Common MDI Issues

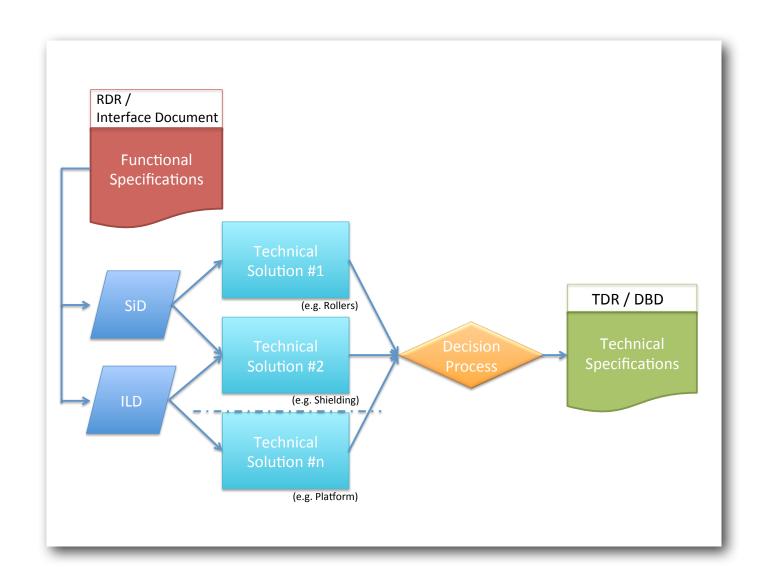
Karsten Buesser

23.04.2012 KILC12



Machine-Detector Interface Organisation

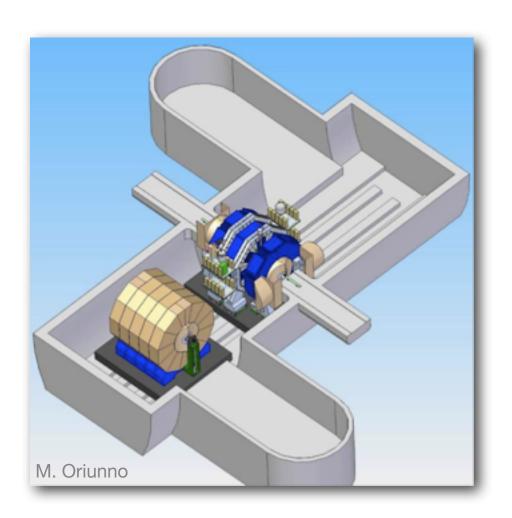
- A fruitful collaboration between:
 - MDI Common Task Group Detector Organisation
 - BDS and CFS groups GDE
 - SiD and ILD Detector Concepts
 - good collaboration with CLIC
 - non-LC groups: experience from detectors at LHC, HERA, SLC, ...
- No single line of reporting
- Depends on decision making in "experimental collaboration style"
 - common agreements wherever possible





MDI Main Topics

- Resources are limited
- Concentrate on topics that are of most relevance for the TDR/ DBD
- Concentrate on cost drivers
 - Civil facilities at the IR:
 - underground areas
 - surface buildings
 - Push-pull system
 - Detector services





Boundary Conditions

- IR Interface Document
 - Functional requirements for the co-existence of two experiments and the machine in a push-pull scenario
 - ILC-Note-2009-050
 - Major milestone and deliverable
- NB: post-RDR work

ILC-Note-2009-050 March 2009 Version 4, 2009-03-19

Functional Requirements on the Design of the Detectors and the Interaction Region of an e⁺e⁻ Linear Collider with a Push-Pull Arrangement of Detectors

B.Parker (BNL), A.Mikhailichenko (Cornell Univ.), K.Buesser (DESY), J.Hauptman (Iowa State Univ.), T.Tauchi (KEK), P.Burrows (Oxford Univ.), T.Markiewicz, M.Oriunno, A.Seryi (SLAC)

