MDI Session at KILC12

Conveners :
Gao Jie (IHEP, China)
Guinyun Kim (Kyungpook Nat. Univ, Korea)
Toshiaki Tauchi (KEK, Japan)
Hubert Gerwig (CERN, Swiss)
Thomas Markiewicz (SLAC, US)

KILC12 : http://kilc12.knu.ac.kr/index.html

T. Tauchi, 26 April, 2012

4 MDI Sessions at KILC12

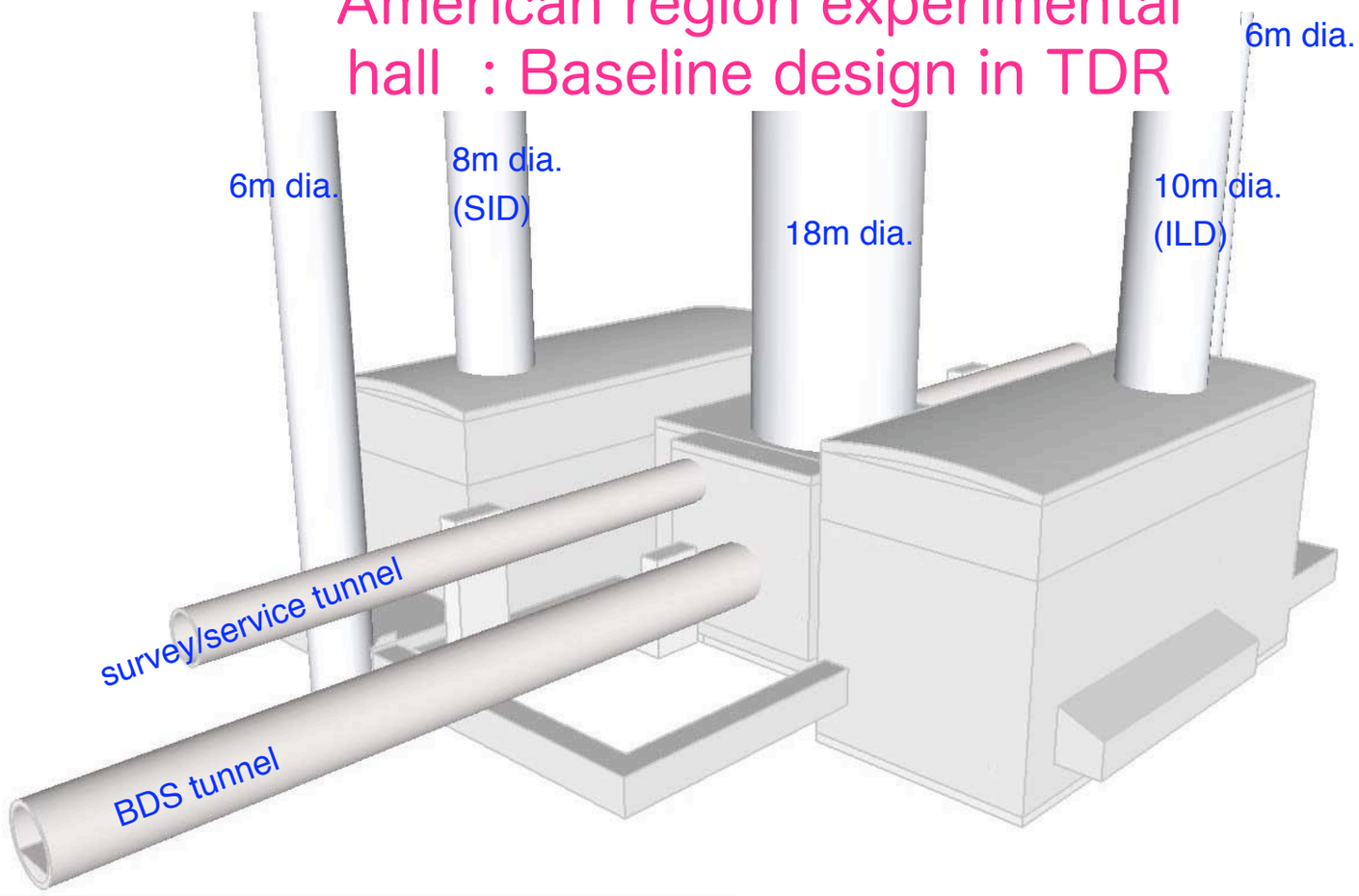
Date and time	Presenter	Title	
8:30 - 10:00, 24 April, 2012; F3-12[70]		**MDI-1**	
8:30 - 8:50	Buesser, K.	ILD MDI, update japanese mountain site	
8:50 - 9:10	Oriunno, M.	SiD MDI	webex
9:10 - 9:30	Markiewicz, T.	SiD Forward: Beampipe, Cal.s and BI	
9:30 - 9:50	Lohmann, W.	ILD Forward	
10:30 - 12:30; B1-4 [300]		**MDI-2**	
10:30 - 10:50	Bambade, Ph.	Beam halo measurement	
10:50 - 11:10	Park, H., Hyun, H.	diamond sensor for the beam halo measurement	
11:10 - 11:20	Parker, B.	QD0 Prototype status	
11:20 - 11:40	Iwashita, Y.	Permanent magnet option for the QD0	
11:40 - 12:00	Burrows, Ph	Update on FONT R&D	
12:00 - 12:20	Strahinja Lukic	Beam-beam effects in luminosity measurement for ILC and CLIC	webex
8:30 - 10:00, 25 April, 2012; F3-9[40]		**Joint with MDI and -BDS for TDR**	
8:30 - 8:50	Seryi, A	Overview of ILC BDS (0.2<Ecm<1TeV) and LINAC end to beam dump	webex
8:50 - 9:00	Tomas, R.	Status of CERN involment in the ILC BDS	webex
9:00 - 9:20	Buesser, K.	MDI in TDR and DBD	
16:00 - 18:00; F3-9[40]		**Joint with MDI and CFS ; review of exp. Hall**	
16:00 - 16:20	Gaddi, A.	Summary of ARUP study of a CLIC cavern with CERN geology	
16:20 - 16:40	Gerwig, H.	(CLIC) MDI alignment plan - detector-QD0 and both BDS sides	
16:40 - 17:00	Sugimoto, Y., Orukawa, G.	Experimental hall in the Japanese Mountain Site	
17:00 - 17:20	Okamura, T., Makita, Y.	Cryogenics system (solenoid, QD0, QF1, crab cavities)in the Japanese Mountain site	
17:20 - 17:40	Kuchler, V	Criteria from MDI and the impact on the cost estimation	
17:40 - 18:00+ α		discussion on "cost-drivers" in the experimental hall	

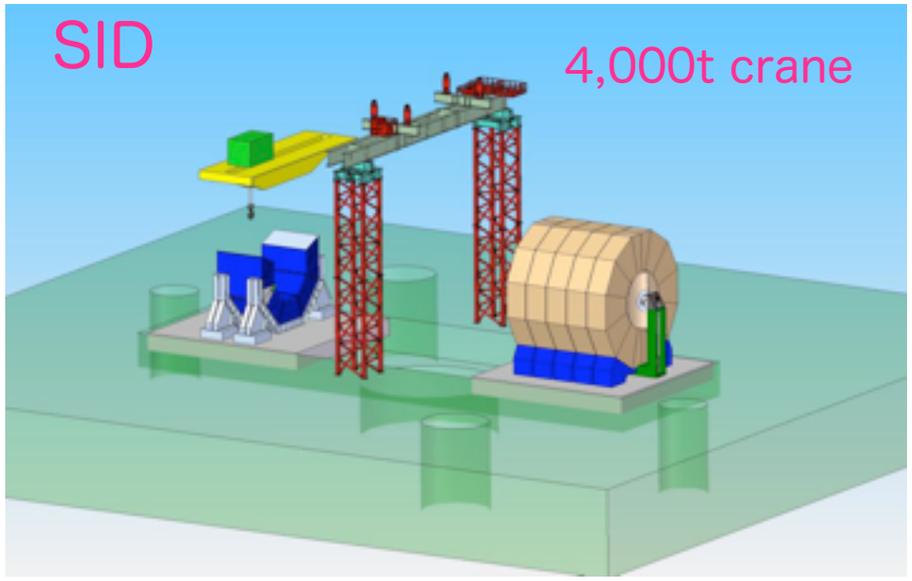
Major issues presented and discussed

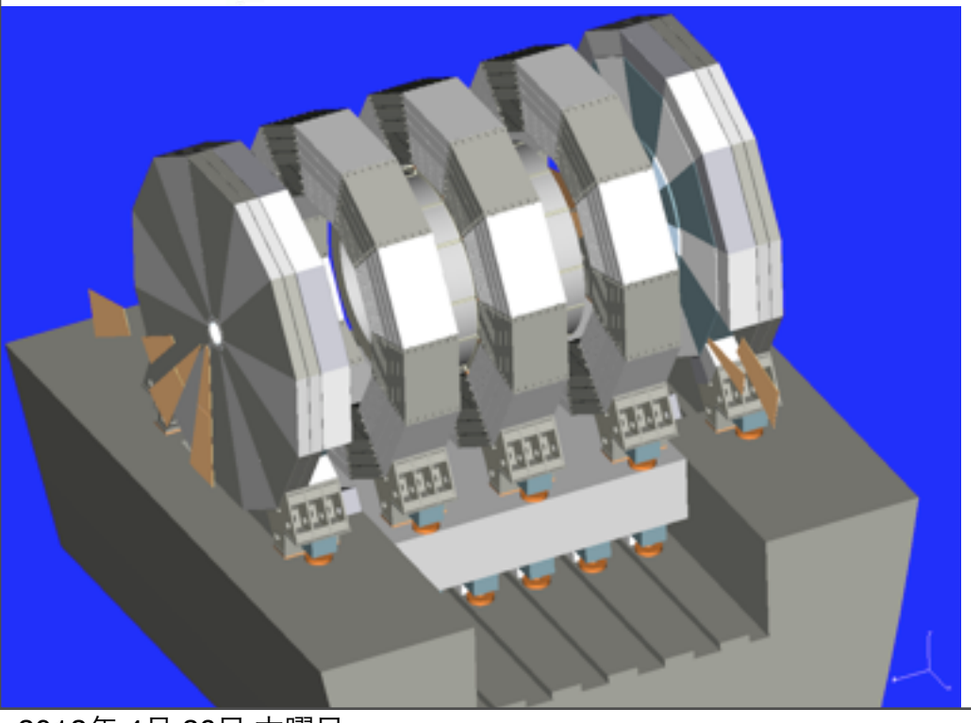
1. MDI and detector integration status reports from SID, ILD for DBD
   Timeline of detector integration at proposed sites
2. ILD and SID forward regions
3. Final double updates (QD0 and QF1)
   superconducting for the split FD
   permanent magnet
4. Beam halo and its measurement by diamond detector
5. Fast feedback system,
   implementation (realistic design) and performance study at ATF2
6. Beam beam effects in luminosity measurements at CLIC and ILC
7. Experimental hall designs - joint with GDE-CFS
   Flat topology in Europe and US : ARUP studies and American design
   Mountainous topology in Japan
   Alignment issue at both beam lines of BDS - survey tunnel
   Cryogenics integration (solenoid, QD0, QF1, crab cavities)
   Cost drivers and requirements from MDI
8. BDS and MDI status for the TDR/DBD - joint with BDS and TDR editors
   CERN contribution

MDI :Experimental hall and detector assembling in Flat topology, presented by K.Buesser, M.Oriunno and V.Kuchler

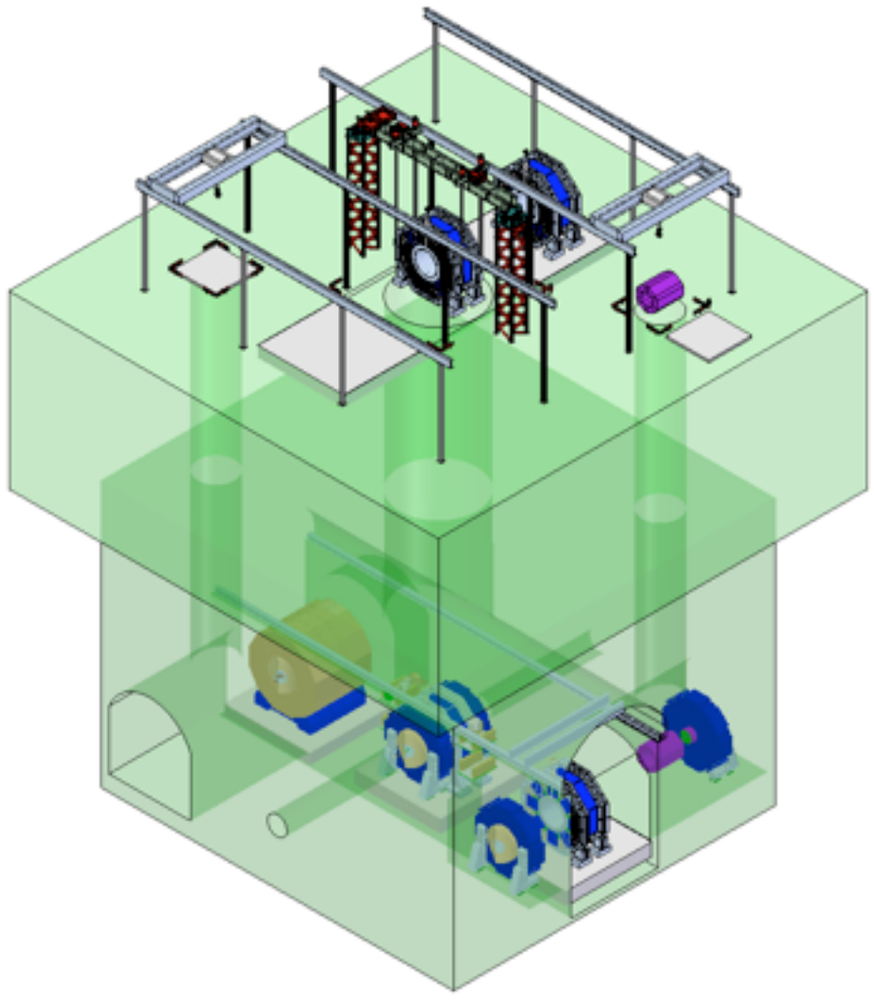
American region experimental hall : Baseline design in TDR



