ILD MDI Issues

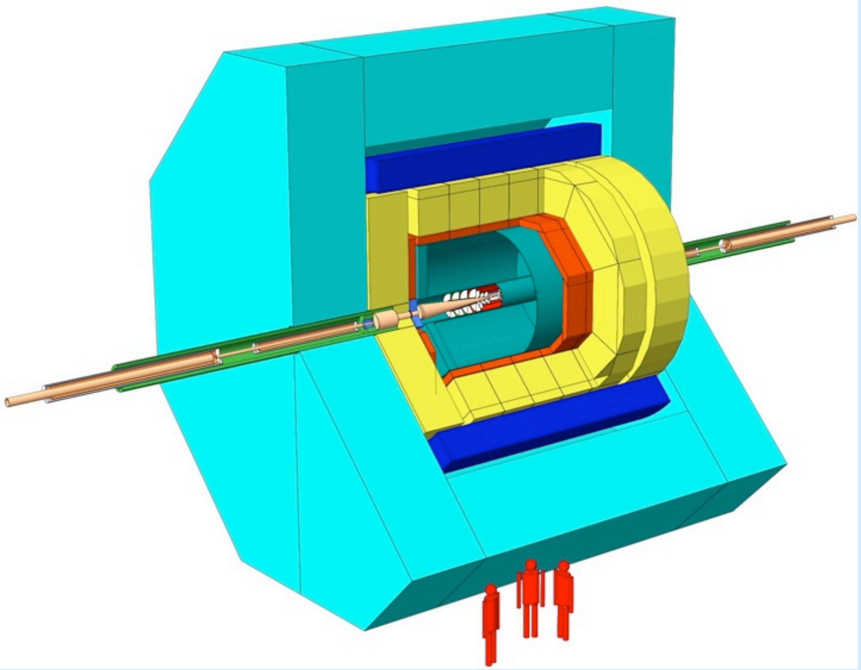
Karsten Buesser

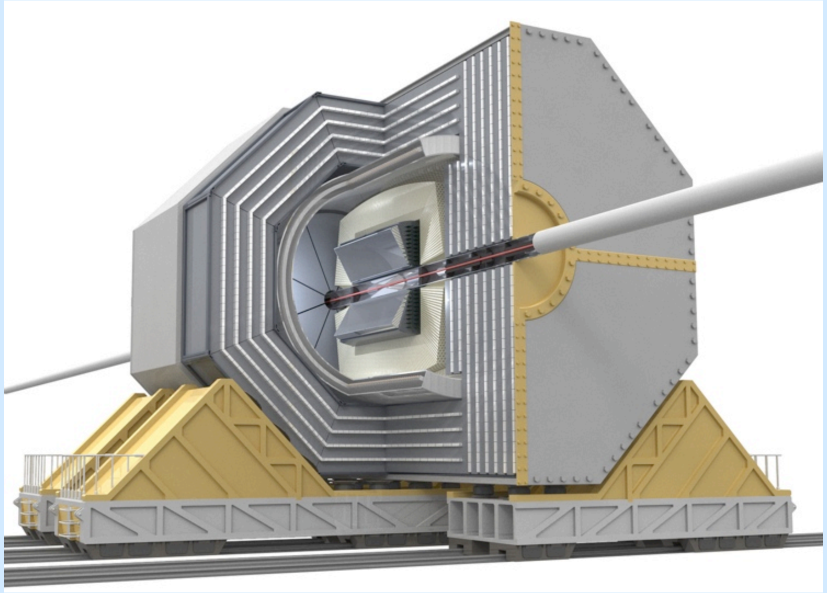
ECFA Workshop

Warsaw

10. June 2008

ILD = GLD ⊕ LDC

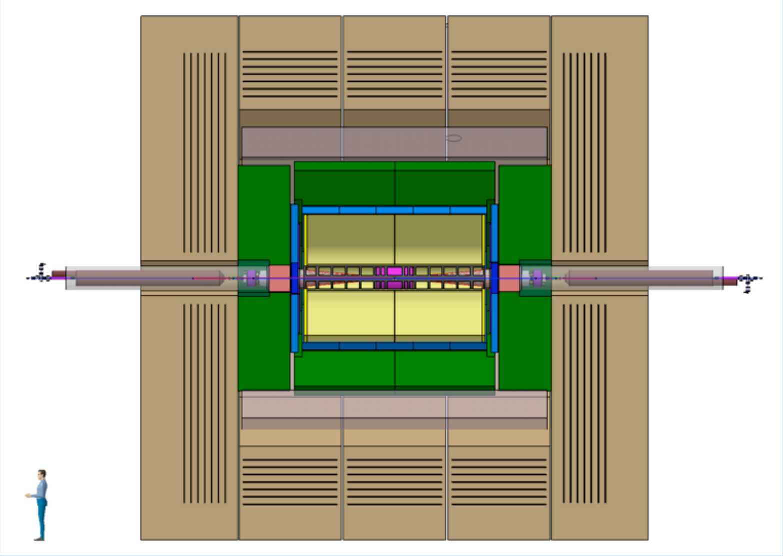




ILD Working Structure

- Joint Steering Board supervises the common effort to find a common detector concept and design which will lead to the submission of a common LOI
- Several working groups have been set up to tackle the critical joint design efforts:
  - Detector Optimisation
    - Conveners: Mark Thomson, Tamaki Yoshioka
  - MDI/Integration
    - Conveners: Toshiaki Tauchi, KB
  - Costing
    - Conveners: Akihiko Maki, Henri Videa
- Contact people form links to detector R&D collaborations

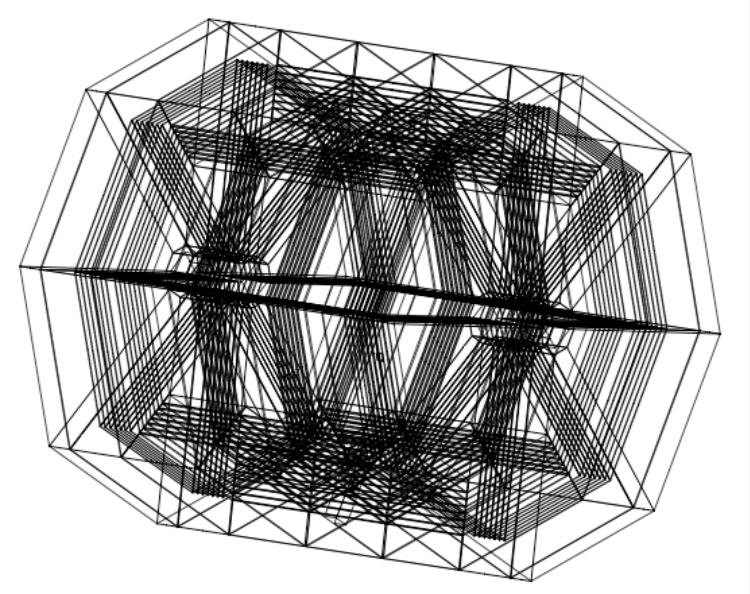
From GLD and LDC to ILD



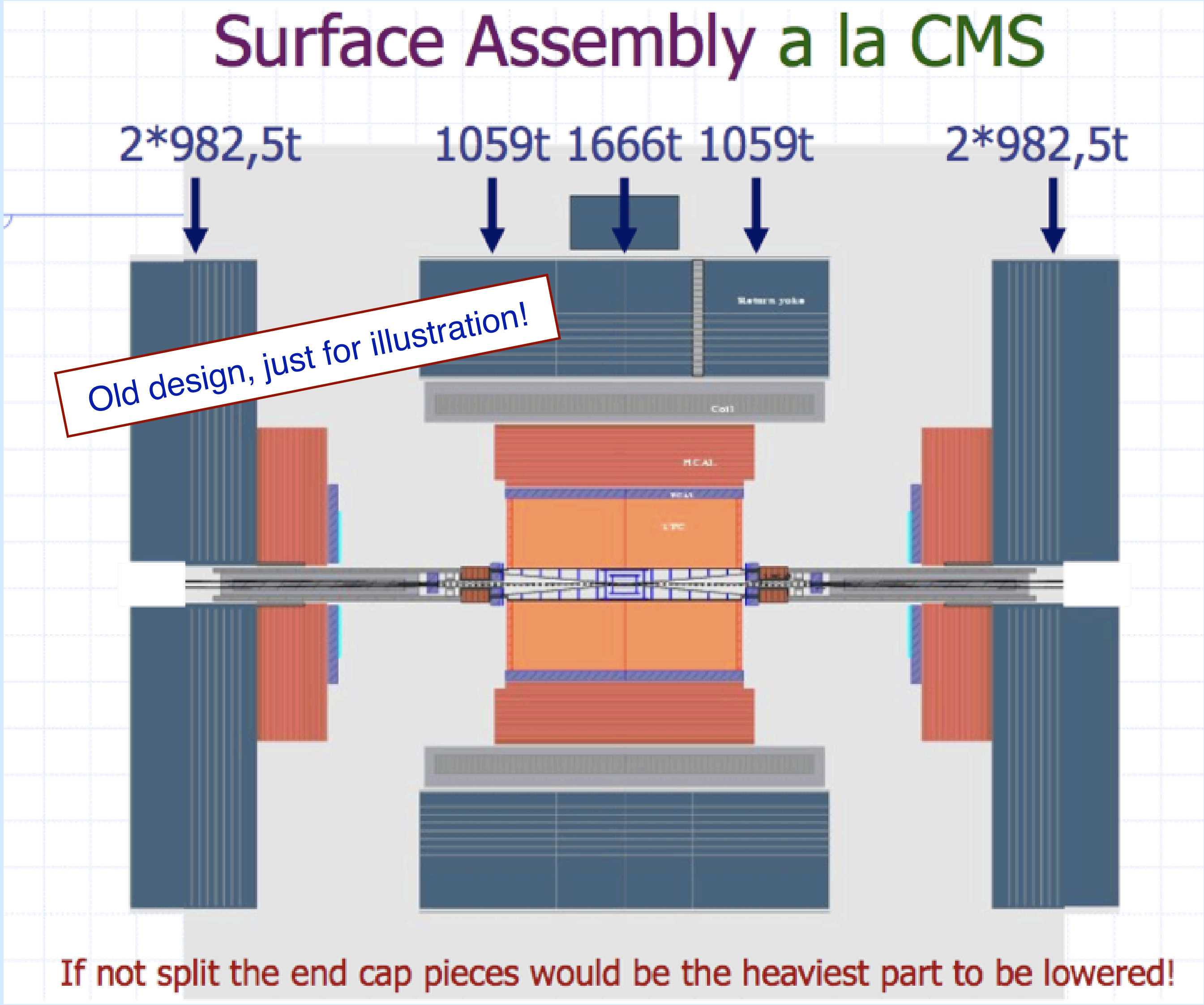
- The parameters of the optimal ILD detector are not yet known
  - Strong optimisation group is working on this, results expected in fall
- Technical work needs detailed detector models now
- Chose two working models:
  - ILD1 (evolution of GLD)
  - ILD2 (evolution of LDC)
- Make sure that the evolution of ILD1 and ILD2 to ILD is natural