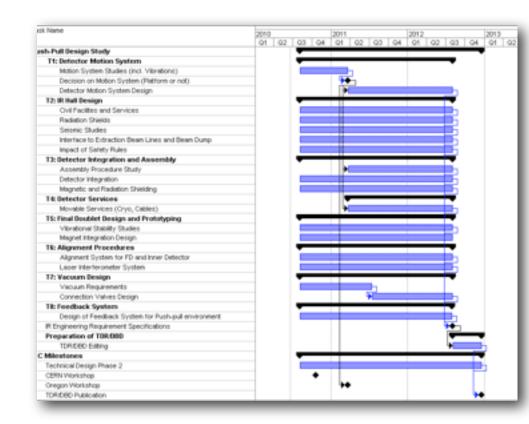
Abstract

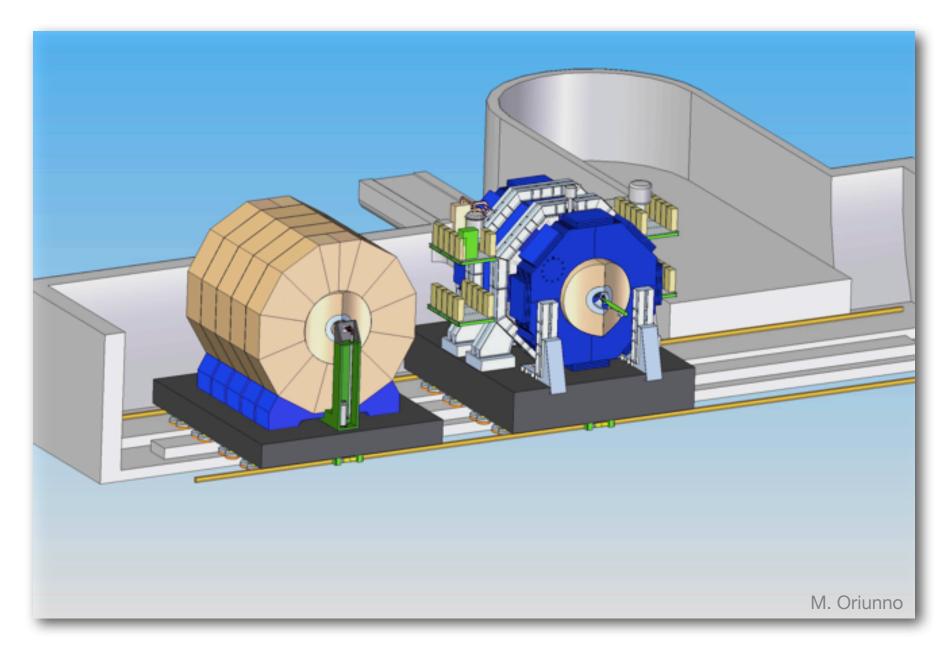
The Interaction Region of the International Linear Collider [1] is based on two experimental detectors working in a push-pull mode. A time efficient implementation of this model sets specific requirements and challenges for many detector and machine systems, in particular the IR magnets, the cryogenics and the alignment system, the beamline shielding, the detector design and the overall integration. This paper attempts to separate the functional requirements of a push pull interaction region and machine detector interface from any particular conceptual or technical solution that might have been proposed to date by either the ILC Beam Delivery Group or any of the three detector concepts [2]. As such, we hope that it provides a set of ground rules for interpreting and evaluating the MDI parts of the proposed detector concept's Letters of Inters, due March 2009. The authors of the present paper are the leaders of the IR Integration Working Group within Global Design Effort Beam Delivery System and the representatives from each detector concept submitting the Letters Of Intent.



Work Plan

- 2010 design study proposal for the push-pull system
- Major milestones:
 - March 2011: agreement on platform-based detector motion system
 - December 2011: agreement on detector hall layout for non-mountain site





Platform-based detector motion system



CFS Interaction Region Studies

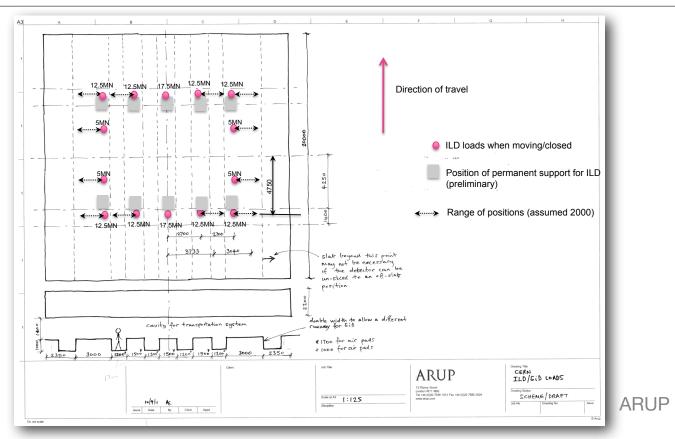
Launched study with contractor ARUP on two tasks:

- Task 1: Design concept for detector movement platform
- Task 2: Layout of CLIC complex based on CERN geology

Joint ILC/CLIC CFS initiative

ARUP Task 1: Platform Design





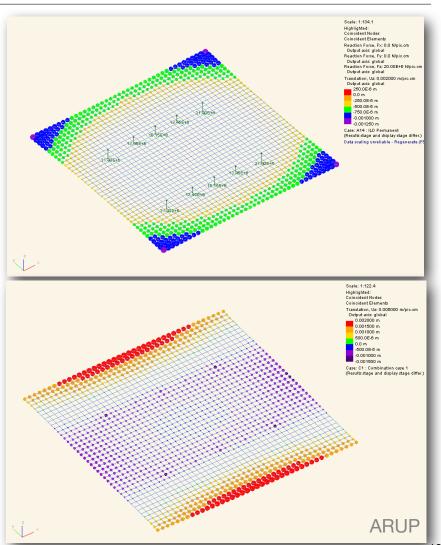
- ILD is the bigger challenge: heavier and larger than SID:
 - Thinner platform at same beam height
 - Larger loads on platform

ARUP Task 1: Platform flexures



- Unloaded platform:
 - Flexure: +0.25mm; -1.25mm

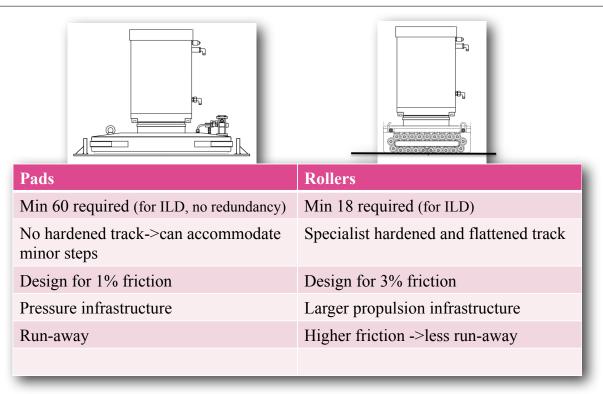
- Loaded platform jacking onto transport system:
 - Flexure: +1.9mm; -1.0mm