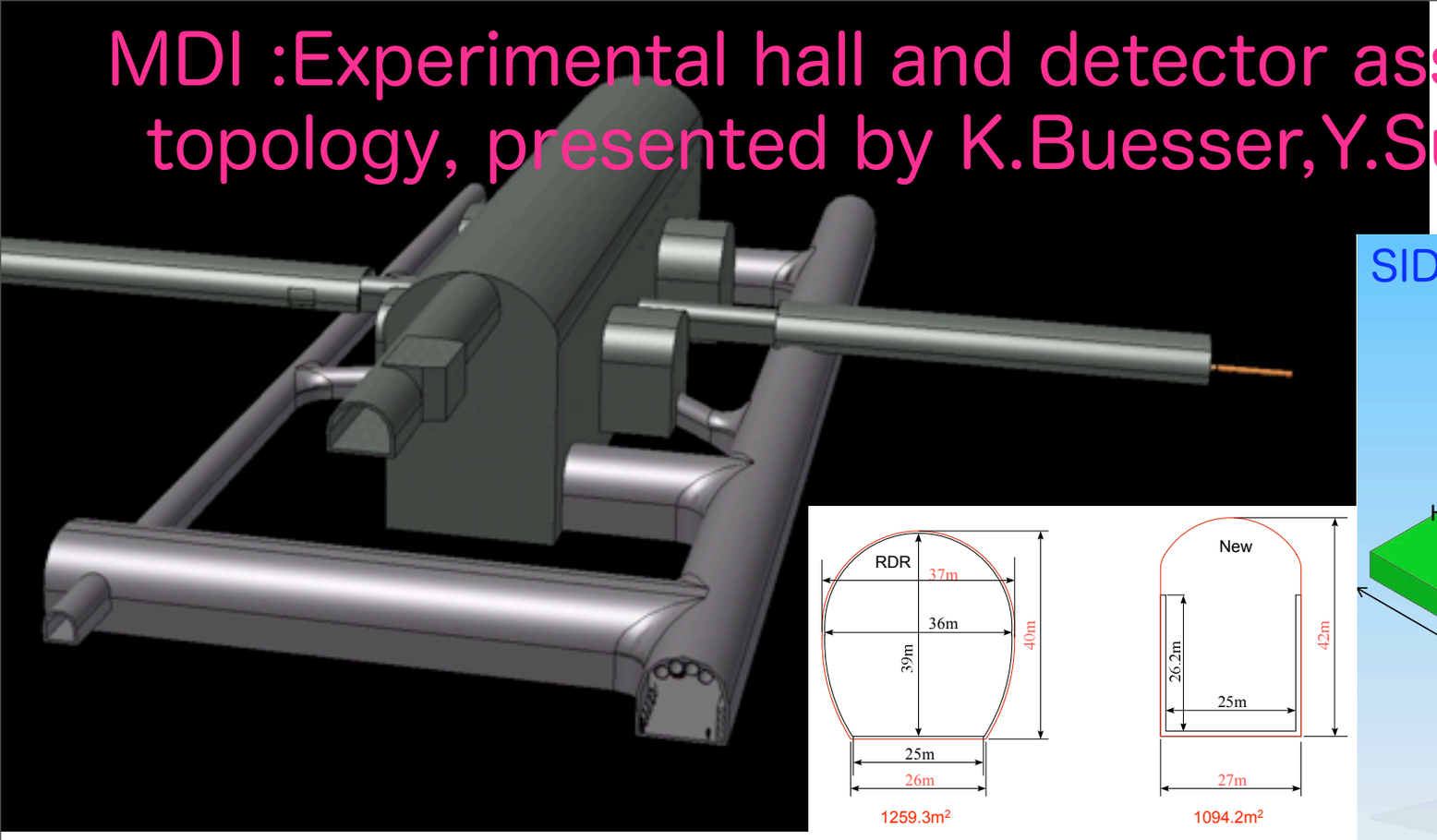


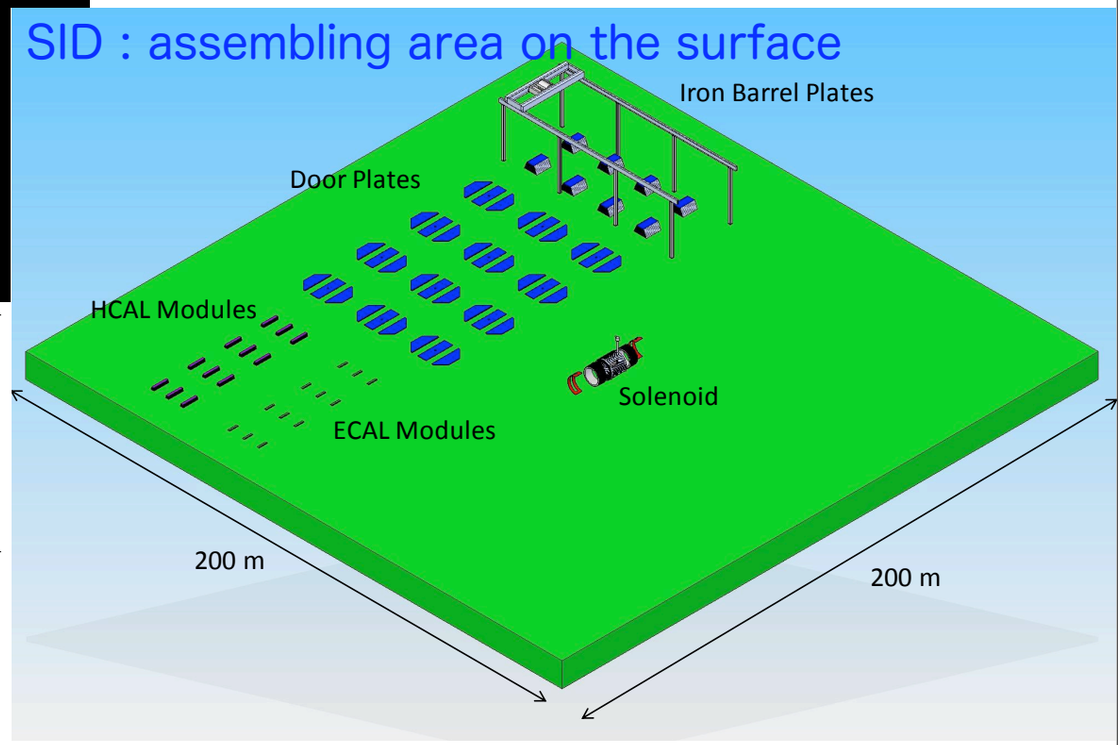


ILD : consisting of 5 rings (CMS like)

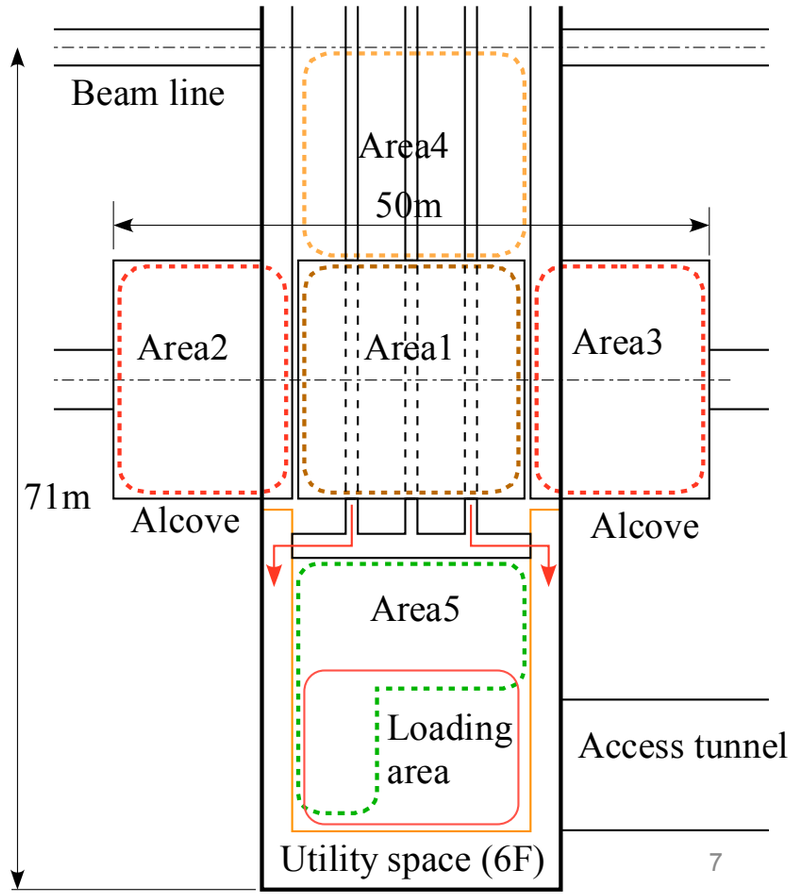


MDI :Experimental hall and detector assembling in Mountainous topology, presented by K.Buesser,Y.Sugimoto and M.Oriunno

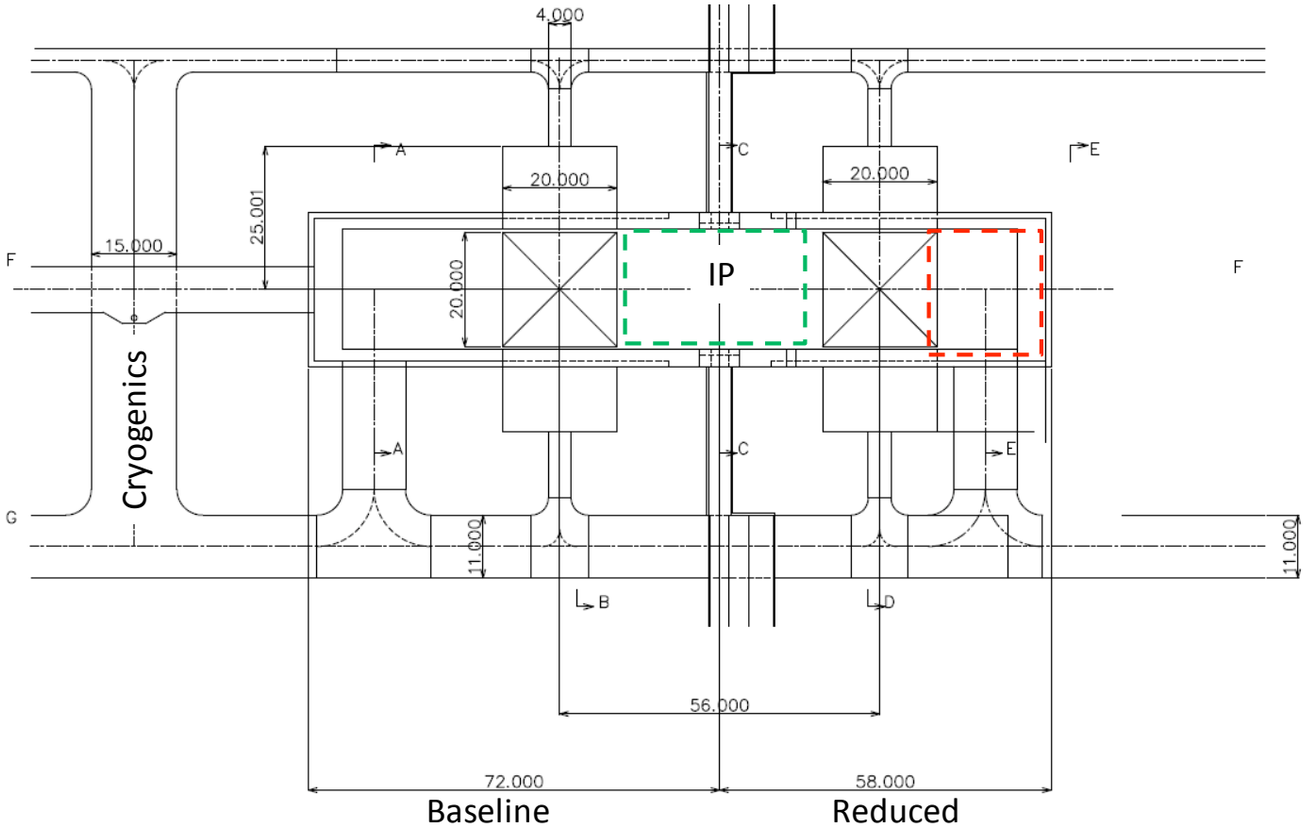




ILD : Assembling area in the hall



SID : Assembling area in the hall - possible option



Summary and Outlook of ILD-MDI by K. Buesser

- ILD MDI work is concentrating on integration issues in the Japanese mountain site hall now
  - Underground facilities are cost drivers!
- We are studying the ILD assembly in the Japanese hall
  - First studies done on 2D models
  - Conclustion expected for ILD workshop May 23-25 2012 (Fukuoka, J)
- We need to understand better the implications of the common use of the infrastructures during the assembly of
  - ILD
  - SiD
  - Machine
- Started to write the DBD....

SID-MDI by M. Oriunno

Summary

SID has developed assembly scenarios for both the Vertical and Horizontal access shaft.

The Detector Hall with vertical shafts has been redesigned and optimized for the push-pull, in a common effort with ILD.

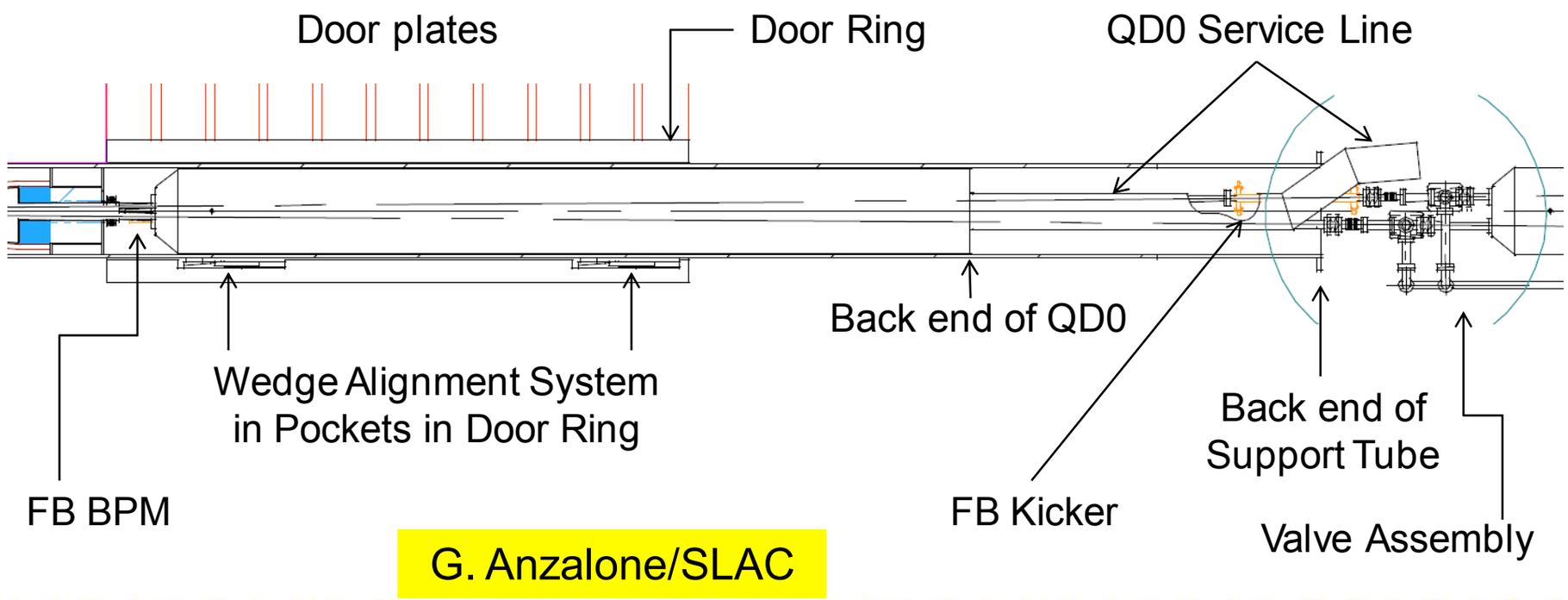
The Japanese Mountain site with horizontal shafts is preferred by SID, being closer to the original assembly procedure considered for the design of the detector.

With the present baseline we believe that there is still a margin to optimize cost and procedure.