Technical Challenges

- Involved labs use different 3d-CAD systems
  - CATIA, I-DEAS, SolidEdge, AutoCAD, etc.
- Sharing CAD models is not straight-forward
- LLR holds the master CAD model
- Workspace model is probably the most effective way
  - CAD master defines workspaces which are treated distributed and indepen-dently
  - STEP files used for data transfer
- Definition of processes, interfaces and workspaces needs to be done carefully
- Common data storage (DESY-EDMS) should be used

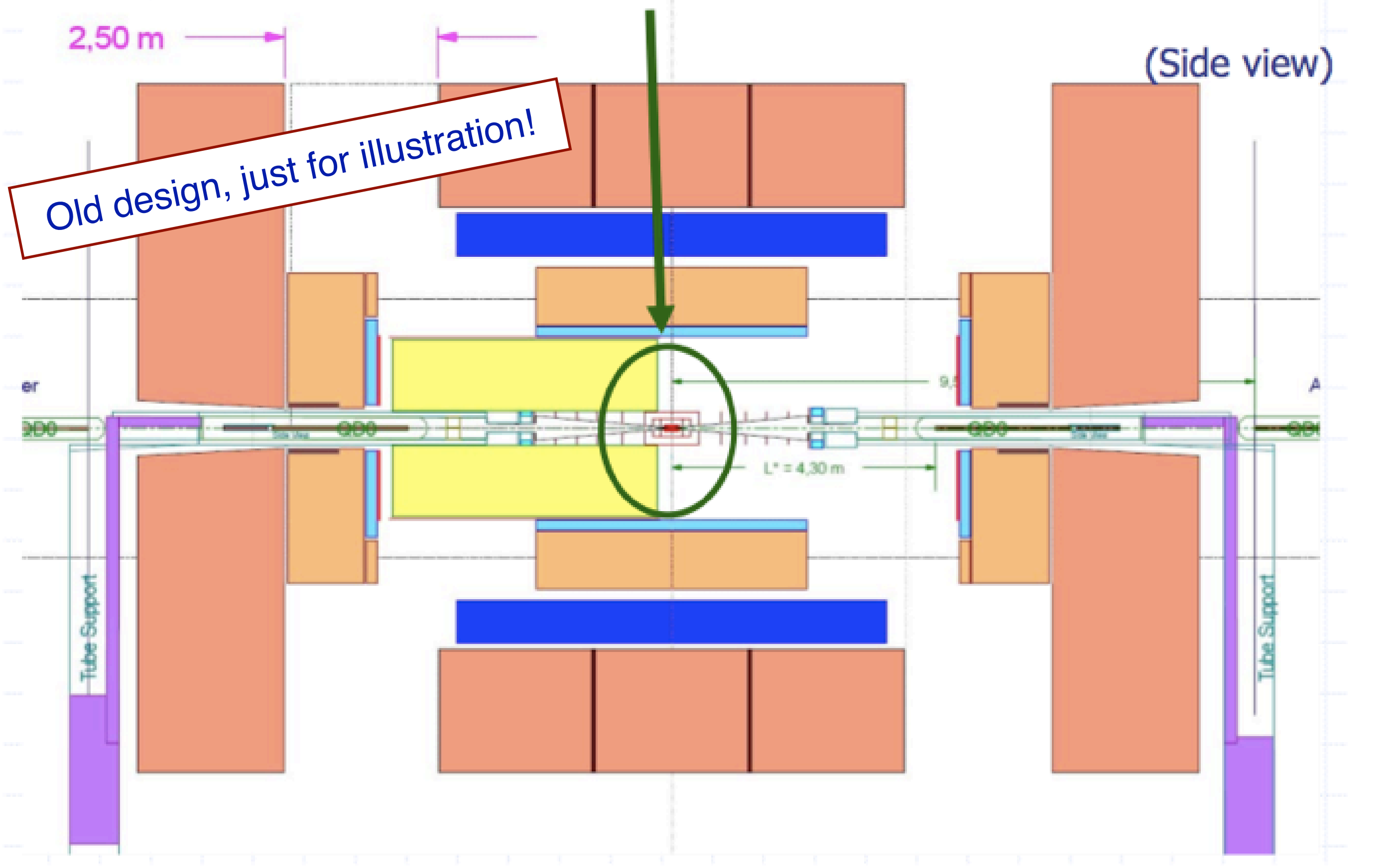


Surface Assembly



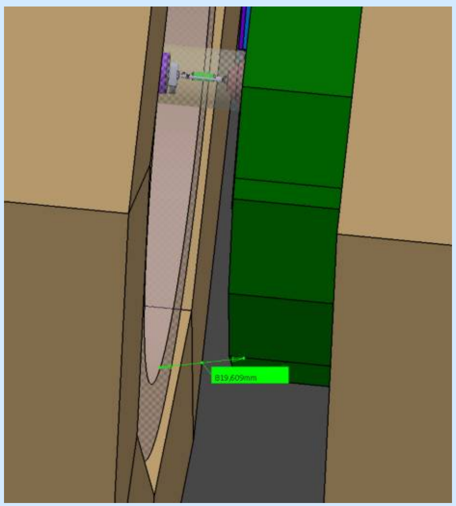
Detector Opening (Vertex Detector Maintenance)

detector opening would just allow to maintain the vertex detector in the garage position without breaking the vacuum.
(Pumping the central beam pipe is assumed to be very time consuming.)



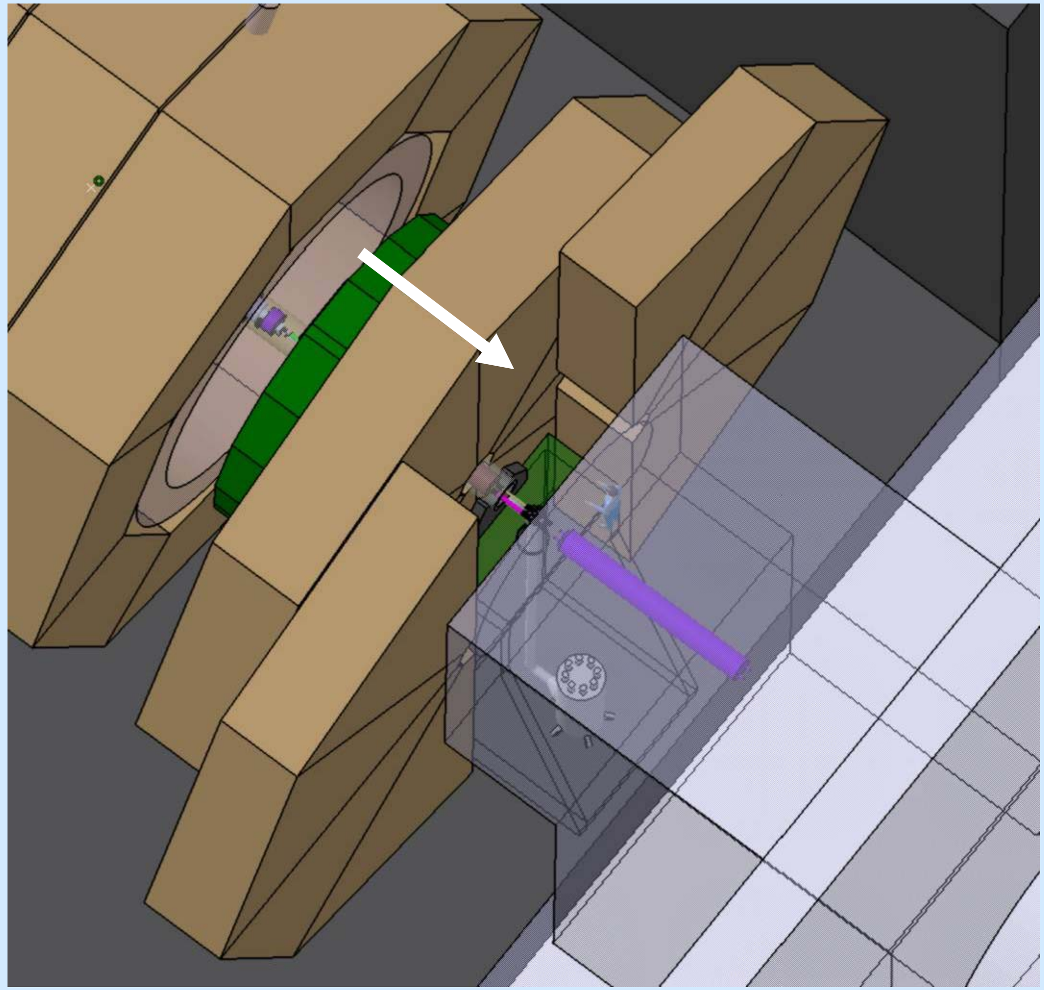
Opening Scheme

- Opening the yoke (2m)