ARUP Task 1:

Detector Movement System





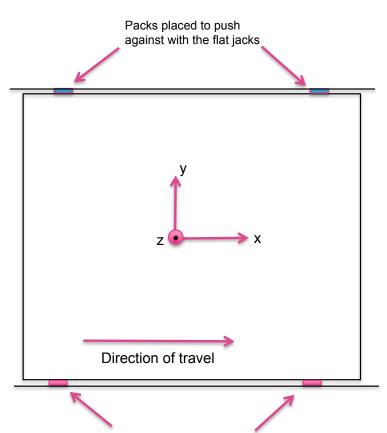
- Two solutions under study:
 - Air pads
 - Hilman rollers

ARUP

ARUP Task 1: Positioning System



The final positioning system



Degree of freedom	Methodology
x, Rzz	Push pull system
z, Rxx, Ryy	Pack adjustment under slab
y (air-pads) illustrated	Lateral push with flat jacks whilst air pads are active
y (rollers) illustrated	Lateral push with flat jacks whilst the lateral slider (on the roller) is un-locked

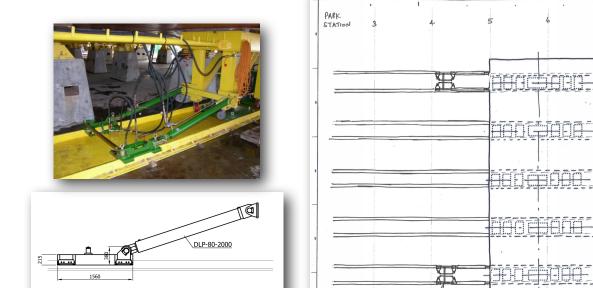
Note, Rxx is rotation about the x-axis, etc

ARUP

Flat jacks push against the lateral packs to achieve precise position in y

ARUP Task 1: Drive System





APS PPU-160 VERTICAL LIP PERMANENT ON TRACK AIRPADS LEVELS TO BE ESTABLISHED AT ALL PARK STATIONS CERN ILC **ARUP** CERN ILC PRIOR TO MOVEMENT AND TRANSPORTATION EYSTEM PACKING FOR EACH PARK DRAFT SCHEME STATION TO BE CALCULATED Scale at A3 1:125 21/7/4 AC Issue Date By Cthid Appd

ARUP

Air pad drive system using grip jacks

Conclusion on ILD movement

Moving the Detector

- Can achieve disp limits of +/-2mm when moving
 - ILD on 2.2m slab with pads or rollers
 - SiD on 3.8m slab with pads or rollers
 - Design works with pads and rollers, choice outside scope of assessment
- Recommended Contingency/Studies
 - Jacking and packing if the invert does flex (to keep the slab permanent supports plane)
 - Provide 50mm packing from the start to allow the height to be reduced
 - Evaluate slab final positioning systems (eg PTFE sliding surface)
 - Movement system not examined in detail (stick-slip accelerations require evaluation, 0.05m/s²)

Un-slicing

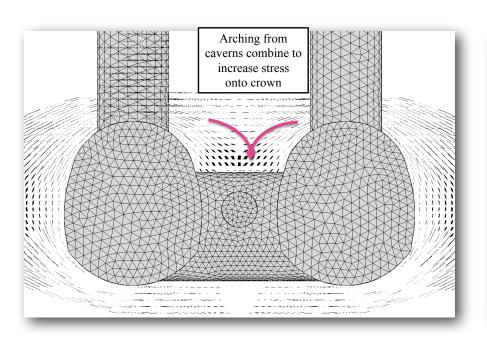
- Limits exceeded when un-slicing......but not applicable
- But props/shims will be needed under tracks when un-slicing to avoid a step

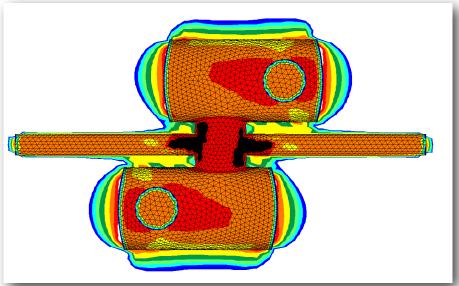
BUT

■ Conclusions above dependent on invert flex ----- Displacement limit of ~0.5mm

ARUP Task 2: CLIC Underground Hall



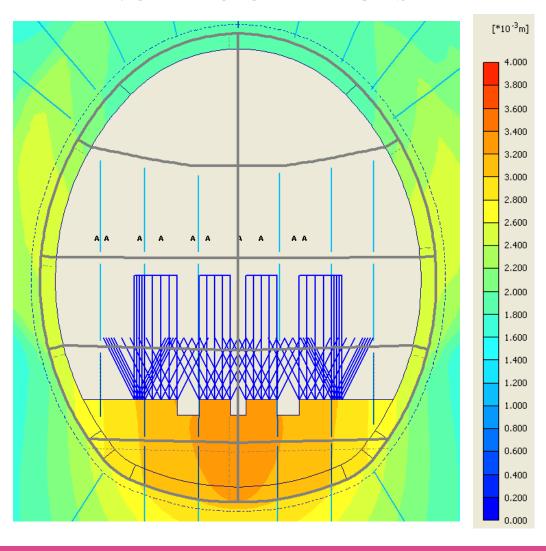




ARUP

- Layout of CLIC underground hall in CERN geology
- Higher stresses mean more complicated lining and rock support and higher risk of rock yield

2D Invert Deformations



Longitudinal: 3.3mm / 16.6m = 0.2mm/m x 20m = 4mm/ 20m > 0.5mm/20m.