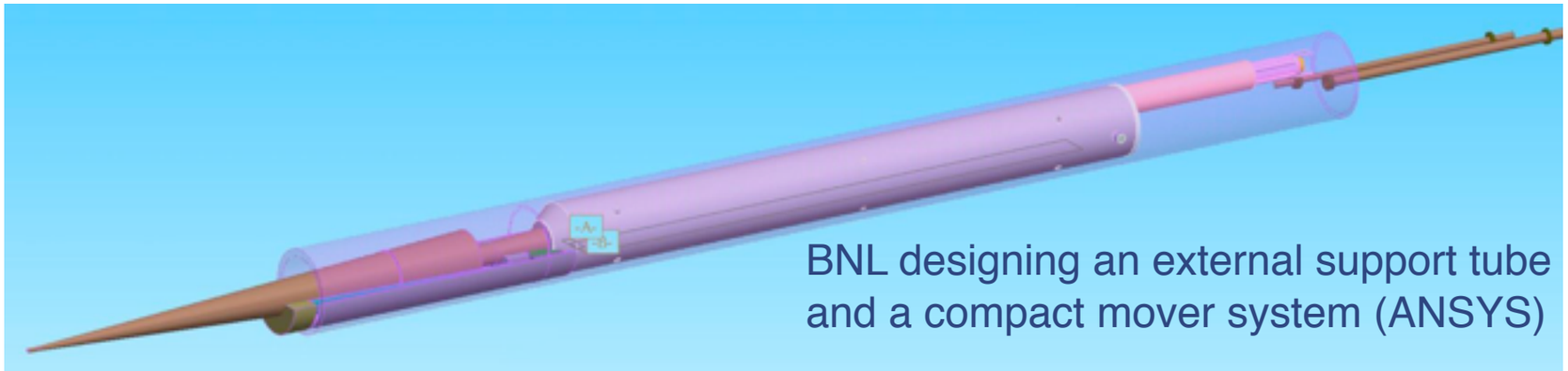
More work is needed to define the layout of the cryogenic distribution and services

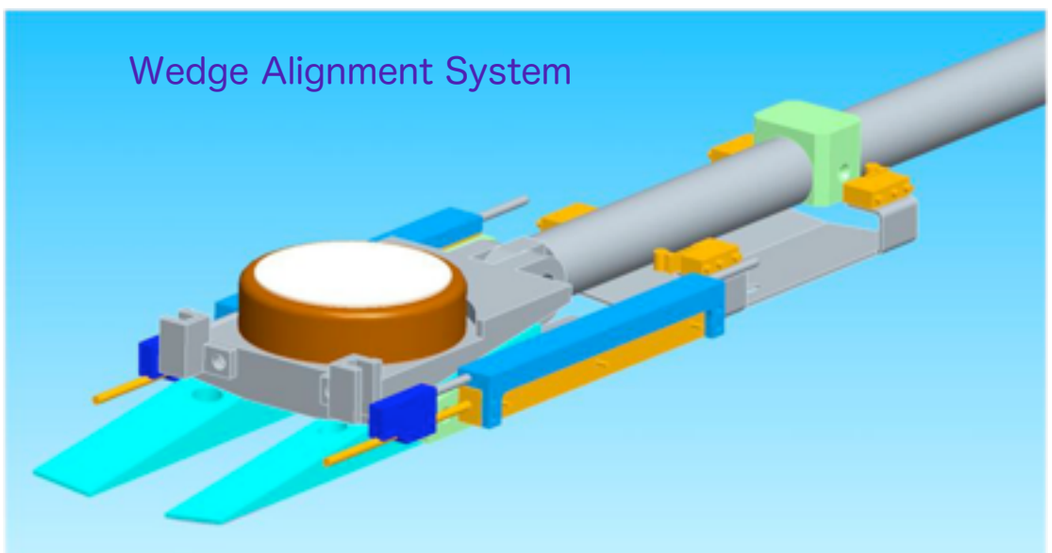
The logistic and procedures of the site on surface for the preassembly of the detector is at an early stage.

SID Forward Region by Tom Markiewicz (SLAC)



G. Anzalone/SLAC



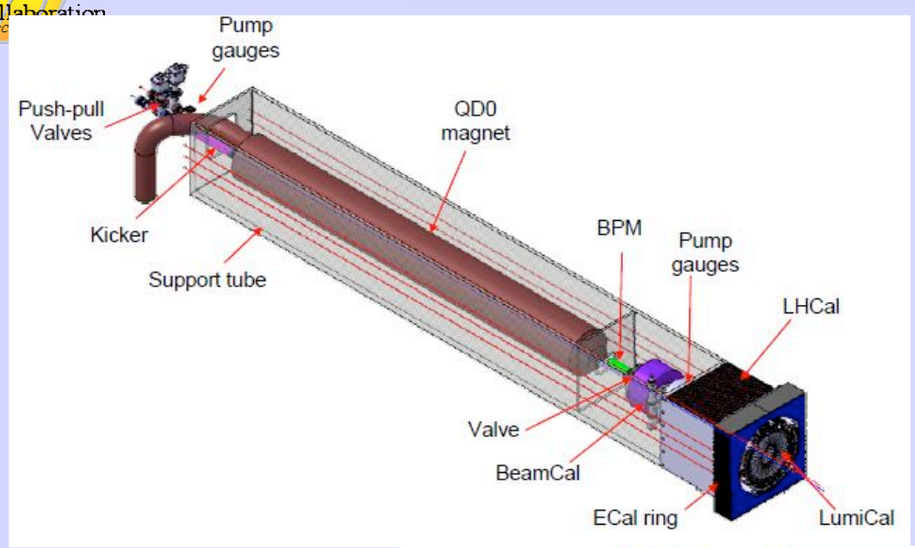


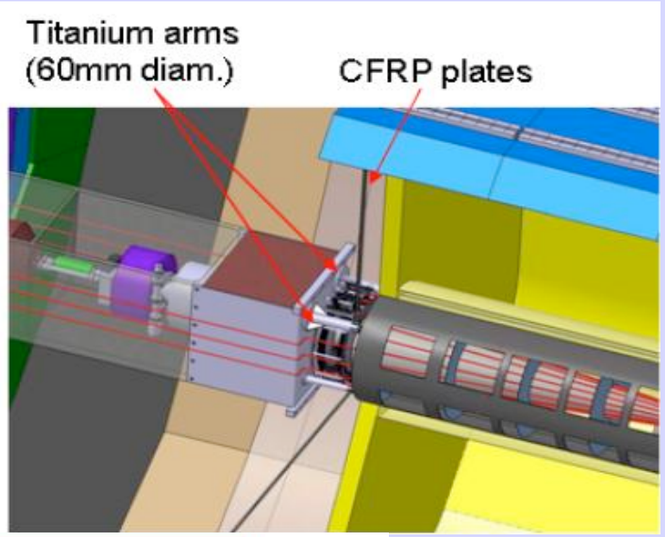
Summary of SiD Forward Status

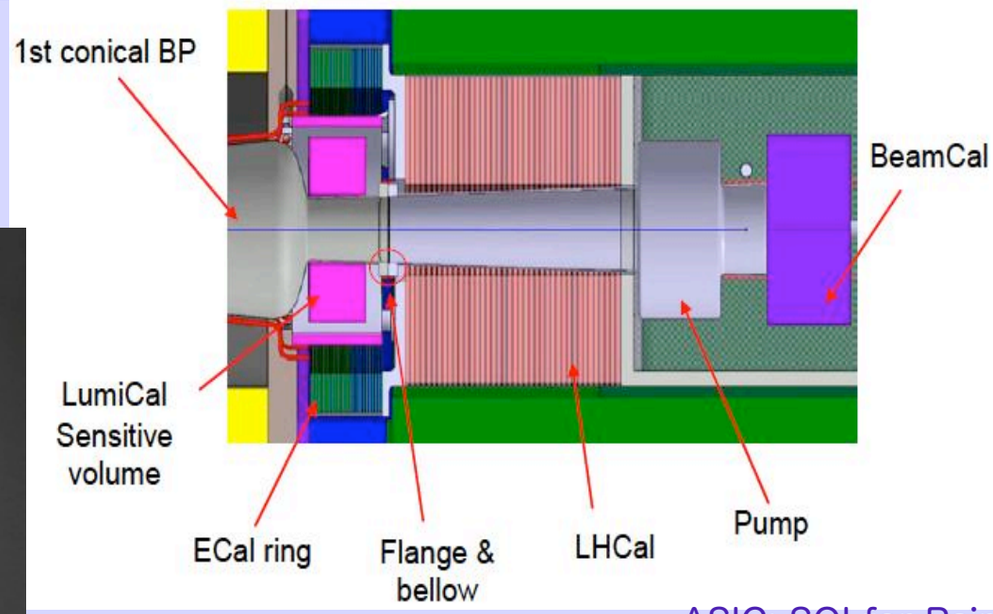
- The 2009 LOI **conceptual** design of the SiD Forward Region has been improved to an appropriate level for the DBD.
- Much more work needed

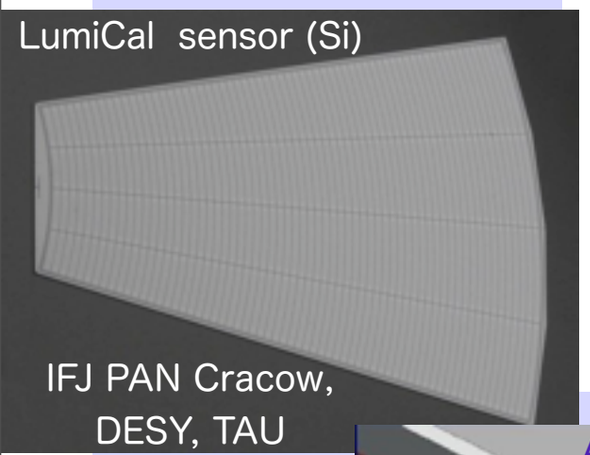
Forward Instrumentation of ILC and CLIC detectors , Wolfgang Lofmann (FCAL collab.)

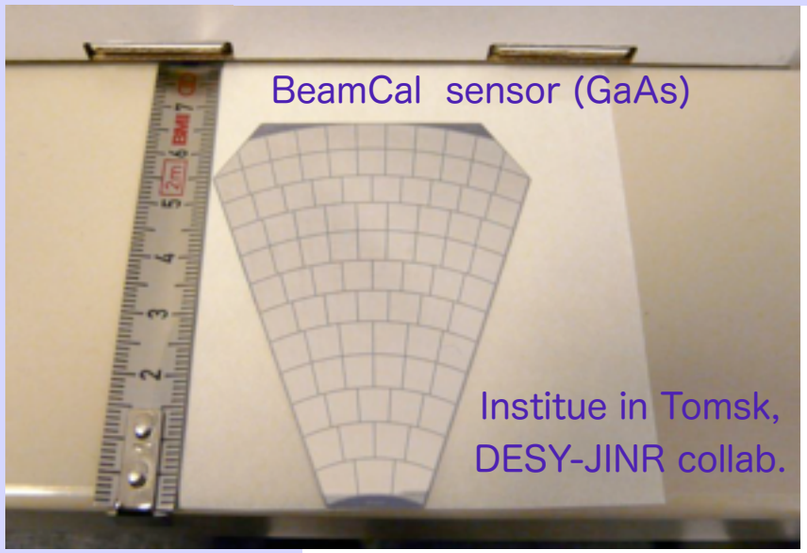
Vorward Region Design, ILD

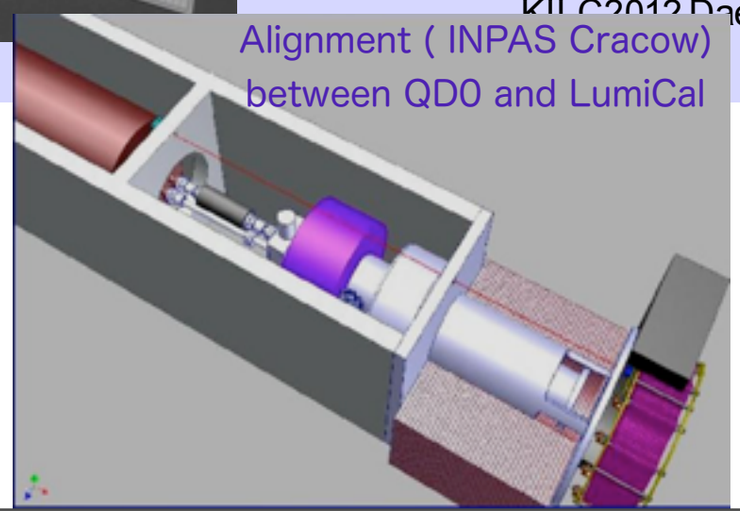




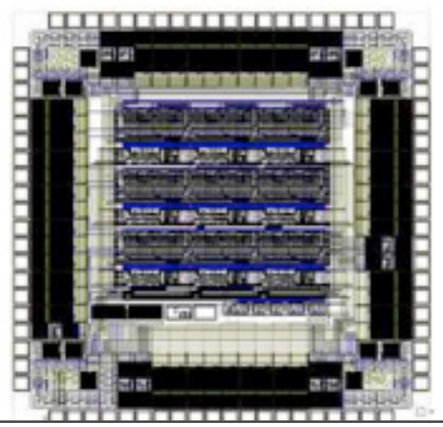




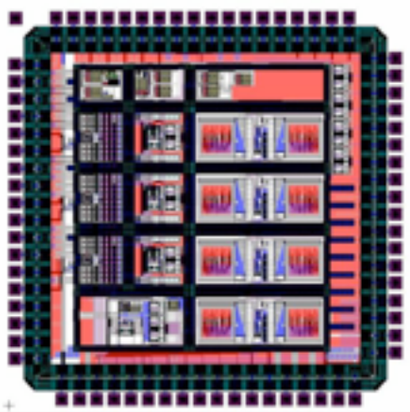




ASIC: SOI for Pair Monitor, Tohoku univ.



ASIC: SLAC-Stanford chip



LumiCal

- precise luminosity measurement, 10^{-3} at ILC , 10^{-2} at 3 TeV

BeamCal (and Pair Monitor)

- hermeticity (electron detection at low polar angles),
- assisting beam tuning (fast feedback of BeamCal and pair monitor data to machine)

Challenges:

- radiation hardness (BeamCal),
- high precision (LumiCal) and
- fast readout (both)

Plans for ATF2 beam halo measurements, Philip Bambade (LAL)

1. Beam halo -> major issue for IR backgrounds at many colliders, e.g. future linear colliders, B factories – also an important problem at ATF2 !
2. Control of halo via collimation / optics essential to enable the most aggressive optics configurations for luminosity performance

Further prospects

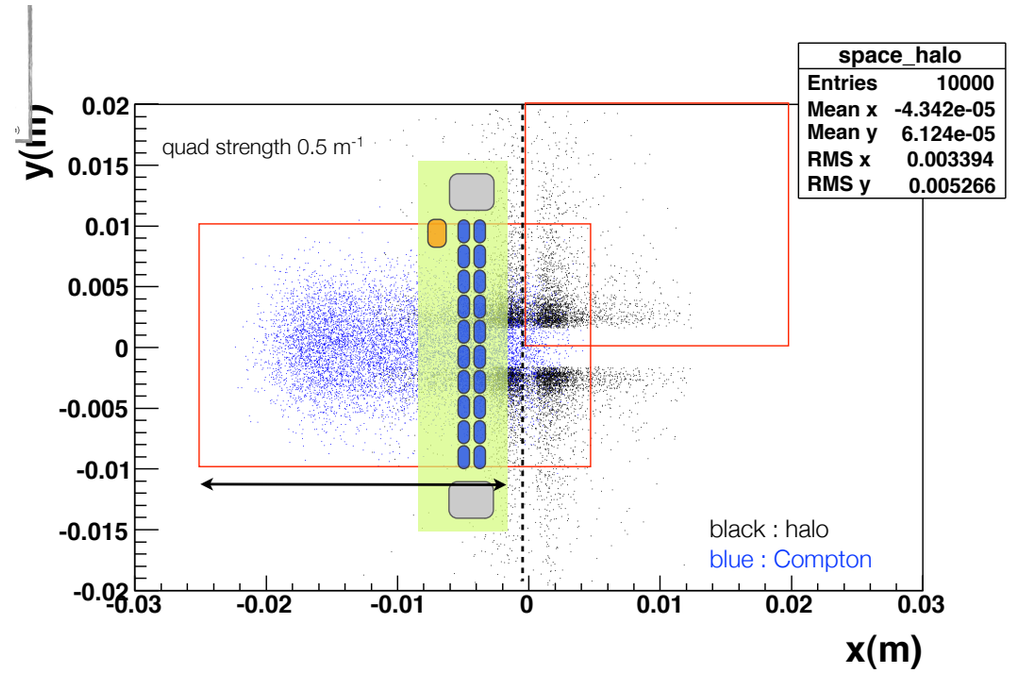
1. Some initial funding support for 2012-2014 and few applications pending…
2. Prepare and test simple prototype sensor for ATF2 ➔ diamond
3. Remote readout with large dynamic range; Mechanics to allow profile measurements (horizontal and vertical)
4. Simulations ➔ more detailed apertures, GEANT4, optics dependences
5. Extra post-IP focusing ? Beam collimation for background mitigation ? Characterize halo and probe Compton recoil spectrum
6. Several other accelerator applications

tentative schedule

	2012-S1	2012-S2	2013-S1	2013-S2	2014-S1	2014-S2
Conception (capteur, readout)	■	□				
Test proto au LAL Conception méca.	□	■	□			
Fabrication (méca., readout)		□	■			
Pré-instal. 1er test instal. finale KEK		□	□	■	□	
Expérimentation en faisceau		□	□	□	■	■
Simulations (géné/tracking/G4)	□	□	□	□	□	□
Évaluation autres appl.			□	□	□	□

