Report from MDI Meeting at SLAC

Karsten Buesser
ILD Integration Meeting
22.01.2015

MDI Meeting

- SiD workshop at SLAC: 12.-14.01.2015
- Attached MDI discussions
  - MDI session during the workshop
  - Expert's discussion (1/2d) after the workshop
- Main topics:
  - Interaction region infrastructure
  - L* issues

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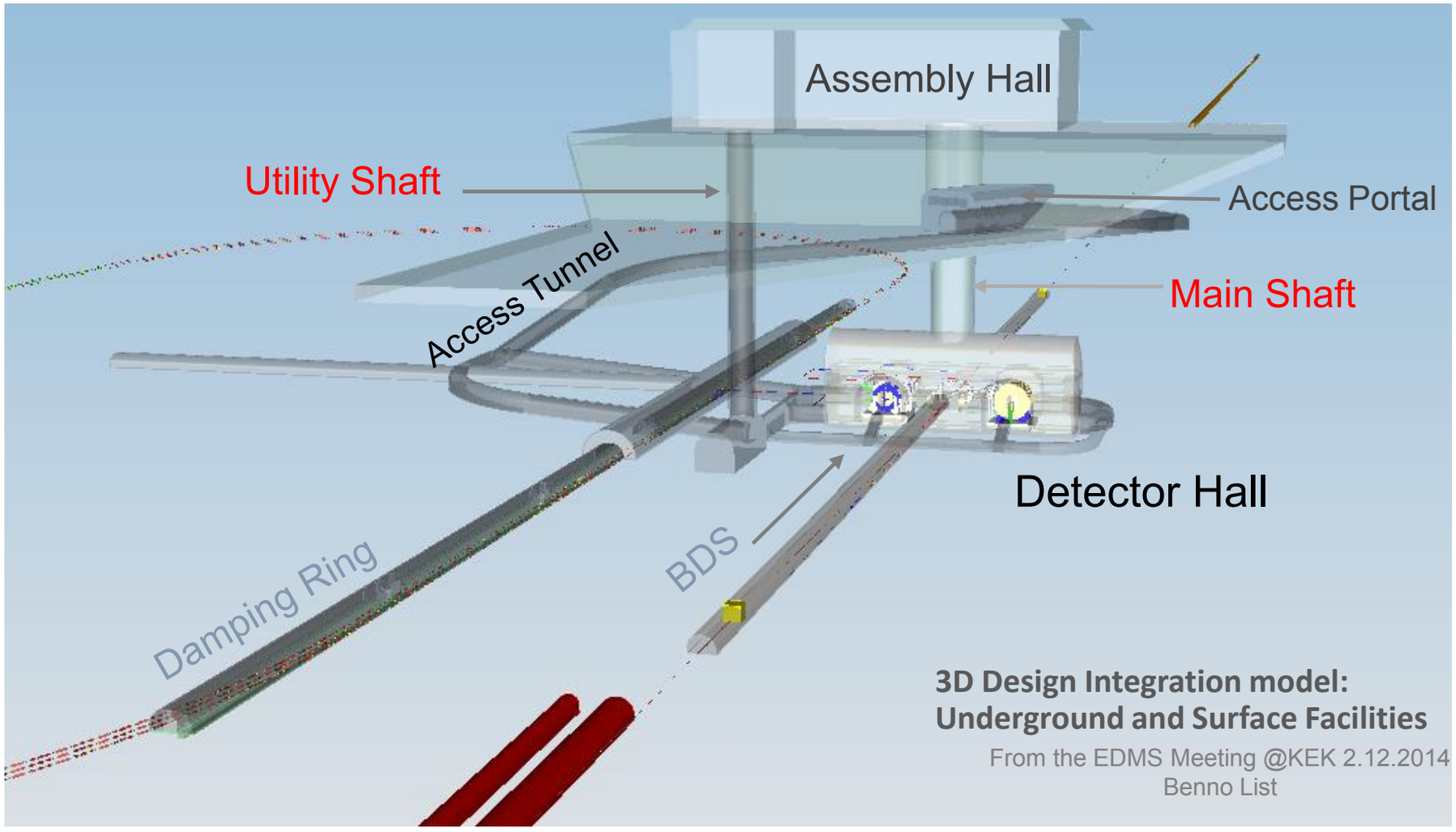
Overview of the DH scheme change

M. Miyahara

3D Model: New Baseline Proposal (Hybrid A')



Baseline Location

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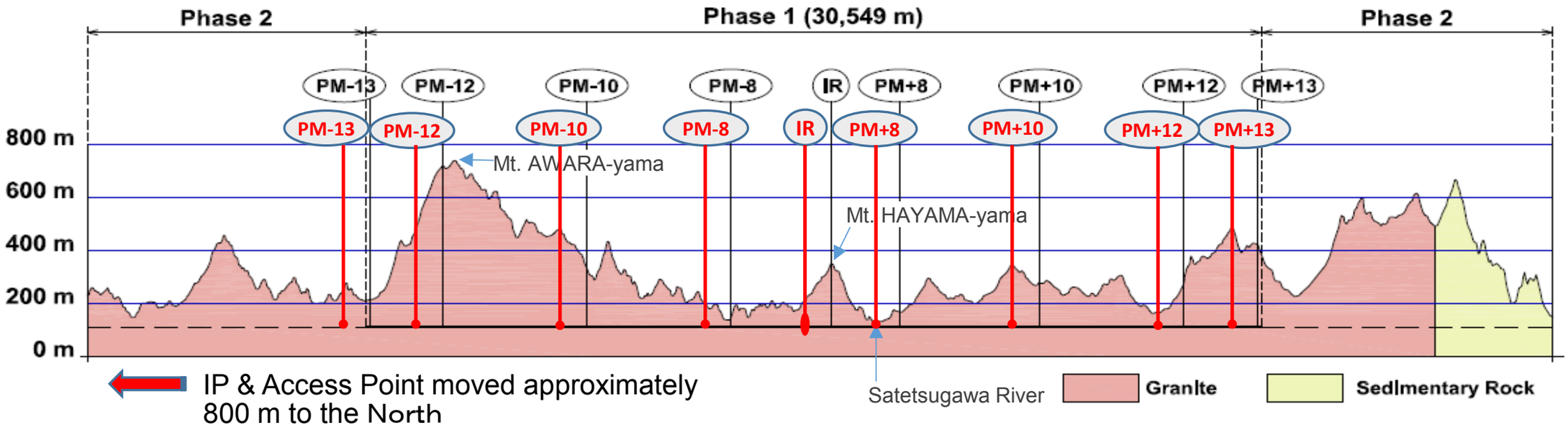
New Baseline location in KITAKAMI Site



Longitudinal section of KITAKAMI Site

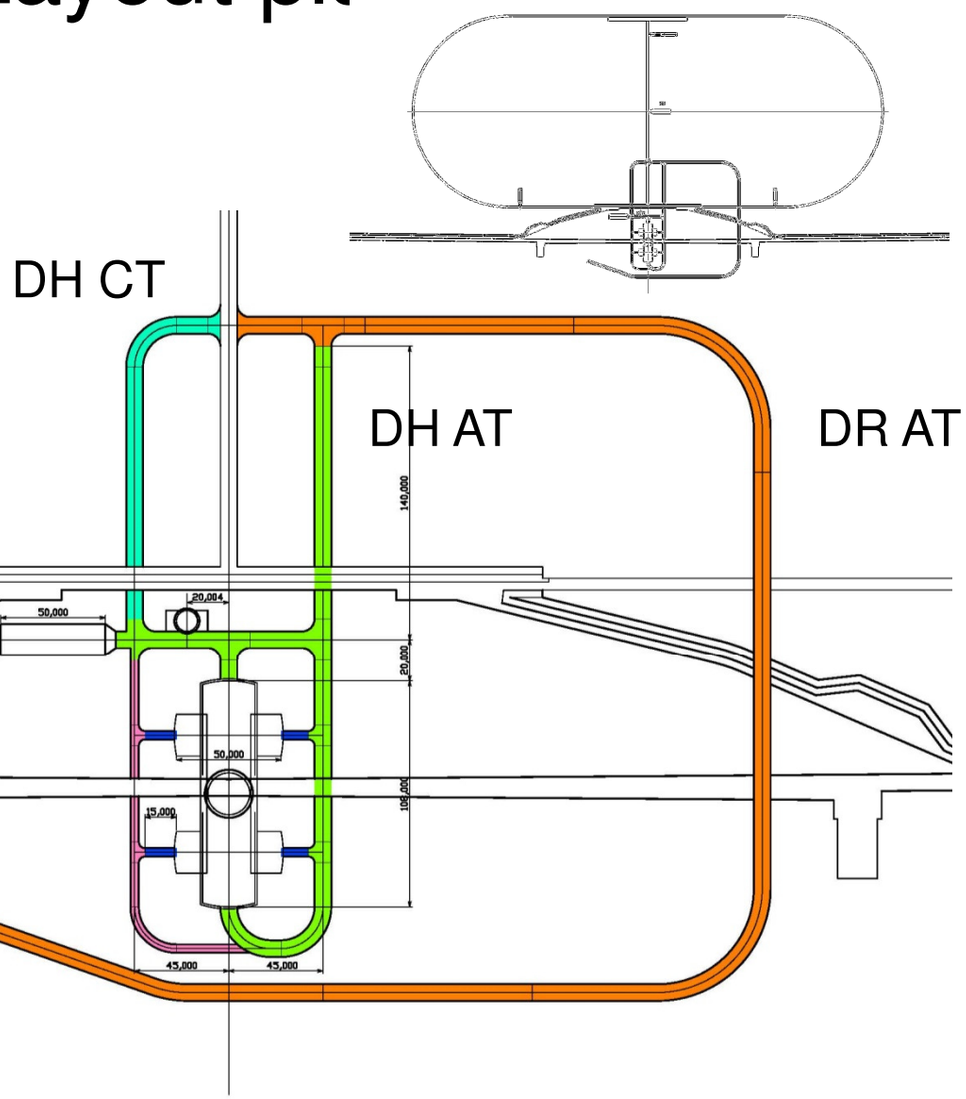
M. Miyahara

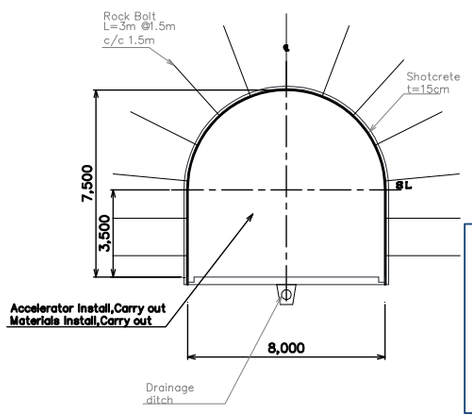
IR Layout

LINEAR COLLIDER COLLABORATION

New Baseline Design Layout plan

Shaft Access for D/H
Detectors assembled in Assembly hall
Two access ways
by elevator and by vehicle





DR A/T H7.5m W8.0m
Access to DR and DH
DR machine installation
D/H vehicle access

Y. Nishimoto

IR Shafts

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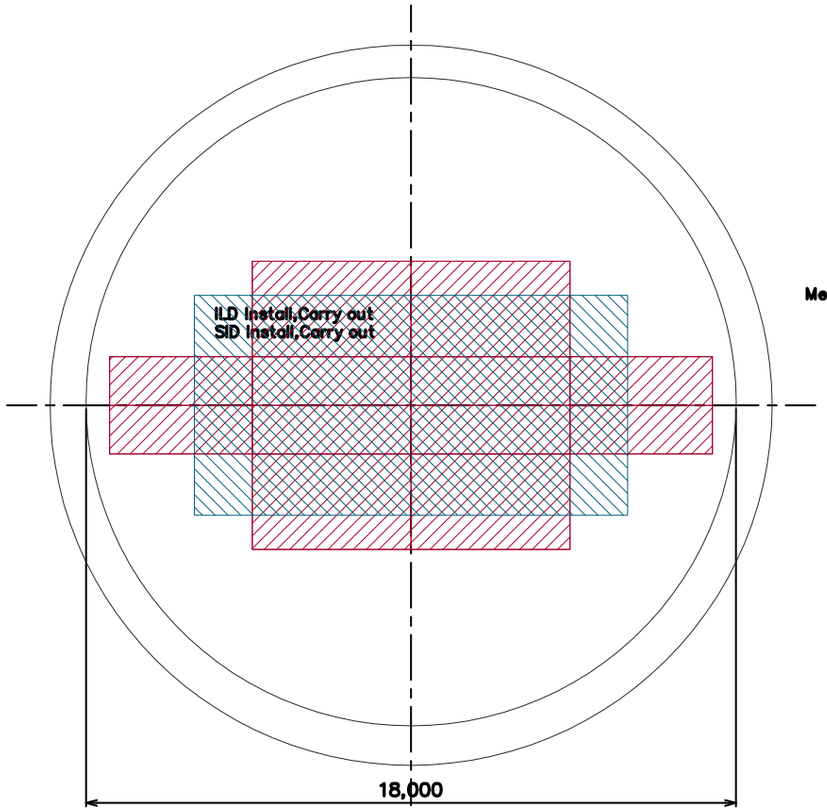
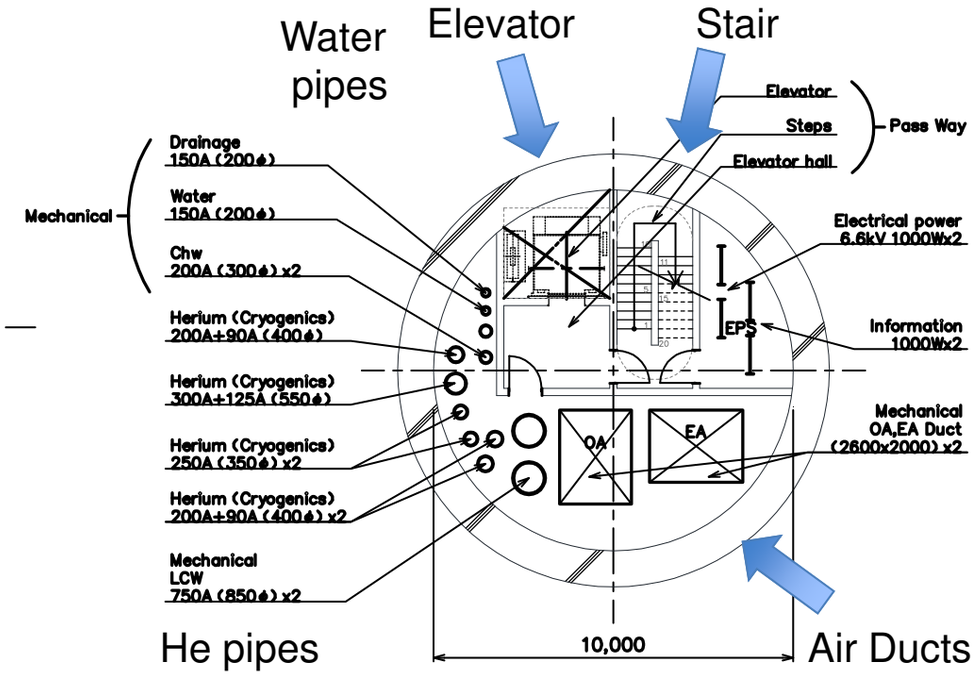
New Baseline Design Shafts