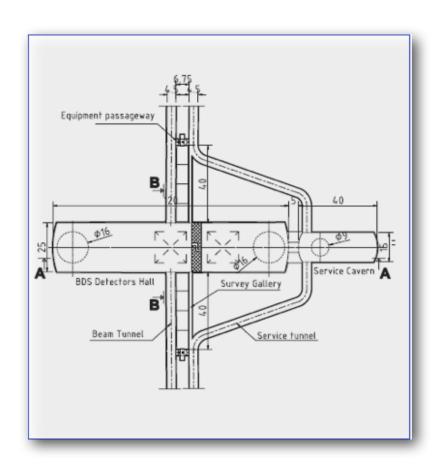
Transverse: 3.3mm-3 mm / 13.5m = $0.023 \times 20 =$ **0.45mm/20m** < **0.5**mm/**20**m.

"Static" analysis carried out, existing data did not allow small strain stiffness, creep and cyclic deformation



RDR IR Hall Layout

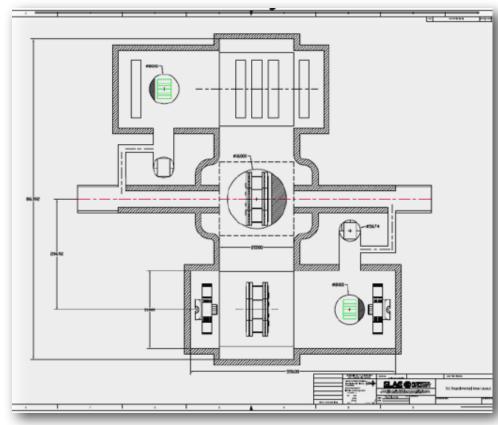
- No optimisation with detector groups done at that time
- Requirements for push-pull interaction region not known at that time
- Will probably not work:
 - Shafts above experiments
 - Not enough space in garage positions
 - No space for services
 - Not optimised for push-pull operations
 - Shielding wall superfluous



Latest IR Hall Layout for Non-Mountain Sites

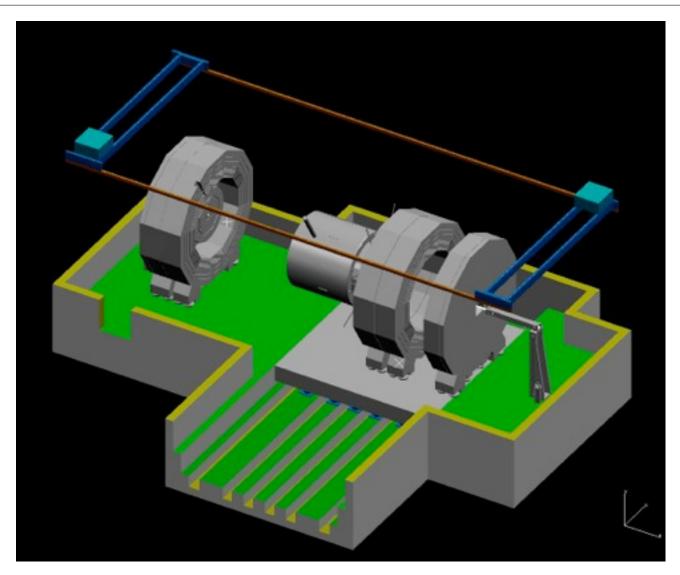


- Z-Shape
- Garage positions allow detector maintenance
- Only one large (~18m) shaft
 - used only in installation phase
- Maintenance shafts (~9m) in garage positions
- Small shafts for elevators (safety issues)



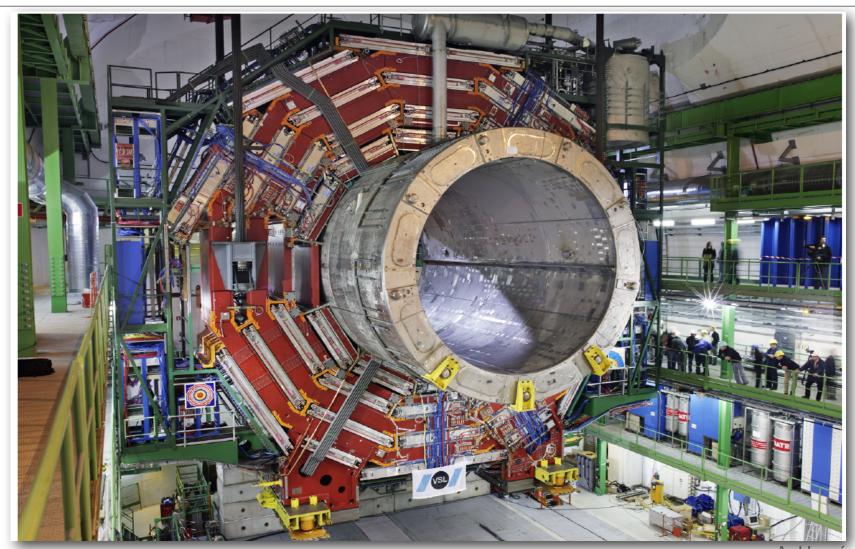
M. Oriunno

ILD in Maintenance Region (non-mountain site)



