron/concrete shieding.
- Only the 4th detector concept is not self shielding!
  - ➔ 3m shielding wall

  or
  - ➔ 3m shielding arround the detector

- **The design of the shielding wall element is reasonable!**
- **The other two picture show that one should go for a shielding arround the 4th detector instead of a shielding wall!**







John Amann

http://ilcagenda.cern.ch/conferenceDisplay.py?confId=1201

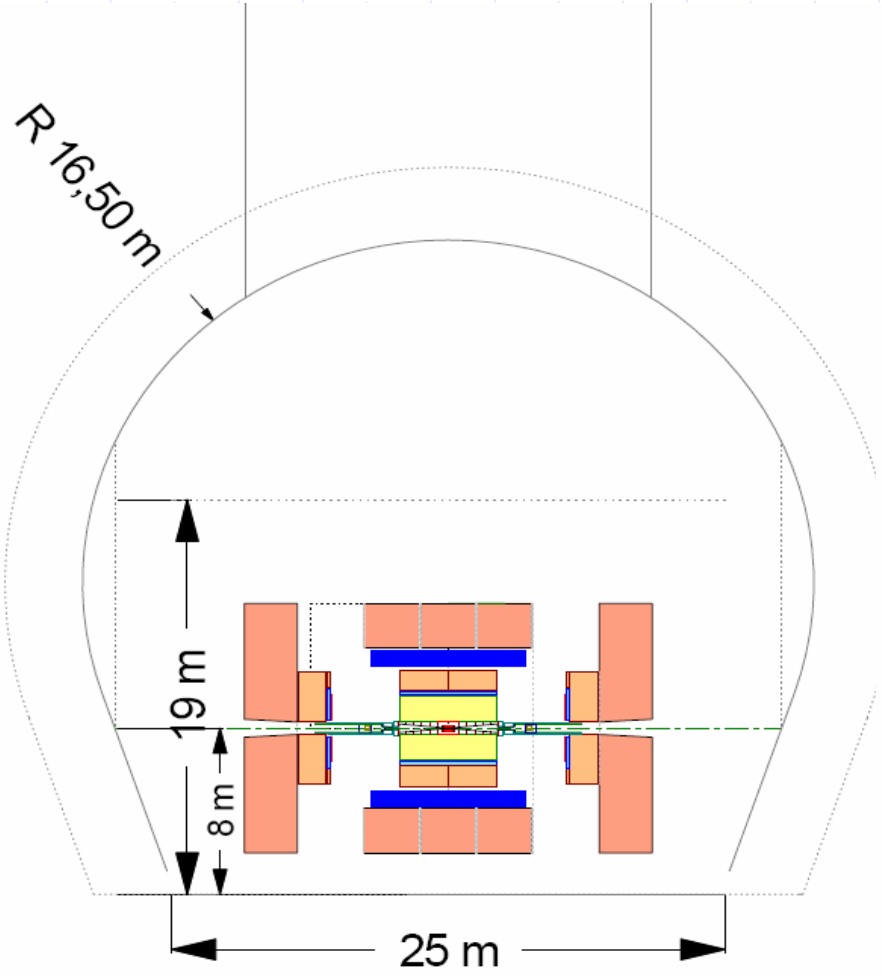
http://ilcagenda.cern.ch/conferenceDisplay.py?confId=1225

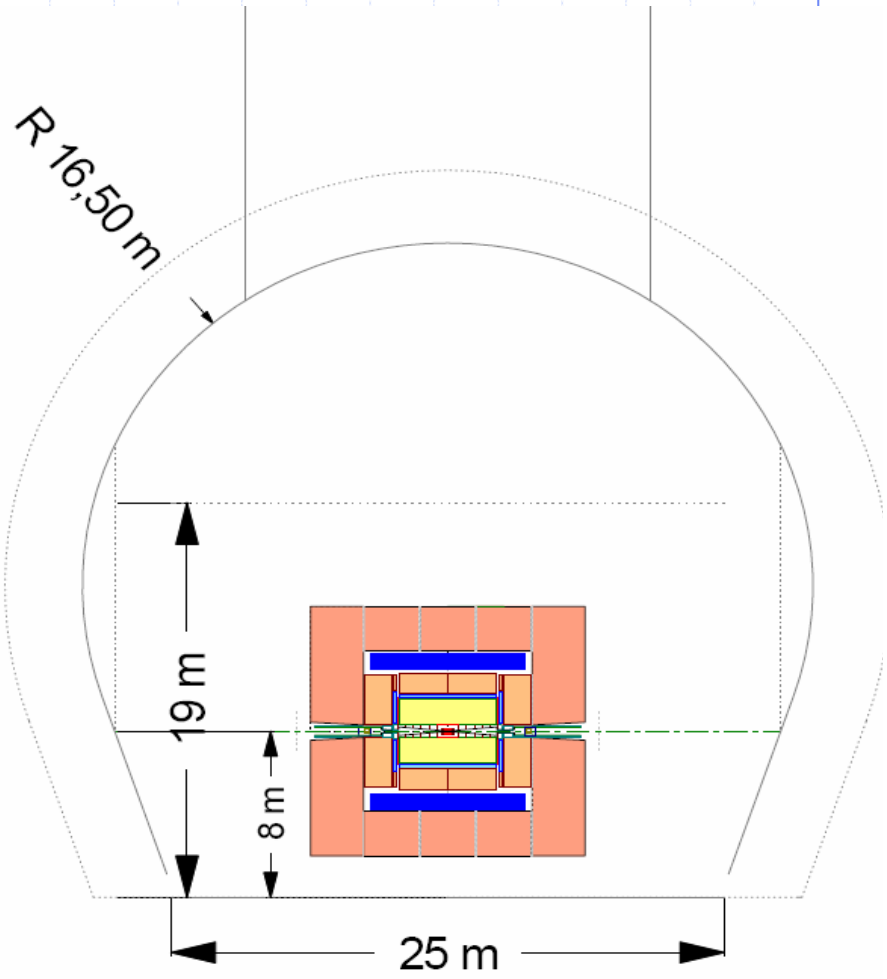
Underground Cavern Size

Q: Cavern Width ?

Not rectangular shape!

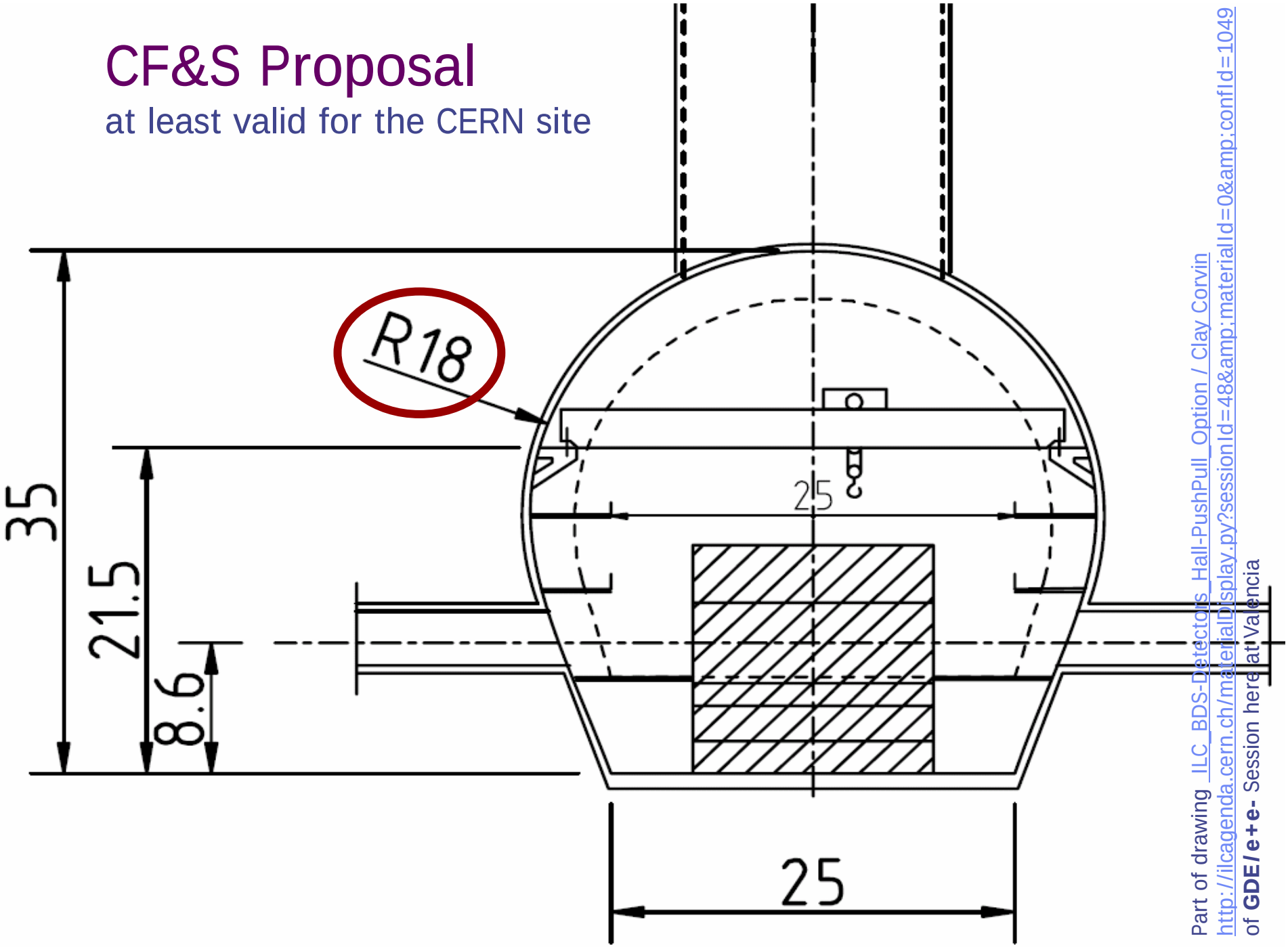
25m seemed to be okay!