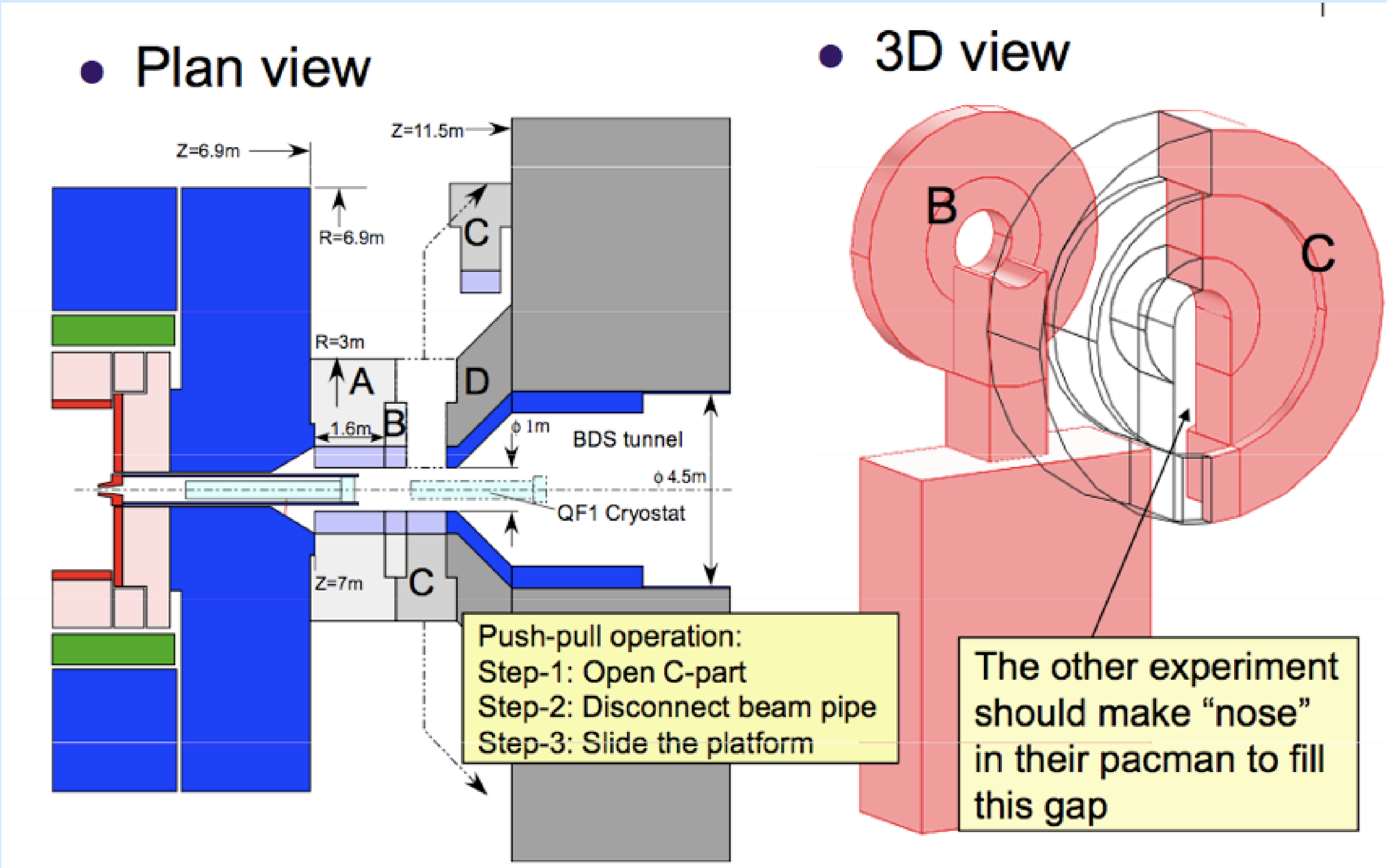


80 cm for access

➔ Enough ?

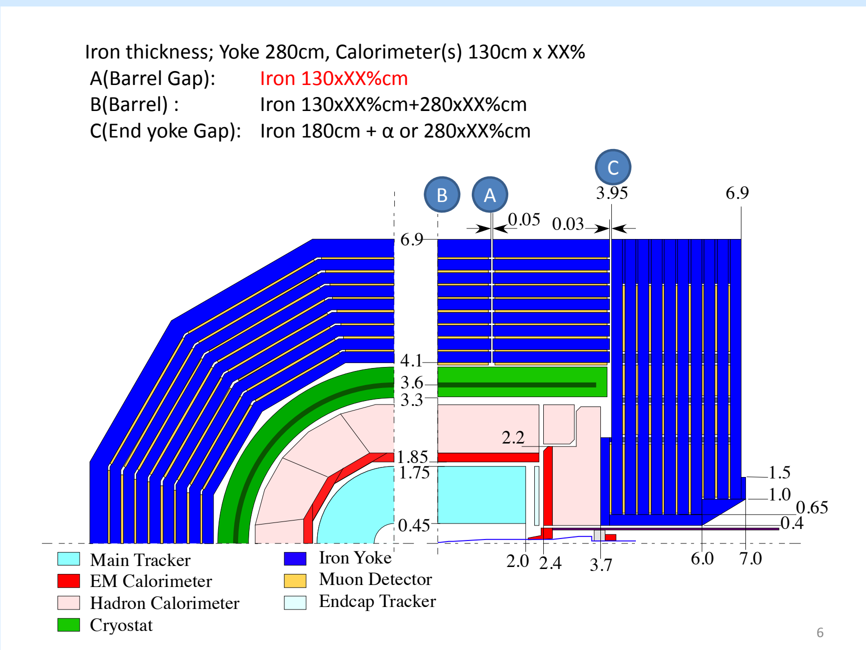


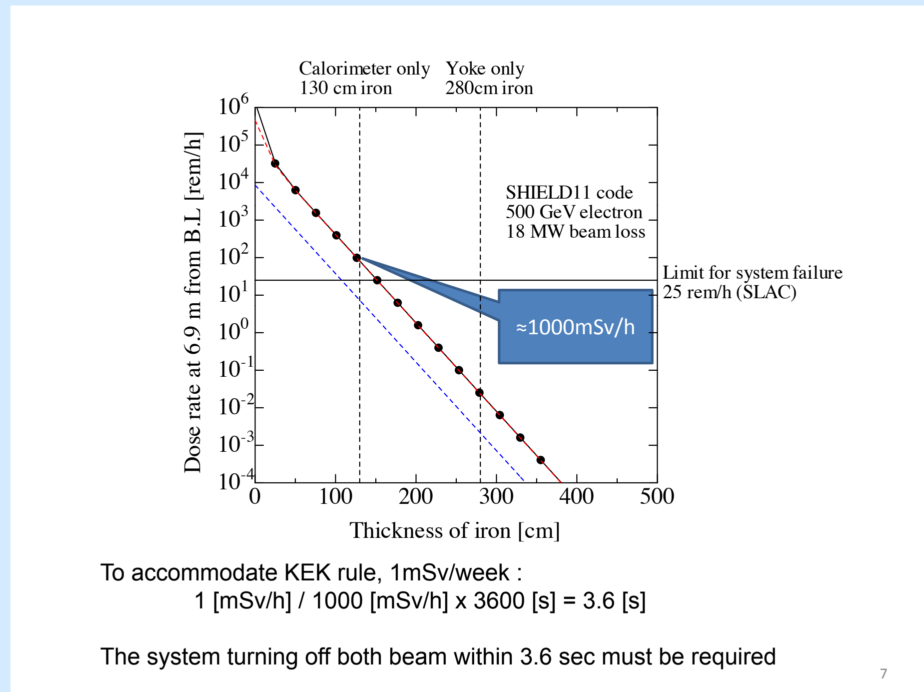
QD0 Support and Pacman Design



- Study done by Y. Sugimoto
- Collaboration with other concepts useful!