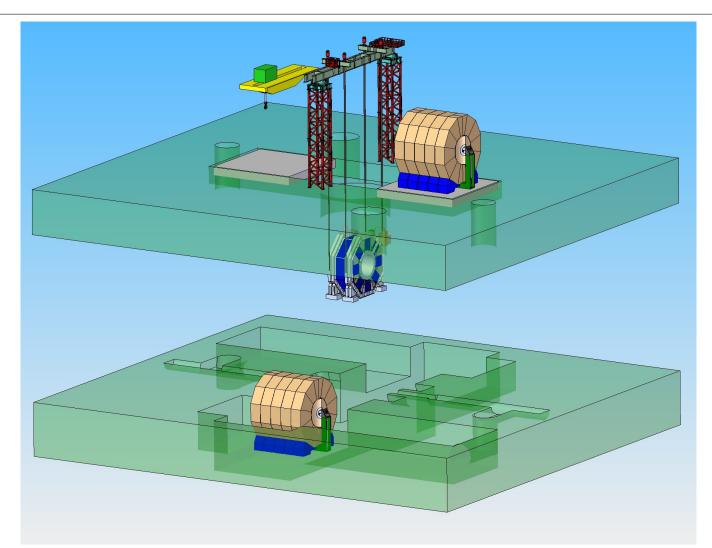


CMS Assembly



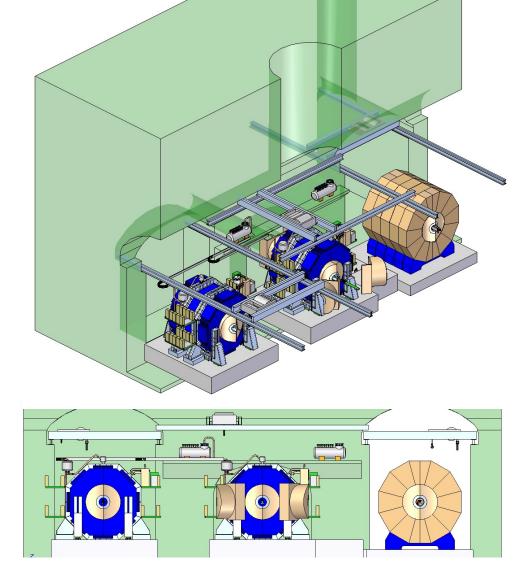


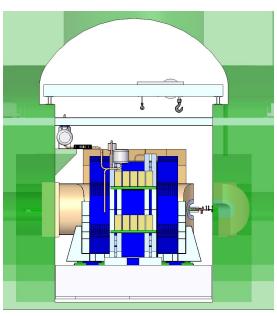
Detector Assembly - Vertical Access

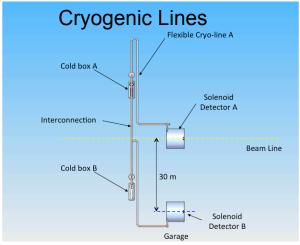


M. Oriunno

Cranes & Infrastructures arrangements, Undergound

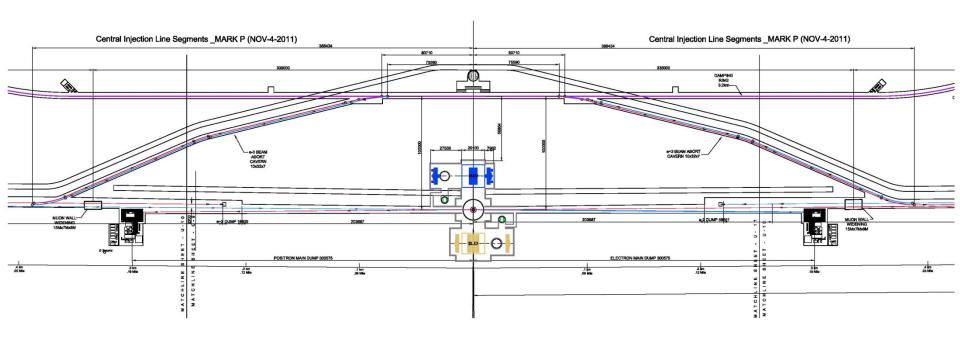






M. Oriunno

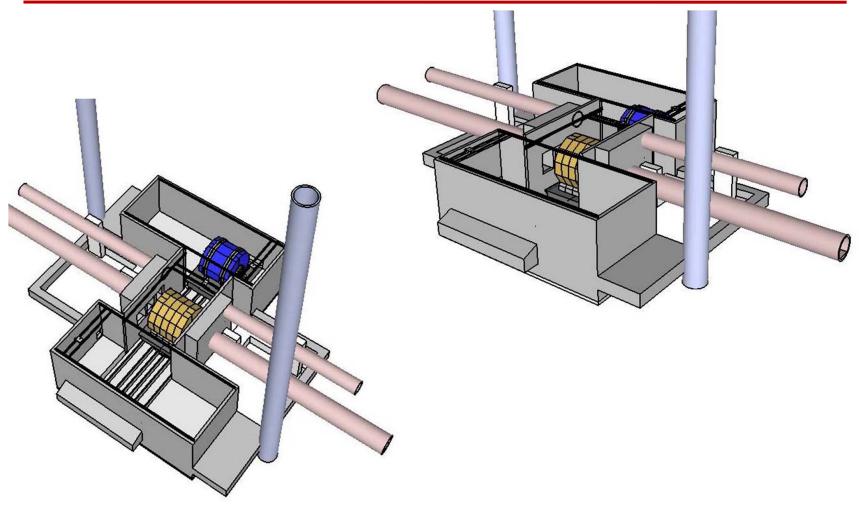
Central Region Integration (American Region)



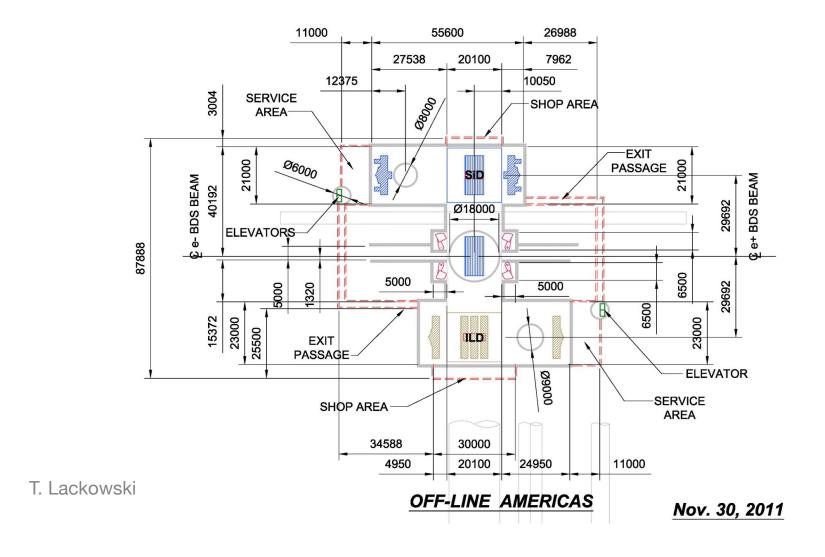
T. Lackowski

Central ILC region is a busy place





Detector Hall Layout (American Region)