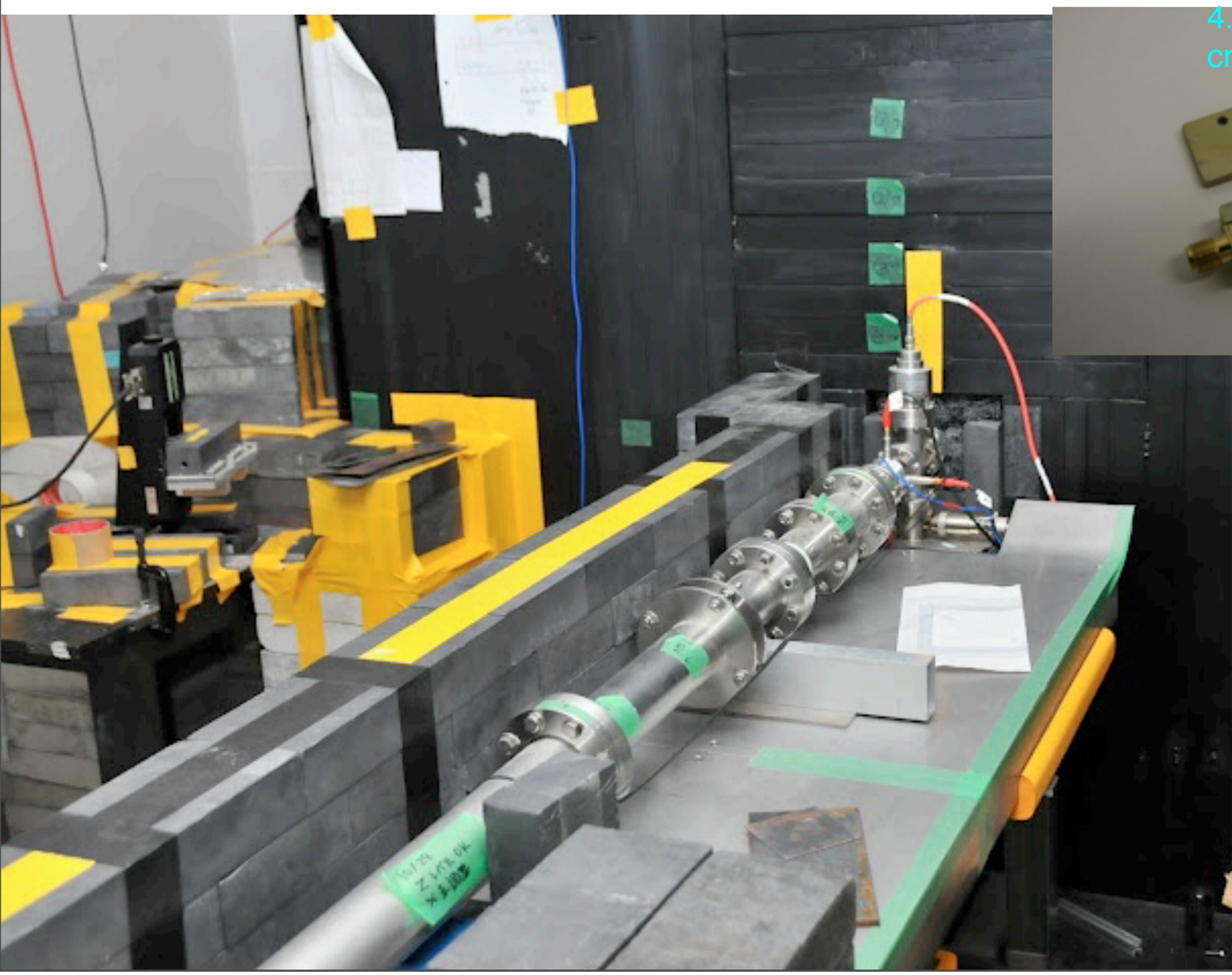
Measurement of Beam halo and Compton recoil electron spectrum after the IP of ATF2 using Diamond detector,

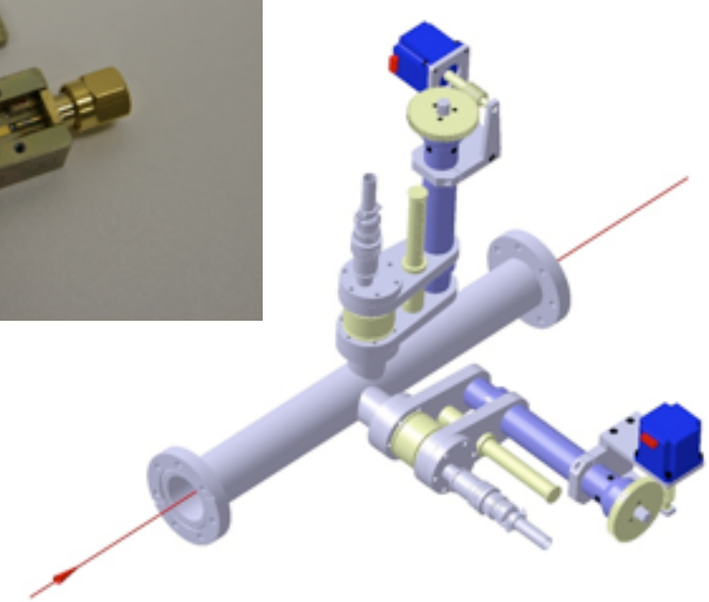
Hwanbae Park (KNU), HyoJung Hyun (KNU, LAL)

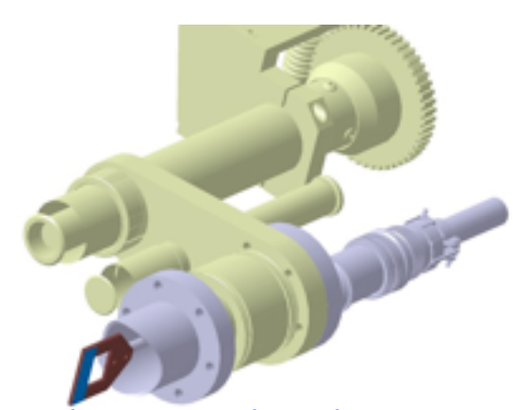


* The plot is one of MAD simulation results

Prototype diamond detector : Aim to first do beam tests in ATF diagnostic area : end of 2012

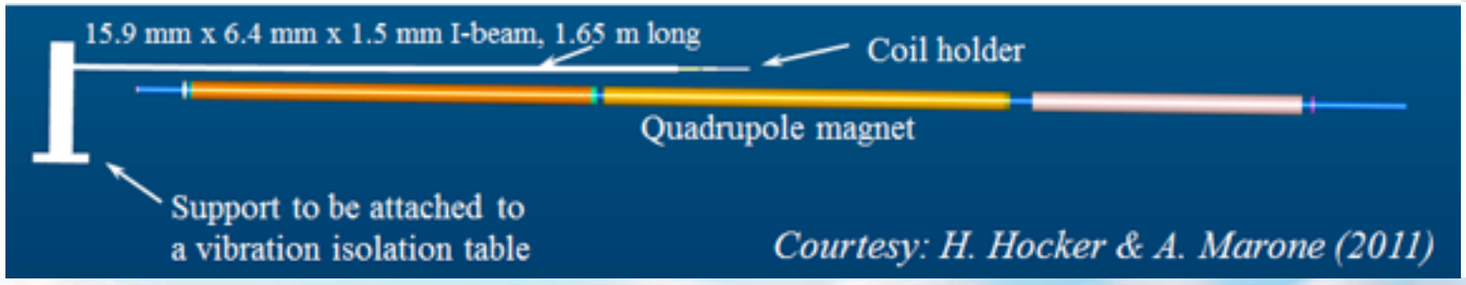


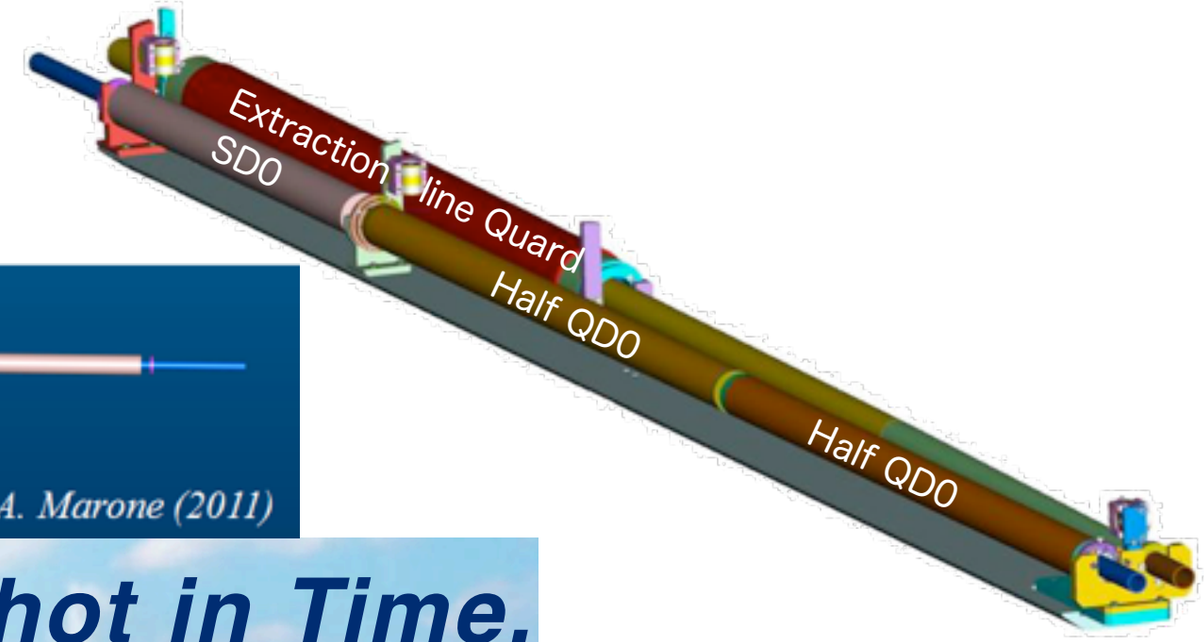




diamond sensor on board

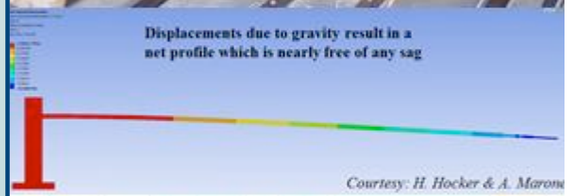
Presented by,
Brett Parker, BNL-SMD

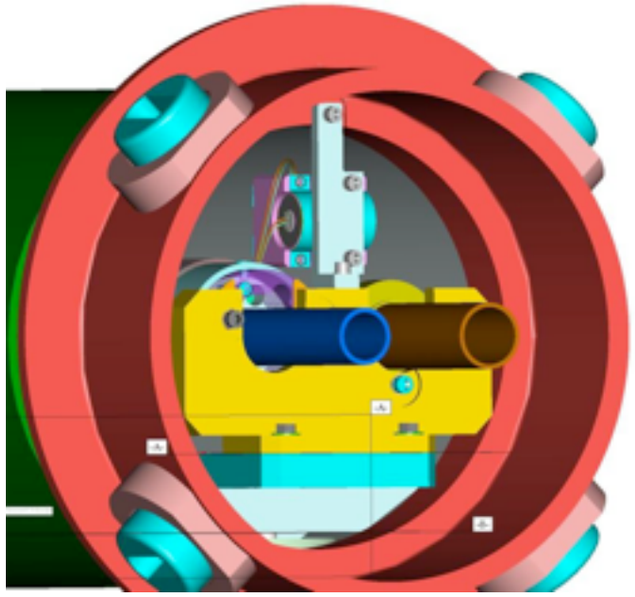




Daegu QD0 Status Snapshot in Time.

- *We have learned what is needed to wind long, slender ILC QD0 coils.*
- *We have new mechanical scenario for how to install and support QD0 in SiD; ILD is also developing their solution.*
- *We expect to have an ILC style QD0 IR magnet system for warm vibration tests; funding is needed for cold tests.*
- *Look to make the most of synergy with SuperKEKB and CLIC stability studies.*
- *We also have ATF2 FF upgrade coils.*





Presented by Y. Iwashita, Kyoto univ.