Hybrid (HT–VS) –Main Shaft
Real Circle

Main shaft D=18m
Center of DH
Detectors Installation

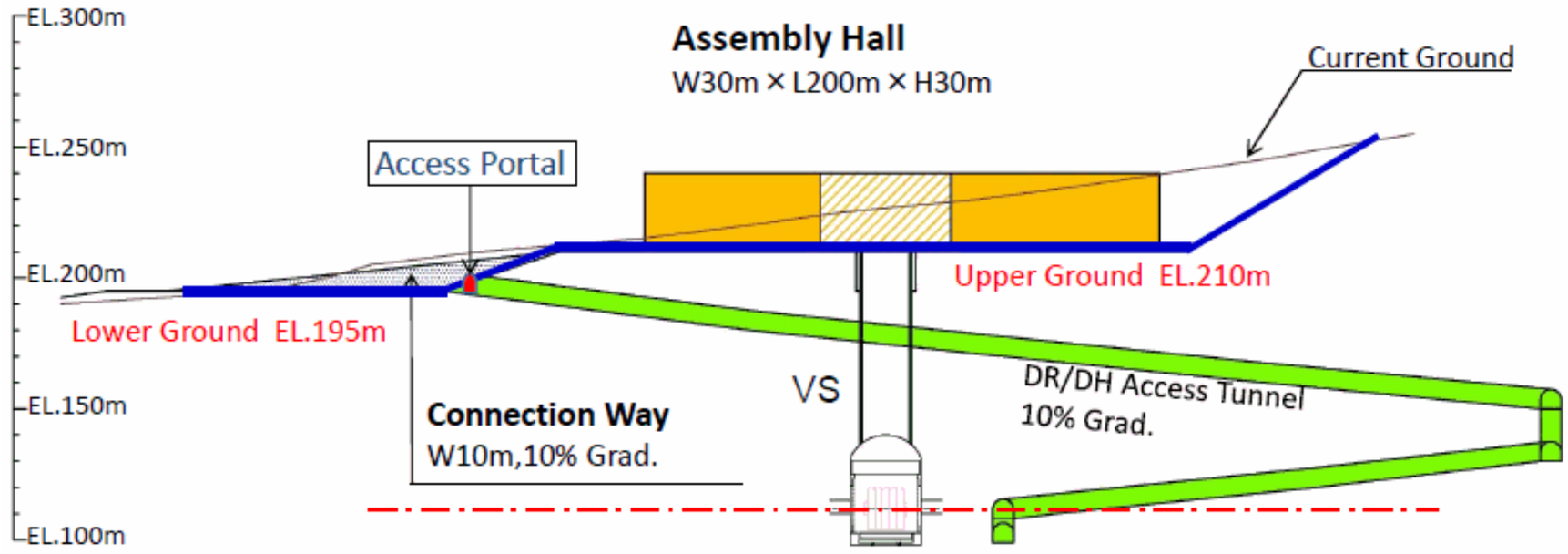


Utility shaft D=10m
Utility lines
Pipes, ducts, cables
Personnel access to D/H
Elevator and stair

IR Layout

LINEAR COLLIDER COLLABORATION

M. Miyahara



Longitudinal section

M. Miyahara

IR Surface Areas

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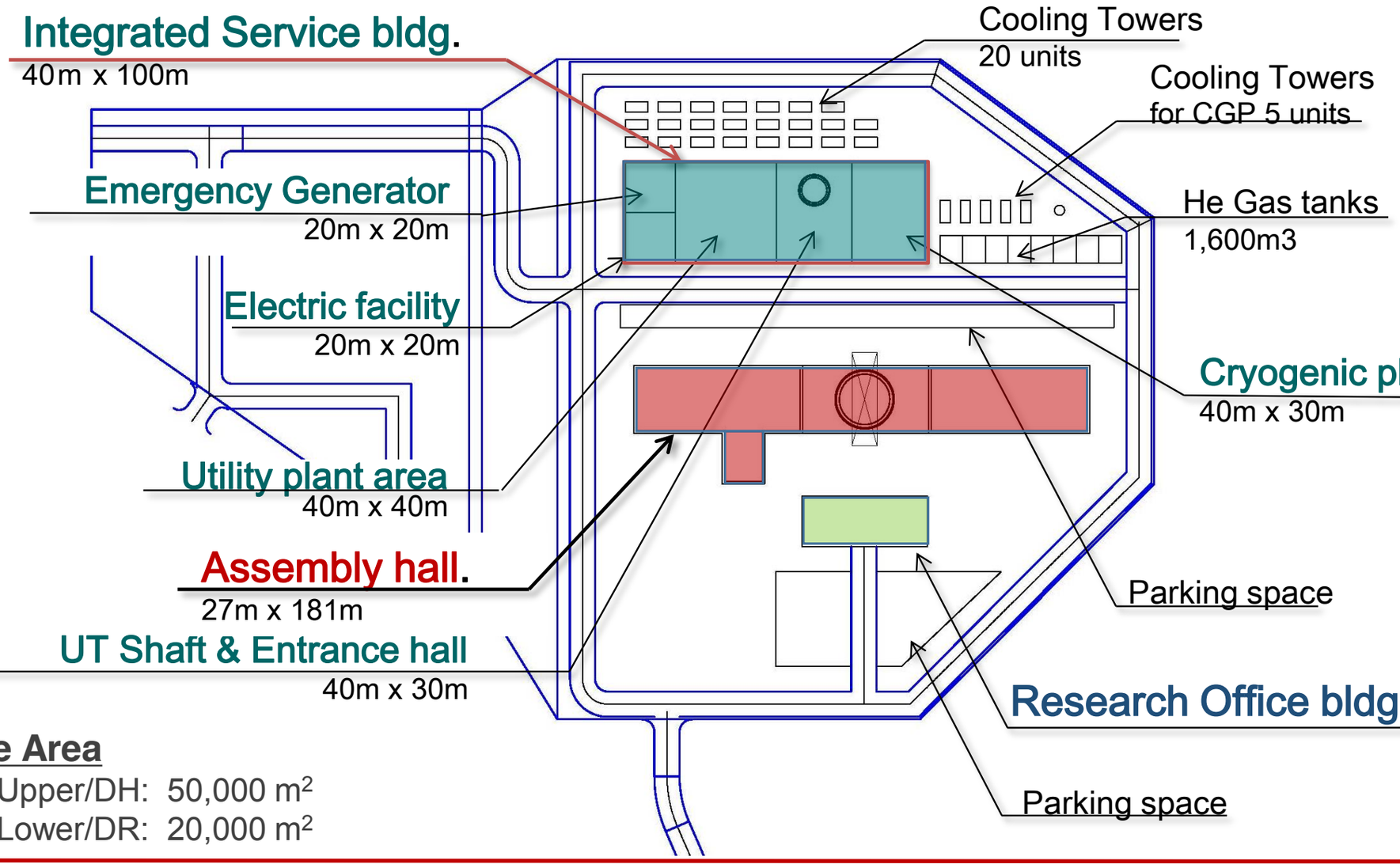
Outline of the ground facilities

Facility Arrangement on the above ground
in Operation Phase



Site Area

- Upper/DH: 50,000 m^2
- Lower/DR: 20,000 m^2

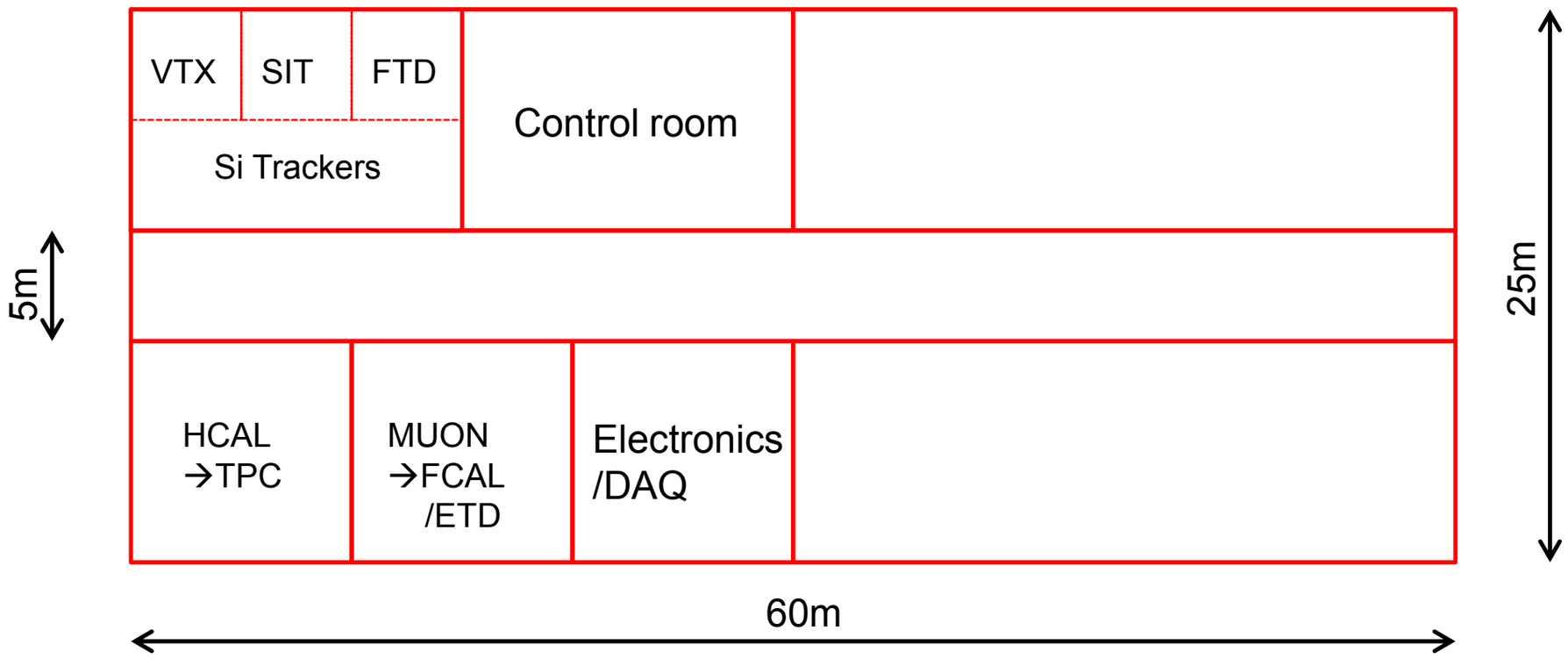
Space requirements of ILD

- We have not made this kind of survey in ILD yet
- My tentative guess is as follows
  - IP Campus building
    - Laboratory and clean room
      - Sub-detector assembly & test before installation / maintenance
      - Control room
      - ~1/2 floor of 25mx60m building
    - Office
      - Rooms for 70~140 persons
      - 3.5mx5.8m x35 rooms (2~4/room) → ~1 floor
  - Main Campus
    - Office:
      - Rooms at least for 120 persons
      - 3.5mx5.8mx60 rooms (>2/room)
      - The site should have extra space (land) to build additional office building later if necessary