- Simulations done at KEK
- Limit at KEK (mis-steering beam loss): 1 mSv/week
- Limit at SLAC (system failure): 250 mSv/h, 30 mSv/event
- Limit at LHC (total beam loss): 50 mSv/h

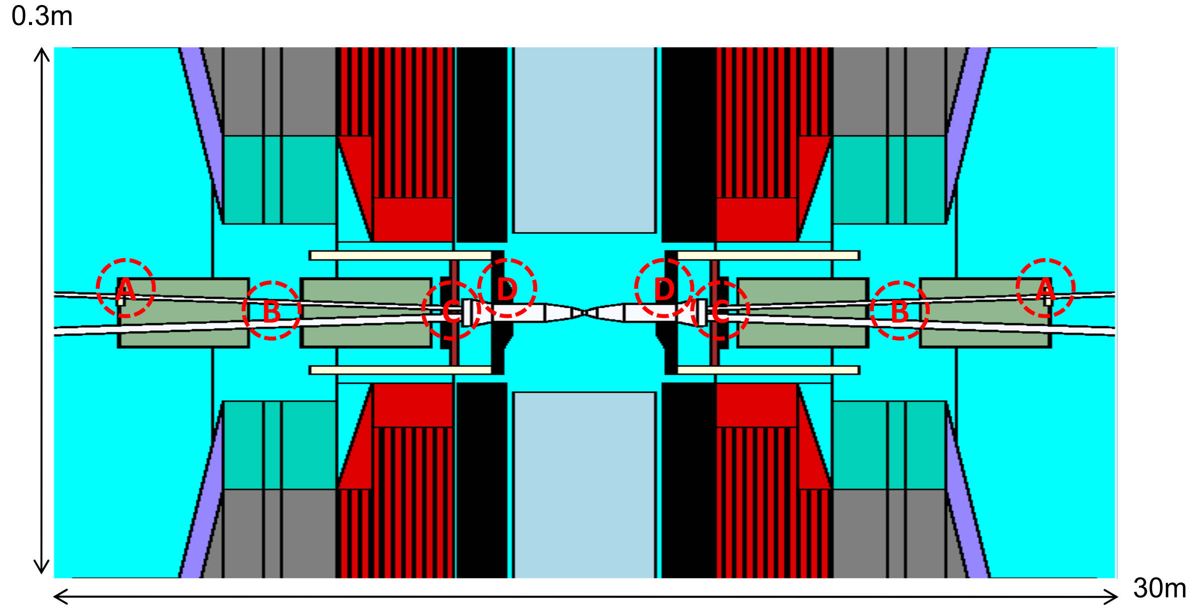




- Empirical formula (top) and 3d simulations

3d Simulations

Source term of radiation in IR hall



Beam loss points with thick components (Normal, Accidental)

A: Final doublet protection collimator (≈0 W, 18 MW)

B: Vacuum valve and flange (≈0 W, 18 MW)

C: Beam calorimeter (<1 W, 18 MW)

D: Luminosity calorimeter (<1 W, 18 MW)

Pseudo target : Iron 12” L x 2” r (17 X_0 L x 2.8 X_0 r)

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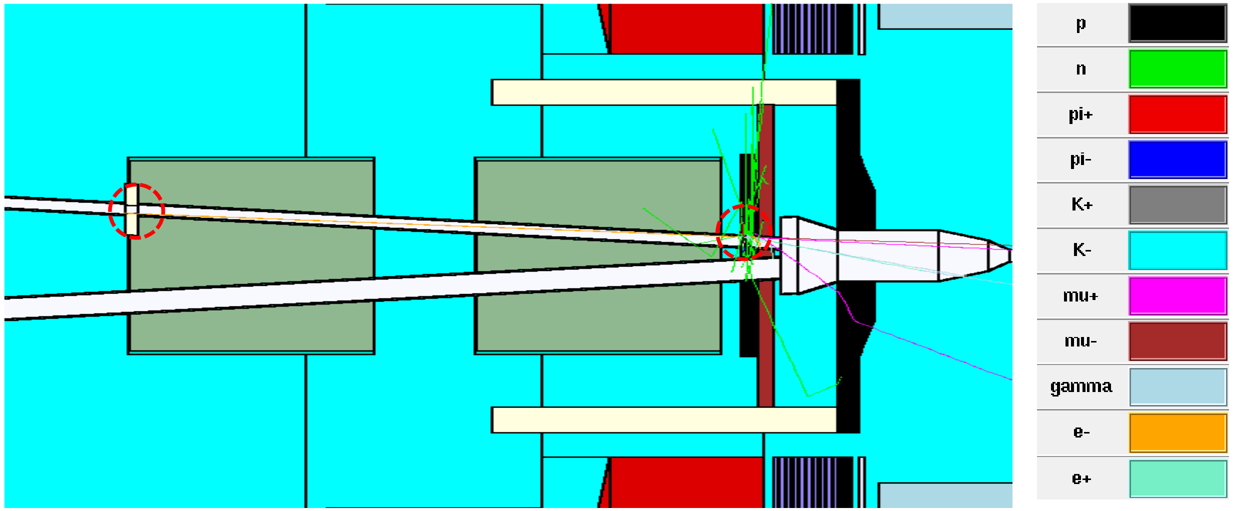
3d Simulations

Source condition 1; Beam hits beam calorimeter

Beam hits beam calorimeter after passing through final doublet protection collimator



1 m x 15 m

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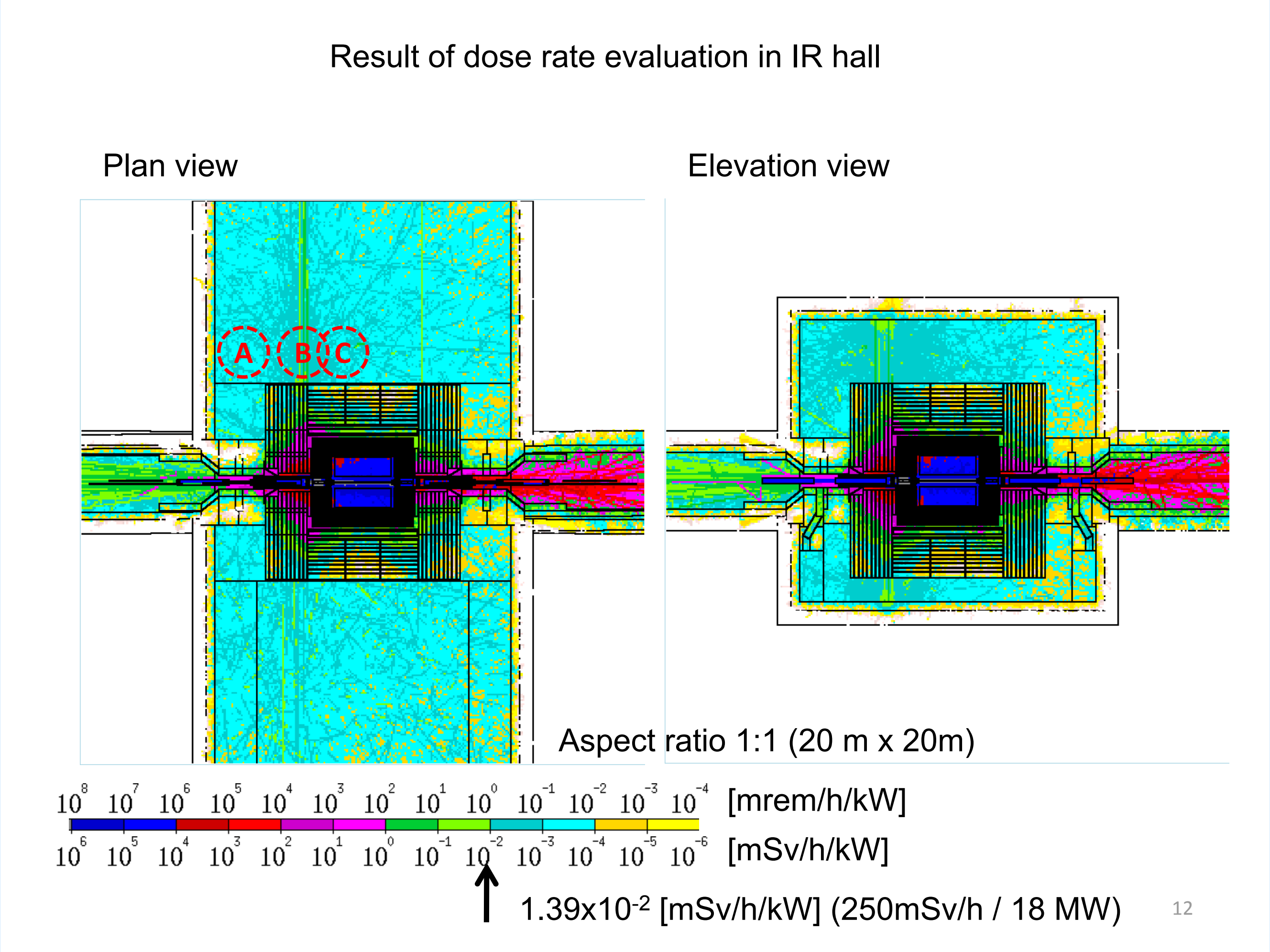
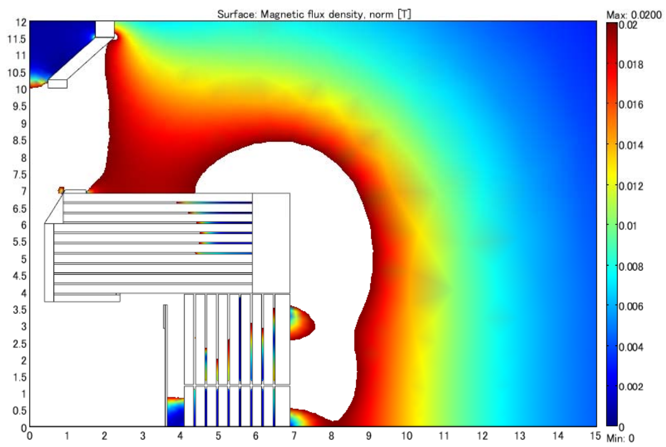
3d Simulations