Permanent Magnet Study Short History

2002~2005 First R&D program for FFQ

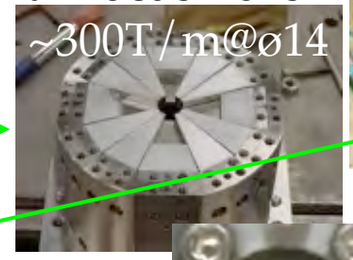
Permanent Magnet Quadrupole for Final Focus Lens in a Linear Collider

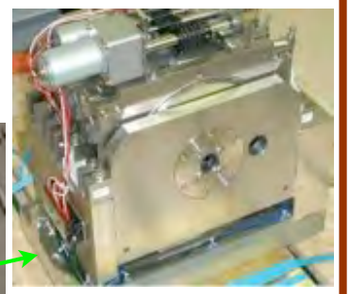
2002 Fixed strength PMQ

2003 Adjustable PMQ (double ring)

2004 Measurement and fine tuning

2005 Higher gradient at small bore





2006~2009 Second R&D program

PMQ for Linear Collider and Neutron optics

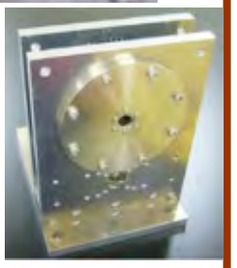
2006 Rapid Cycling Sextupole for neutron

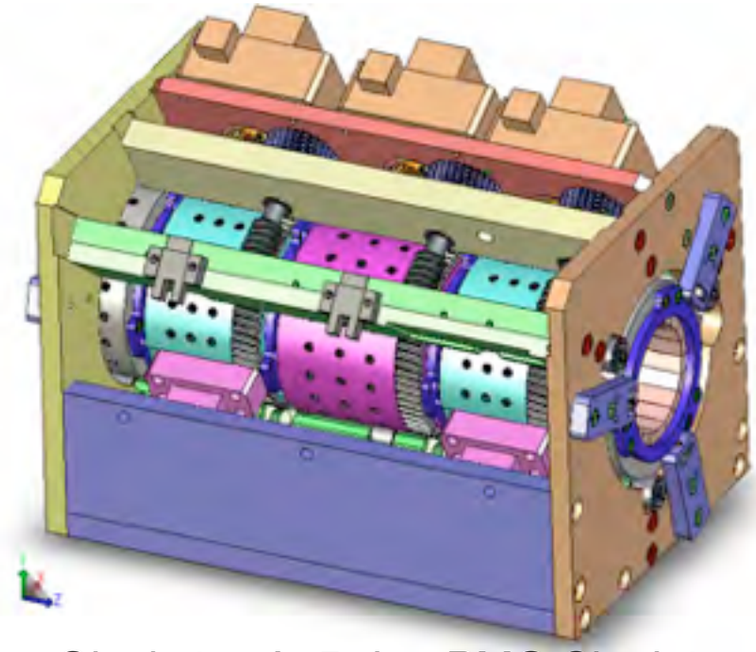
2007 Adjustable PMQ (2nd model) started

2008 Assemble, Measurement and Adjustment

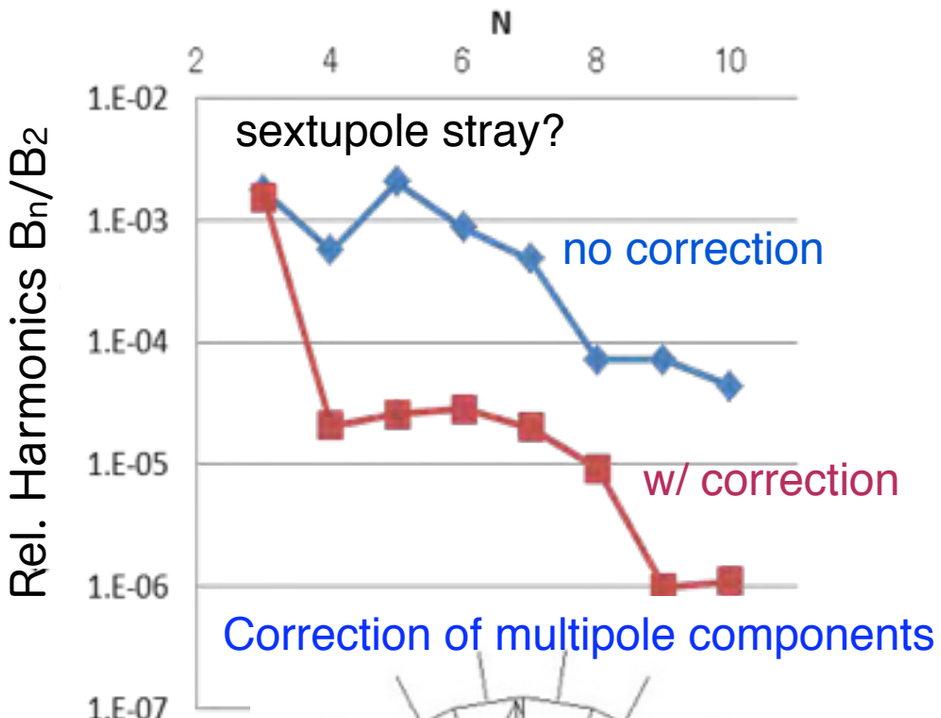
2009 Design and fabrication of Magnet mover

No project budget since then.

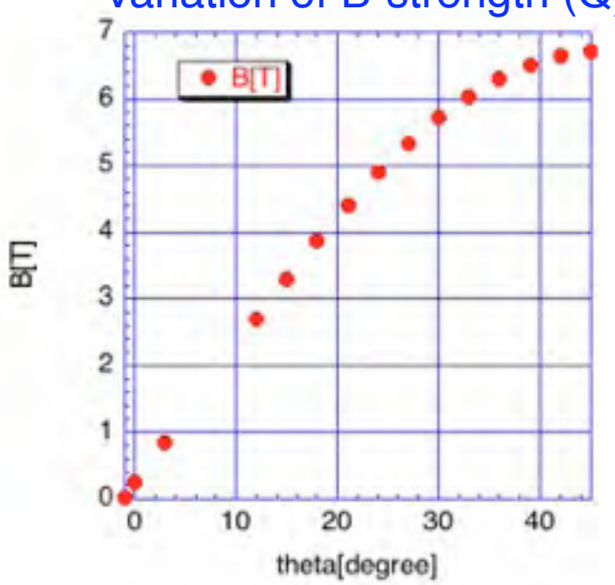




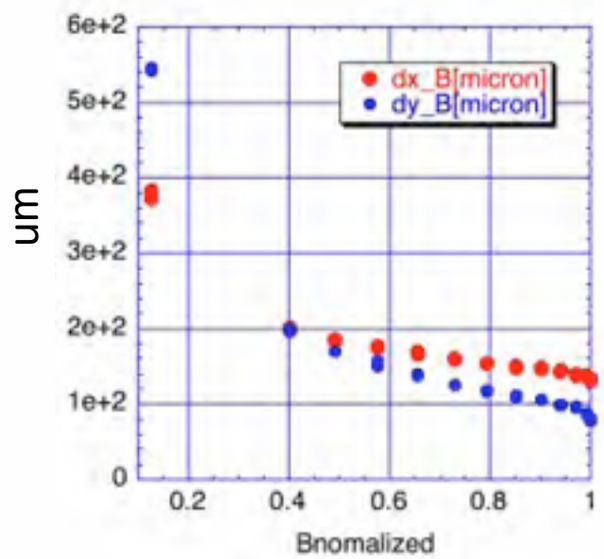
Gluckstern's 5-ring PMQ Singlet

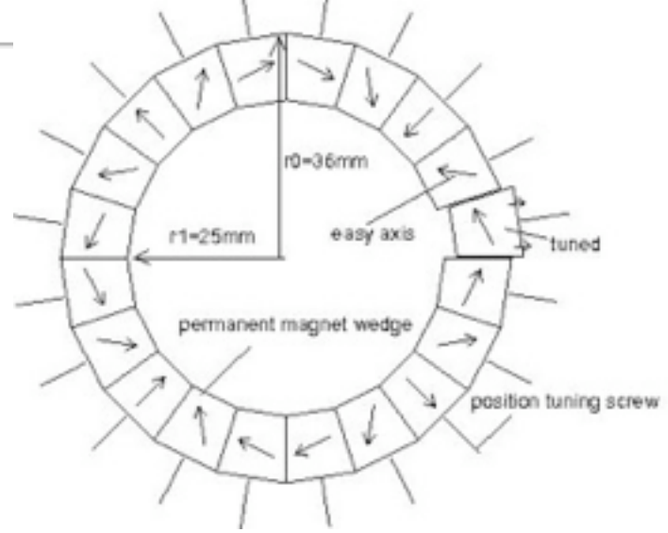


Variation of B-strength (Q)



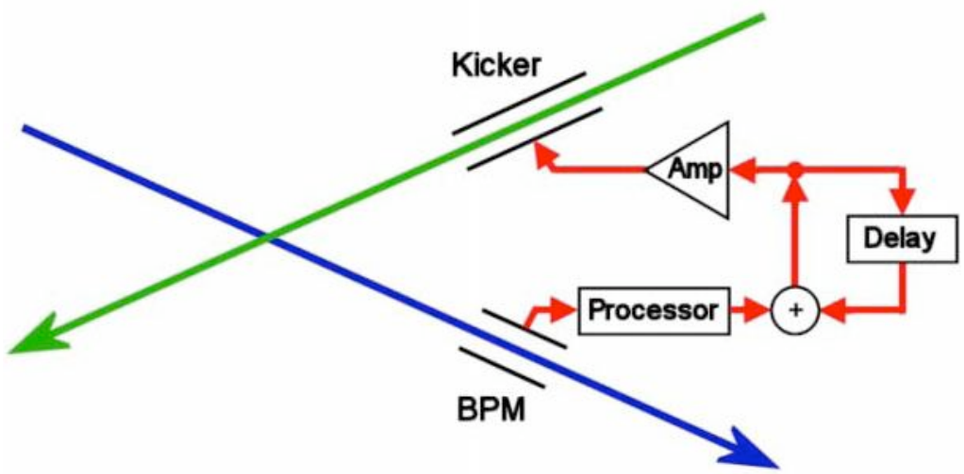
Movement of B-center (Q)



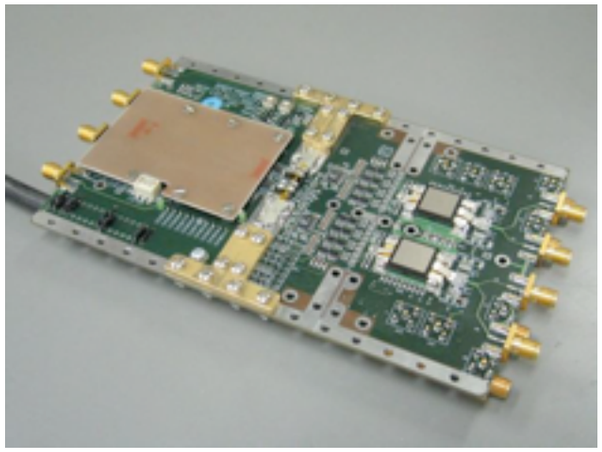


Status of IP FB system design

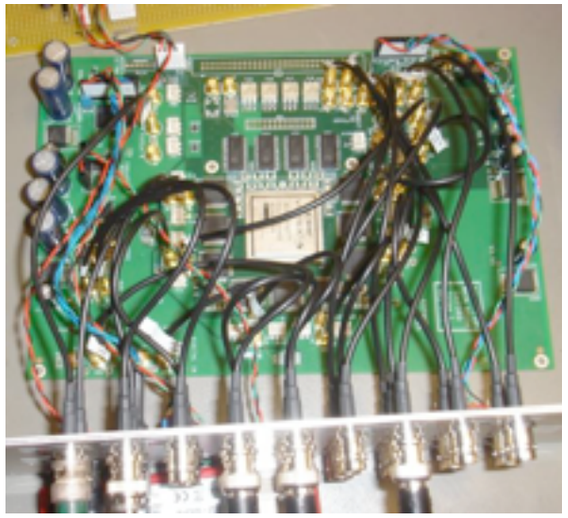
Philip Burrows, JAI, Oxford univ.

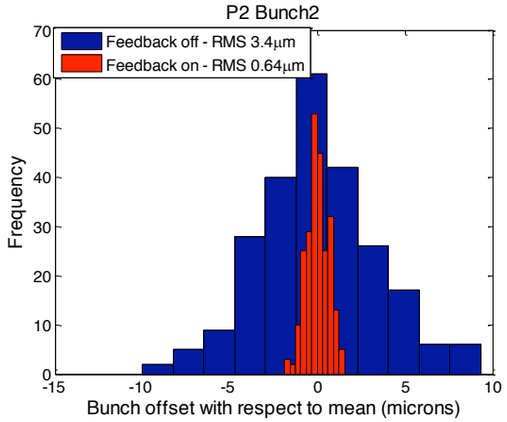


Analog circuit of FONT3 for CLIC



Digital FB board of FONT5 for ILC





Summary: LC FB design

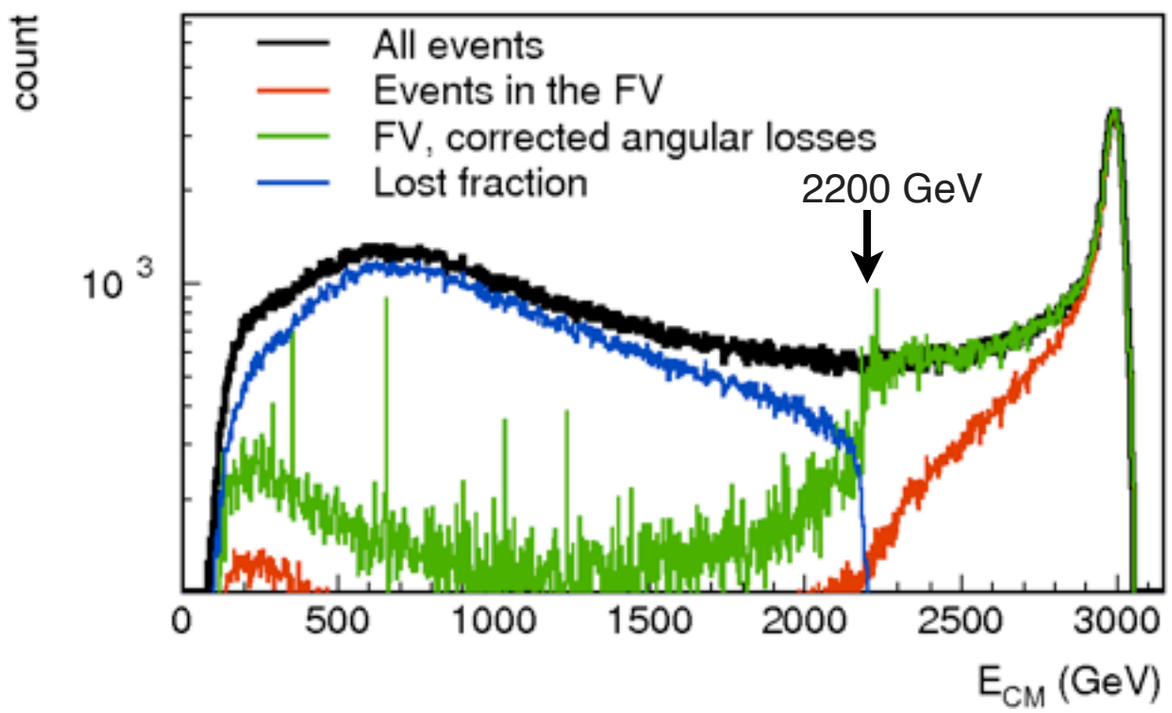
- **Well developed IP FB system concept for both ILC and CLIC**
- **Simulations demonstrate luminosity recovery capability**
- **Demonstrated prototypes with required performance parameters**
- **Progress on designing customised beamline components for ILC case**

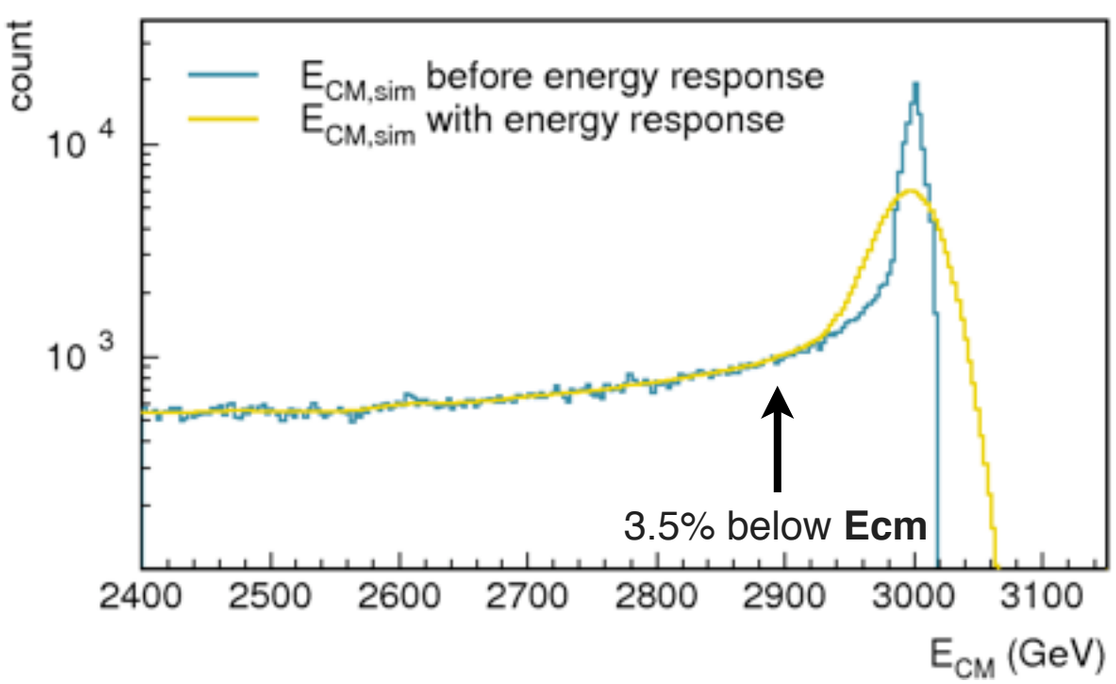
Summary: ATF2 IPFB

- **Conceptual IPFB design established**
- **New kicker has been fabricated**
- **Use FONT amplifier to drive kicker**
- **Use FONT5 FB board for digitisation + signal processing**
- **Measurements indicate good beam quality for 2-bunch mode with up to 300ns bunch spacing**