Laboratory space

Y. Sugimoto

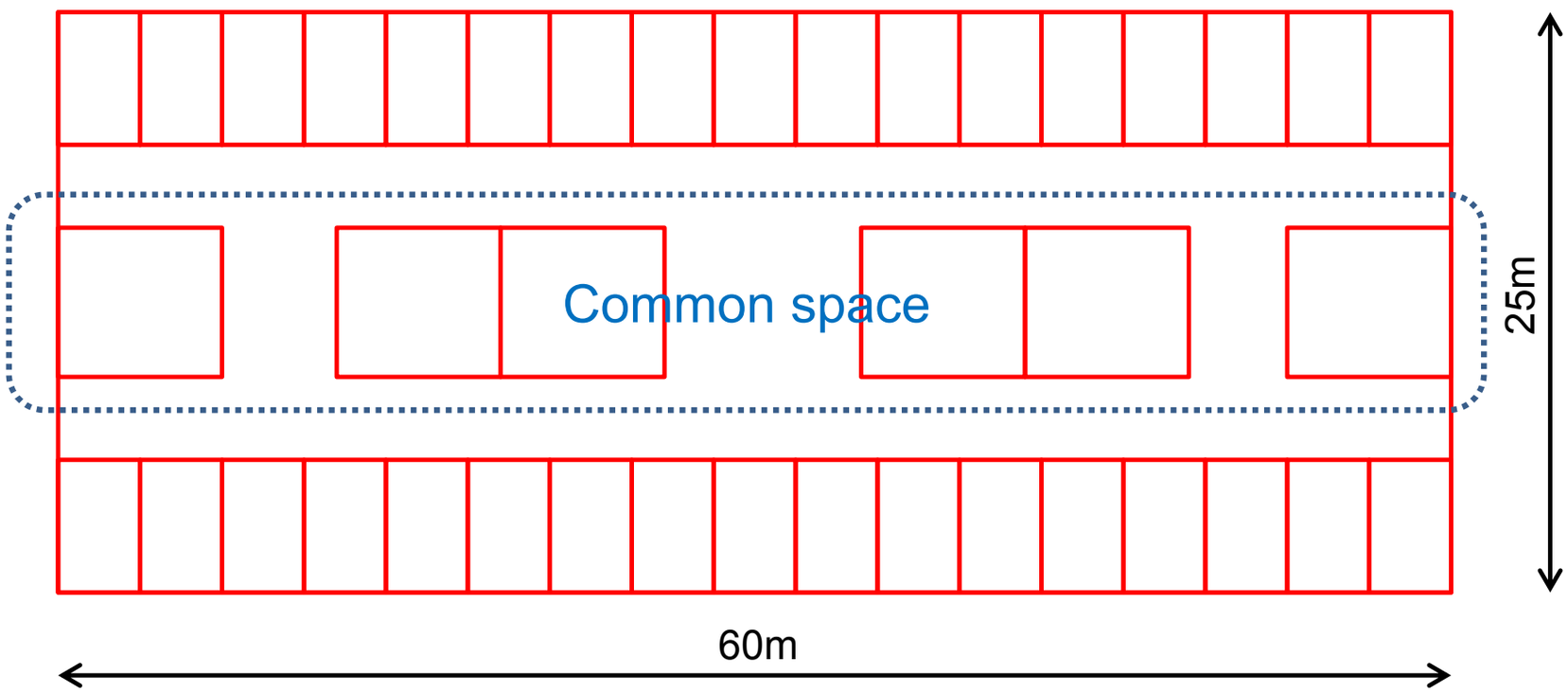
- Because of difference in installation schedule, the same space can be used by different sub-detectors;
  - HCAL → TPC
  - ECAL → Si trackers
  - MUON → FCAL, ETD



Office space

Y. Sugimoto

- It seems ~34 office rooms can be put in a floor with meeting rooms, rest rooms, elevators in common space



Cost comparison

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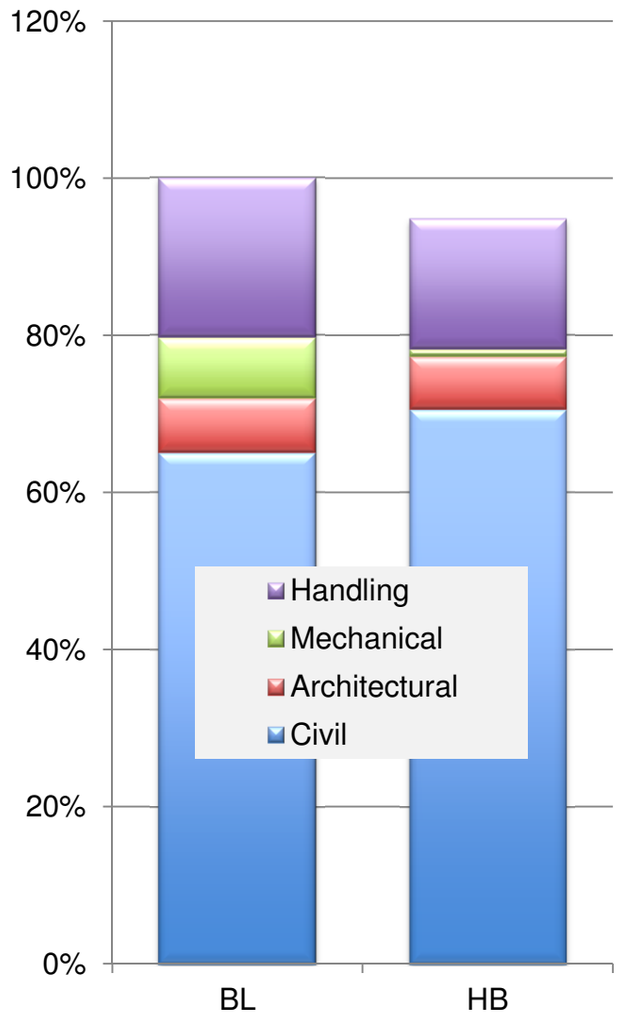
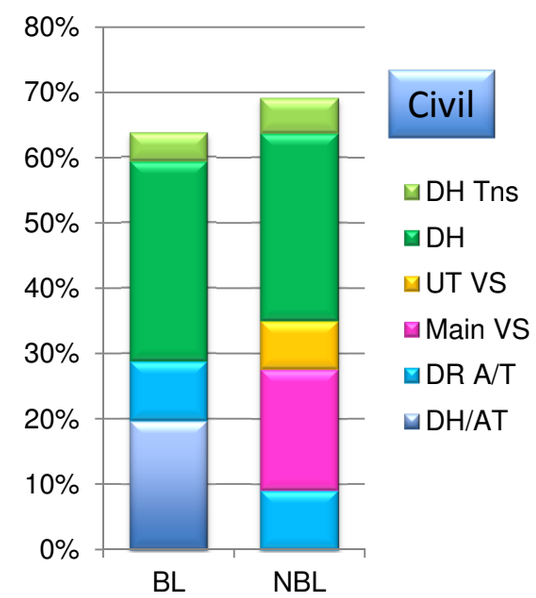
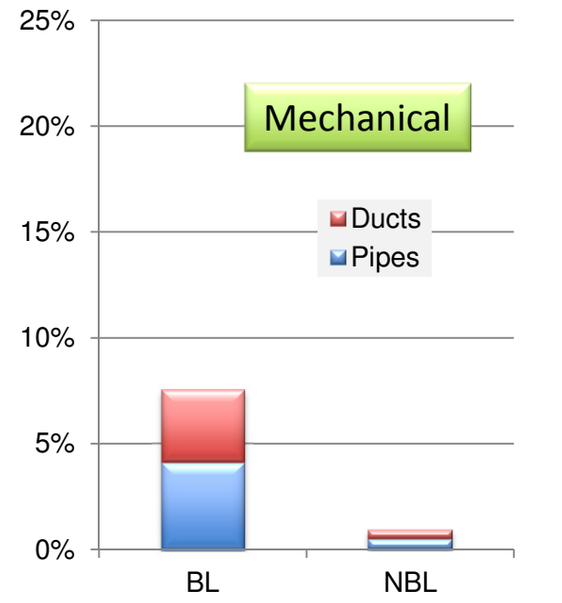
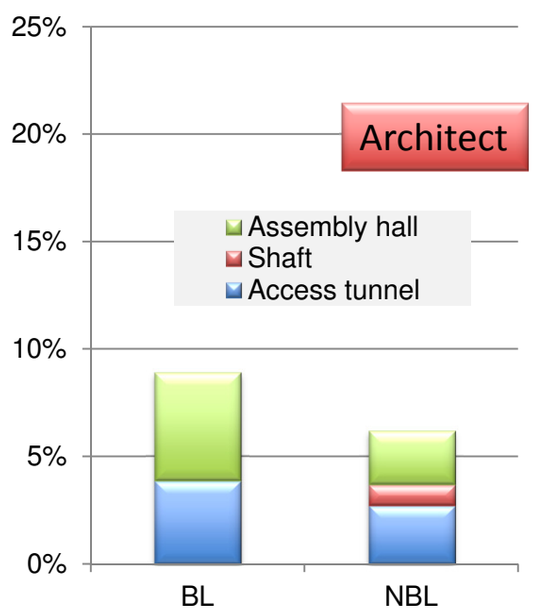
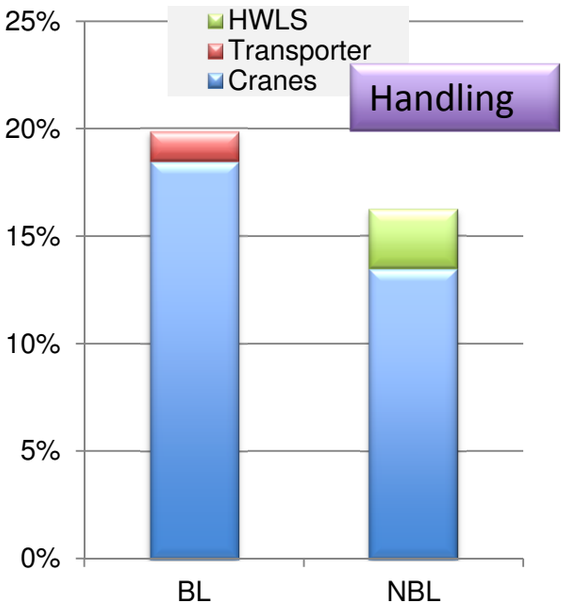
Cost Summary