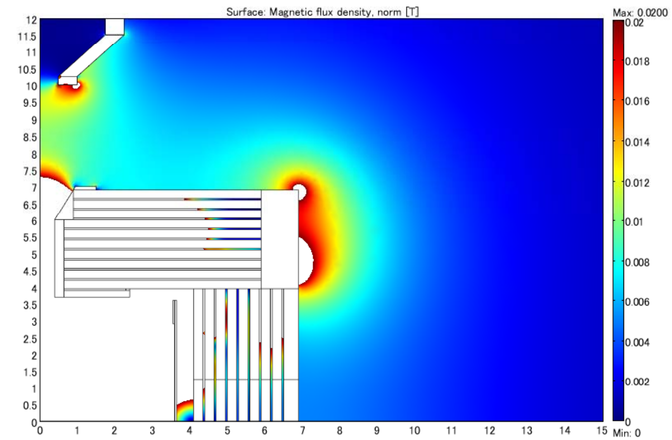
- Self-shielding detector should be possible
- add concrete layer if necessary

Magnetic Stray Fields

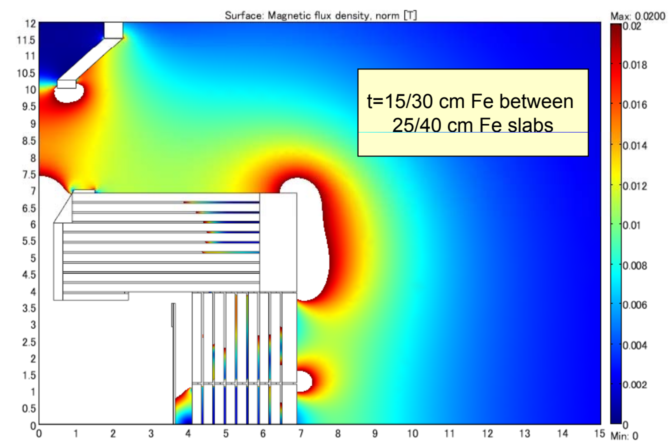
GLDc



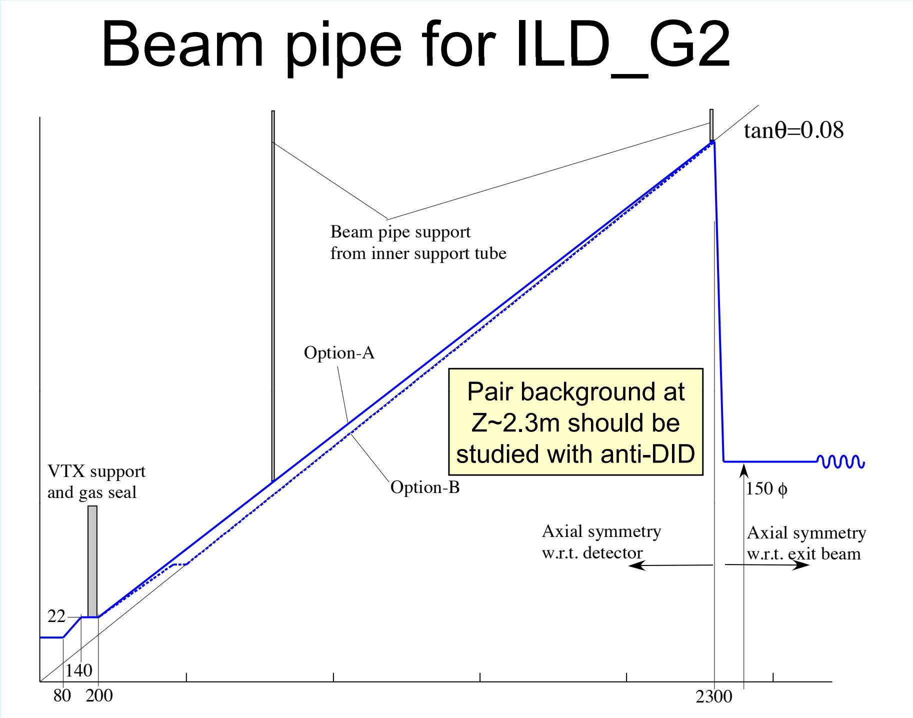
With no gap between rings

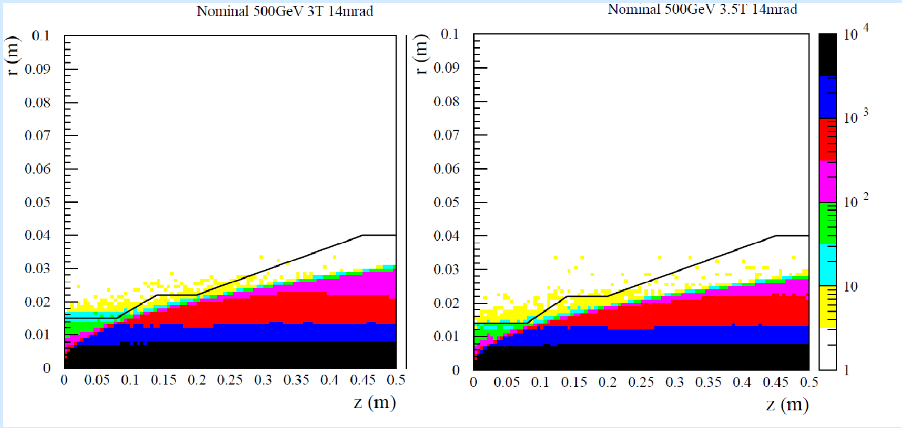


Gap partially filled with Fe



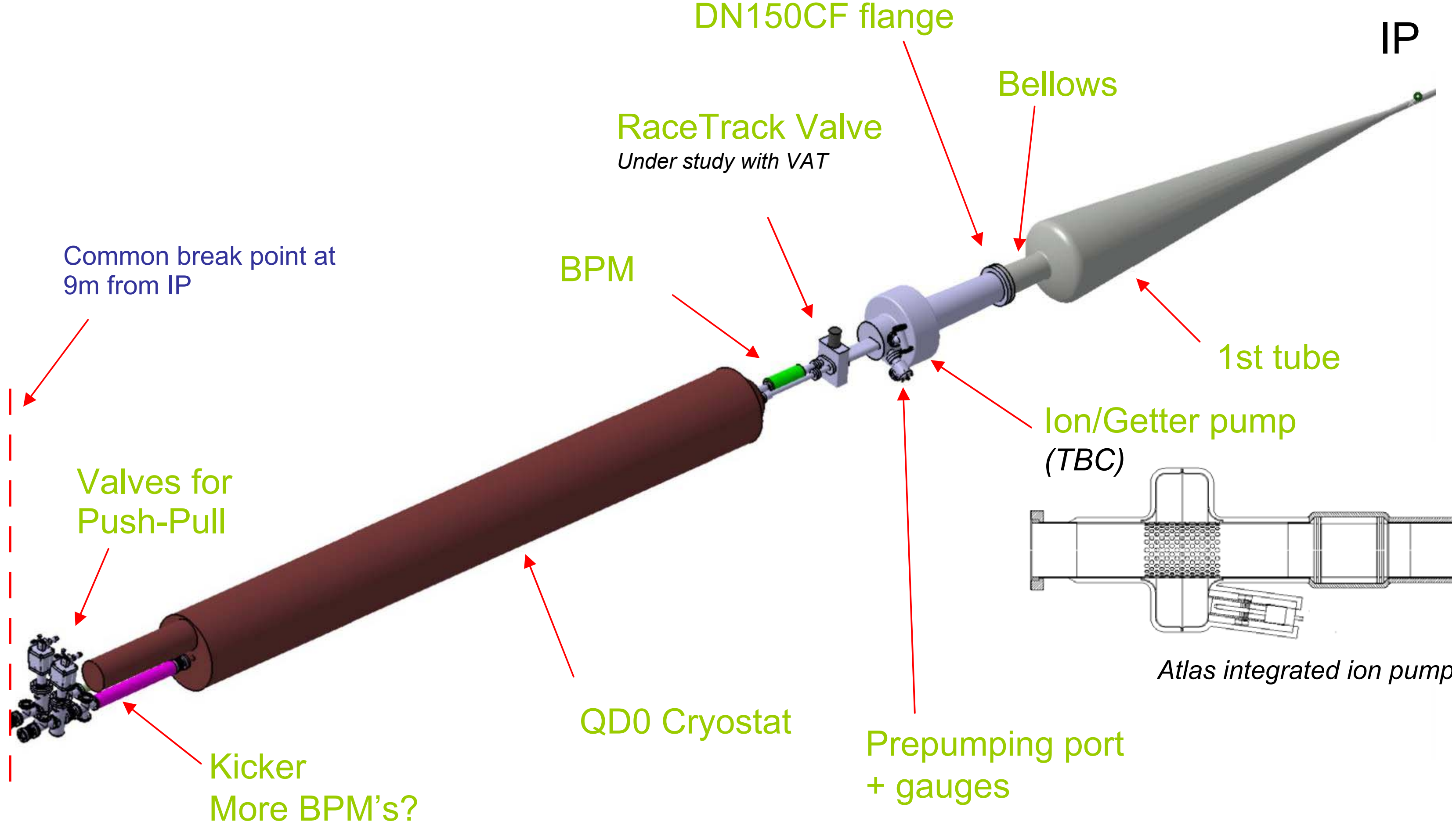
- Limit : 200G at 10m in z and Yoke outer radius + 0.5m