CF&S Proposal

at least valid for the CERN site

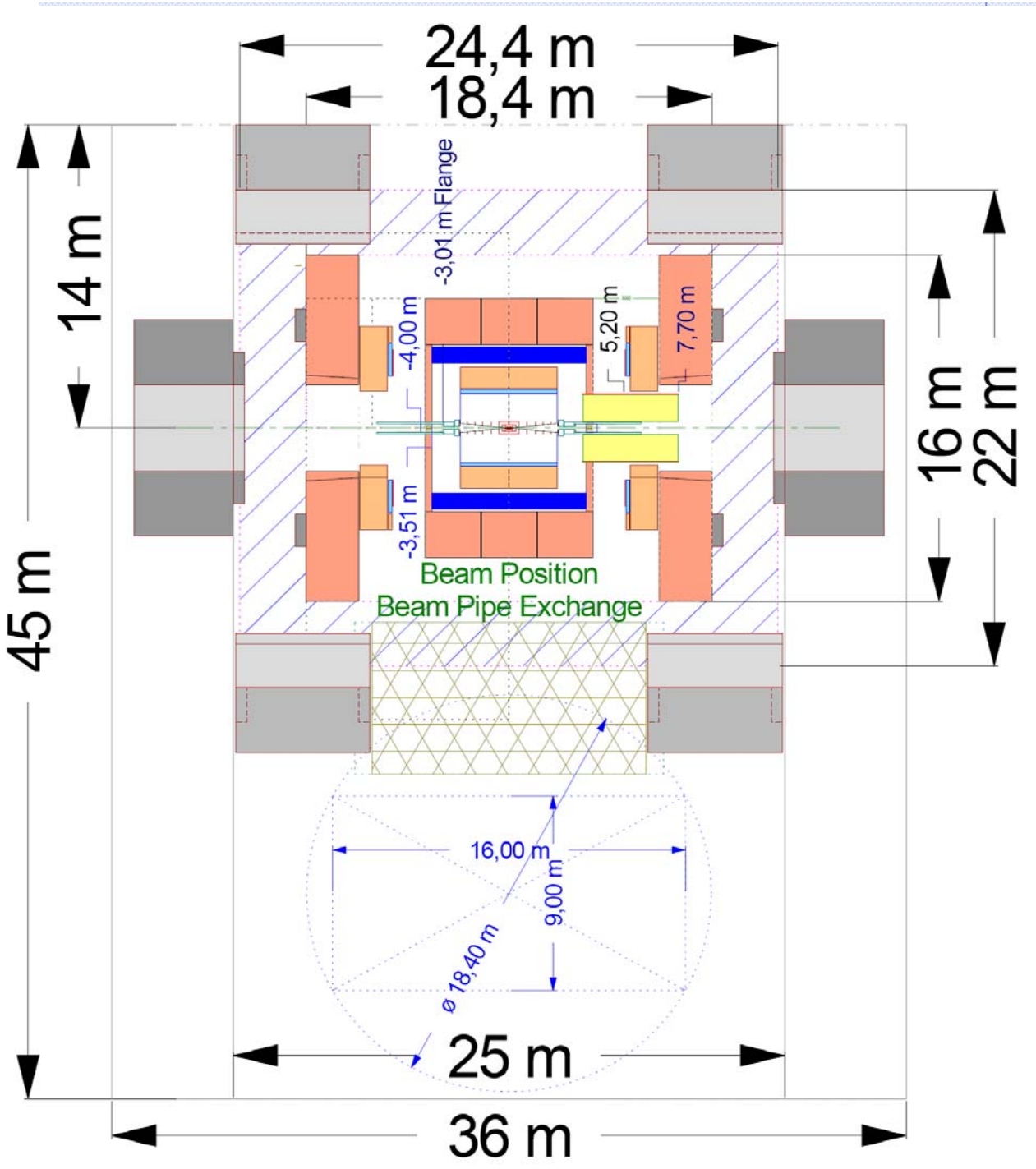


Part of drawing ILC_BDS-Detectors_Hall-PushPull_Option / Clay Corvin
http://ilcagenda.cern.ch/materialDisplay.py?sessionId=48&materialId=0&confId=1049
of **GDE/e+e-** Session here at Valencia

Underground Cavern Size

Detector in Beam Position (open)

- First attempt to define the underground cavern size



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Underground Cavern Size

Detector in Garage Position (open)

(It was a surprise for me!)

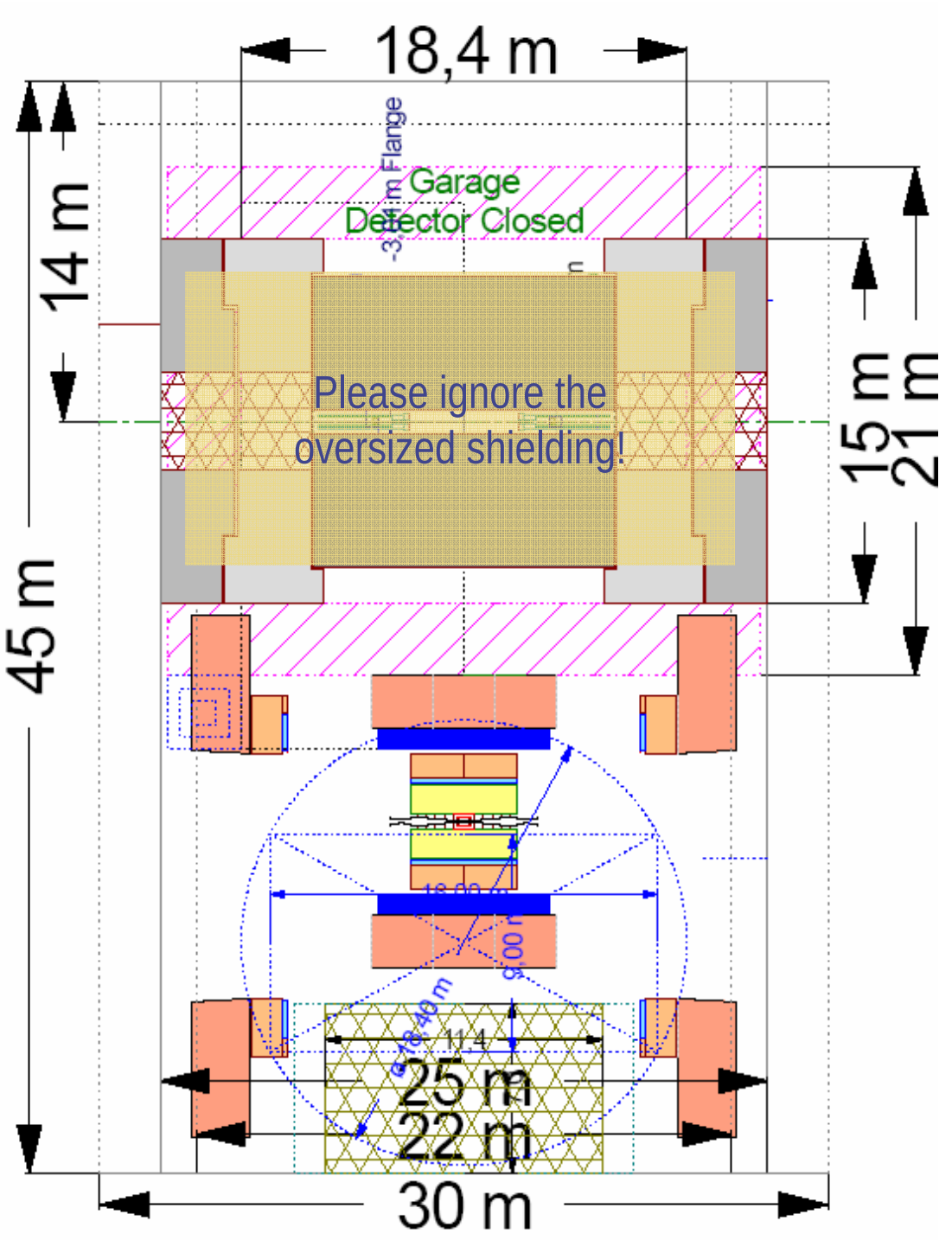
Q: E-Trailer ?

- It is in way!
- Alternativies:
  - Split it
  - Electronic Cavern
  - At the yoke
  - In the shaft

Q: Allowed cable length? (Detector to Electronic)

Q: Necessary space for electronic?

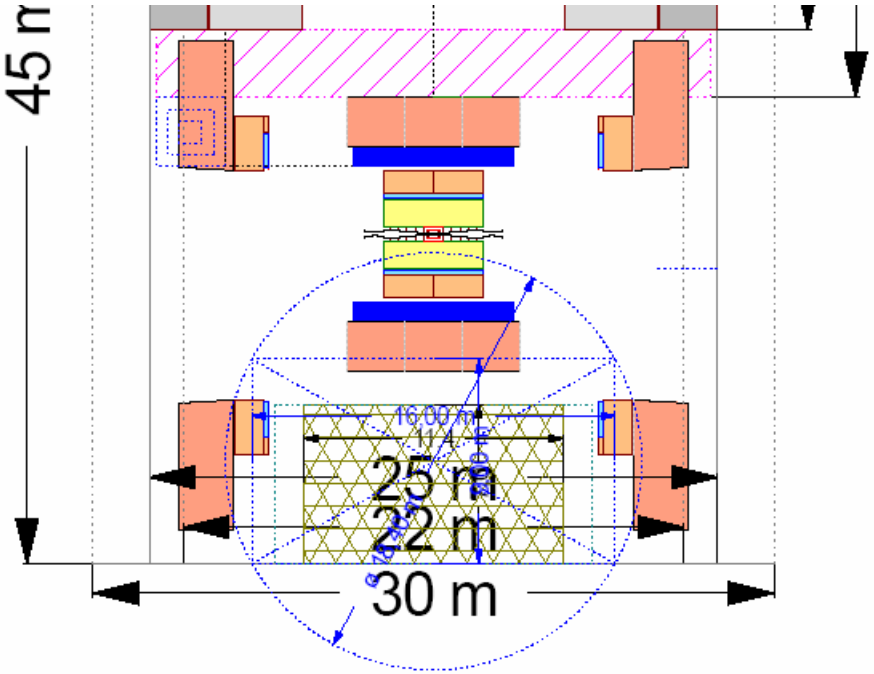
Q: Cable route for the inner detectors? (Along the support tube?)

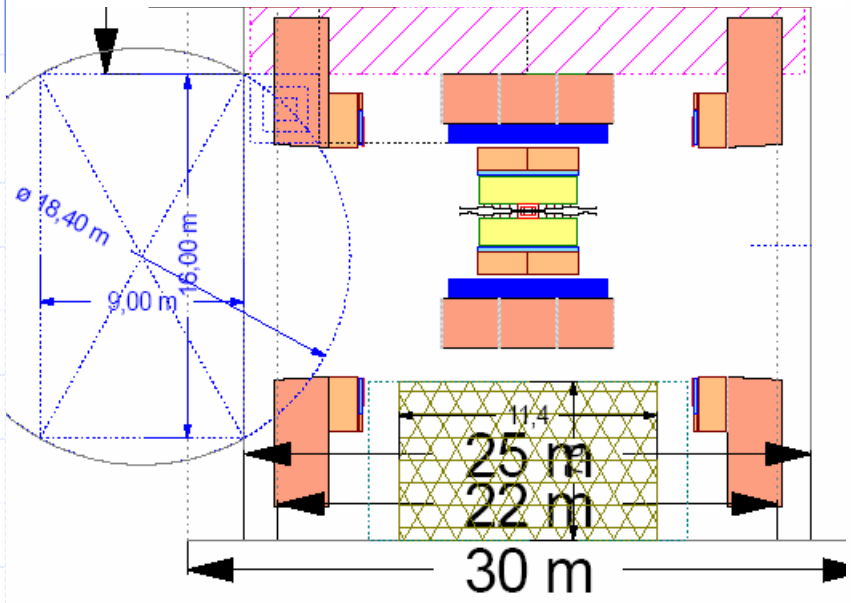


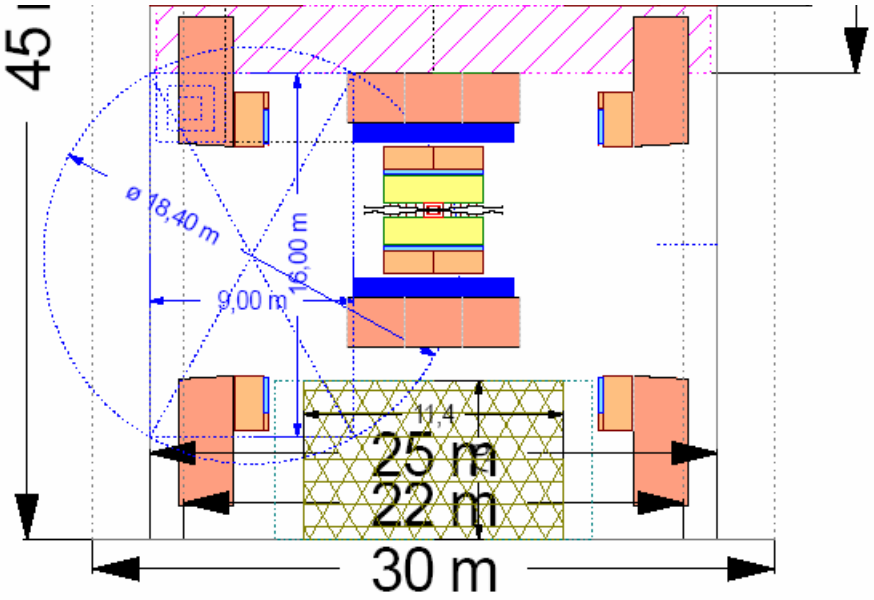
Detector in Garage Position

Q: Shaft Position ?