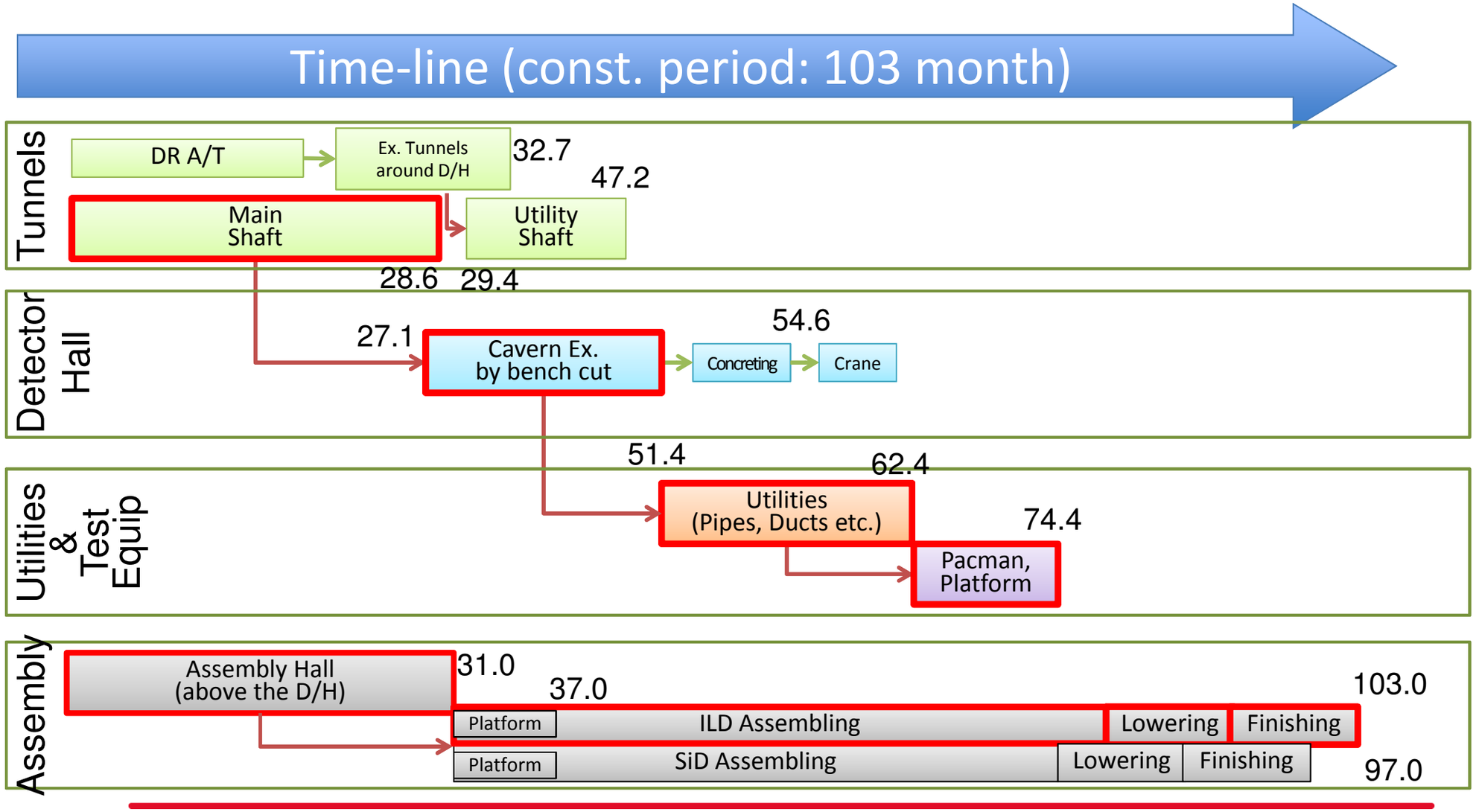


Y. Nishimoto

Timeline

LINEAR COLLIDER COLLABORATION

New Baseline Construction Procedure

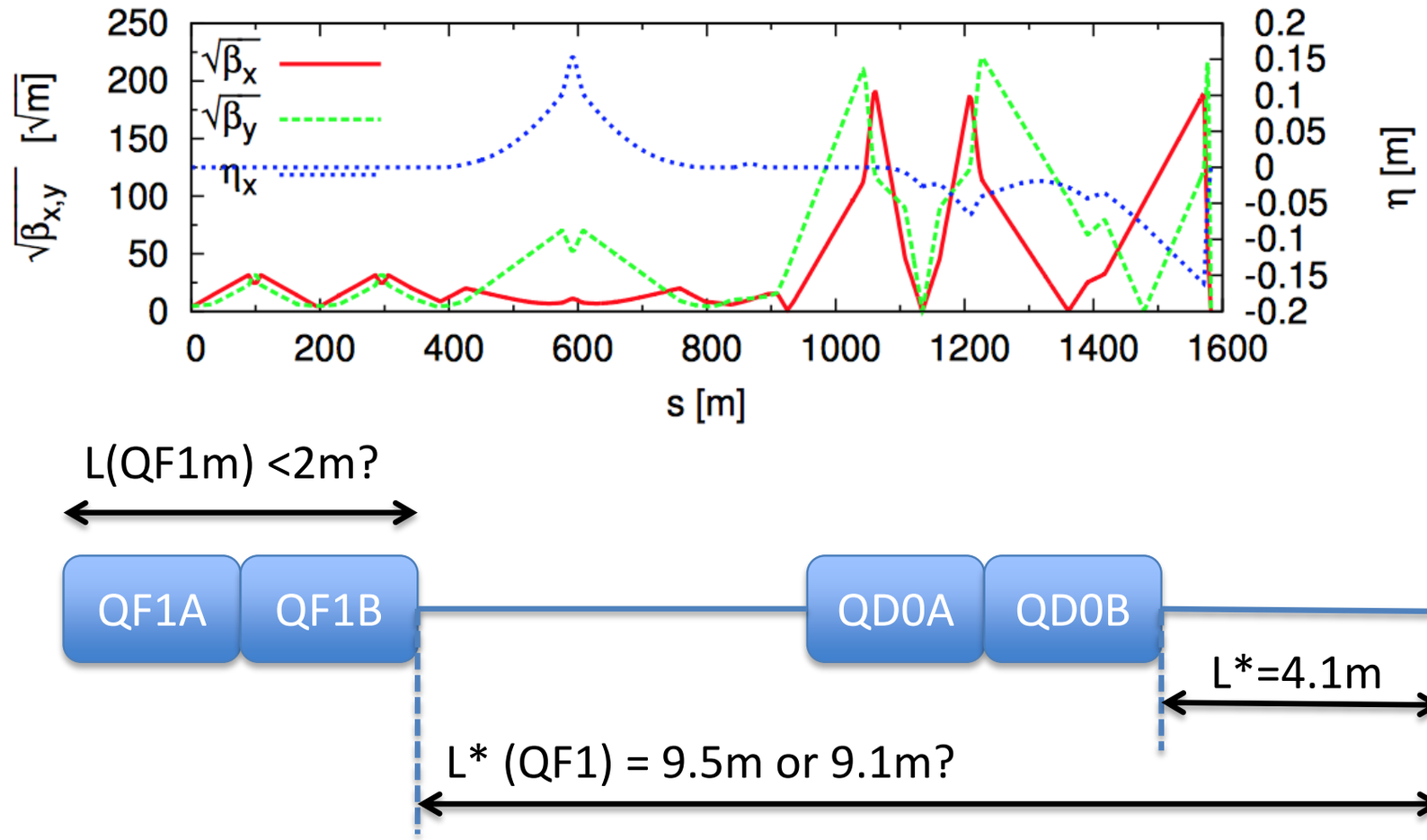


Y. Nishimoto

BDS Optics

L*=4.1m Optics

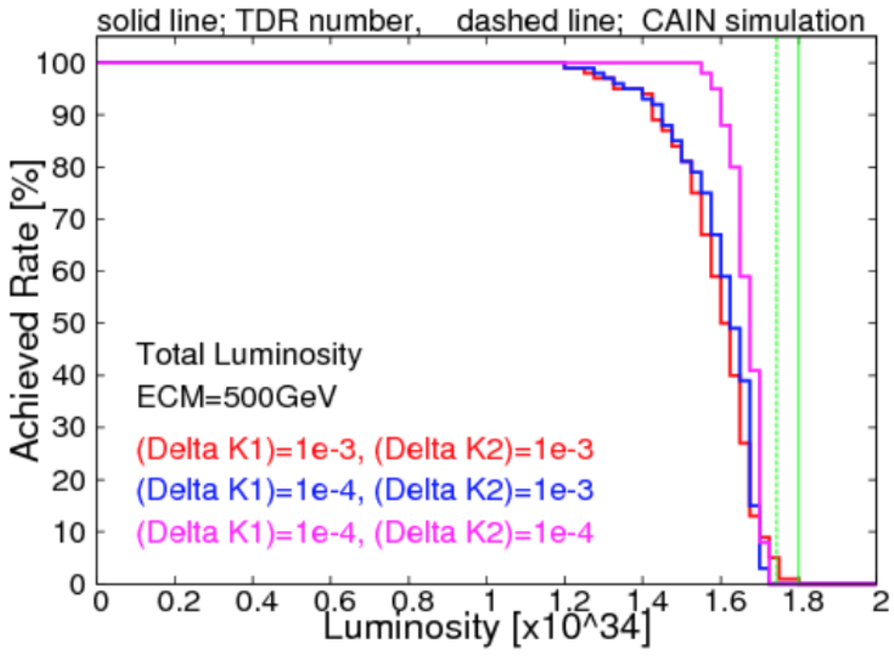
Tools: *MADX, MAPCLASS, SAD, Lucretia*

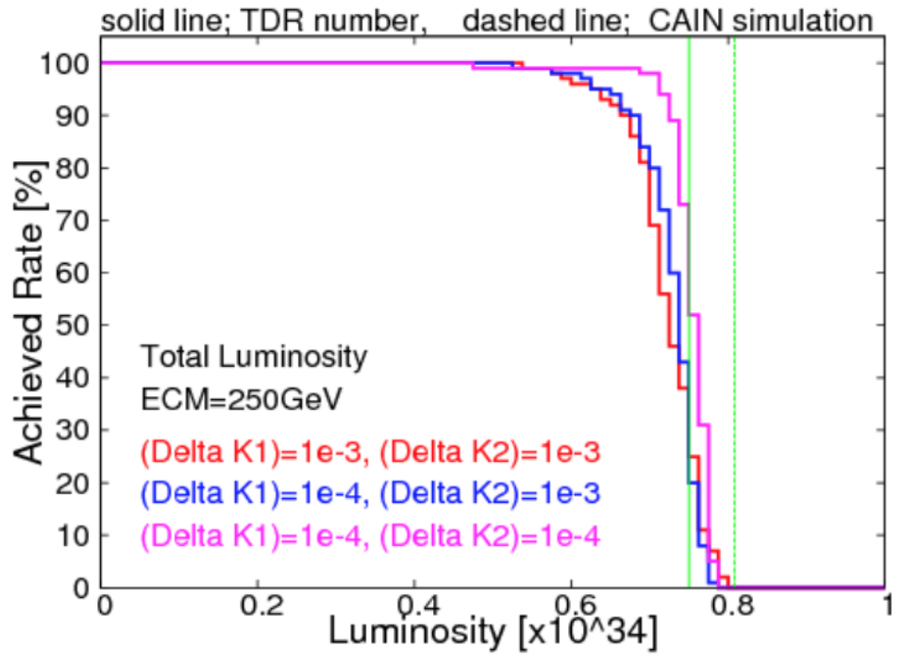


- Have optics solutions for E_{CM} = 250 GeV with improved collimation performance by powering front halves of QF1 & QD0 magnets only.
- Tuning performance driven by QD0->QF1 distance
  - Prefer QF1 closer to QD0, also shorter QF1

G. White

MC Tuning Simulations
(*T. Okugi, KEK) – SAD + CAIN*

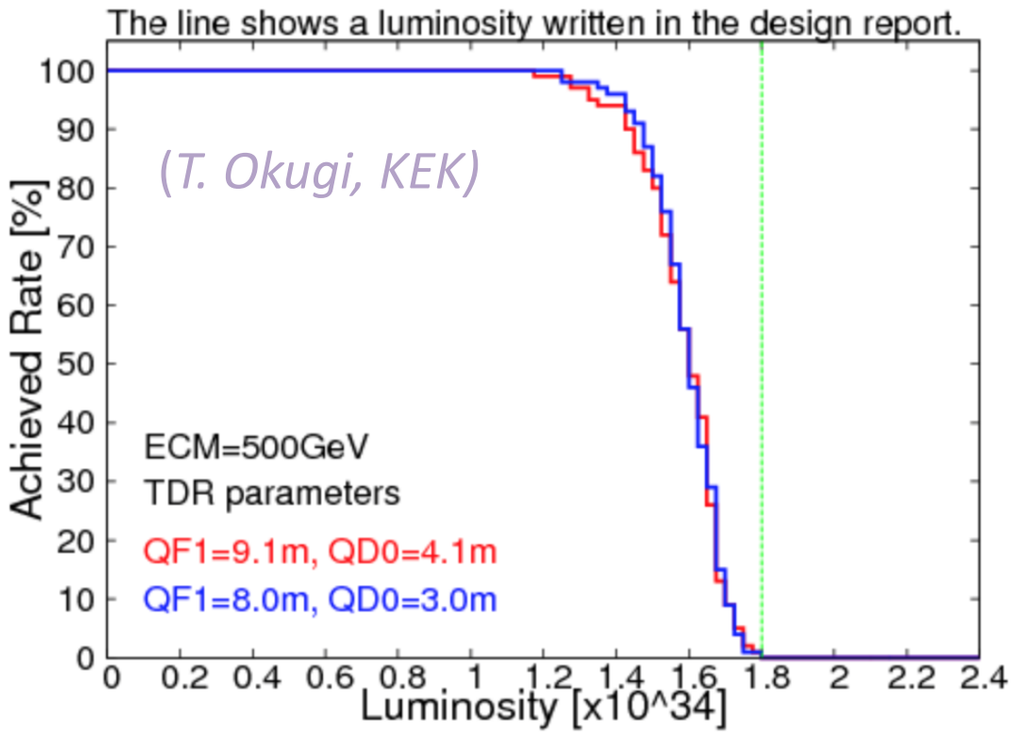




- Tuning simulation results for E_{CM}=250,500 GeV
  - *Compare magenta lines to outer green lines depicting design lumi*
- 4.1, 9.1m QD0, QF1 L* configuration
- Standard tuning algorithms no longer sufficient to deliver design luminosirty, more work required in the future to specify a tuning system and/or improved assumption of BDS delivered beam quality.

G. White

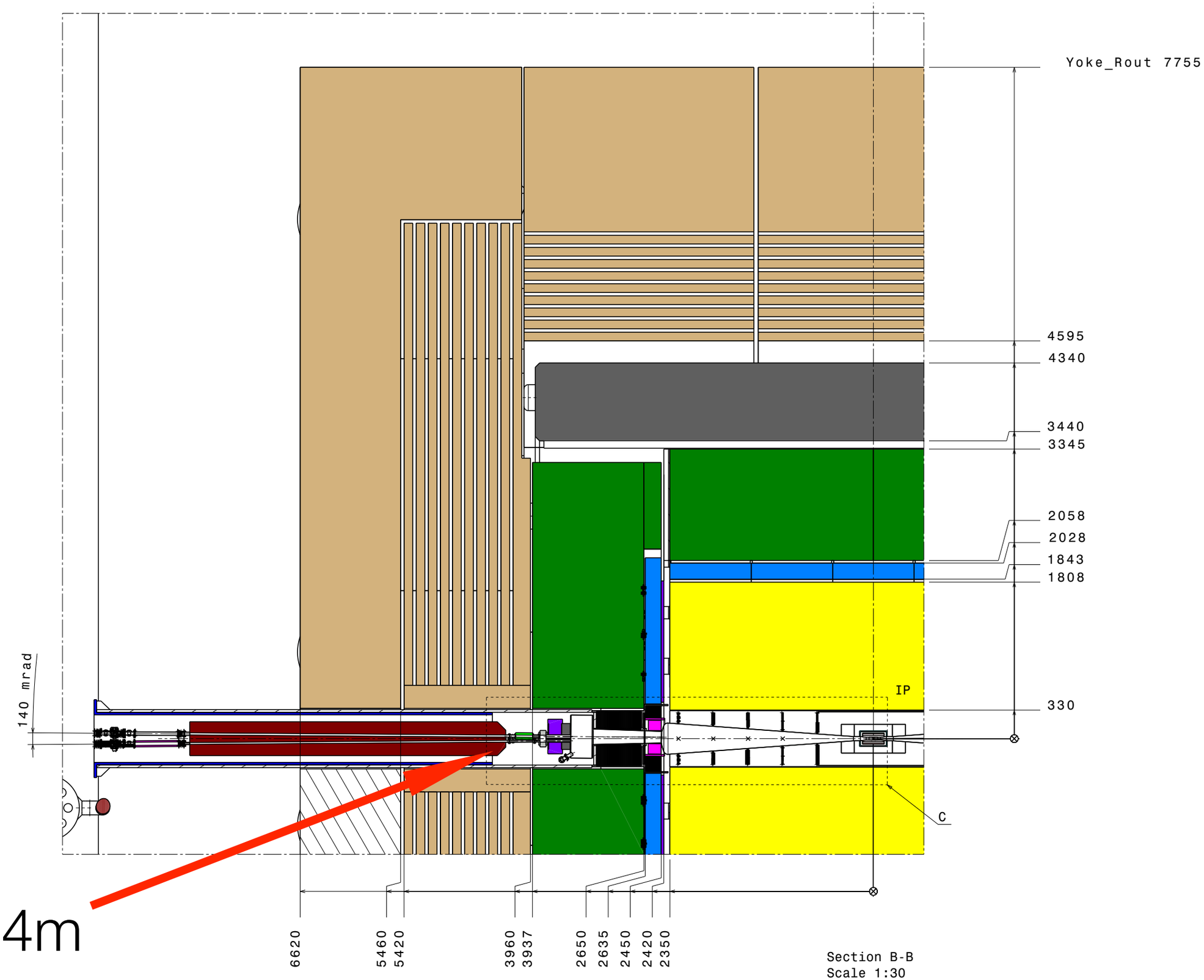
Recover Tuning Performance @ Smaller L* by Moving in QF1