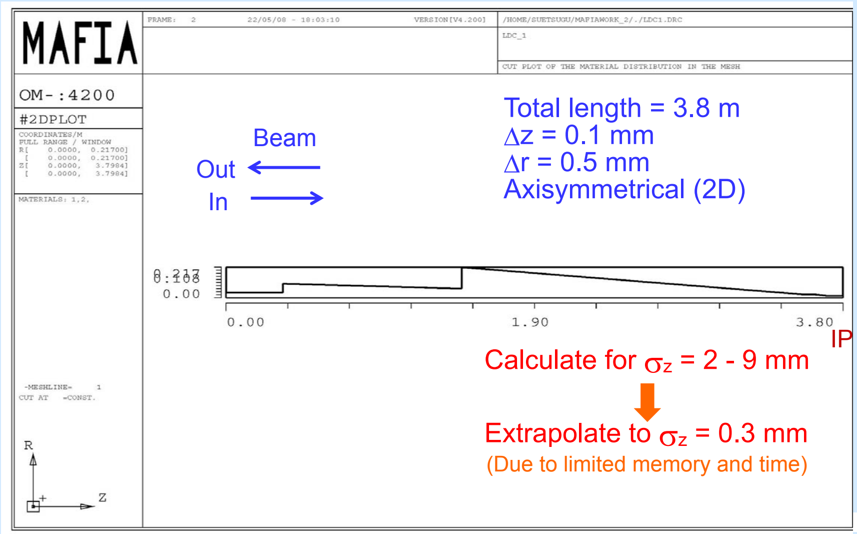


- Designs are converging
- Poiting or non-pointing?
- Backgrounds are under control

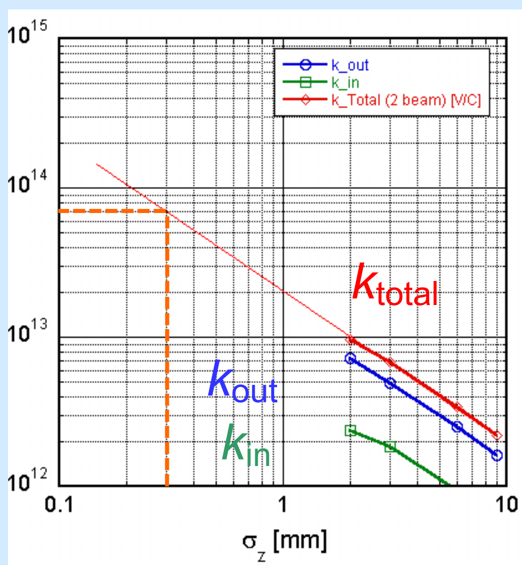
- Beam line design for 14mrad and L* 4,5m



Beam Pipe Wakefields and Heating



Results



k_{total} (two beams) ~7×10^{13} V/C @ σ_z = 0.3 mm

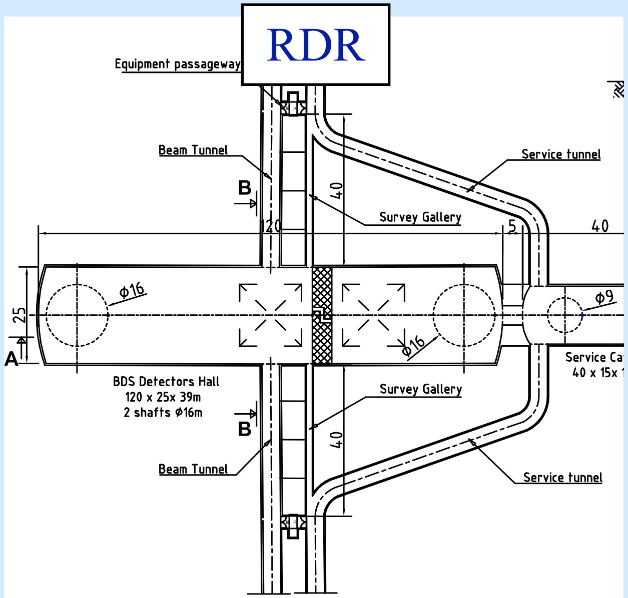
If q = 3.2 nC, N_b = 5400 bunch, and f_r = 5Hz : $I = 8.6\times10^{-5}$ A

$\therefore P = kqI$ = ~20 W (one side)

Almost the same to the result for LDC-1

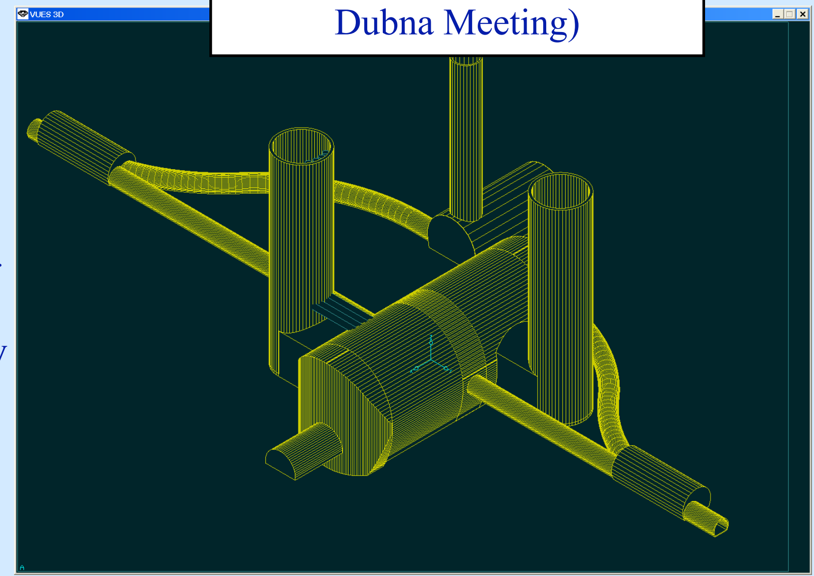
Evolution of the Detector Hall

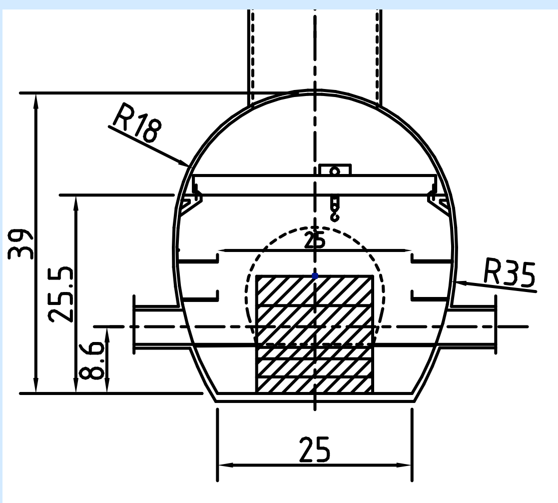
RDR



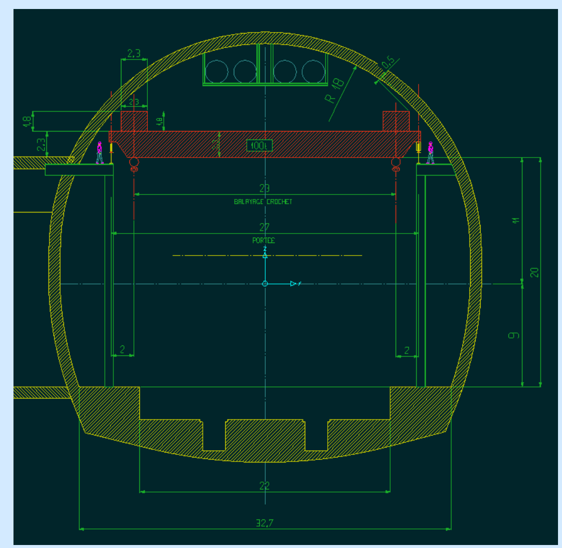
Surface Assembly

Newer Proposals (J. Osborne, Dubna Meeting)