➔ ~10m longer hall







Norbert Meyners, MEA

Table of IR assumptions

Item	SiD	LDC	GLD	CMS	Vancouver WBS (for each hall)	For Valencia Config.A (for single common hall)	Config.B (for single common hall)	Determined by
Parameters that define the underground hall volume								
IR Hall Area(m) (W x L)	28x48 (18x48)	30x45	25x55	26.5x53 max	32x72	25x110	25x110	Detector concepts
Beam height above IR hall floor (m)	7.5	8	8.6	8.79m	8.6	8.6	8.6	Concepts, BDS
IR Hall Crane Maximum Hook Height Needed(m)	5m above top of detector	19	20.5	18m	30	20.5	20.5	Detector concepts
Largest Item to Lift in IR Hall (weight and dimensions)	100t PACMAN shielding	55t, 3m x 3m x 1,5m, E/HCAL end cap quadrant	Pieces of yoke 400t	20t instal tool 7x4m		400t	400t	Detector concepts
IR Hall Crane	100t/10t aux.	80t (2x40t)	400t	20t	20t x 2	400t +2*20t	400t +2*20t	Detector concepts
IR Hall Crane Clearance Above Hook to the roof (m)	TBD by engineering staff	6	TBD	5 m	5	14.5 (includes arch)	12.5 (includes arch)	CF&S group
Resulted total size of the collider hall (W x L x H)	28x48x30 (18x48x30)	30x45x25	25x55x35	53x26x25	32x72x35	25x110x35	25x110x33	Concepts & CF&S group
Parameters that define dimensions of the IR hall shaft and the shaft crane								
Largest Item; Heaviest item to Lower Through IR Shaft (weight and dimensions)	Coil package 600t – size End-dors 2000t each/halfs	Central Part ~2000t; 12-14m x 7m;	270t coil 9*9m Iron-15m	1950t		9*9m 400t	14*16m 2000t	Detector concepts

continued at next page=>

http://www-project.slac.stanford.edu/ilc/acceldev/beamdelivery/rdr/docs/BDS_CFS_Valencia.doc

ILC MDI Engineering Forum at CERN

12.-13. Oct. 2006 (http://indico.cern.ch/conferenceDisplay.py?confId=1561)

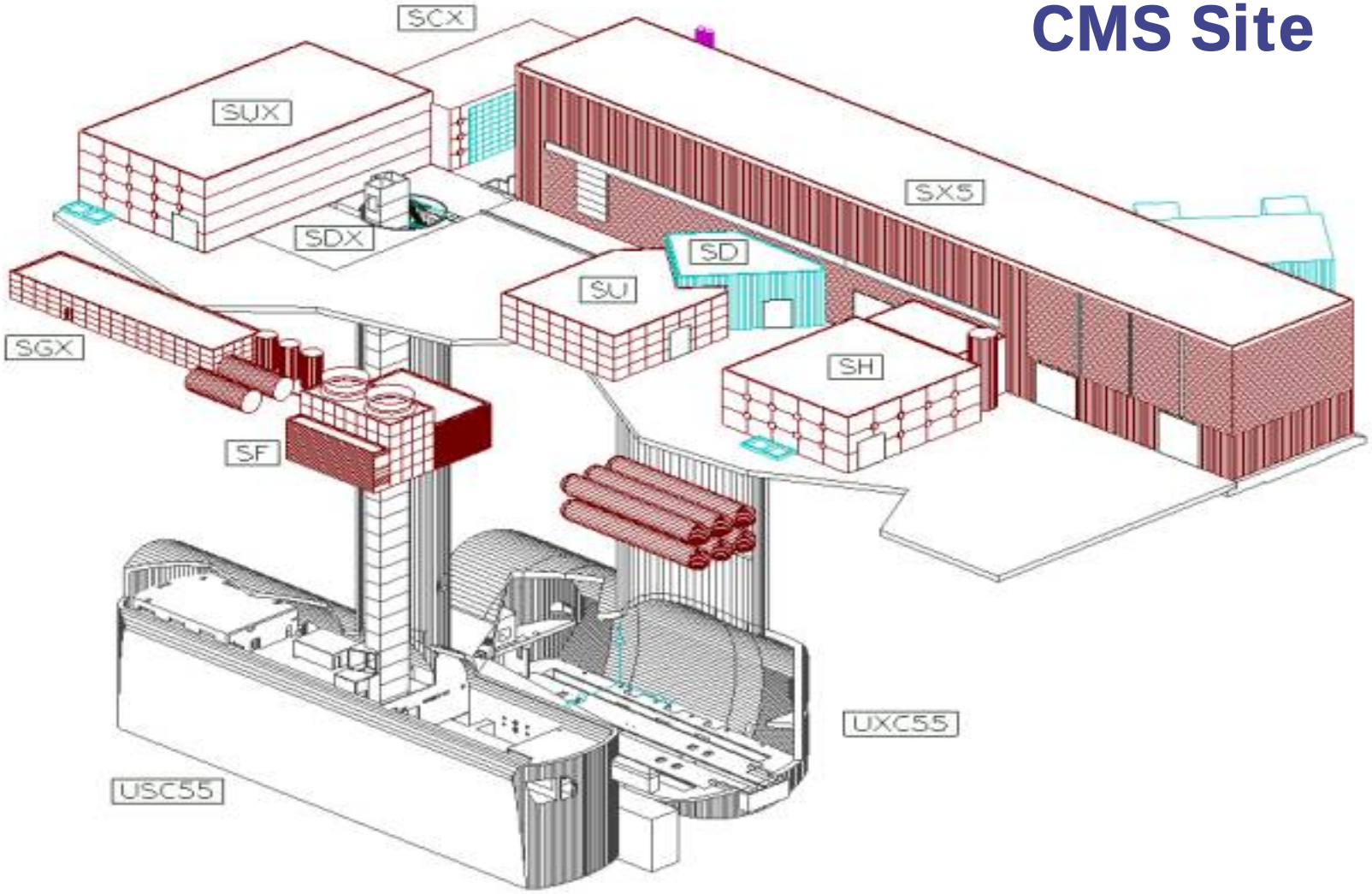
- **Visit to ALICE TPC**
- **Visit to ATLAS**
- **Visit to CMS**
- **Talks and Discussions**

Impressive!

➔ **Service Cavern**
➔ **Second Access Shaft**
➔ **Survey Galery**
➔ **Two Cranes**