- Can recover lumi performance at small L* by moving QF1 closer to IP.
  - Improved collimation depth
- Would require moveable QF1 to be compatible with push-pull operations…

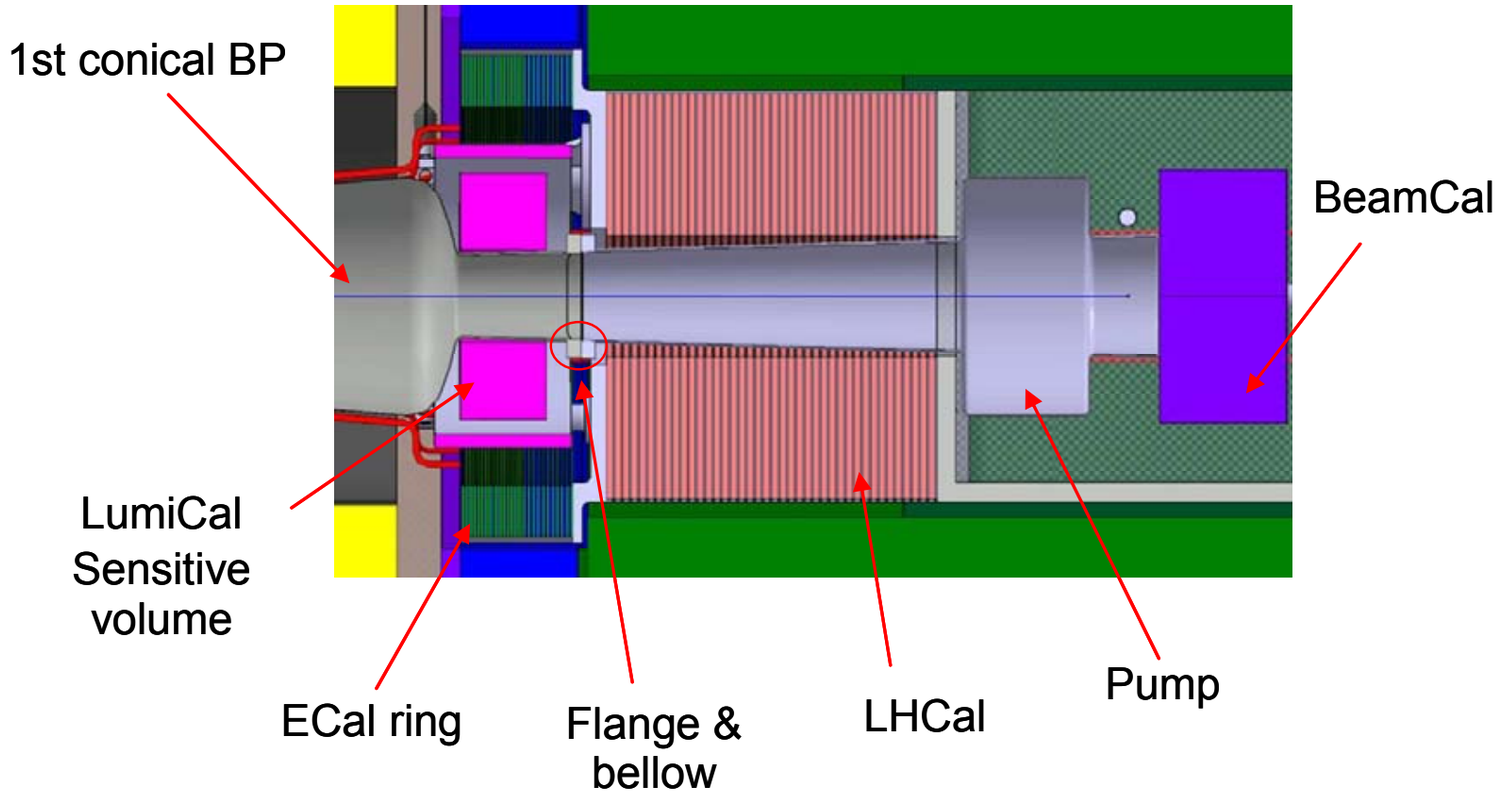
G. White

ILD Dimensions



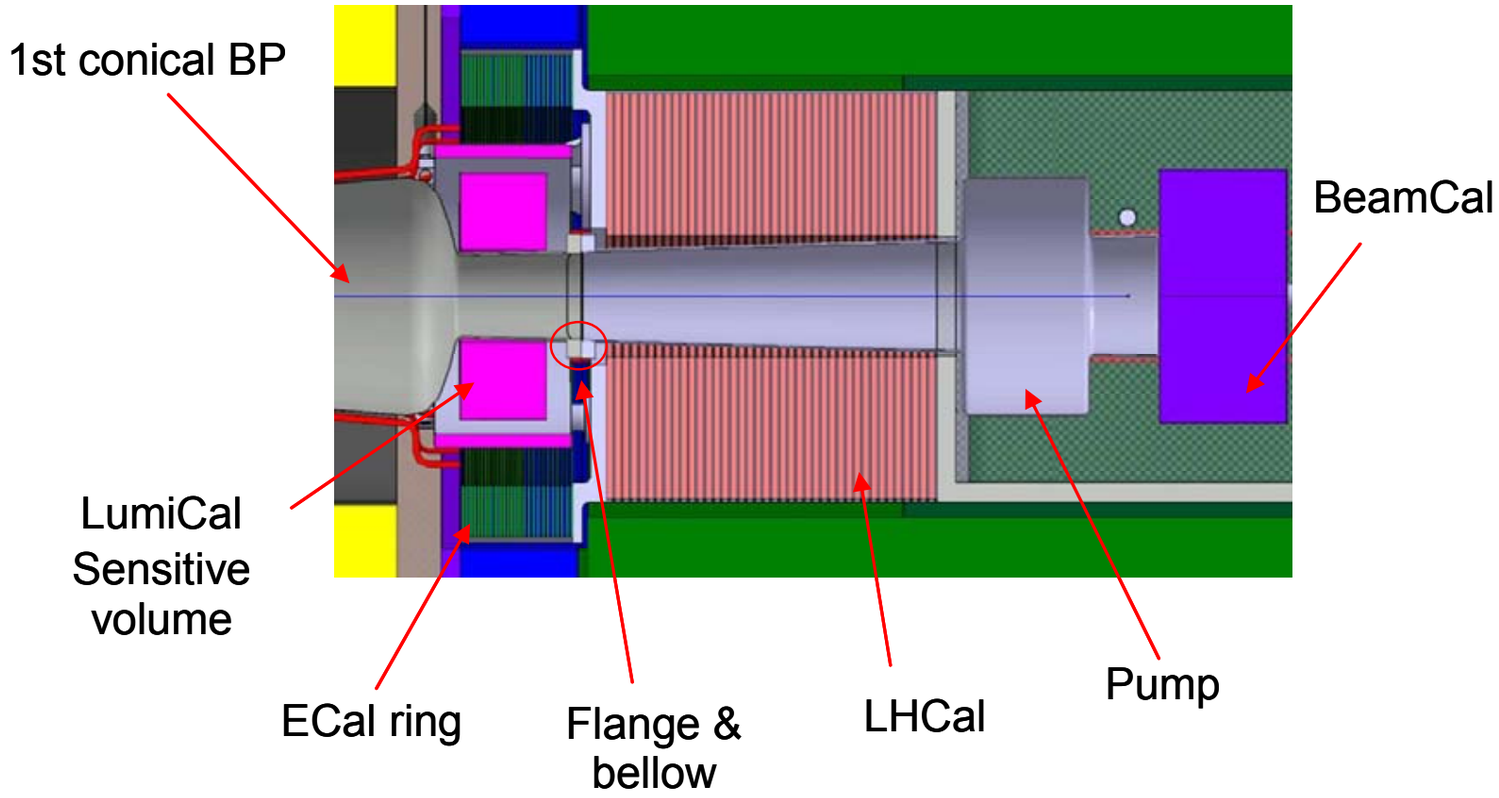
L*=4.4m

Forward Region - possible changes towards L*=4m



- Need to find ~40cm in current design
- Look into design optimisations of all structures
  - maybe find some 10cm there, but more?
- Biggest devices:
  - Pump in front of BeamCal (30cm)
  - LHCAL (~50cm)

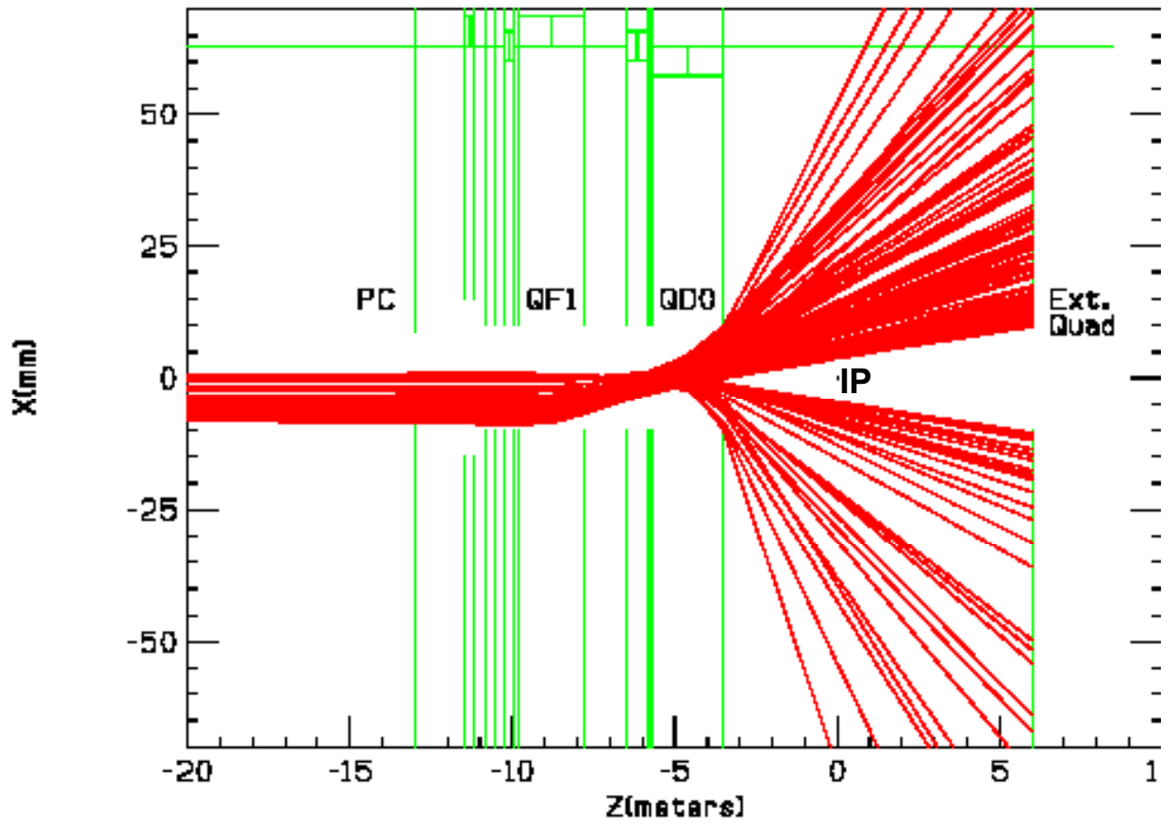
FCAL



- FCAL collaboration will look into optimisation of existing BeamCal and LumiCal design
  - not sooo eager to start activities on LHCAL
- Lucia Bortko (Zeuthen) has started background simulation on pair background with new BeamCal location

How relevant is the Vacuum inside the detector?

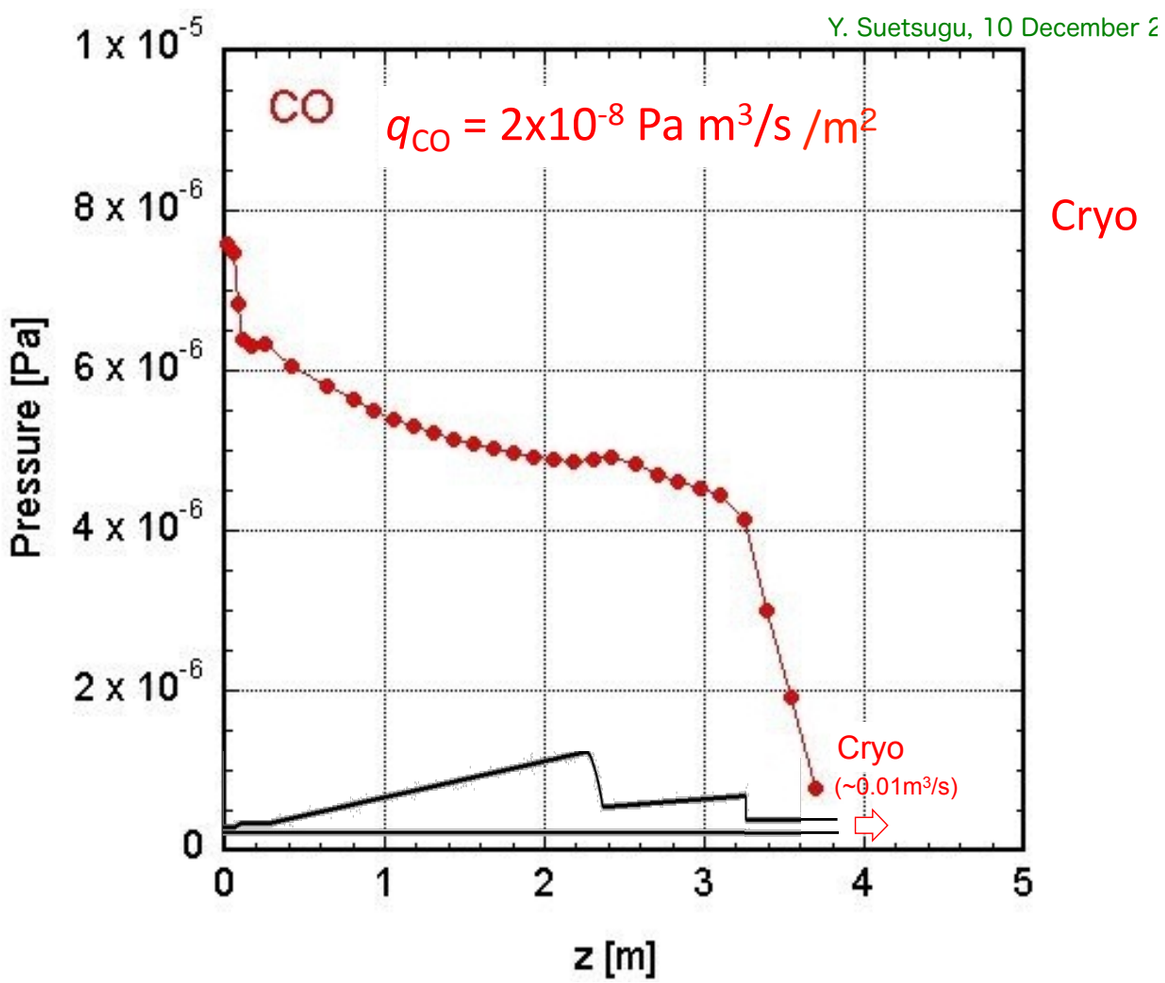
- Beam-Gas scattering in the BDS upstream is relevant for detector backgrounds
- O(10 nTorr) is the required vacuum level up to +- 200m
- Beam-Gas background produced inside the detector is mostly forward peaked - leaves the detector through the beam pipe
- So in theory, vacuum level inside the detector could be much higher
- To be checked with full detector simulations!