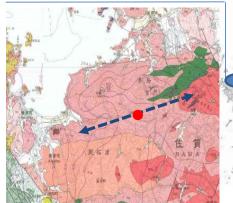


Common Features of Both Candidate Sites

- Geographical Feature of the Detector Hall Area
- Location: in Mountainous Area
- Surface: almost Forest Zone
- Earth Covering Depth is Large:

200 m ~400 m

SEBURI Site-B





Geology of the Whole Region

- Located in the Stable Granite Rock
- no Active Faults, no Volcano
- no source of vibration

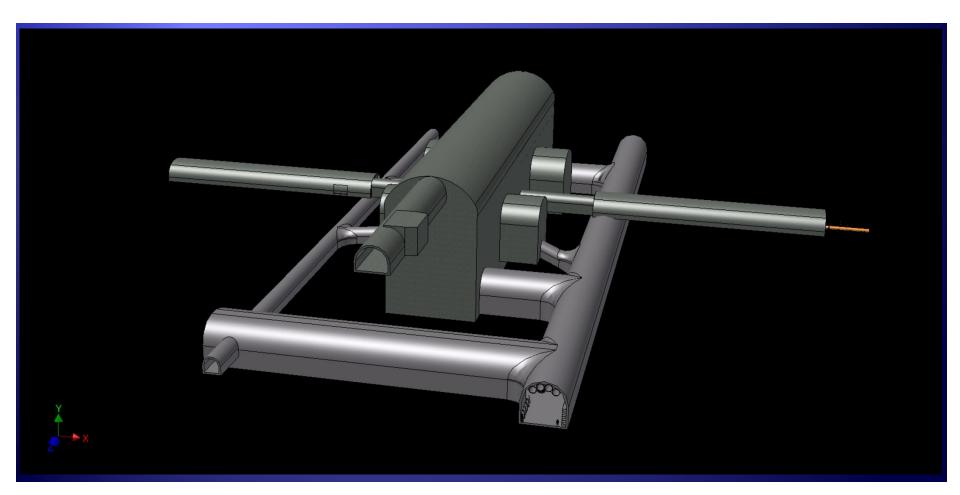
ilc

Mountain Site Configurations



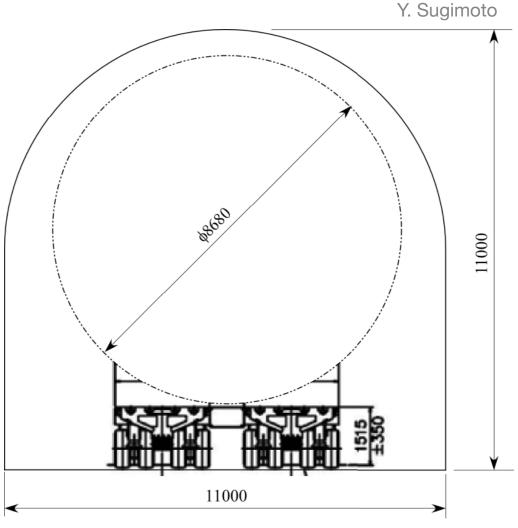
Need more time and space underground

Japanese Hall Design (Status: 22.03.2012)