CMS surface hall

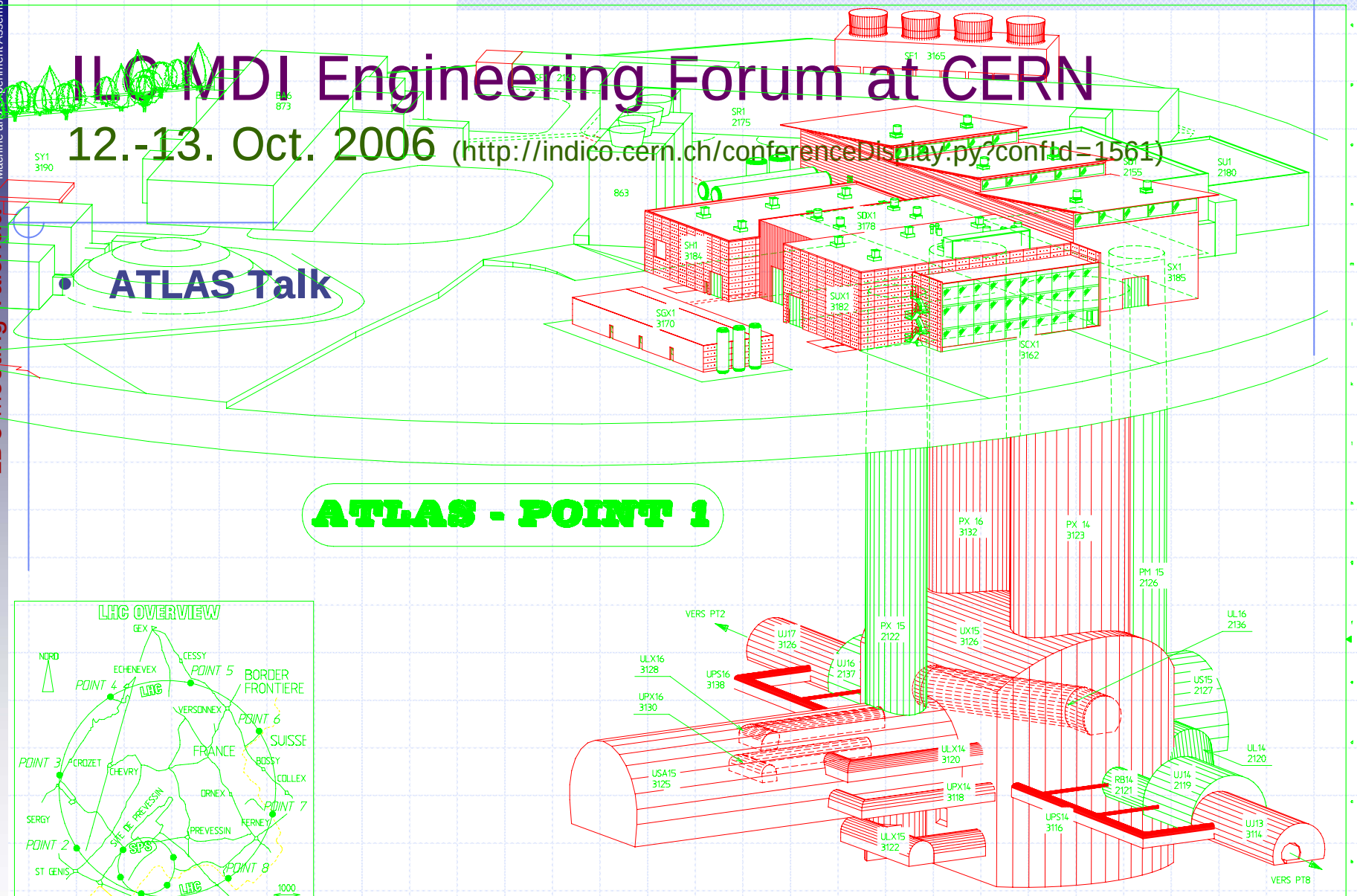
CMS Site



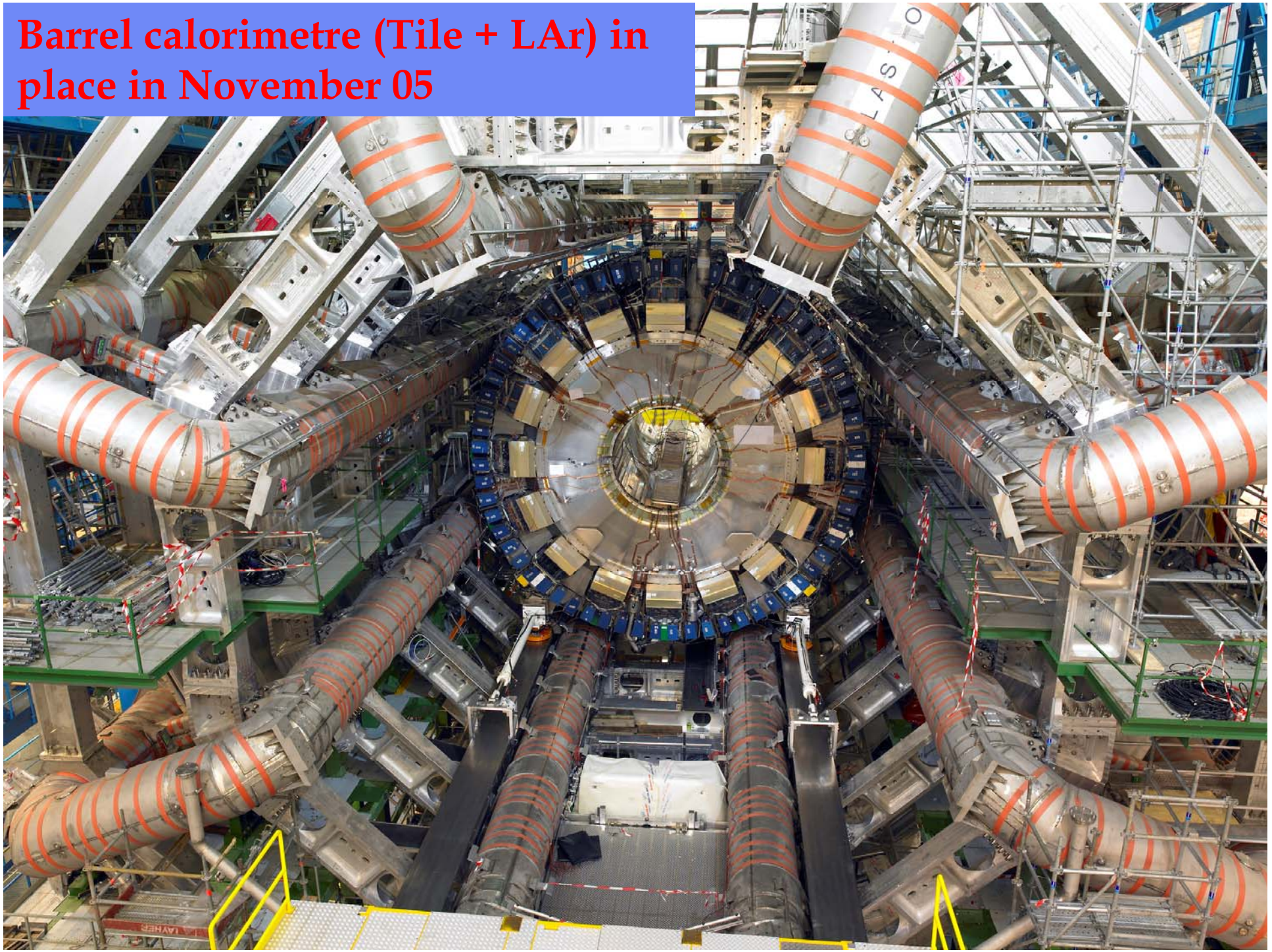
ILC MDI Engineering Forum at CERN

12.-13. Oct. 2006 (http://indico.cern.ch/conferenceDisplay.py?confId=1561)

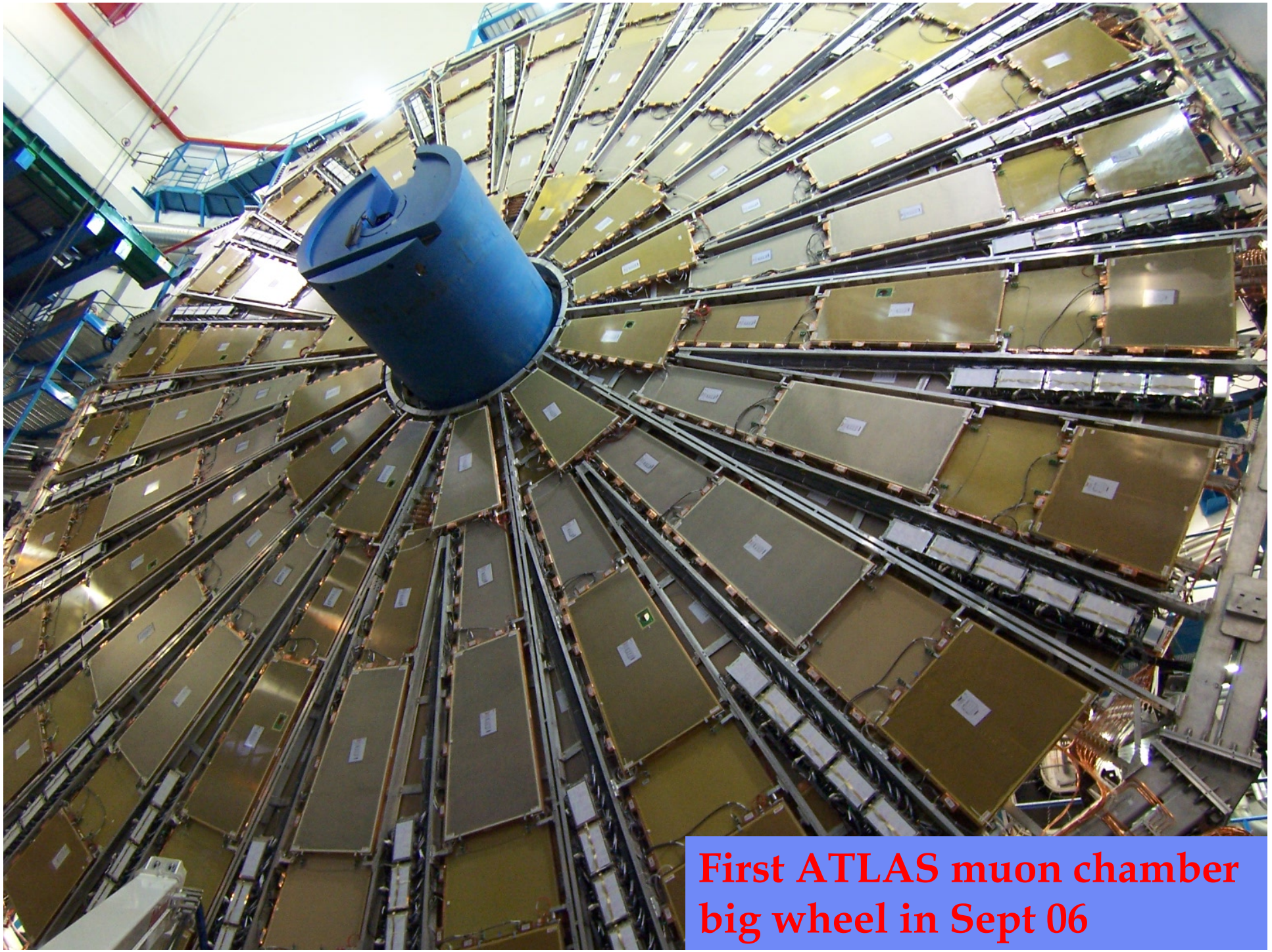
- **ATLAS Talk**



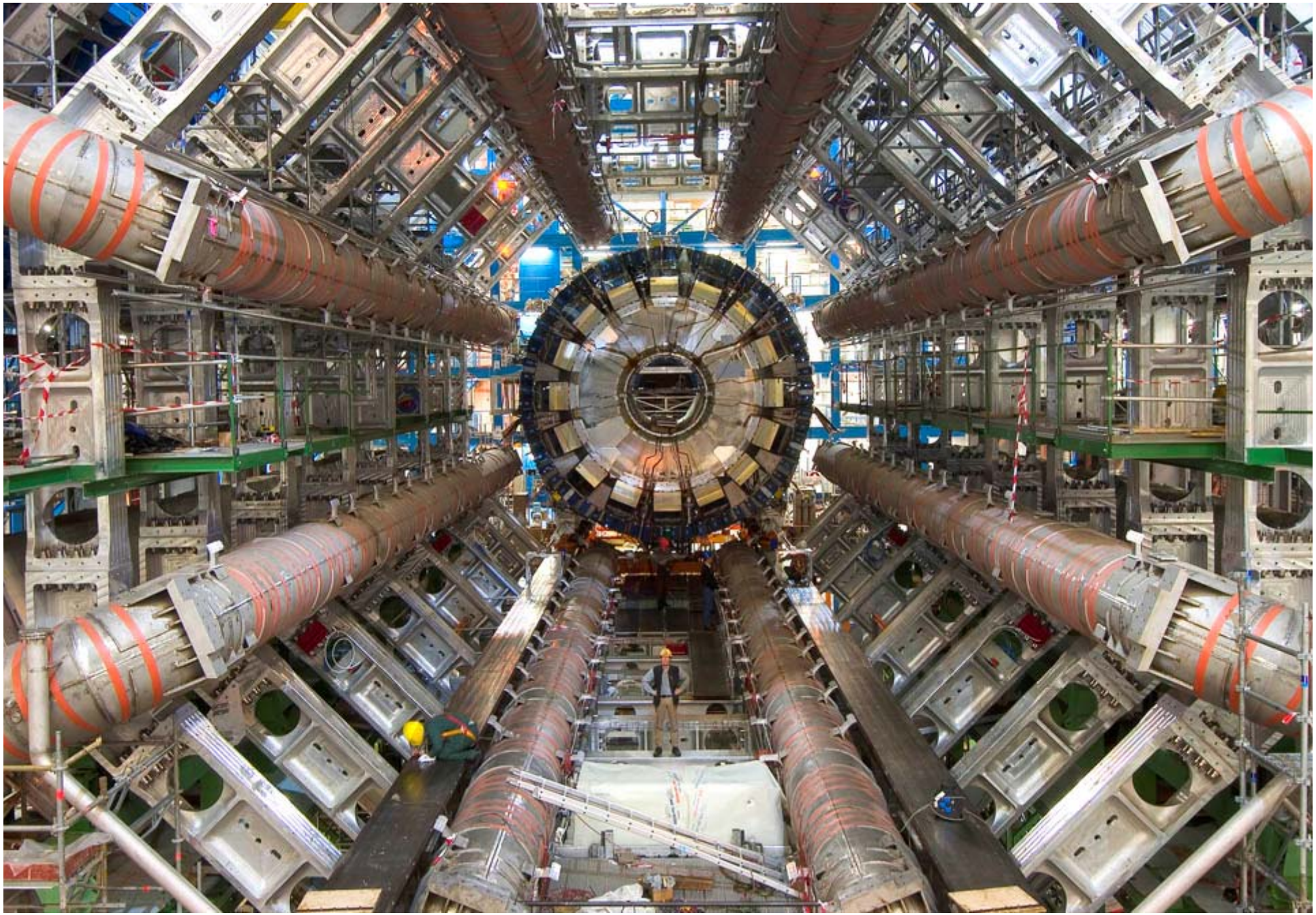
Barrel calorimetre (Tile + LAr) in place in November 05



Work between the muon chambers layers



First ATLAS muon chamber big wheel in Sept 06



Task Force: Technical Feasibility of Push-Pull

- We formulated in contact with the LDC contact persons a priminary answer for the LDC community! ➔ next pages
- Do not be mislead by wrong arguments!
- Or by the technical details in the report Andrei Seryi gave

  „Report from the Push-Pull Study Group (Andrei Seryi (*SLAC*))"
  (http://ilcagenda.cern.ch/getFile.py/access?contribId=19&sessionId=26&resId=0&materialId=slides&confId=1049)
- It was not an technical issue!