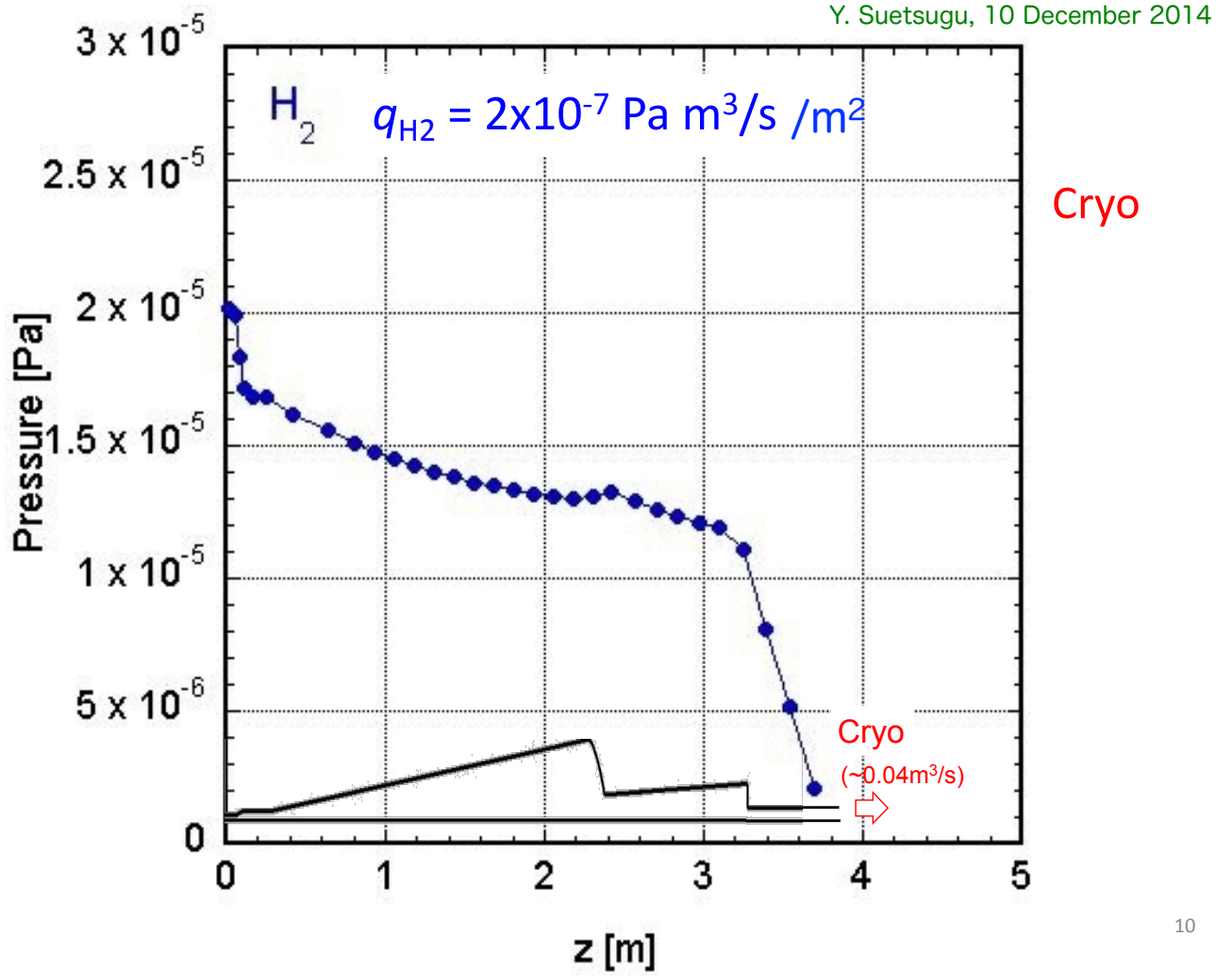


L. Keller

Revisited Vacuum Studies at KEK

- Y. Suetsugu checked impact of cryogenic QD0
  - Vacuum levels without pump but with cold QD0:



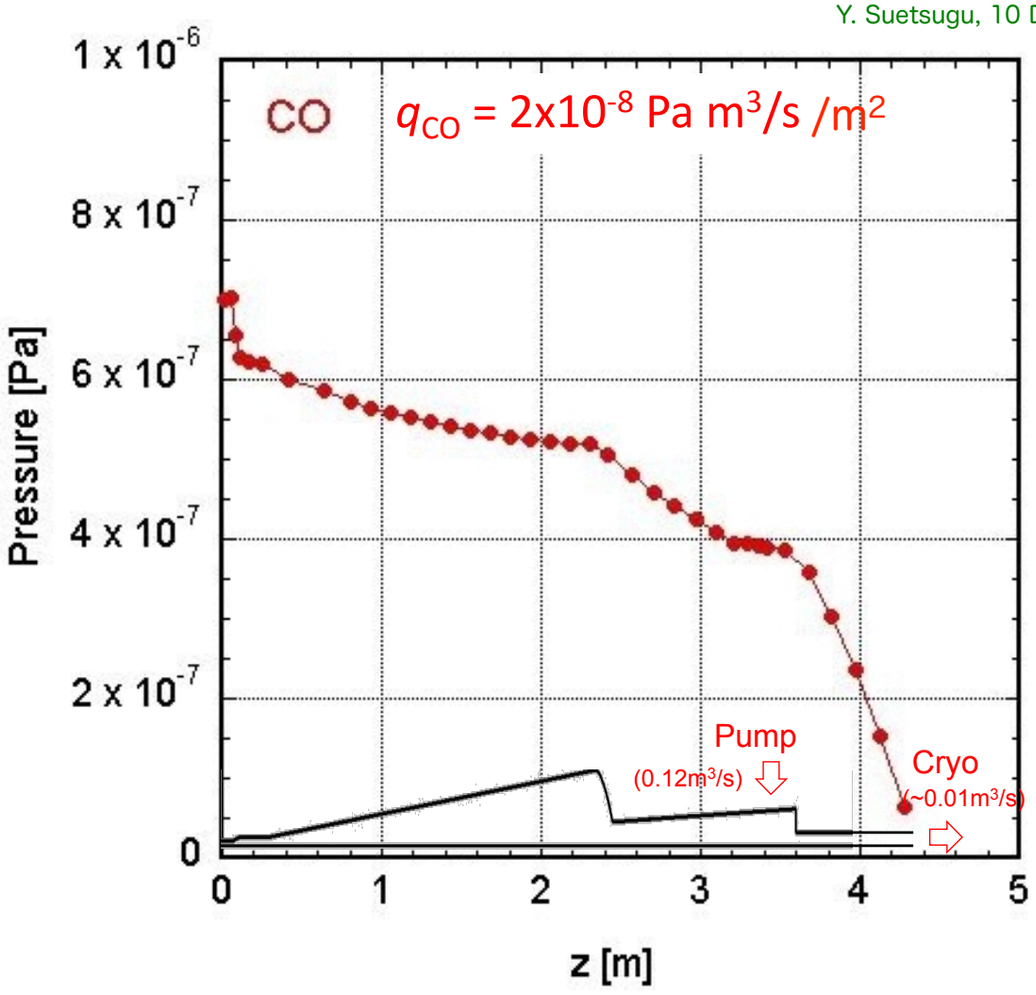


- CO: 6.8E-6 Pa (50 nTorr); factor 10 above DBD value
- H_2: 2E-5 Pa (150 nTorr); factor 20 above DBD value

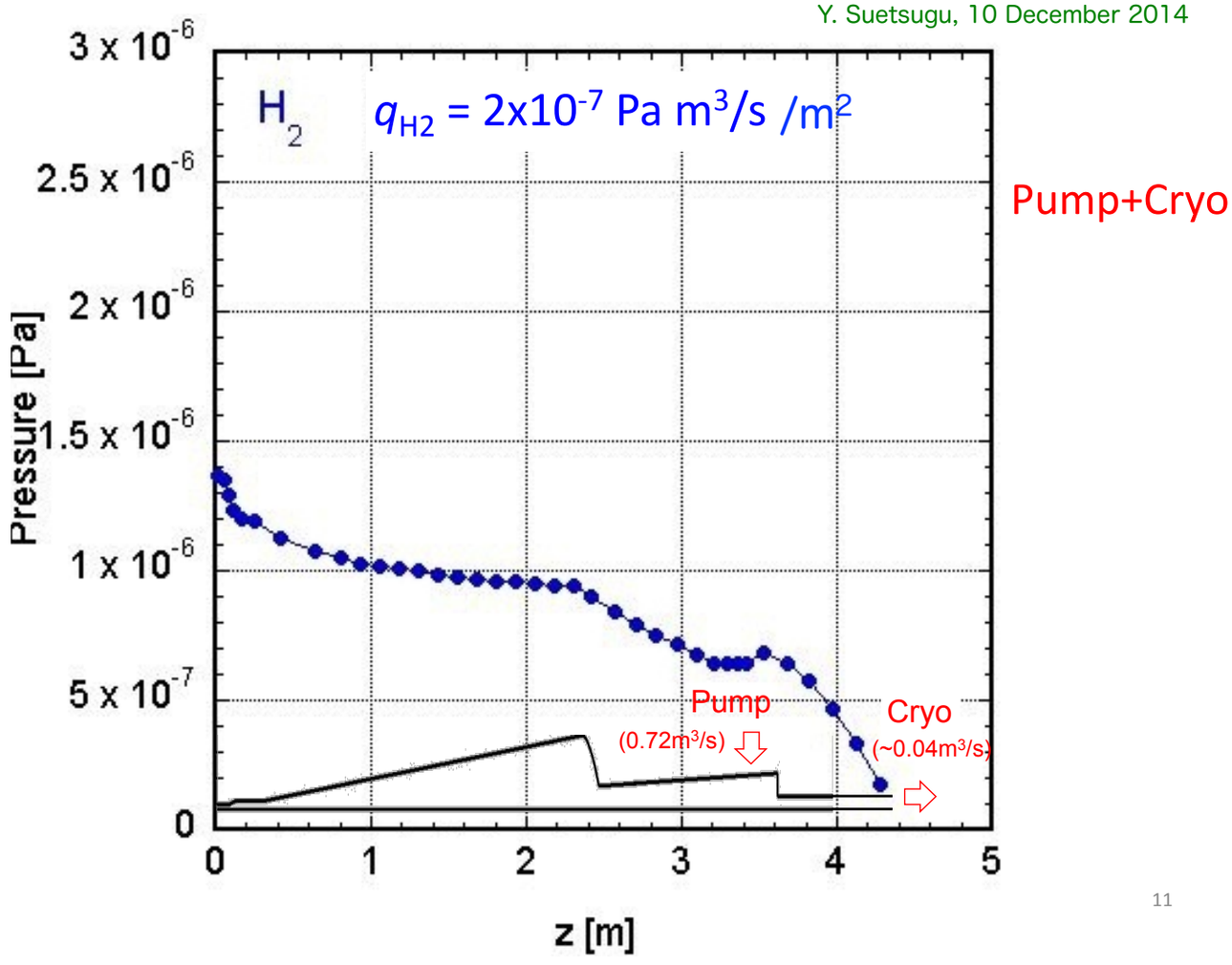
Revisited Vacuum Studies at KEK

- Vacuum levels with pump and cold QD0:

Y. Suetsugu, 10 December 2014



Y. Suetsugu, 10 December 2014



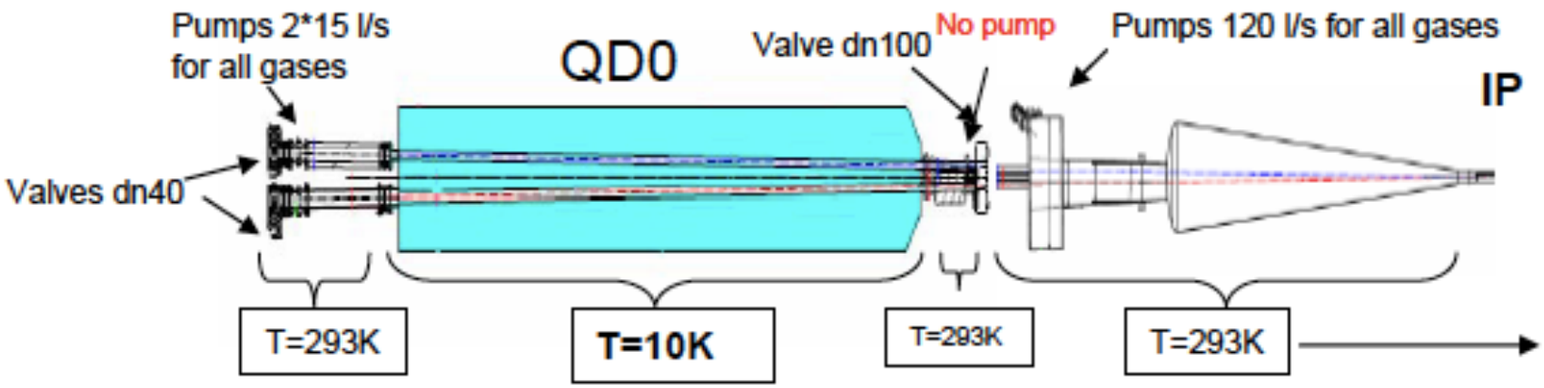
- CO: 6.5E-7 Pa (4.8 nTorr); similar as DBD numbers
- H2: 1.4E-6 Pa (10 nTorr); similar as DBD numbers

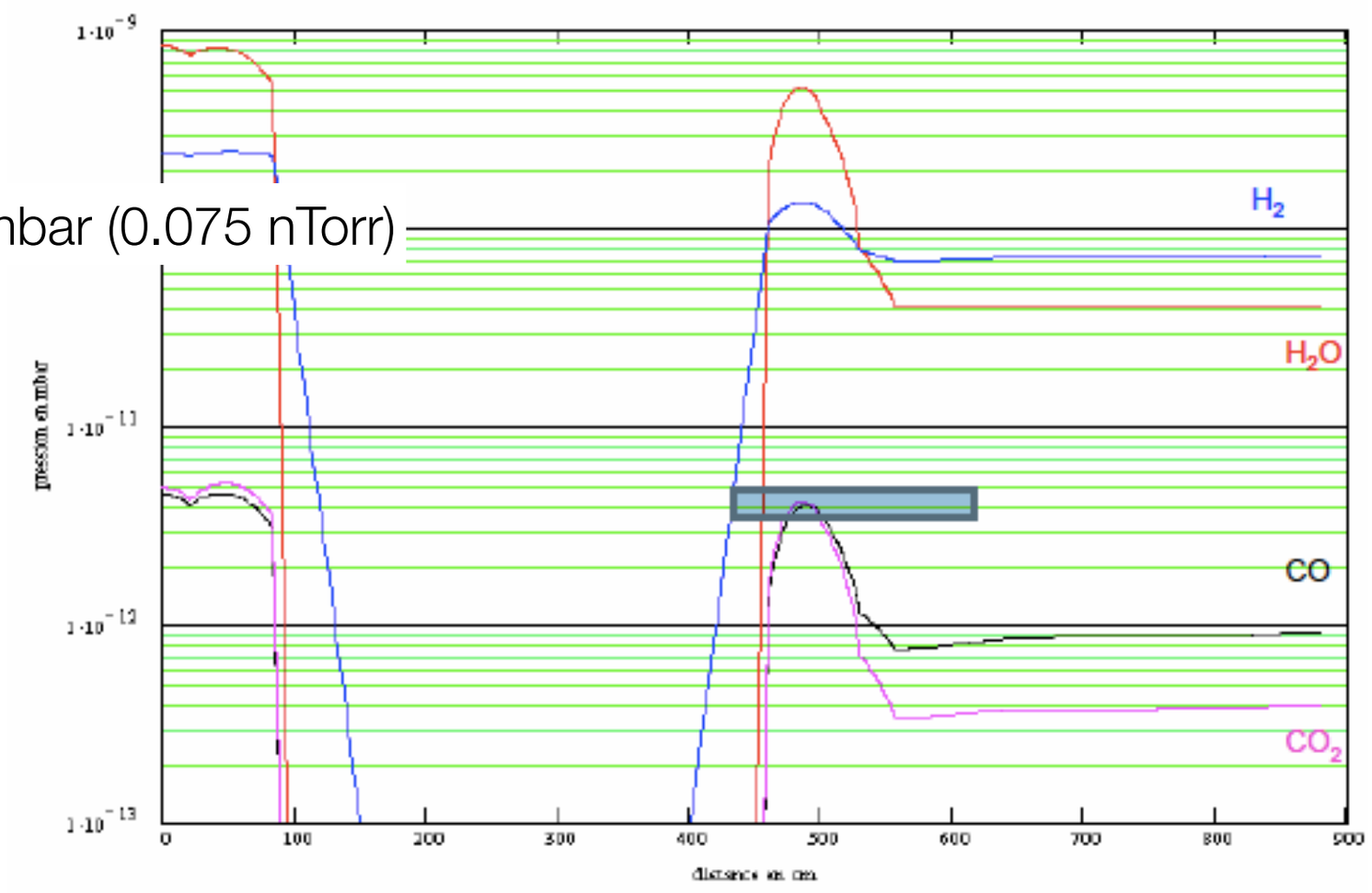
Vacuum Studies at LAL

UNDER STATIC CONDITION

QD0 + IP region

B. Mercier





10^{-10} mbar (0.075 nTorr)

IP region with baking

Alu or Cu or SS after 100h pumping

τ (H_2) ≈ 2.10^{-13} mbar.l.s^{-1}.cm^{-2}
τ (H_2O) ≈ 0 mbar.l.s^{-1}.cm^{-2}
τ (CO) ≈ 2.10^{-15} mbar.l.s^{-1}.cm^{-2}
τ (CO_2) ≈ 5.10^{-16} mbar.l.s^{-1}.cm^{-2}

Between valves dn40 and dn100
Without baking

T=293K

τ (H_2) ≈ 5.10^{-12} mbar.l.s^{-1}.cm^{-2}
τ (H_2O) ≈ 2.10^{-11} mbar.l.s^{-1}.cm^{-2}
τ (CO) ≈ 1.10^{-13} mbar.l.s^{-1}.cm^{-2}
τ (CO_2) ≈ 1.10^{-13} mbar.l.s^{-1}.cm^{-2}

T=10K

τ (all gases) ≈ 0 mbar.l.s^{-1}.cm^{-2}
σ (all gases) = 1 few monolayers

For H_2 beam screen 2% surface

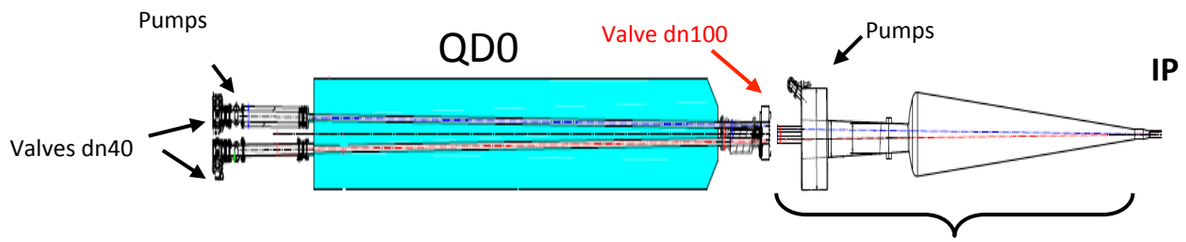
Vacuum Studies at LAL

ILC

IP vacuum

15/12/2014

possible changes towards L*=4m



Need a pumping system between the two DN 100 valves (hot part of the IP chamber)

Proposal for a distributed pumping: coating NEG (Non evaporate Getter)

→ Length reduction

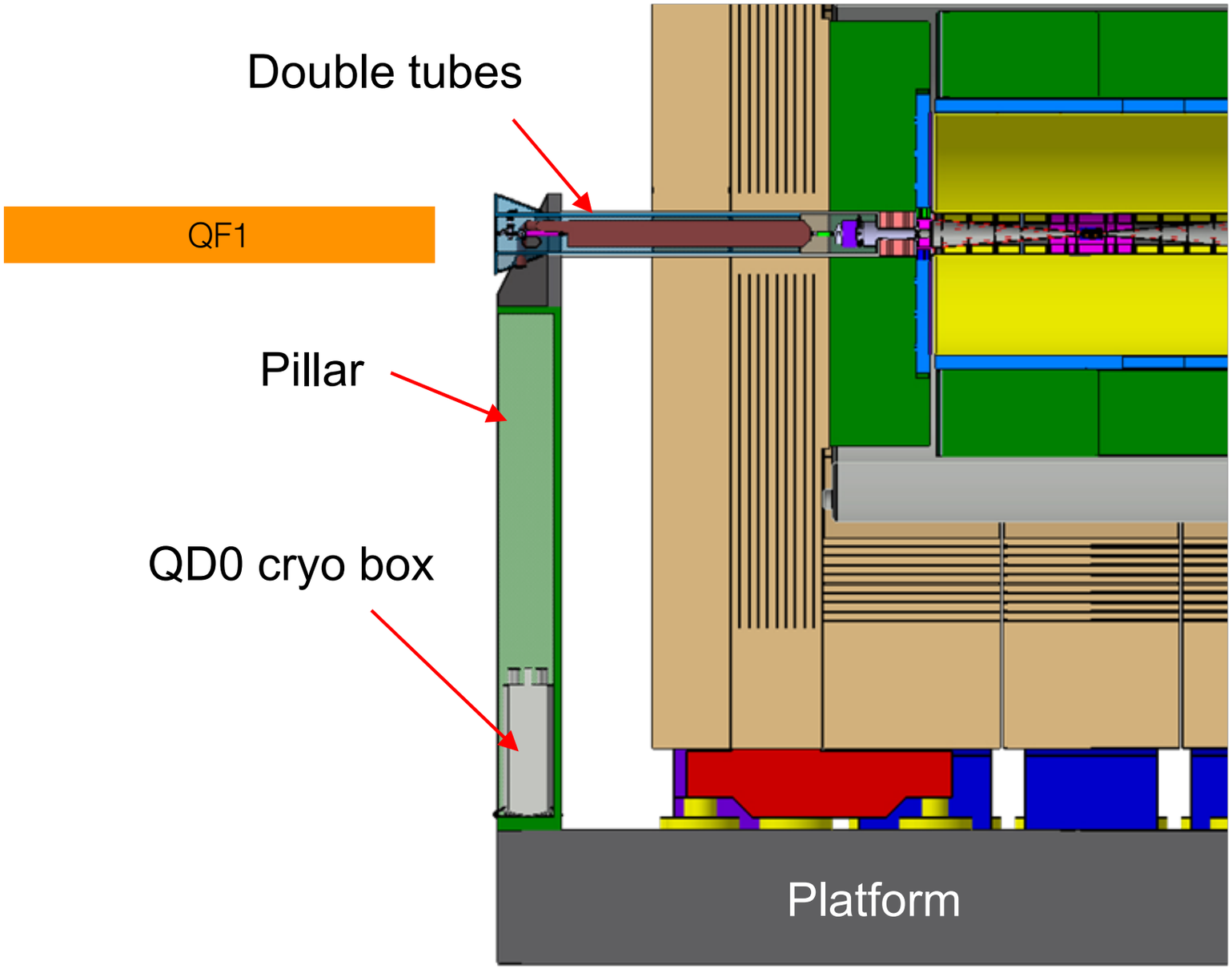
→ Improved vacuum level (to quantify)

→ Need to in situ baking of beam pipe

B. Mercier

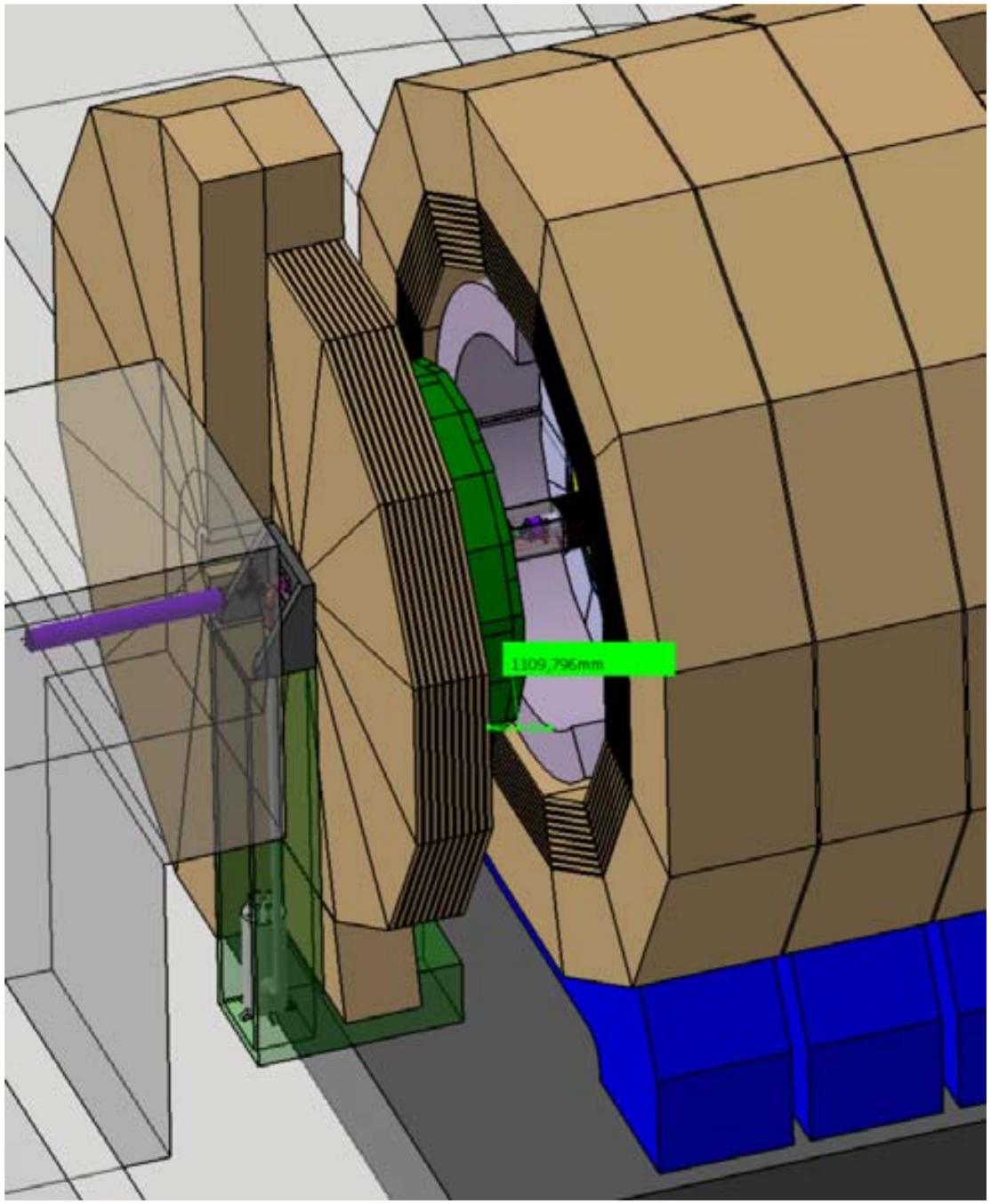
What about QF1?