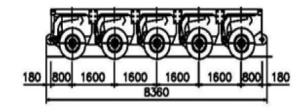


- Enlarged Alcoves
- 142 m long

G. Orukawa





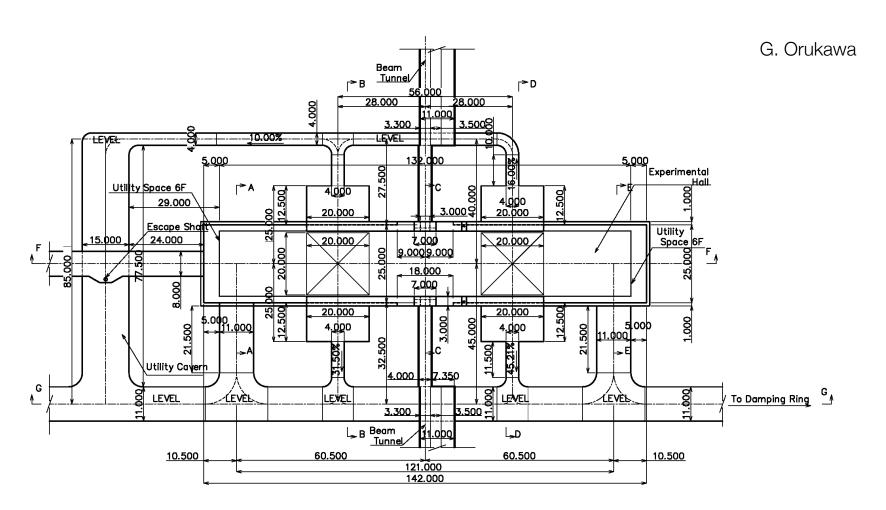


- 225t/5axles → 450t with 2-trailers
- Capable of ~7% slope

Access Tunnel Diameter

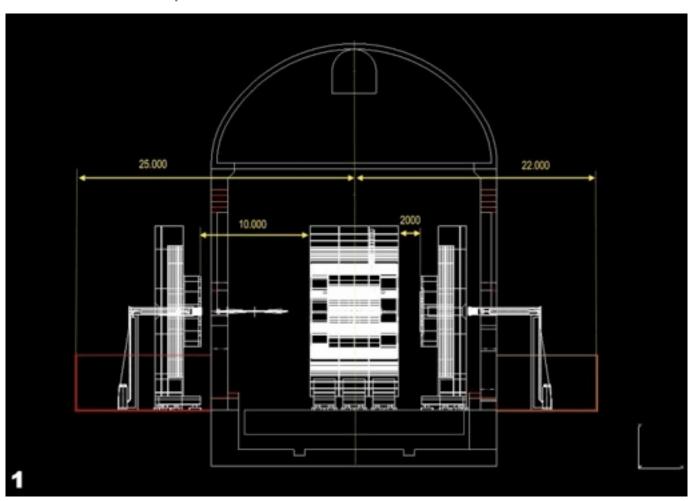
Biggest piece: solenoid coil

Japanese Hall Design (Status: 22.03.2012)



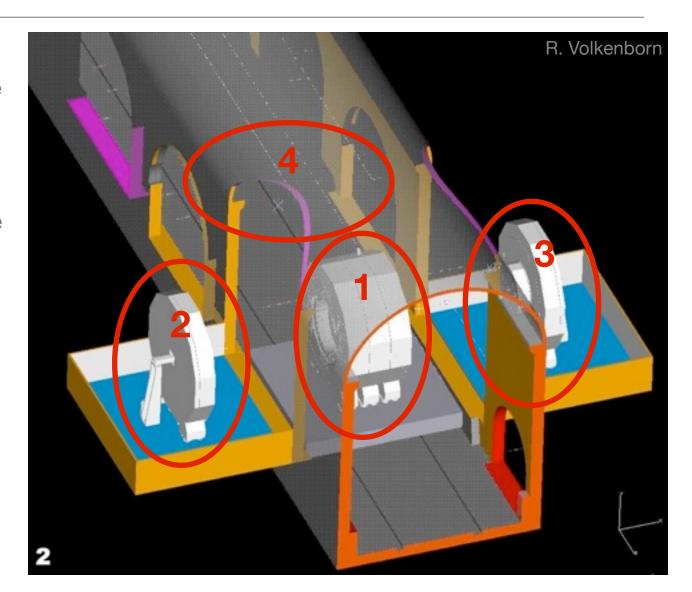
Maintenance Position (ILD Study)

• Alcoves needed to open the detector for maintenance

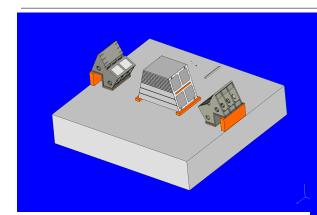


Underground Construction Space (ILD Study)