  (We did not find a technical show stopper, but it will need effort and money.
  It adds an engineering challenges to the challenges you already have,
  when you build a detector!)
- Look a Barry's talk from Wendsday evening!

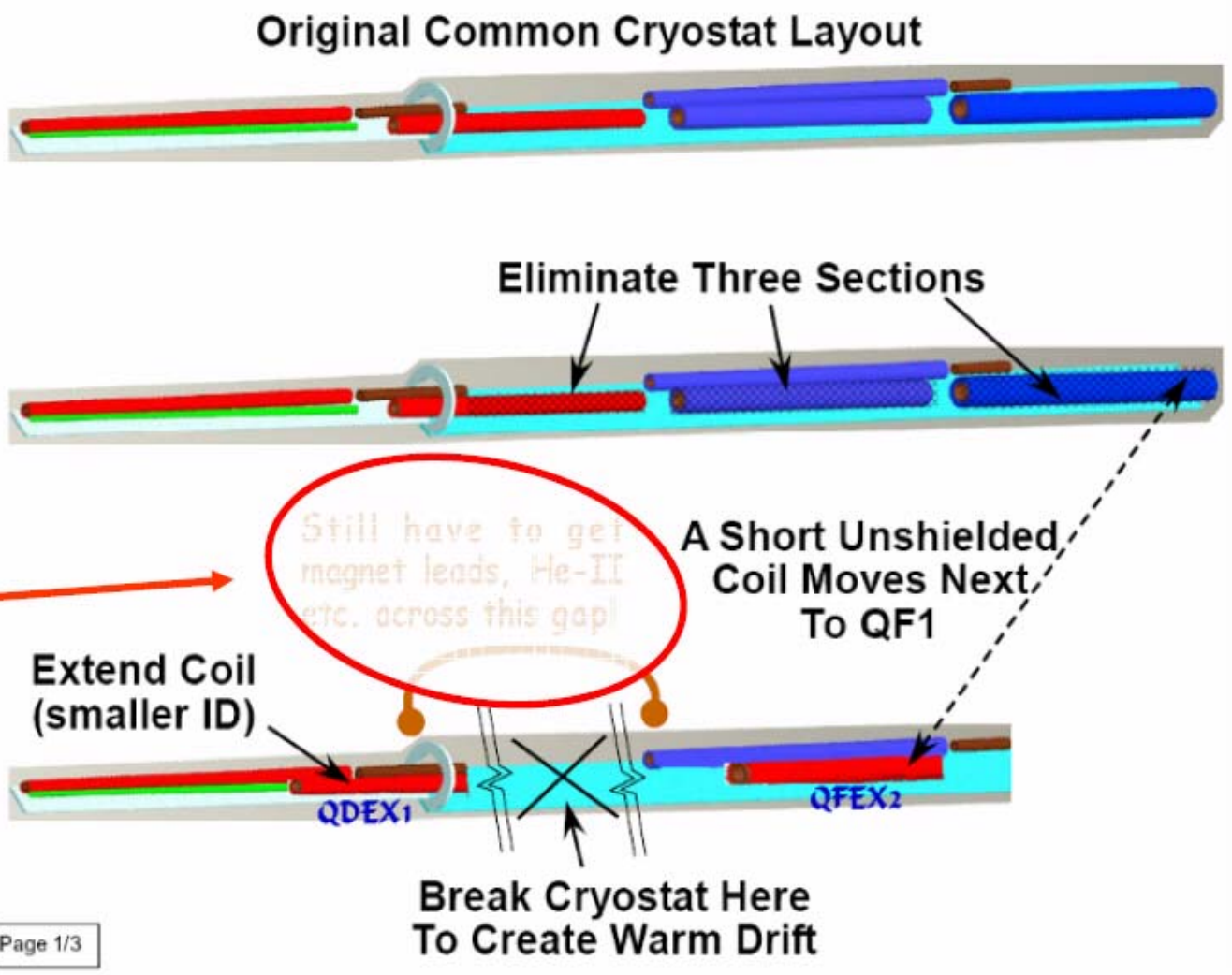
  It is to reduce the costs
  to be written in the RDR!

Do we have a chance aganist the cost argument? **NO!**

- Decision in two weeks! (Barry)

Push-Pull
Beam Pipe Breaking Point

- B.Parker, Y.Nosochkov et al. (see ref for details)
- In further discussion realized that this connection should not be used, to allow quick move
- The QD0 part of cryostat will be connected to part of cryo system (2K) attached to detector



http://ilcagenda.cern.ch/conferenceDisplay.py?confId=1187

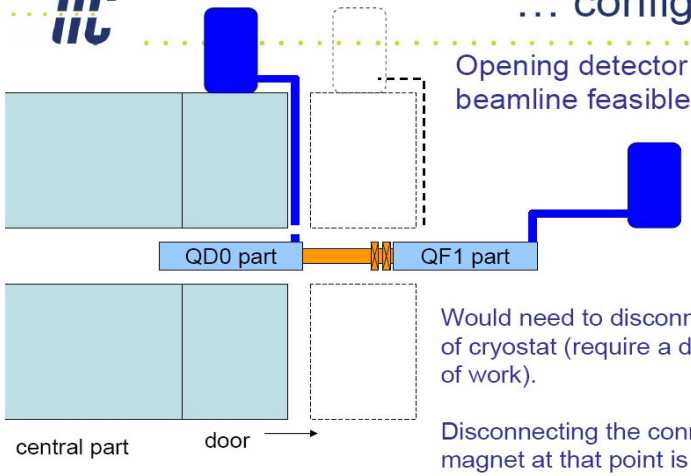
Push-Pull

QD0 Supply

Example: Engineering Challenges

… configuration A

Opening detector along beamline feasible, but not fast

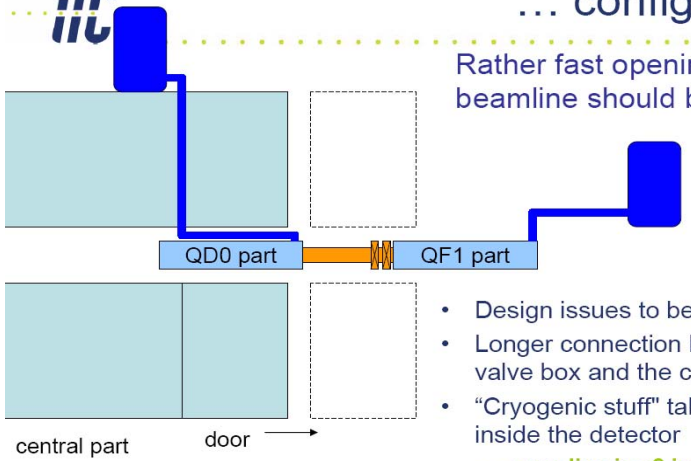


Would need to disconnect the QD0 part of cryostat (require a day (maybe days) of work).

Disconnecting the connection to the magnet at that point is fairly invasive (reliability issues). This cannot be a routine action.

… configuration B

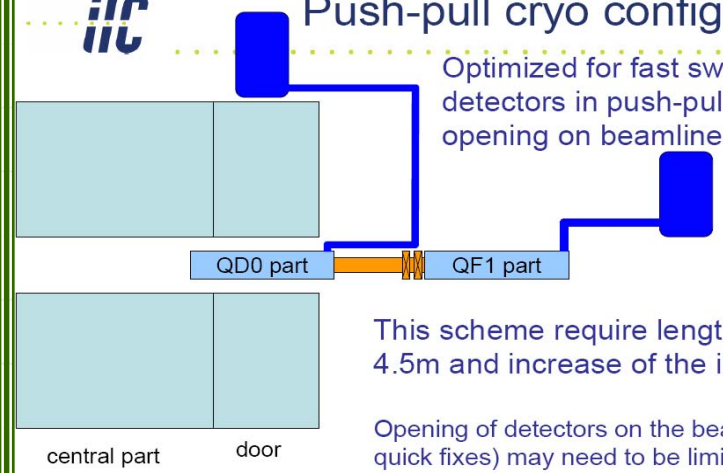
Rather fast opening along the beamline should be possible



- Design issues to be solved:
- Longer connection between the valve box and the cryostat
- "Cryogenic stuff" takes up space inside the detector
  - **cryo line is ~8 inches in diameter and can grow for longer path**
- Installation of FD and cryo lines

Push-pull cryo configuration C

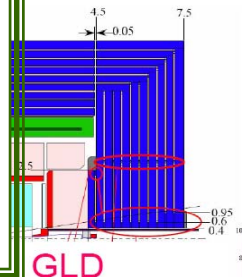
Optimized for fast switch of detectors in push-pull and fast opening on beamline



This scheme require lengthening L* to 4.5m and increase of the inner FD drift

Opening of detectors on the beamline (for quick fixes) may need to be limited to a smaller opening than what could be done in off-beamline position

Detector sizes & opening on beamline

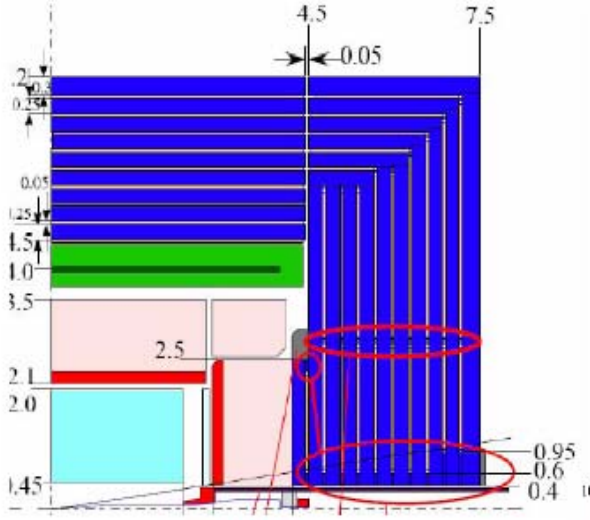


	SiD	GLD
IP	0	0
End of detector	5.9	7.5
Desired opening	2	2.5
Warm section need to end after z=	7.9	10
Reduced opening for fast fixes	2	1.5
Warm section need to end after z=	7.9	9

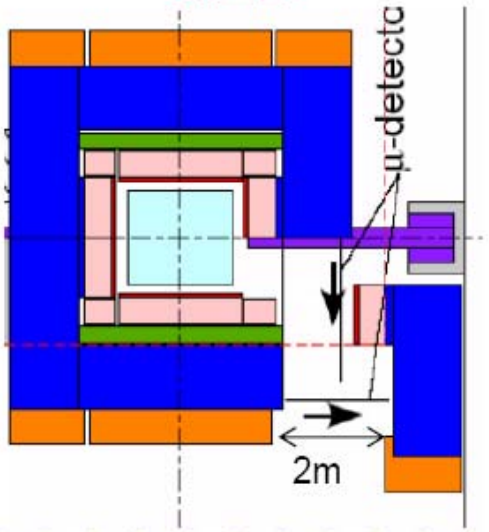
SiD (opened)