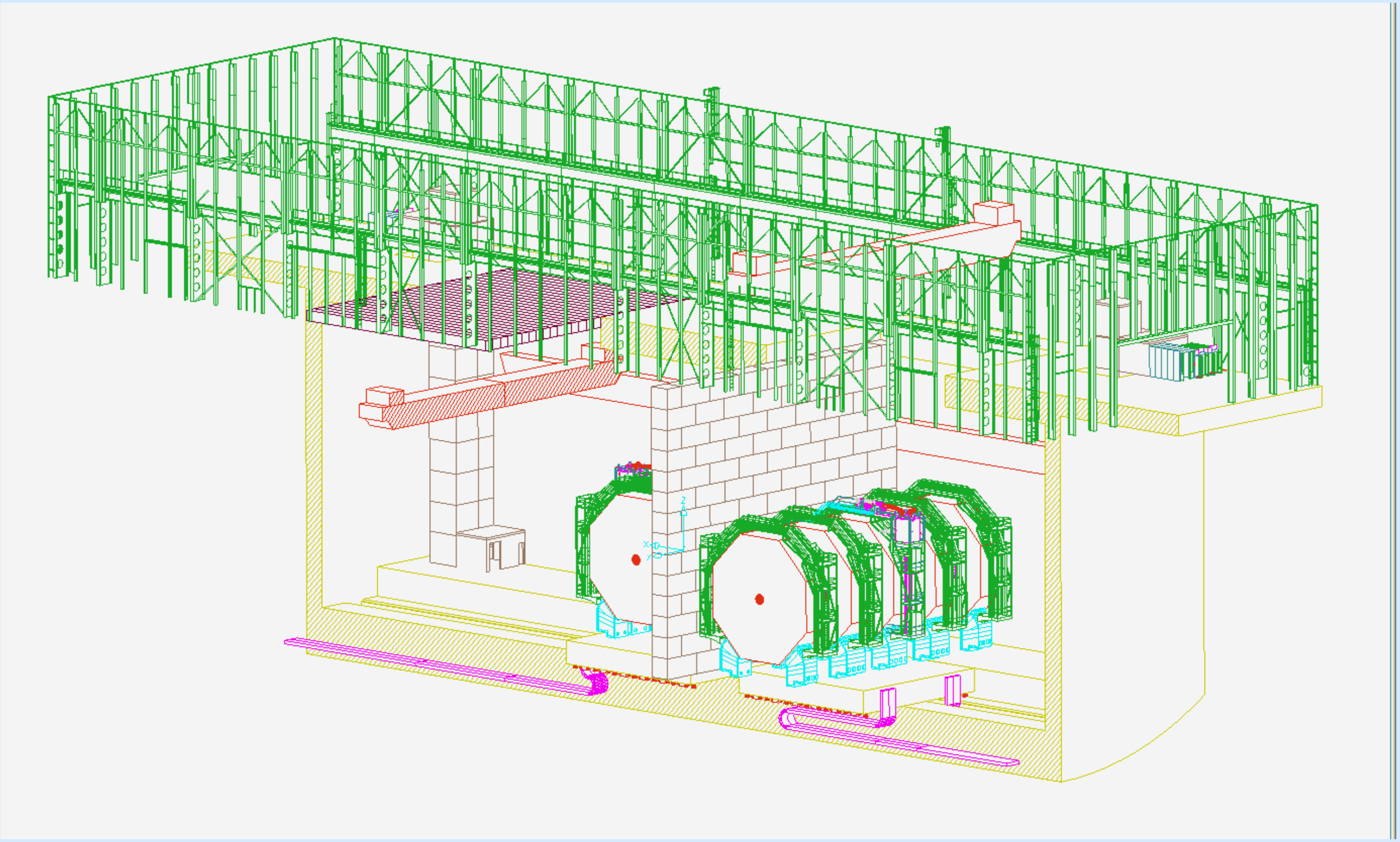




Re-design
Crane: 400t ➞ 100t

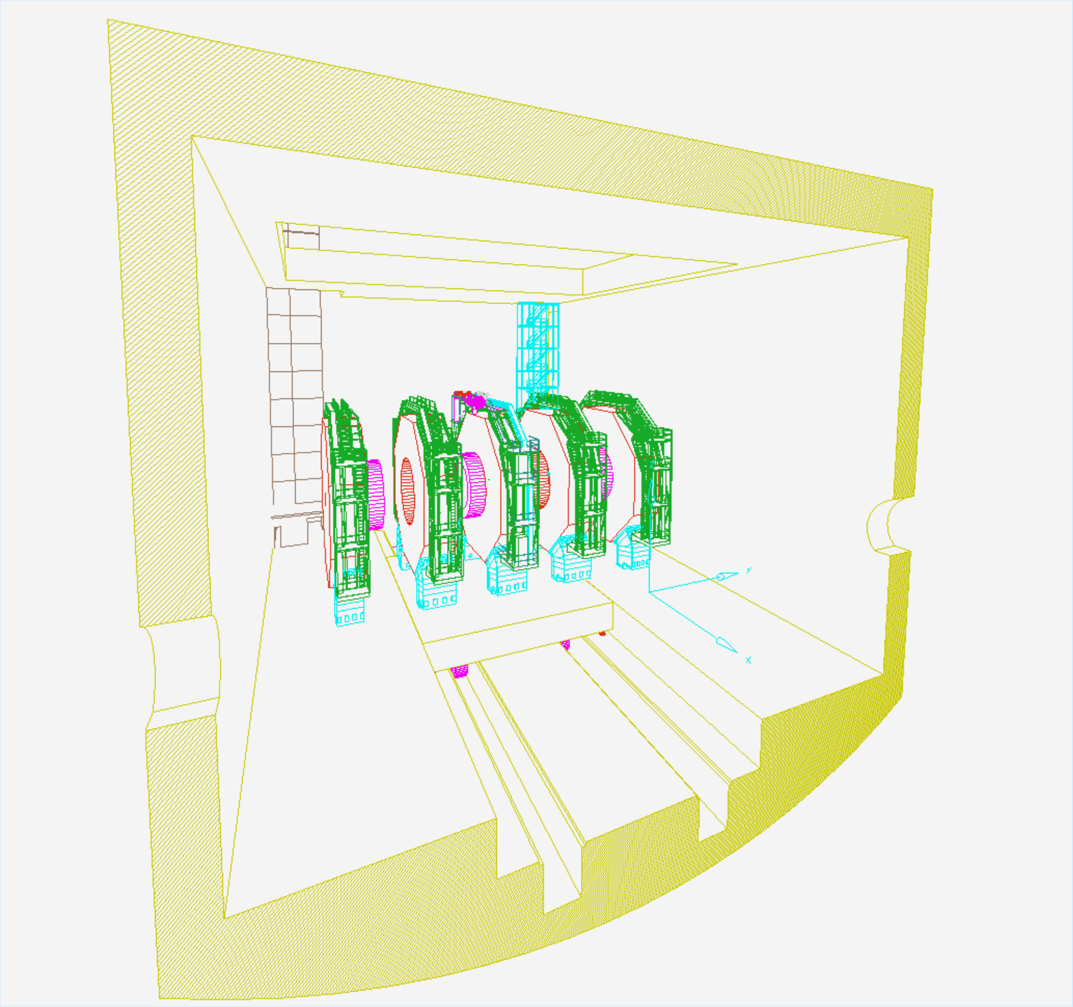


Shallow Site Study



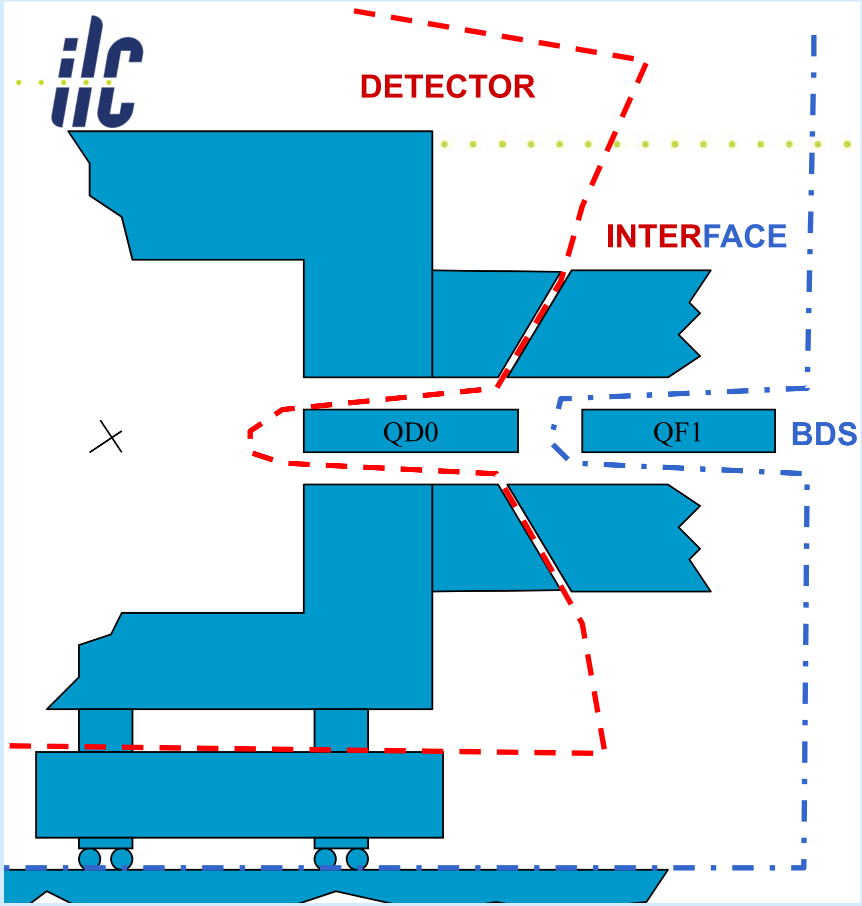
- First rough estimate: saves 5% on the detector hall costs

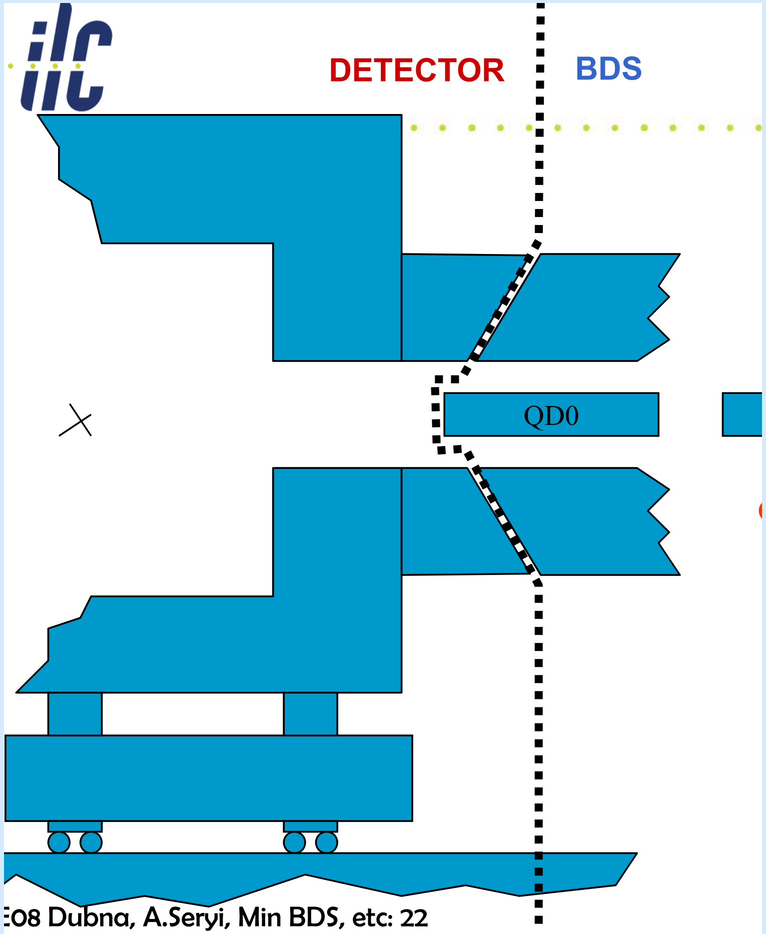
Push-pull: Platform or not?