- Need several assembly areas in the hall
- Studies on space, transportation and time requirements are on going



Example: ILD Yoke Assembly



• Crane: >200t

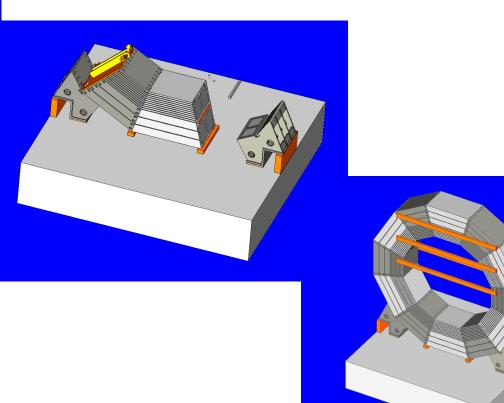
Scaffoldings

Tooling

Surveying equipment

Transport capacity in access tunnel

• ...



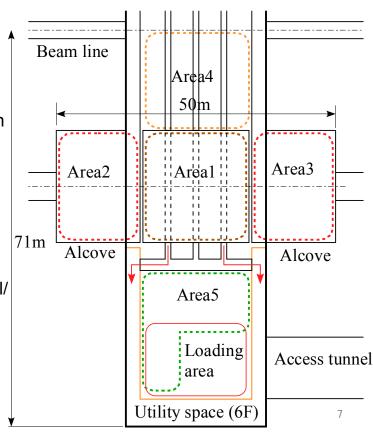


ILD Assembly Study for Japanese Site

Detector assembly area

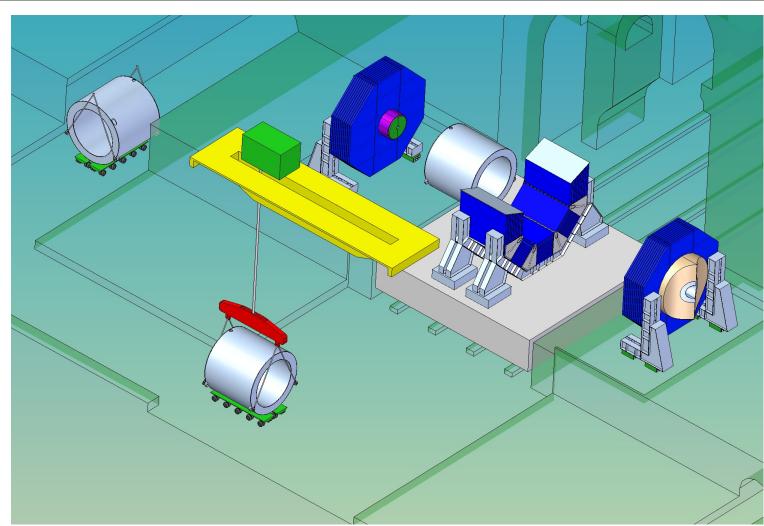
Y. Sugimoto

- Area 1: Platform
 - YB0 assembly
 - Barrel detectors installation/ cabling
 - Endcap calorimeters installation
- Area 2/3: Alcoves
 - Endcap calorimeters cabling
 - QD0 support tube assembly
 - FCAL install/cabling
- Area 4: Tentative platform on beam line side
 - YE, YB+, YB- (iron yoke and muon detector) assembly/install/ cabling
- Area 5: Loading area side
 - HCAL rings assembly
 - Tooling assembly
 - Storage area





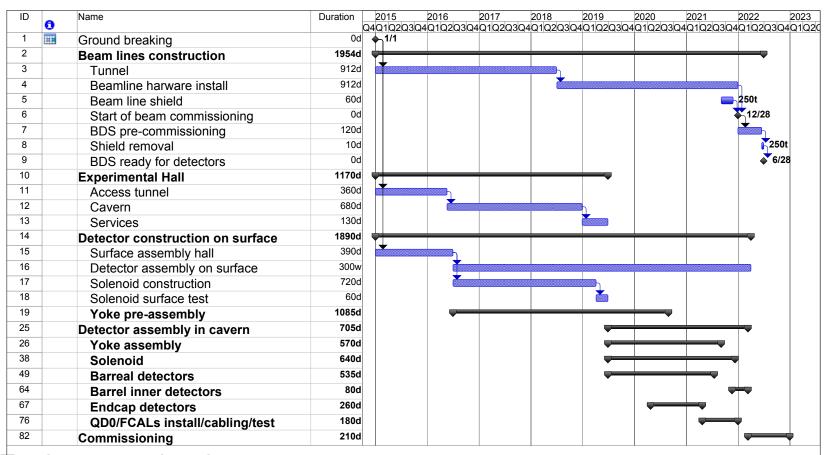
SiD Installation Study



M. Oriunno

ILD Time Line Study

Y. Sugimoto



- Total construction time: ~8 years
- Detector underground construction: ~3 years

Summary and Outlook

- Machine-Detector Interface work is a collaborative effort between SiD, ILD and the machine groups
- Focus of the work is now on cost-drivers for DBD/TDR: push-pull system, hall design
- Non-mountain site detector hall design mature
- Mountain-site detector hall design has very different requirements
 - Special review session at KILC12 (Wednesday 16:00)
- Start to concentrate on the editing process for DBD and TDR