Since opening of

Detector sizes & opening on beamline

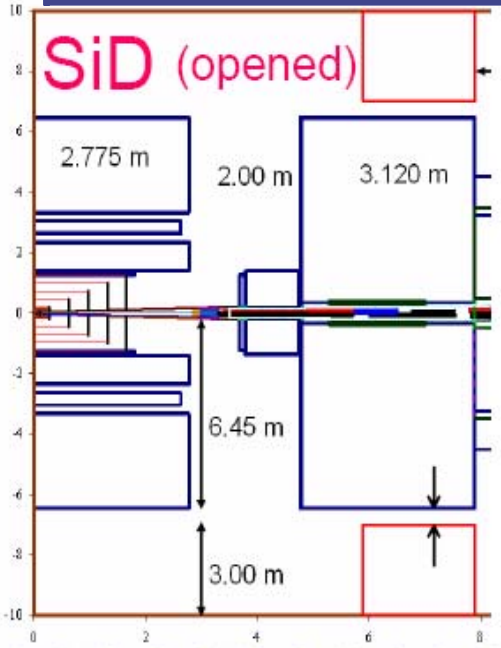


GLD

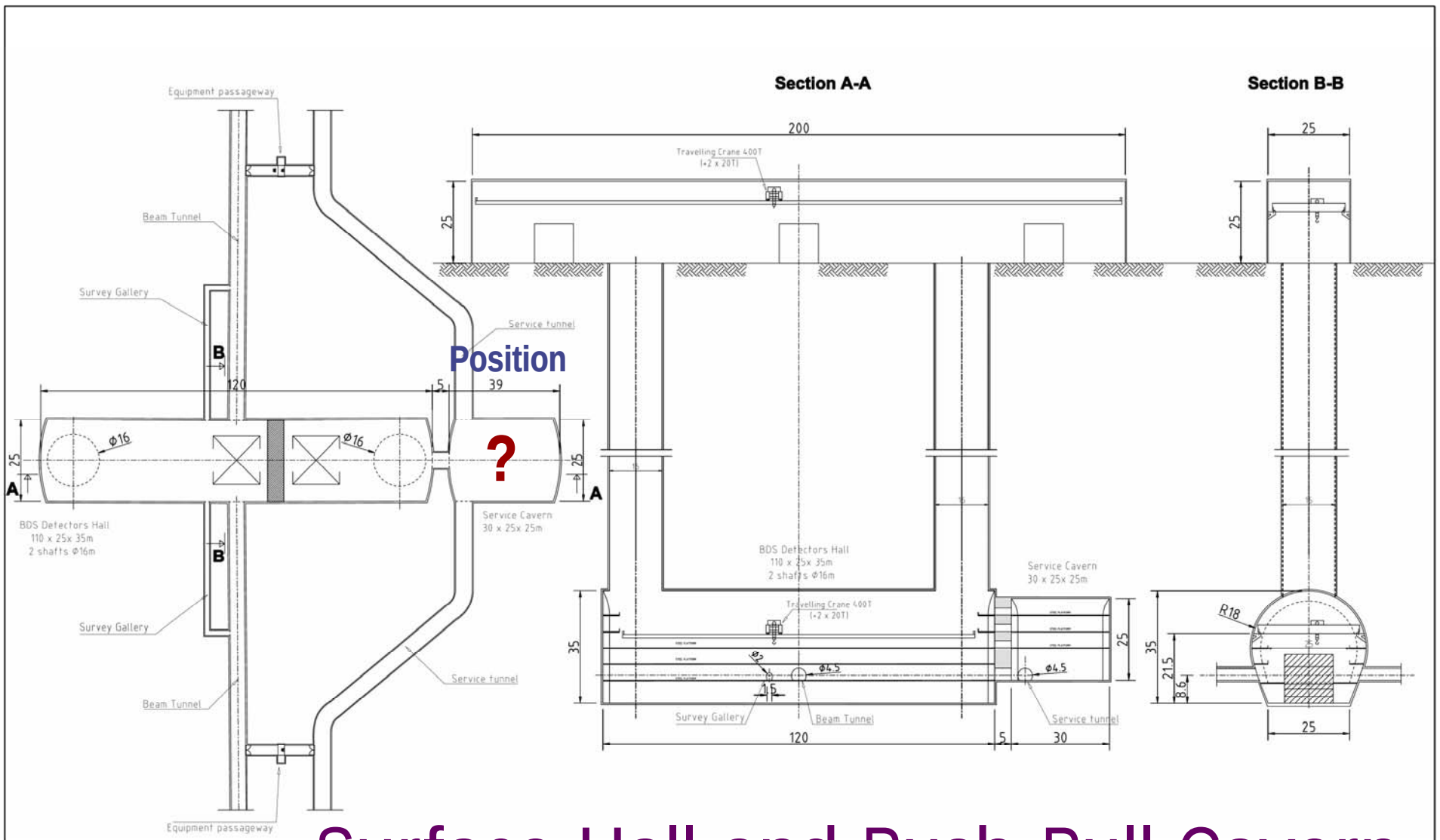


	SiD	GLD	LDC
IP	0	0	0
End of detector	5.9	7.5	6.2
Desired opening	2	2.5	3
Warm section need to end after z=	7.9	10	9.2
Reduced opening for fast fixes	2	1.5	2
Warm section need to end after z=	7.9	9	8.2
TPC fully move out			7.7

SiD (opened)



Since opening of detectors on the beamline is intended only for quick fixes, the required width for opening may be smaller that for opening off-beamline



Surface Hall and Push-Pull Cavern

with Shielding Wall and Service Cavern

Drawing ILC_BDS-Detectors_Hall-PushPull_Option / Clay Corvin
http://ilcagenda.cern.ch/materialDisplay.py?sessionId=48&materialId=0&confId=1049 of **GDE/e+e-** Session at Valencia

Preliminary LDC position on a possible PUSH-PULL detector configuration at the ILC

02.11.2006

The LDC detector concept group in this document tries to formulate a position on the question whether or not a push-pull arrangement for the ILC detectors is feasible. The position summarised in this note is mostly the result of the work of the LDC members in the push-pull task force, Norbert Meyners, Karsten Buesser, Henri Videau, and the LDC contact people. Due to the shortness of time we have not been able to discuss these questions widely in the community. Such a discussion will take place in Valencia, at the LDC meeting, which is scheduled for the time right after the ECFA meeting.

We like to stress that we can only give a very preliminary assessment of the push-pull configuration at this moment. We therefore concentrate on a few important items of technical feasibility, which are discussed below.

The LDC concept stresses that we are convinced that two detectors at the ILC are of very high importance. We are convinced that two detectors, designed towards the same general physics questions, but realised in complementary technologies and designed and operated independently of each other, offer a significant advantage and, in the end, will significantly increase the scientific output and return from this machine. Any technical considerations should take into account that both detectors should be operated on an equal footing, that nothing is done which jeopardises the operation of one or both detectors, and that the construction and operation of both detectors remains equally attractive for the community.

Preliminary LDC position on a possible PUSH-PULL detector configuration at the ILC (02.11.2006) /2

We have studied the feasibility of a push-pull configuration in a very superficial and pre-liminary manner. We think that there are no fundamental reasons why such a scenario can not be made to work, if enough effort and enough money is put into its realisation. It clearly is an engineering challenge to move two detectors of some 10000 metric tons each over 10th of meters into a position which is known on the micron level - a challenge, which to understand, to investigate fully, and for which to propose solutions will require much more time than a few weeks. In the end we will need a real engineering study to come up with real and reliable numbers. Such a study has not yet been done for the LDC concept.

Nevertheless we like to make a few rather general statements:

1) Because we are lacking a detailed engineering study, we do not think that we can claim that we can do the switch-over between two detectors within 10.5 hours We do not exclude that a careful study will show ways how to achieve such a goal. At the moment however the most optimistic scenario which we can support is that we can do a switch-over in a few days, which, after some time and experience, may be reducible to about one day. We should not forget that this time does not include any time it will take for the machine to restart after this rather major interruption. It also does not include any time needed to take dedicated data on the Z-pole to do a data-based re-alignment of the detectors.

Preliminary LDC position on a possible PUSH-PULL detector configuration at the ILC (02.11.2006) /3

Deeper Hall (~2m)	To move the heavy detectors as a whole will require a much stronger support structure for the detectors. We think this has to be taken into account by increasing the vertical distance between the beam-line and the hall floor by something like 2m.
Sophisticated Cabling	We like to point out that a push pull scenario needs a much more sophisticated planning of the cabling system of the detector. There will be obviously no time to de-cable and re-cable the detector between moves. In the end it might well be that the possibility to move these cables might define the moving speed.
Trailer Size	On the movable platform the magnet power supply and the dump resistors will need to be included.
Counting Room	We should not forget that for each detector one will need space for counting rooms in a service cavern like CMS or with a false floor with a good height of about 1,8m or like L3 in the shaft or in a trailer. (It is however doubtful whether all this could be put in a trailer and if we do so we would need a bigger hall.)
Survey Galeries	Since we will need to do frequent re-alignment, the design of the hall should foresee the infrastructure to do this. This might mean the inclusion of some survey galleries or the like, which allows the installation of a stretched wire system, a hydrostatic levelling systems or something comparable. This will be vital to re-connect the final focus system and the detector after each move.
Effort & Money	In summary based on our current and very incomplete knowledge, we think that there are no a-priori arguments why such a solution can not be made to work, if enough effort and money is spent on it.

Preliminary LDC position on a possible PUSH-PULL detector configuration at the ILC (02.11.2006) /4

In addition we like to point out the following things:

Even though a sound engineering design of a push pull situation can probably show ways on how to make things work, we should not omit that there will remain a significant risk associated with this scheme. This might result in much longer down-times than we think at the moment, and might require significantly longer re-calibration times of both detector and machine. We should not forget that we then concentrate everything on one beam-line. Any major component failure in this beam-line will result in a shutdown of the machine.

A major problem which will need careful consideration is the sociological one:

- How do we make sure that there are two equal detectors, not a first and a second one?
- If we fail, how will we be able to assemble a strong enough collaboration for the second detector?
- How do we ensure that every little budget crisis will not be used to kill the second detector?

Summary

- Underground Cavern
  - Size 55m x 25m — OKAY, with inclined Walls!
  - Shaft at the end — OKAY
  - Service Cavern — **YES**
  - 2. Access Shaft — **YES**
  - Separation Wall: — **NO, NO, NO**
- Surface Assembly (To save time)
  - CMS style — OKAY and preferred
  - GLD style — Possible
- Push-Pull (To save a lot of money) — **Technical Challenging**, but possible or?
  - ➔ **Money & Effort** — **„Sociological“ Difficulties**
    - ➔ **Longer & Deeper Cavern**
    - ➔ **...**

  Acepted (for the RDR) **or?**

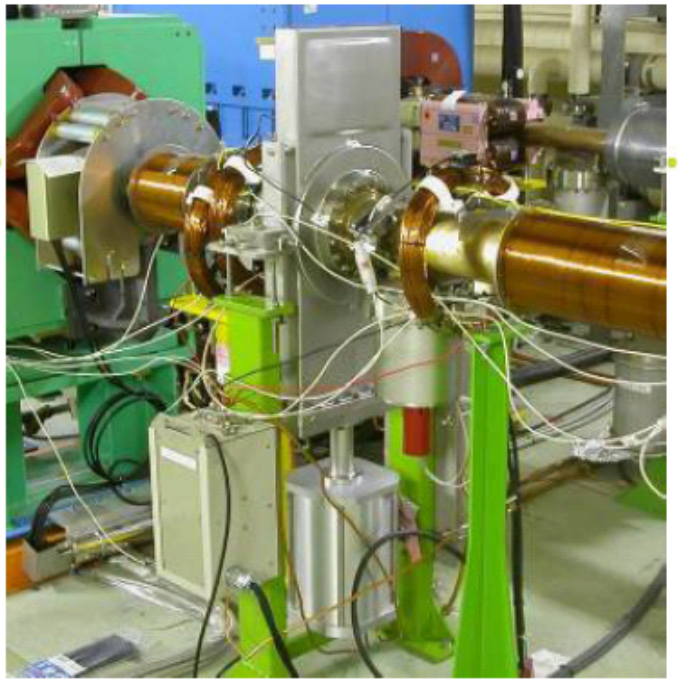
  How much **complementary** are the three concepts?