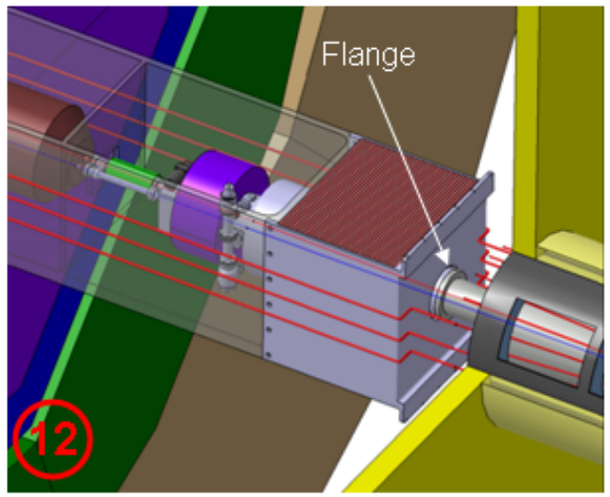
- BDS studies indicate that a smaller L* for QD0 might require also a smaller L* for QF1
- This might also have an impact on ILD:

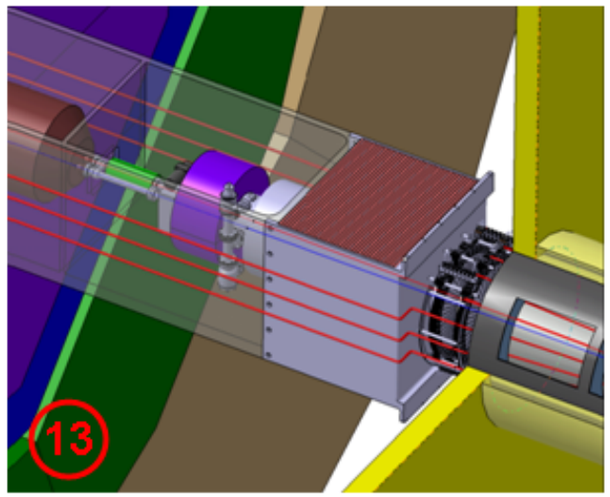


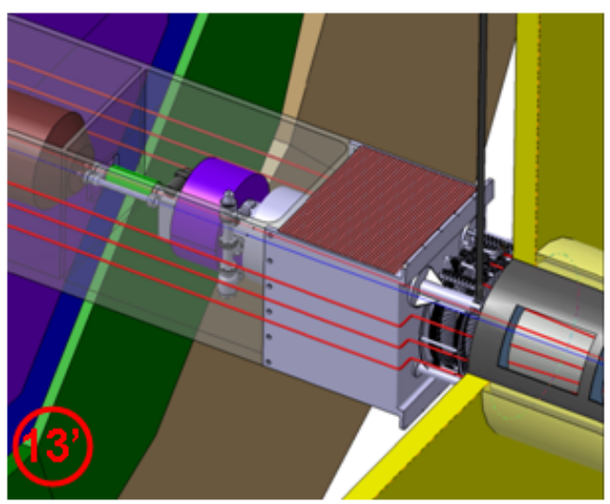
Current ILD Opening Procedure

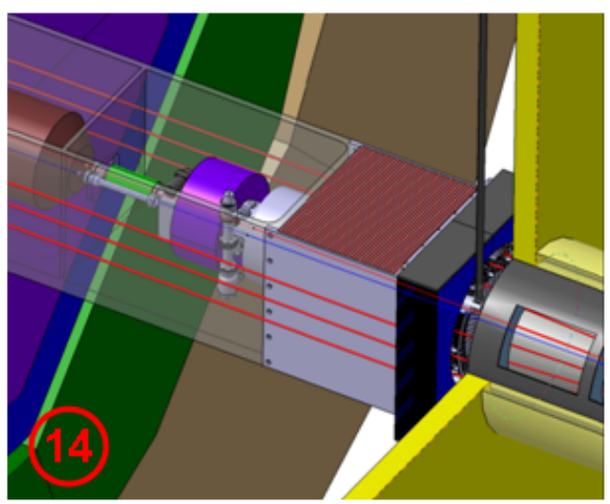
- Need to move endcap far enough out to have access to inner detector to open flanges





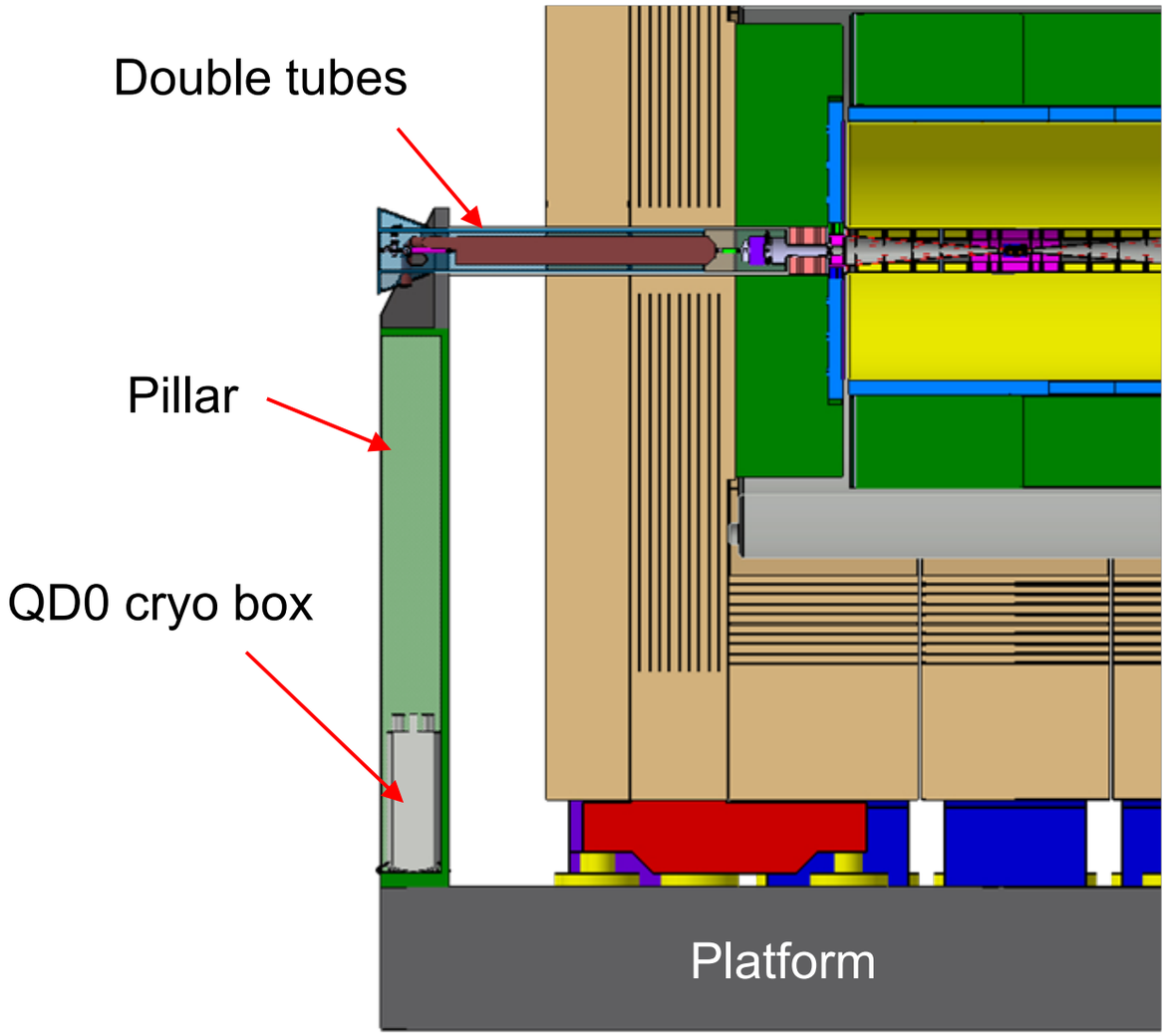






ILD and QF1 L*

- If QF1 comes closer and the QD0 support pillar eventually moves closer to the endcap, the current opening scheme needs to be modified
- Need to re-think the QD0 support using a pillar
- Maybe a temporary QD0 support in the garage position is needed
  - has impact on cryo supplies…
- Would abandon the possibility to open the detector on the beam line
  - anyhow rarely needed in push-pull scenario



New Change Request: increase tunnel length

- Add 1.5km of tunnel on each sides of the lilacs
- Mainly to solve timing problem between production of positrons and collisions at the IP
- Just passive beam transport lines for the start
- Offers elegant upgrade paths for E_{cm}
  - this would require additional cryo modules

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CHANGE REQUEST NO. ILC-CR-0004	EDMS No: D*01092915	Created: **18-12-2014**
		Last modified: **18-12-2014**

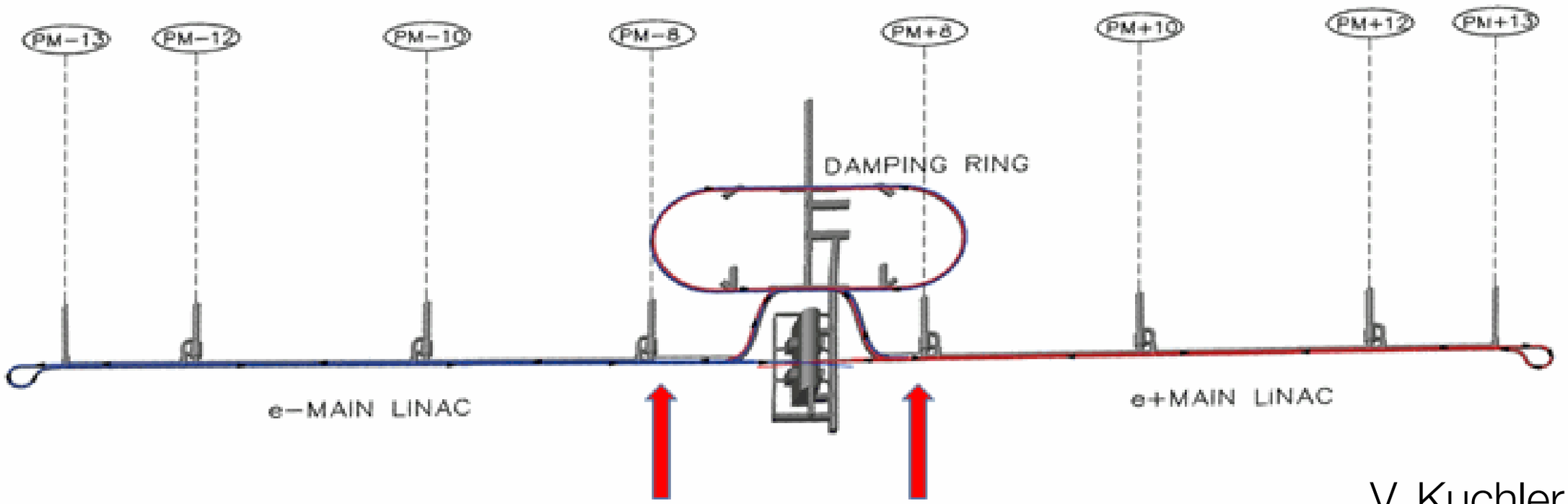
EXENSION OF THE ELECTRON AND POSITRON MAIN LINAC TUNNELS BY APPROXIMATELY 1.5 KM

It is proposed to extend both the electron and positron main linac tunnels by approximately 1.5 km (total machine length approximately 3 km). For the baseline the additional tunnel length will be filled with simple passive beam transport lines.

V. Kuchler

Where should the extra linac tunnel be inserted?

- High energy ends of linacs
  - ✓Cryogenics station at PM+-8 can be reinforced later
  - ✓Additional access tunnel not needed



V. Kuchler

Summary and Outlook

- ILC Interaction Region design for the Kitakami site is proceeding
  - underground area design is the new baseline now
  - concentrating on area buildings and infrastructures
- Trying to understand requirements from SiD and ILD for IR area
  - lab space, office space, assembly infrastructure, etc.
- BDS group is designing new L* optics
  - QD0 L*=4.1m would favour QF1 L*<9.5m
  - has impact on ILD engineering design
- High on the to-do list: background studies with different residual gas levels
  - have agreed collaboration with SiD (J. Strube)