- A platform might be a good but expensive idea
- Maybe the detector could be stable enough to be moved on air pads w/o the need for a platform
- Key element is the yoke
- Study started

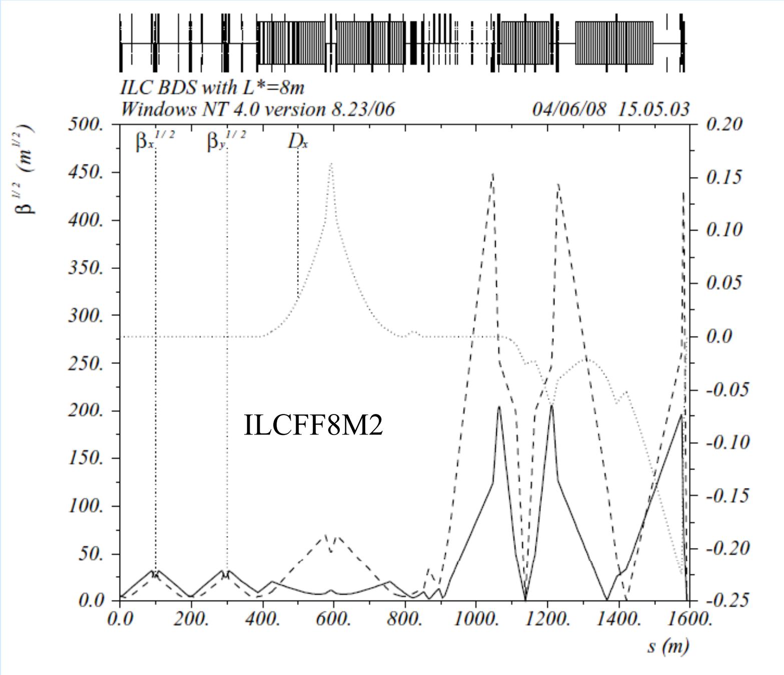
Optimise Machine-Detector Interface

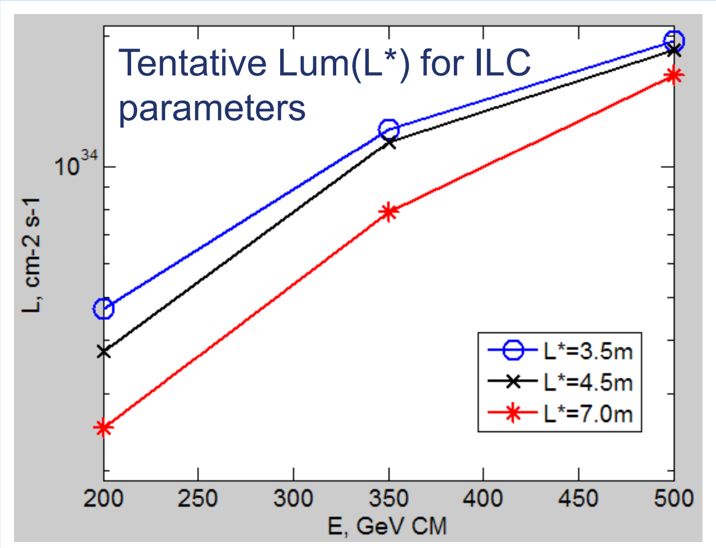




- Shown by A. Seryi in Dubna
- Requires L* ~ 7-8m
- Needs a lof of more work before any decision could be taken

Enlarging L*





- Instananeous Luminosity would be reduced by 20-30%
- Much easier MD Interface
- Better stabilisation of the QD0/QF1 magnets
- Shorter round-trip time for feedback systems
- Integrated Luminosity loss might be small!
- A lot of work needs to be done to show feasibility!

IR Interface Document and ILD

CHALLENGES AND CONCEPTS FOR DESIGN OF AN INTERACTION REGION WITH PUSH-PULL ARRANGEMENT OF DETECTORS – AN INTERFACE DOCUMENT*

B.Parker (BNL), A.Herve, J.Osborne (CERN), A.Mikhailichenko (Cornell Univ.), K.Buesser (DESY), B.Ashmanskas, V.Kuchler, N.Mokhov (Fermilab), A.Enomoto, Y.Sugimoto, T.Tauchi, K.Tsuchiya (KEK), J.Weisend (NSF), P.Burrows (Oxford Univ.), T.Markiewicz, M.Oriunno, A.Seryi, M.Sullivan (SLAC), D.Angal-Kalinin (STFC), T.Sanuki, H.Yamamoto (Tohoku Univ.)

Abstract

Two experimental detectors working in a push-pull mode has been considered for the Interaction Region of the International Linear Collider [1]. The push-pull mode of operation sets specific requirements and challenges for many systems of detector and machine, in particular for the IR magnets, for the cryogenics system, for alignment system, for beamline shielding, for detector design and overall integration, and so on. These challenges and the identified conceptual solutions discussed in the paper intend to form a draft of the Interface Document which will be developed further in the nearest future. The authors of the present paper include the organizers and conveners of working groups of the workshop on engineering design of interaction region IRENG07 [2], the leaders of the IR Integration within Global Design Effort Beam Delivery System, and will also include representatives from each detector concept submitting the Letters Of Intent.

INTRODUCTION

The process of finding an acceptable technical solution for Interaction Region involves searching a balance between complex and often contradictory requirements coming from machine or detector. An Interface Document was thought as a way to keep track of the achieved agreements and assumption, and also as the way to highlight existing contradictions and focus the efforts for their resolution. The latter imposes the present Interface Document to be an evolving entity. The first attempt of creation of the Interface Document was undertaken at the IRENG07 workshop. The paper presented represents the next draft, which will be further developed as an integral part of LOI preparation.

FUNCTIONAL REQUREMENTS

In this section, the minimal functional requirements, to which all detector concepts are bound, are summarized. These requirements are closely related to fundamental properties of design and less dependent on site location and similar specifics. In contrast, the next section will describe more detailed specification and outline the present working models and likely technical solutions.

The list of minimal functional requirement starts with the need to have two detectors in a single collider hall, able to work in turns, in push-pull mode.

The speed of push-pull operation is the first defining assumption. We set as the goal that hardware design should allow the moving operation, reconnections and possible rearrangements of shielding to be performed in a few days, or less than a week.

The range of detector sizes considered in the design include detectors with half size of 6-7 meters, performing optimally if the IP to start of QD0 quadrupole (L* parameter) would be in the range of 3.5-4.5 meters (different L* is allowed for different detectors), while the distance from IP to the second quadrupole QF1 is 9.5 meters, which drives many parameters of the design, including the hall width.

The off-beamline detector is shifted in transverse direction to a garage position, located 15m from the IP. The radiation and magnetic environment, suitable for people access to the off-beamline detector during beam collision, are to be guaranteed by the beamline detector using their chosen solution.

The IR and detector design is to satisfy the beam parameters defined in the RDR [1] including nominal, Low N, Large Y and Low P parameter sets.

INTERFACE SPECIFICATIONS

The superconducting final doublets, consisting from QD0 and QF1 quadrupoles (and associated sextupoles SD0 and SF1) are grouped into two independent cryostats, with QD0 cryostat penetrating almost entirely into the detector. The QD0 cryostat is specific for the detector design and moves together with detector during push-pull operation, while the QF1 cryostat is common and rests in the tunnel.

Radiation shielding is essential with two detectors occupying the same Interaction Region hall. Detector should either be self-shielded or need to assume responsibility for additional local fixed or movable shielding (walls) to provide area accessible for people near the second detector when the first is running with beam. The radiation criteria to be satisfied are for normal operation and for accident case. In the normal operation, the dose anywhere near non-operational second detector should be less than 0.05mrem/hour. In the accident case the dose should be less than 25rem/h for maximum credible beam (simultaneous loss of both e+ and e- beams anywhere near the IP, at maximum beam power), and the

*Work supported in part by US DOE contract DE-AC02-76-SF00515.

- Discussion of IR Interface Document and especially the minimal functional requirements has just started within ILD
- Probably no major dis-agreements
- But: needs careful checking!

Summary

- MDI/Integration Working group is in full swing
- Joint detector concept is under development
- Critical questions under study, e.g.:
  - Radiation protection
  - Push-pull: platform or not?
  - Interaction region design: beampipes, etc.
  - Integration efforts: how to come to a sound engineering design of the joint ILD detector?

- ILD will converge to one set of parameters not before fall this year
- Technical challenges in a worldwide collaboration should not be under-estimated