Beam-beam effects in luminosity measurement for CLIC (and ILC)

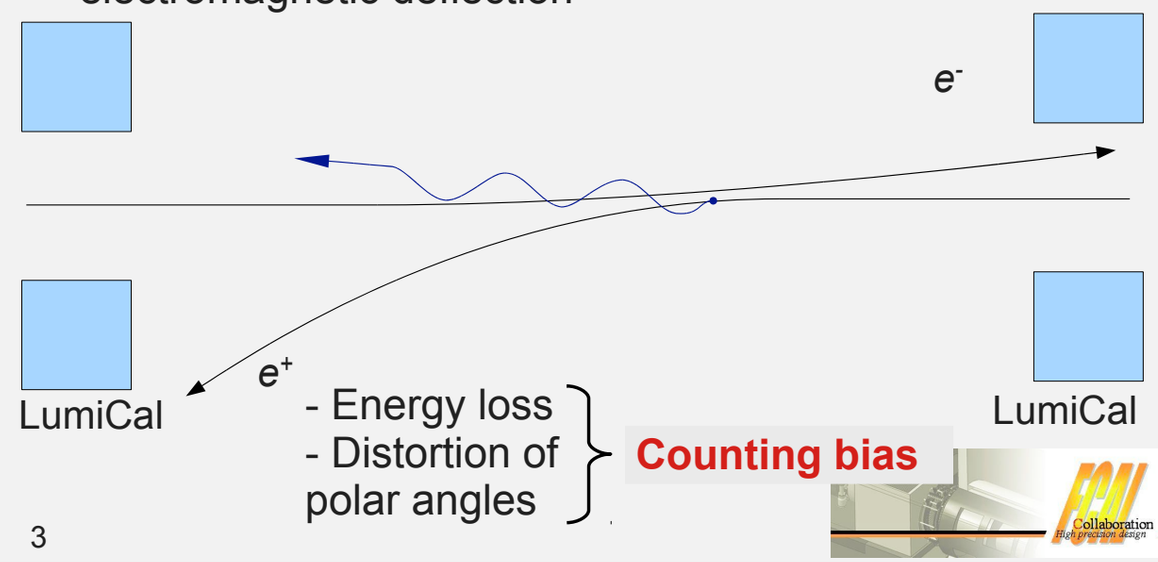
S. Lukić - HEP Group Vinča, Belgrade, Serbia





Bhabha scattering

- Deviation from ideally symmetric kinematics due to the emission of *beamstrahlung* and ISR, as well as the electromagnetic deflection



3

Conclusions

- The luminosity spectrum at CLIC extends down to almost zero CM energy
- Bhabha events at lower energies mostly invisible to the LumiCal
- Above 2200 GeV, the luminosity spectrum can be measured with good precision, the residual uncertainty in the peak is several permille
- Energy reconstruction capability of the LumiCal is crucial for the $\sqrt{s}$ reconstruction at CLIC
- These and some alternative methods applicable at ILC – both the BS and the EMD angular losses can be corrected to better than 1 permille

MDI and BDS

with the TDR editors

1. The editors reminded that the TDR draft must be completed by early May.
2. CERN contribution confirmed as;

CERN involvement in the ILC BDS

R. Tomas

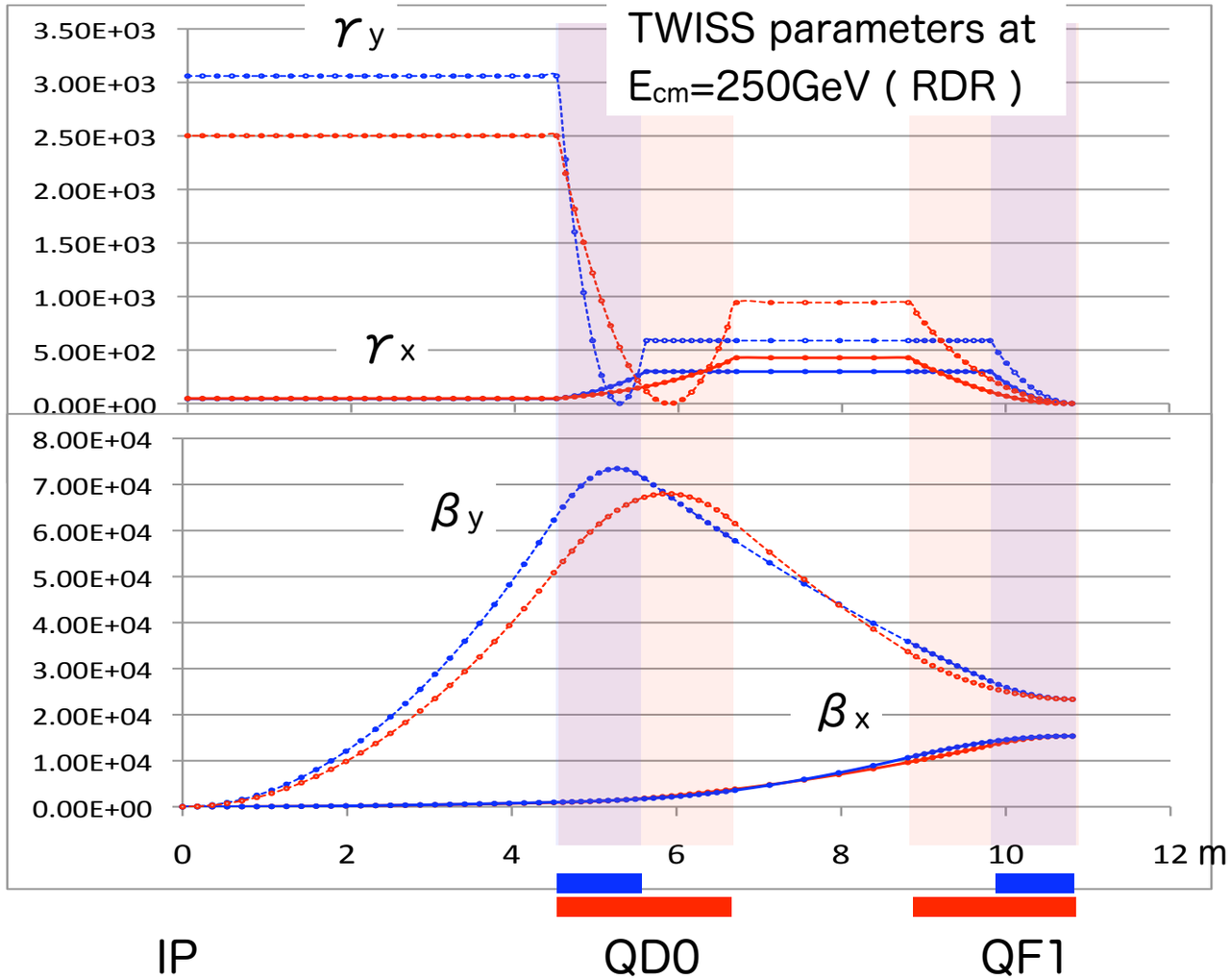
First considerations with:
J. Barranco and H. Garcia

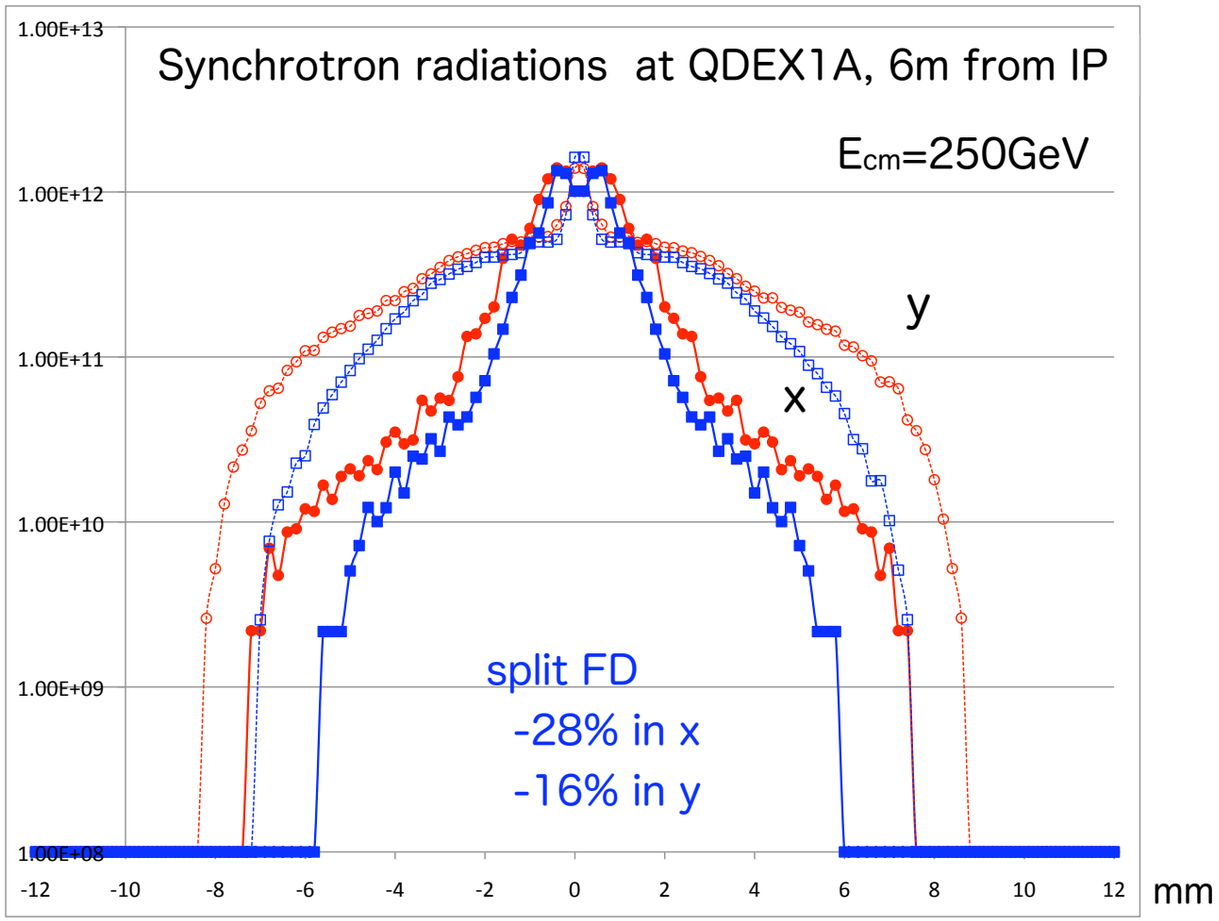
Summary of discussions with:
D. Angal-Kalinin, B. List, D. Schulte, A. Seryi, S. Stapnes and N. Walker

Motivation

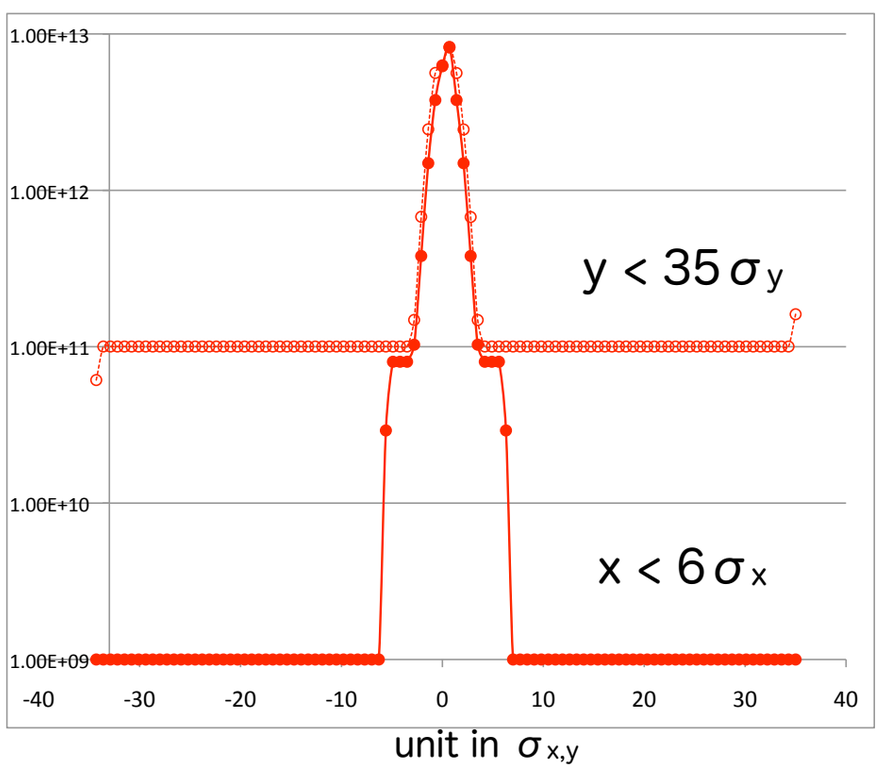
- **CERN would like to reinforce existing CLIC-ILC collaborations. BDS areas have lots of synergy.**
- **ILC needs some help**

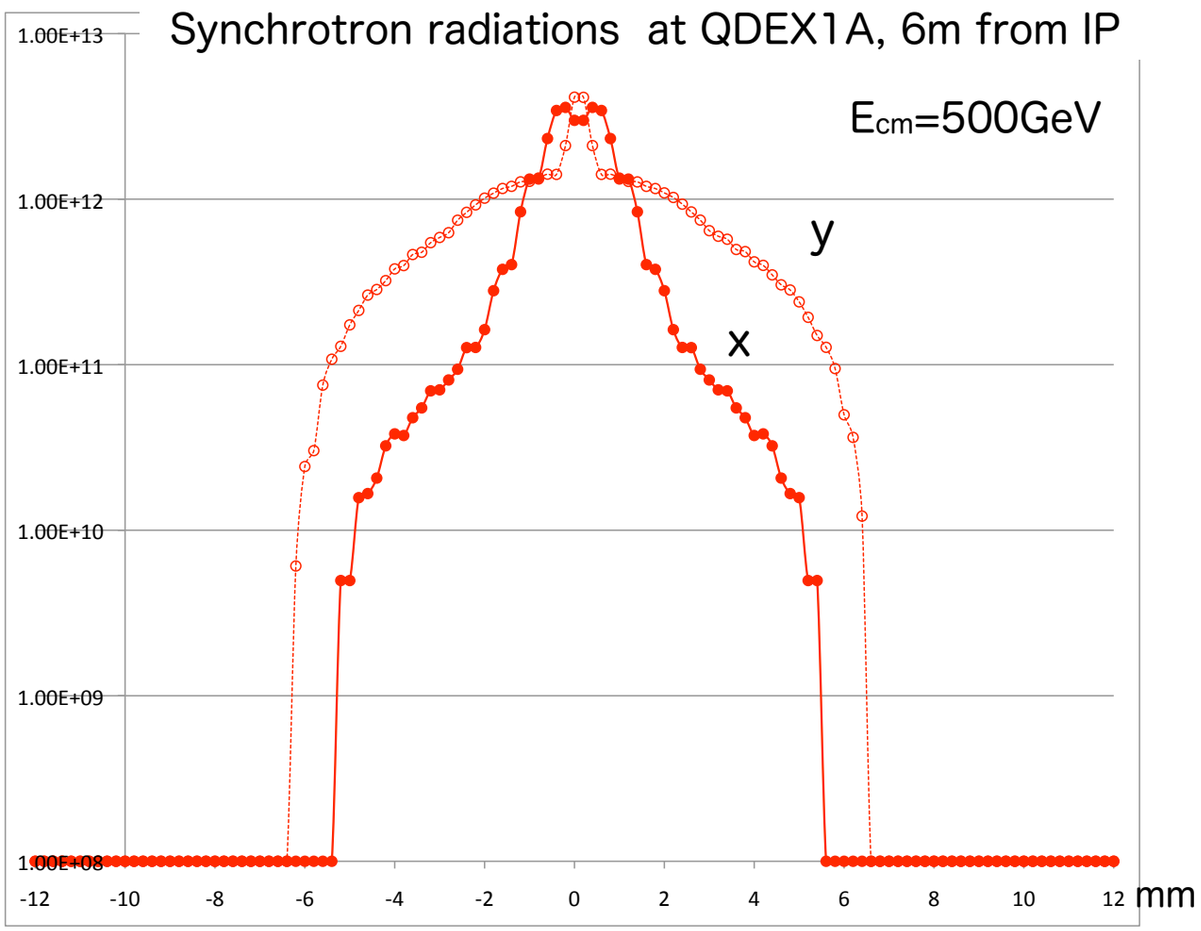
3. MDI chapters in TDR-I (R&D since RDR) , TDR-2(baseline) and DBD (common)
   - topics and authors are identified for these chapters ; i.e working progress