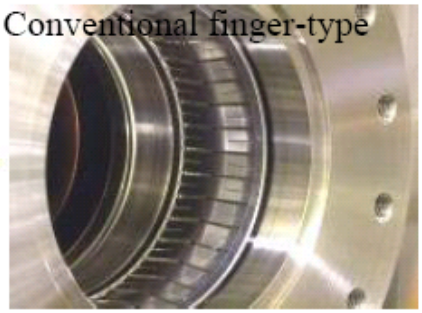
Open Questions:

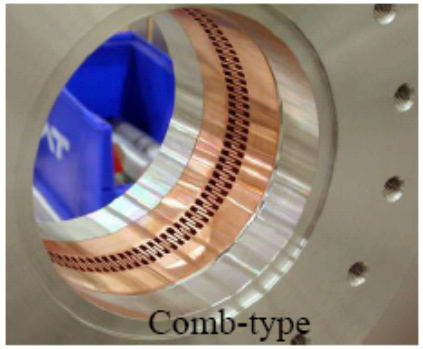
- Where Electronic and Auxiliary Caverns? (Size, Cables, Pipes, ...?)
- When to start detailed/Engineering Design? (Gaps, Fixtures, ...?)
- .....

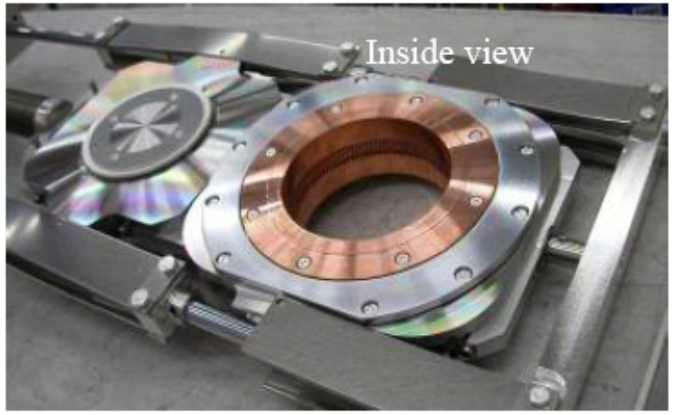
Vacuum connections

- In the warm part between two FD cryostats (QD0 and QF1 parts), a vacuum connection will be made with double valves
- Each valve would have dual apertures (at 7m from IP the beamlines are 10cm apart) or (Y.S.: preferred) would consist of two independent gates
- RF shield is needed
- Photos show gate valves considered for KEK Super-B [Y.Suetsugu, KEK]
- The technology is applicable for ILC (sizes to be scaled down) [Y.S.]



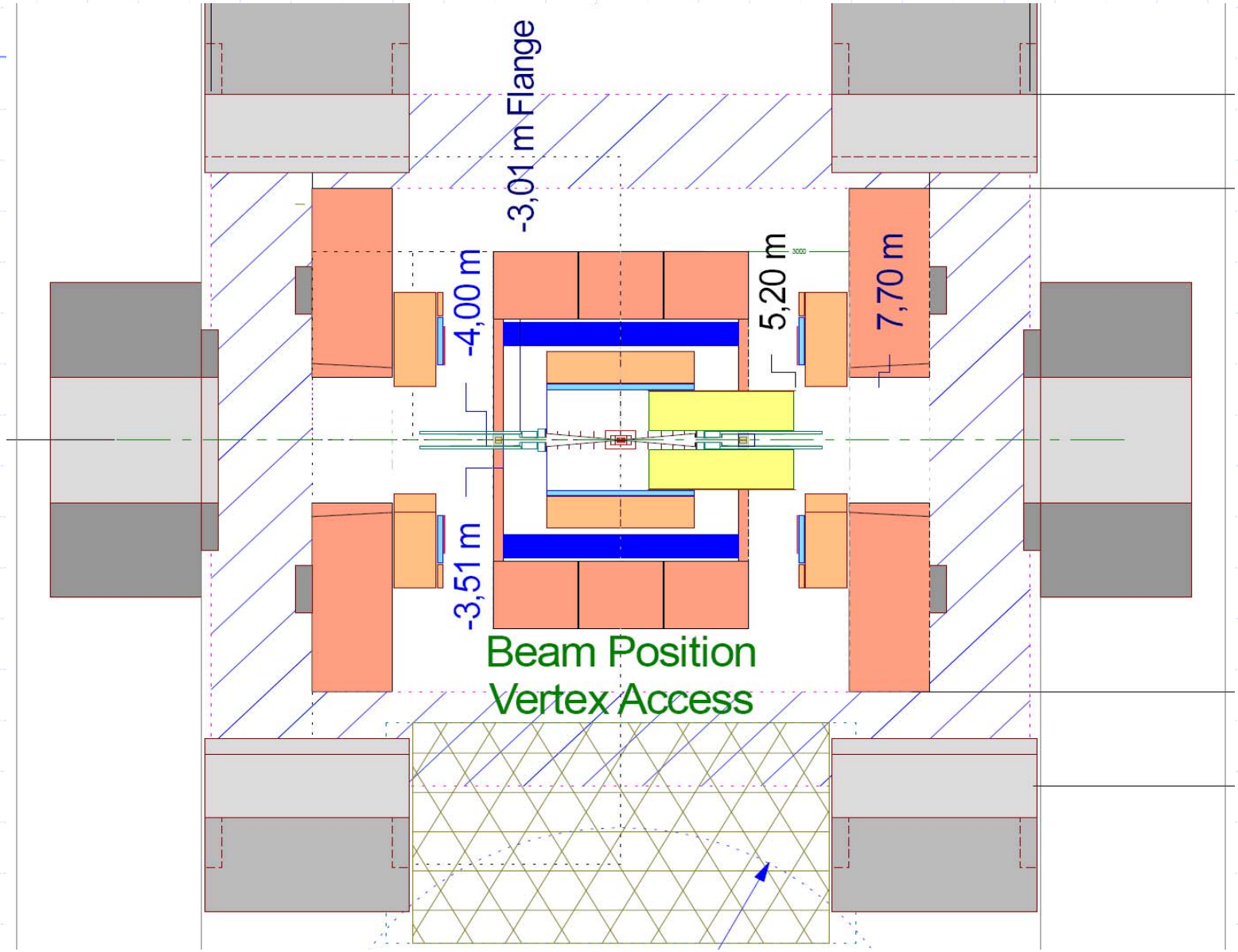




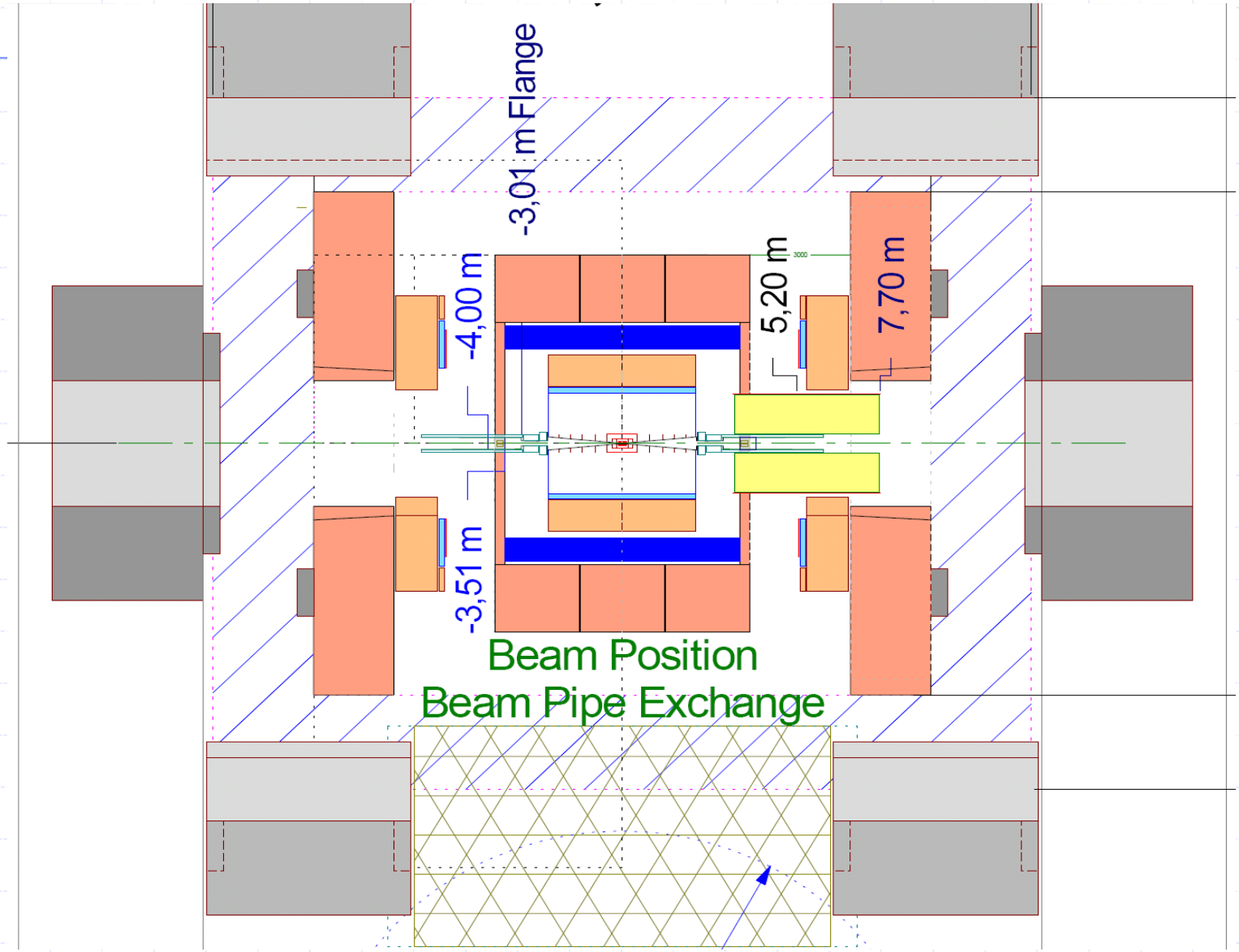


Gate valve with comb-type RF shield and its modifications (Ag plated SS => Cu teeth). Y.Suetsugu, KEK, in collaboration with VAT Co.

Vertex Access



Beam Pipe Exchange



Would 1 IR lead to 1 Detector?

- **NO!** We have no intention of going to one detector.
- In my opinion, the case for two detectors is much stronger, if it does not require a second expensive beam line
- However, it the burden on the detector community is to develop two **complementary** detectors.