Beam Profile : Gaussian (<3σ) + flat





MDI and CFS (GDE)

Experimental hall review by GDE-EC

Summary by GDE-PMs

Progress in CFS

- **Design and Costing for TDR nearly finished**
  - Asia and Americas
  - (Europe design / cost due in late May)
- **Completely new, more mature design than RDR**
- **Excellent Cost performance**
- **Adaptation to Japanese candidate sites started**
- **Draft TDR content reviewed**

Detector Hall CFS Review

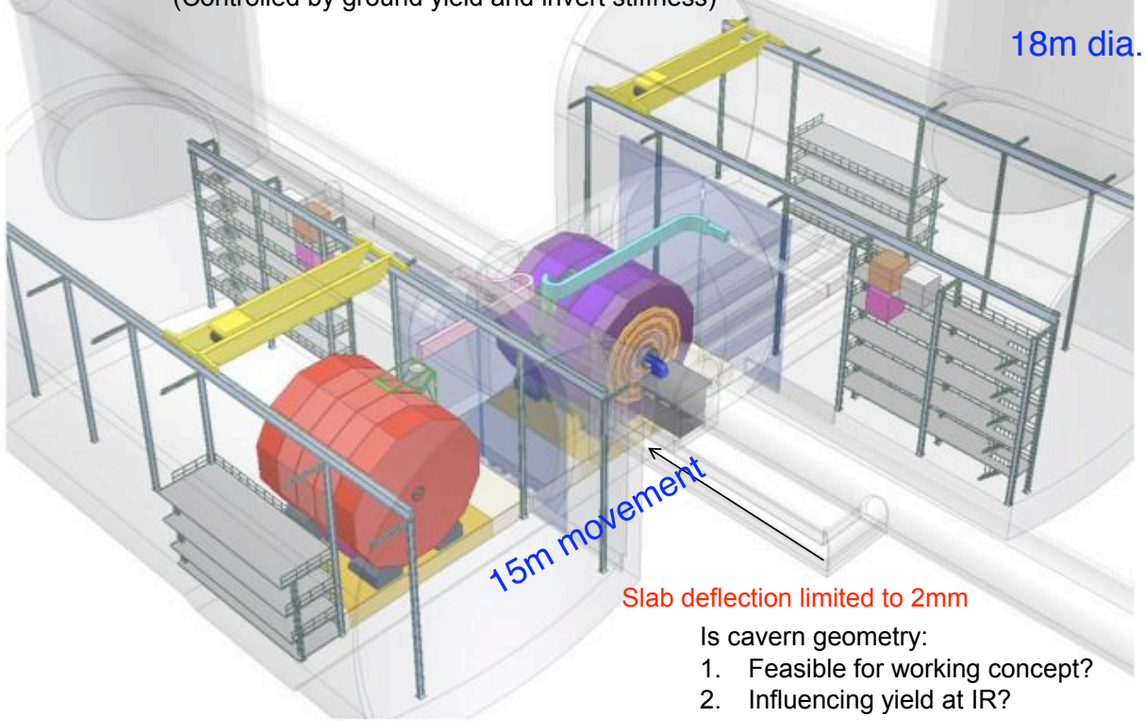
- **Review Questions:**
  - Are the Criteria understood?
  - Does the Design satisfy the criteria?
  - What are the cost-drivers?
  - What are the outstanding issues?
- **Presentations:**
  - Alignment requirements (special tunnels)
  - Underground Assembly schemes
  - Cryogenic systems
  - Cost roll-up
- **Report to be written.**

Presented by,
A. Gaddi, CERN

18m dia.

How do we limit cavern invert deflection to less than 0.5mm (creep and absolute)
(Controlled by ground yield and invert stiffness)

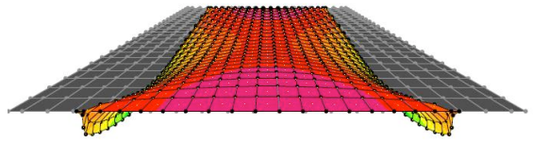
18m dia.



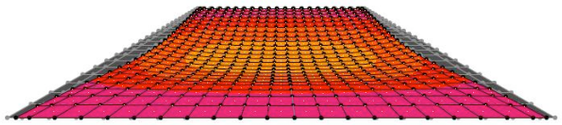
Slab deflection limited to 2mm

Is cavern geometry:
1. Feasible for working concept?
2. Influencing yield at IR?

Serviceability Limit State Analysis
Invert Slab Deformed Shape

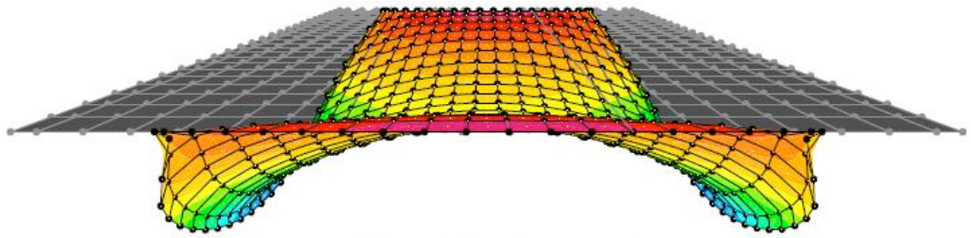


Ground Pressure +



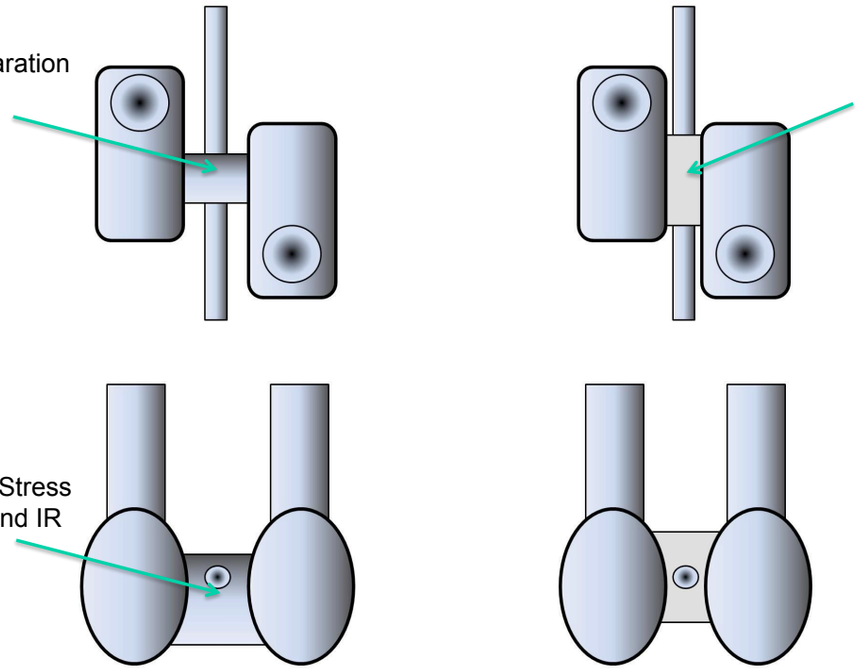
Moving Slab +

+ Self Weight



Final Deformation

Revision G | Caverns Moved Closer

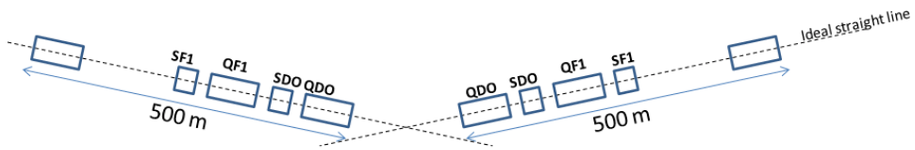


Talk conclusions.

The optimization of the CLIC experiment area layout has involved the detector and civil engineers for a couple of years, including very useful discussions with our ILC colleagues from the MDI & CFS groups.
The proposed design has been validated by an external consultant, who has looked in detail to the geological aspects, with particular attention to the long term stability of the cavern slab.
We are now working on the implementation of Arup's recommendations into the CLIC Interaction Region baseline design.
Exchange of ideas is continuing with ILC MDI community, under a very positive and collaborative spirit, also in view of the new requirements given by the proposed ILC Japanese mountain site.

Alignment approach in MDI area

Determination of the position of QD0 w.r.t other components of the BDS (1)

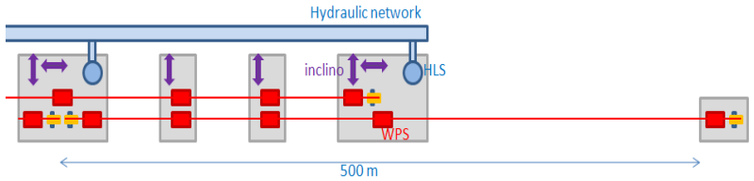


Requirements:

- ✓ Position of the zero of QD0 w.r.t ideal straight line of the 500 last meters of BDS: ± 10 μm rms (including fiducialisation)
- ✓ Longitudinal relative position between QD0 and QF1: ± 20 μm rms

Solutions:

- ✓ Main difference concerns the MRN network (due to lack of space):
  - No overlapping of stretched wires in the last 250 m
  - No HLS system needed for modeling of the sag; will be extrapolated on the last 250 m.
  - Longitudinal monitoring of QD0 w.r.t QF1: capacitive sensors and CFRP bar



MDI - Survey mini galleries

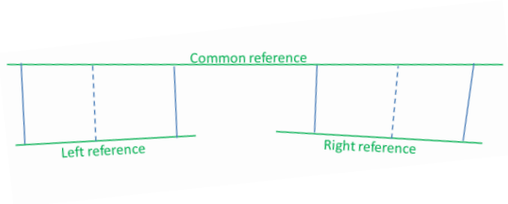
Left side w.r.t right side

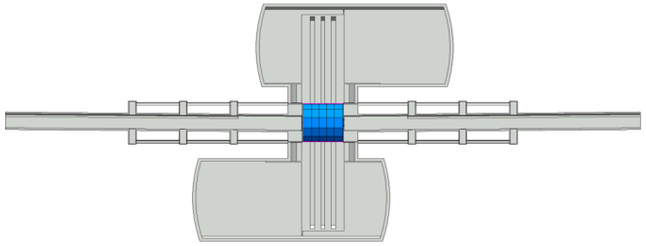
Requirements:

- ✓ Determination of left reference line w.r.t right reference line : within ± 0.1 mm rms
- ✓ Monitoring of left reference line w.r.t right reference line : within a few microns
- ✓ Monitoring of the position of left QD0 / right QD0 within ± 5 μm rms

Solutions:

- ✓ Determination of left reference w.r.t right reference line & monitoring of one BDS w.r.t other:
- ✓ stretched wires/optical system on both side by a common reference (as in the LHC), using the survey galleries