Luminosity sharing & efficiency

- Assumptions in the two IR baseline:
  - **machine is designed to allow switch between detectors on the timescale of weeks-months**
  - **estimated switch-over time, for realignment of BDS beamlines and their retuning, is 3-4 days**
    - the pulse-to-pulse switch-over, which is sometime mentioned, is not supported by hardware of present ILC baseline
- Considerations for single IR
  - **it may be argued that recovery of full luminosity in a BDS that was OFF only for a day, should be rapid**

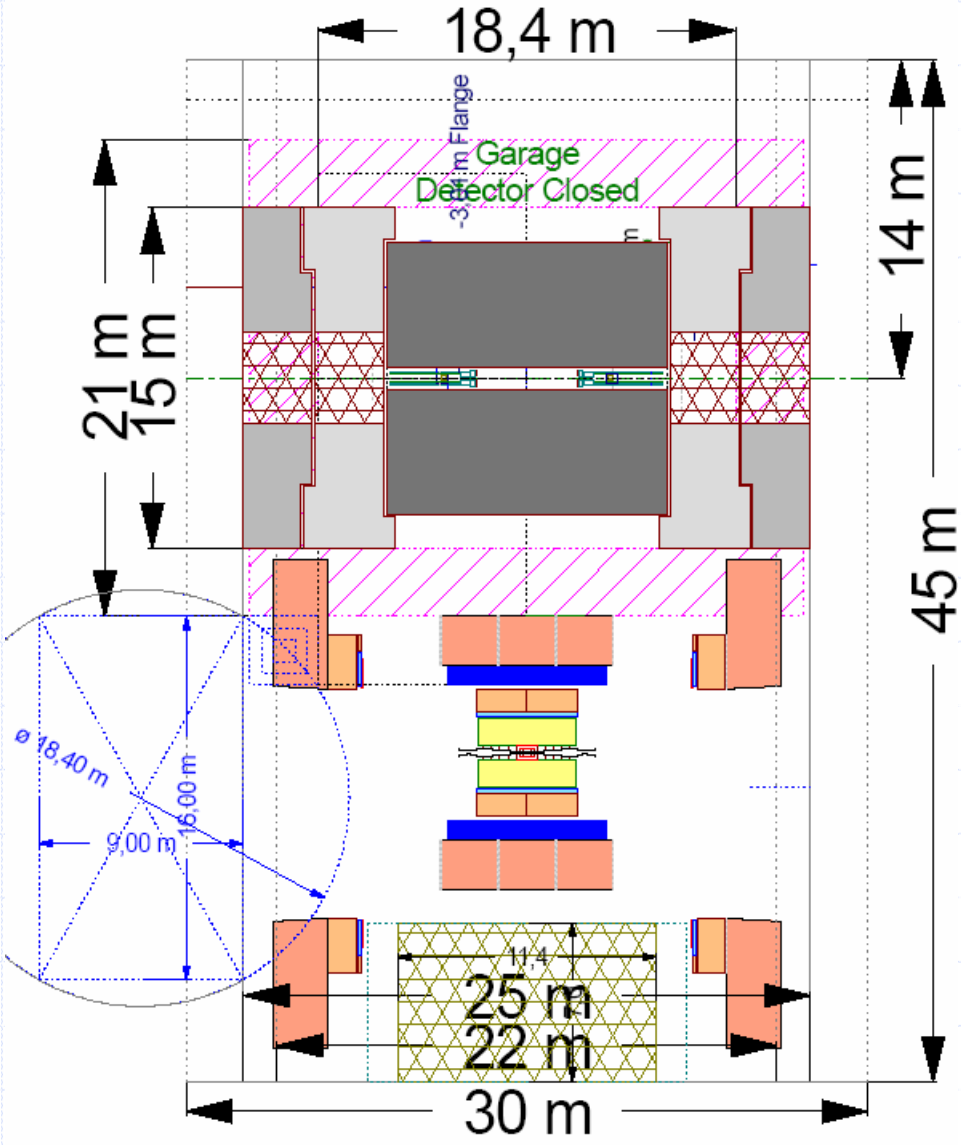
Different L*

- Next slide shows how different L* can be arranged
- Part of FD which stays with detector is different
- Fixed part of FD is the same
- Optics study show that such change of drift between QD0 and QF1 parts of final doublet is possible
- However, with different L* there could be more time spent for retuning the optics, collimation, etc.
- It may be beneficial to consider a unified L* for push pull design. (E.g. 4.2-4.5m?)
- For the moment, still consider L*=3.5m, as moving to longer L* may only simplify the FD design

Detector in Garage Position

Q: Shaft Position ?

Best position
with E-Trailer! (?)



Detector in Garage Position

Q: Shaft Position ?

Best shaft position without trailer! (?)

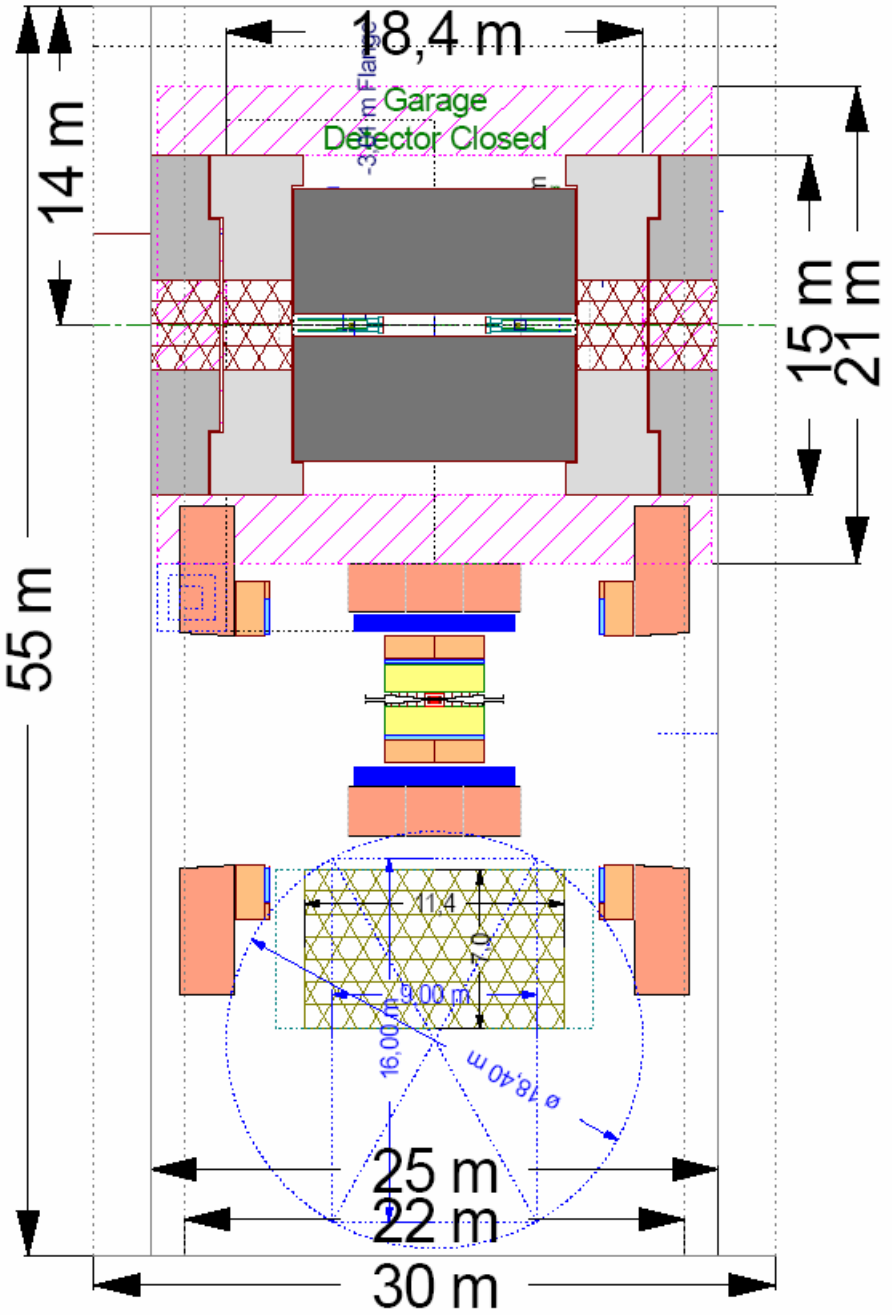
Only trailer problem left

Q: But how the stair case and the elevator in the shaft?

➔ Turn rectangle and all detector rings (?)

Q: Second shaft?

Safety

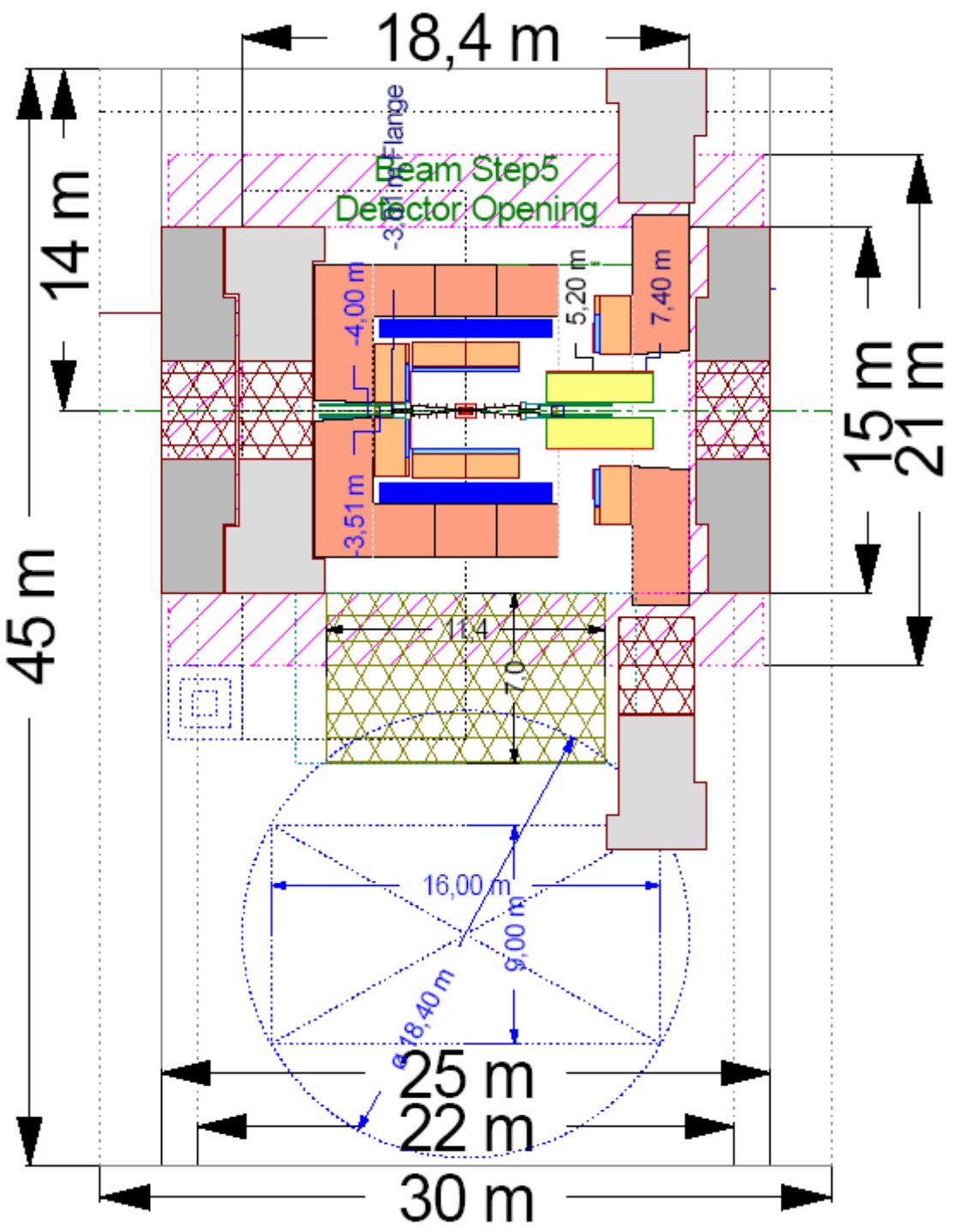


Detector in Beam Position

Shielding modifed

- 4m for Machine
- Overlaps at the Gaps

➔ E-Trailer smaller



Norbert Meyners, MEA