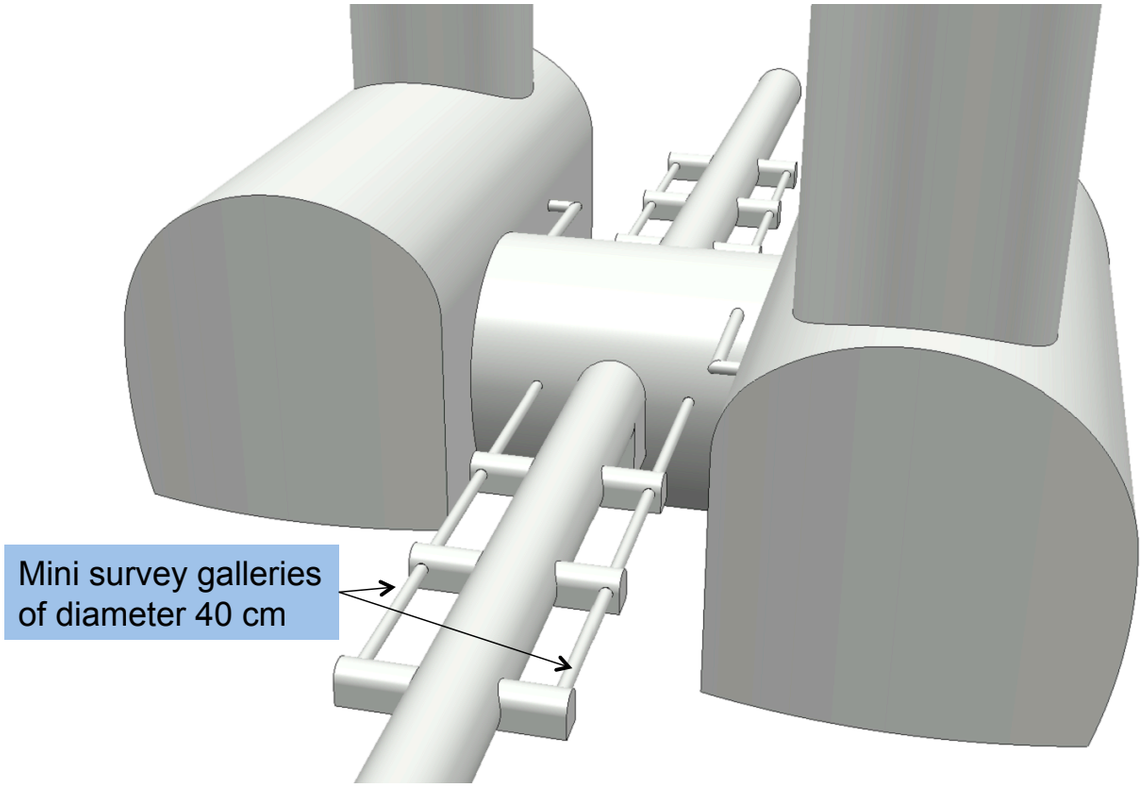




Presented by,

H. Gerwig, CERN

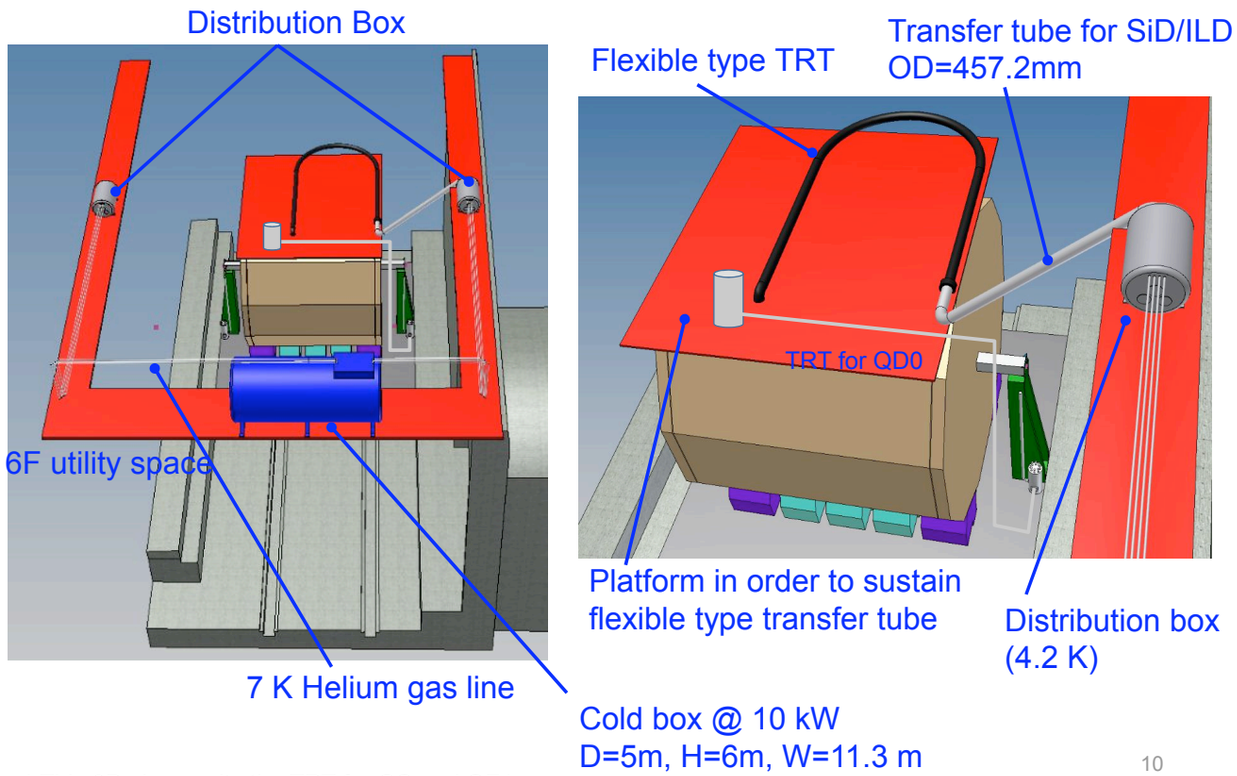
MDI area – proposed survey channels



Conclusion

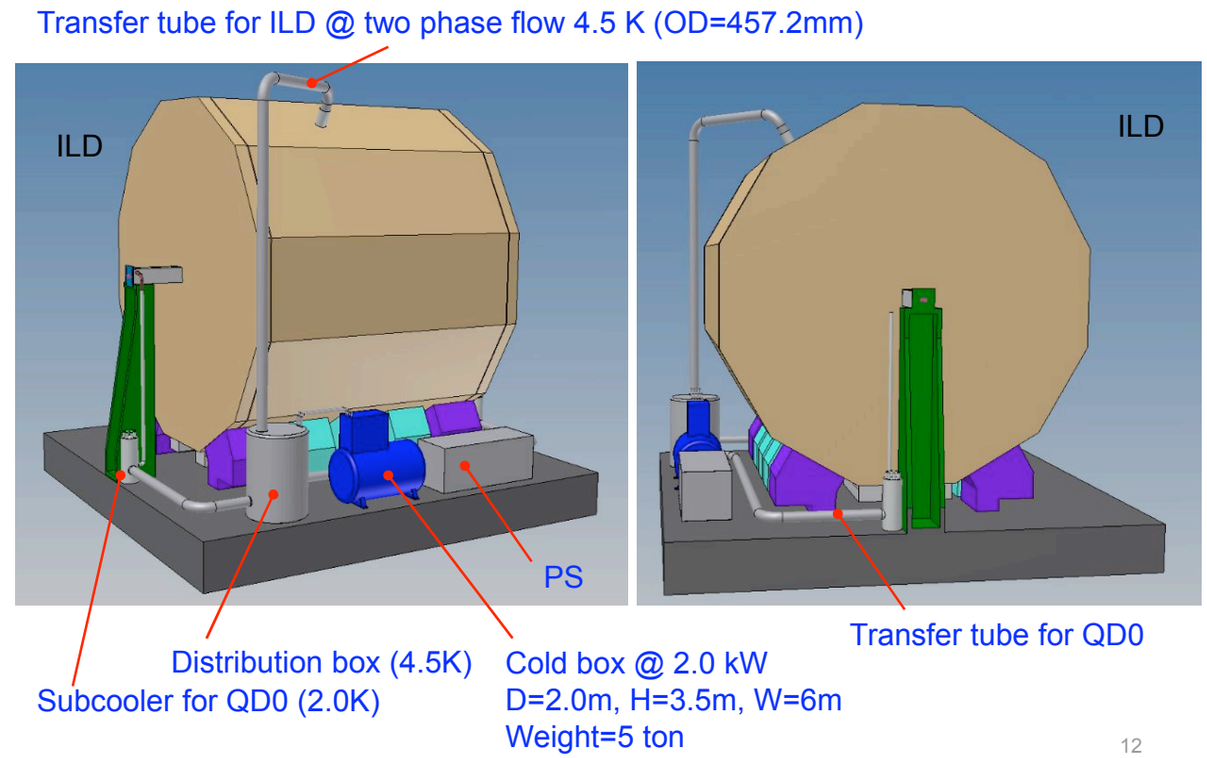
- ✓ Same strategy of pre-alignment in BDS and main linac (stretched wire, overlap)
- ✓ tighter requirements for position and adjustments in BDS
- ✓ Active pre-alignment with cam movers
- ✓ Special solutions required for final focus and stretched wire around QD0
- ✓ Relative position of QD0 monitored through detector by Rasnik/ Rasdiff (NIKHEF)
- ✓ Due to ground movements induced by push-pull CLIC prefers a solution with mini survey galleries
- ✓ Allows survey link of both BDS ends when detector is on IP

Schematic 3D view of Plan-A



* This 3D view omits the TRT for CC and QF1.

Schematic 3D view of Plan-B



Advantage and Limitations for each plan

Plan-A
(advantage)
1. Maintenance and assembly of detector and cold box can be performed independently.
2. Maintenance of cold box is simple because control point and equipment such as valves are not so much.

(disadvantage)
3. ・Flexible Type TRT has to be applied between cold box and detectors (SiD/ILD, QD0).
   ・Minimum bending radius of flexible TRT will be quite large such as several meter. Large space for flexible TRT has to be required.
   ・Confliction with another equipment such as crane access will occur frequently.
4. Cooling capacity tends to become large compared with actual heat load depending on the situation. In such case, thermal balance has to be maintained by means of heater installed in the subcooler. It is hard to optimize cooling operation according to the cold mass condition.

Plan-B
(advantage)
1. There is no need to use the flexible type TRT.
2. Cryogenic Control to keep steady state is quite simple because it is less control point of each refrigerator and cold box is independent of one another.
3. It is easy to perform cooling optimization and power saving operation depending on the situation.

(disadvantage)
1. Cost of control system becomes larger than that in the case of Plan-A. Failure frequency will be tendency to rise.
2. Confliction between cryogenic facility and detector will frequently occur during assembly and maintenance.

Presented by,
T. Okamura, KEK

Summary

- We propose two different cooling schemes (Plan-A and Plan-B).
- Flexible type which must be dynamically driven is disadvantage of Plan-A.
- Of cause, it is necessary to use flexible type tube for warm helium gas in the case of Plan-B. But it is not difficult because of ordinary simple tube and smaller bending limit.
- It is difficult to optimize performance of facility for example power saving mode in the case of Plan-A.
- From the view point of cryogenics and operation, Plan-B is more conventional and simple cooling scheme.

26 April, 2012

Engineering Specifications updated

Engineering Specifications (2) : Experimetnal Hall	RDR	SiD	SiD in Mtn. site	ILD	ILD in Mtn. site	
Parameters that define the underground hall volume						
IR Hall Area(m) ; (W x L)	25x120		25x142		25x142	Z-shape in EU ar
Beam height above IR hall floor (m)	8.6	9(7.5)	9(7.5)	9(8)	9	from top of the p
IR Hall Crane Maximum Hook Height Needed(m)	20.5	5m above top of detector	5m above top of detector	20.5	20.5	
Largest Item to Lift in IR Hall (weight and dimensions)	400t	380t(HCAL)	380t(HCAL)	55t, 3x3x1.5m	400t	
IR Hall Crane	400t+2*20t	400t(200tx2)/10t	(215t+30t)x2	80t(40tx2)	(250t+30t)x2	
IR Hall Crane Clearance Above Hook to the roof (m)	14.5(includes arch)		15.8	6	15.8	
Utility caverns(m) ; (W x L xH)	40x15		77.5x15x13.5		77.5x15x13.5	
Resulted total size of the collider hall (W x L x H)	25x120x39	20.2x90x30	25x142x42	29x100x30	25x142x42	
Area at garage position		19x 55.5	25x50	with side cavern	25x50	
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)	9x16m, 2000t	3287t (Barrel Iron)	-	3500t, 15.7x7.81m	-	
IR Shaft Size : diameter(m)	16	18, 8	-	18, 10	-	
IR shaft fixed surface gantry crane. If rented, duration	1.5 years	1.5 years	-	1.5 years	-	
Surface hall crane should serve IR shaft	Yes	Yes	-	Yes	-	
Other shafts near IR hall for access	No	Yes	-	No	-	
Elevator and stares in collider hall shaft	Yes	?	-	Yes	-	
Size of access tunnel at Mtn. site (W x H, m)	-	-	11x9	-	11x11	cable racks in th
Inclination of access tunnel at Mtn. site (%)	-	-	< 7	-	< 7	
Length of access tunnel at Mtn. site (km)	-	-	1.5	-	1.5	
Parameters that define dimensions of the surface assembly building and its crane						
Surface Assembly Building Area ((W x L , m)	25 x 100 / detector	200x200		30x60	27x100 / detector	
Largest Item to Lift in SurfAsm. Bldg. (weight and dimensions)	400t	380t(HCAL)	(125+α)t, 6.79φ x6.066 (solenoid)	180t	400t, 8.6φx8 (solenoid)	
Surface Assembly Crane	400t+2*20t	400t(200tx2)/10t	400t(200tx2)/10t	2x80t	(200t+20t)x2	same as in the ha
SurfAsm. Crane Maximum Hook Height Needed(m)	18	20	20	19	20.5	
SurfAsm. Crane Clearance Above Hook to the roof (m)	7			5m to ceiling	6.5	
Resulted volume of surface assembly building (W x L x H, m)	25 x 100 x 25			30x60x24	27x200x27	area is the main
Parameters that define crane access area and clearance around detector						
SurfAsm. crane accessible area (needed) / available (W x L, m)	20 x 102	200 x 200	200 x 200	28x56		SID's very prelin
IR hall crane accessible area (needed) / available (W x L, m)	22 x 98		18x98	28x41	18x98	
Maximum Detector Height(m)		16.15	16.15	15.74	15.74	
Detector Width (m)		18.53(14.334)	18.53(14.334)	15.665	15.665	
Minimum Detector Clearance (W x L x H, m)		12.4x11.2x12.4	12.4x11.2x12.4	15.67x13.26x15.74	15.67x13.26x15.74	from LoI
FILL IN OTHER IMPORTANT PARAMETERS WHICH ARE MISSING						
Maximum AC power (MW)	-					540KW/exp
Temerature control (°C)	-					
Humidity control (%)	-					
Sump Pump Control System (ground water)	-					
Cryogenics system : 4K He liquefier and large dewar	-	same level as the coil	same level as the coil	service cavern	service cavern	the liqufier will
Dump registor	-	on the detector	on the detector	service cavern	service cavern	damp resister ca

30 September, 2011

Engineering Specifications (1) : Push Pull Issues	unit	proposed	SiD	ILD
Time for Exchange experiments with rough alignment (mm)	day	1		
Time for Fine alignement, vacuum evacuation	day	1		
Time for Restart the machine and experiment	day	1		
Time for Beam calibration and alignment for the nominal luminosity	day	1		
Number of Pushpull operation	/year	10		10
Number of Pushpull operation for 15 years	times	150	100	150
Detector total weight	tons	15,000	10,000	15,500
Detector beam level	m	9	9	9
Maximum acceleration on the detectors during the movement	G	0.05		
Total moving distance from IP to the garage position	m	15		25
Residual magnetic field at IP from detector in the garage	Gauss	50		50
Pulling forces with two lines (multiple anchoring points?)	tons/line	300		
Number of anchoring points		4		
Movement speed	cm/min	10	6 to 30	
Displacement due to the movement : radius	mm	20		
Displacement due to the movement : angle	mrad	2.5		
Adjustment of the movement : x,y	(±)mm	1		
Adjustment of the movement : angle	mrad	0.1		
Slow downward movement of the floor within ±50m around IP (for several weeks?) with feedback system	mm	5		
Platform : width	m		20	14
Platform : length	m		20	14.8
Platform : thickness	m			2.2
Platform : wall clearance	mm		10	
Platform : max. vibration transfer function for microseisms	1<f<100Hz		1.5	
Platform : pulling force in locomotion system with rollers	tons	750	500	750
Platform : pulling force in locomotion system with airpads	tons	300		300
Roller : a roller system must be supplemented by another system that allows a 3-axis movement on IP. A good candidate would be a grease-pad system on top of the roller supporting platform.				
Airpad : Standard airpad systems have the disadvantage of requiring a slight lift of the load of around 5 mm. However as the landing is obtained by leaking air through orifices this landing is very smooth as it had been verified by installing accelerometers on CMS elements.				
hydraulic jacks :				

20 May, 2011

Engineering Specifications (3) : QD0 Issues	unit	value	
Mover : number of degrees of freedom		5	horizontal x, vertical y, pitch φ, yaw ψ, roll α
Mover : Range per x,y degree of freedom	mm	± 2	
Mover : Range per φ, ψ degree of freedom	mrad	± 1	
Mover : Range per α degree of freedom	mrad	± 30	
Mover : Step size per degree of freedom of motion	μm	± 0.05	
Before BBA : Accuracy per x,y degree of freedom	μm	± 50	
Before BBA : Accuracy per φ, ψ degree of freedom	μrad	± 20	
Before BBA : Accuracy per α degree of freedom	mrad	± 20	
BBA : alignment accuracy per x,y	nm	± 200	from a line determined by QF1s for 200ms
BBA : Accuracy per α degree of freedom	μrad	± 0.1	from a line determined by QF1s for 200ms
Vibration stability : $\Delta(QD0(e^+)-QD0(e^-))$	nm	50	within 1ms long bunch train

Engineering Specifications (4) : Radiation shield	unit	value	
Self shielding		must	
Normal operation : anywhere beyond the 15m zone housing the off-beamline detector	μSv/hour	0.5	
Accidental beam loss : dose for occupational workers	mSv/hour	250	The acident is defined as the simultaneous loss of both e^+ and e^- beams at 250 GeV/beam anywhere, at maximum beam power.
Accidental beam loss : integrated doze for occupational workers	mSv/accident	1	
Accidental beam loss : beam shut-off time after the accident	beam-train	1	

Engineering Specifications (5) : Vacuum	unit	value	
in the 200m upstream of the IP	nTorr	1	$=1.3 \times 10^{-7}$ Pa
in the remainder of the BDS system	nTorr	10	$=1.3 \times 10^{-6}$ Pa
in the 18m zone of the detector			not specified in the IR document