

# **TILC09 MDI Summary**

#### J. Gao

**ACFA Plenary (Main Convention Hall)** 

**Tuesday 21 April 2009** 

#### TILC09 ACFA-MDI Conveners

Jie Gao, Tomoyuki Sanuki, Guinyum Kim, R.K.Bhandari, Sergey Schuwalow, Tom Markiewicz, Toshiaki Tauchi



# TILC09 AFCA MDI Session Schedule

### TILC09 BDS-MDI Session Schedule

SE SASI	9:00-10:30	11:00-12:30	14:00-15:30	16:00-17:30
Friday Apr. 17	Joint P	Plenary	AAP Review ACFA Plenary - Lols	
Saturday Apr. 18	BDS (404) MDI(304)	ATF2/BDS (404) ACFA Parallel	AAP-CesrTA Gamma gamma (401)	AAP-FLASH ACFA Plenary
Sunday Apr. 19	Joint : ACFA and GDE/BDS Push-Pull (202)	Joint : ACFA and GDE/BDS LEP, IR-doc. (202)	AAP-SCRF Gamma gamma (401)	AAP-SRF, ATF (201) ACFA Parallel
Monday Apr. 20	AAP-AS MDI (202)	AAP-AS/BDS MDI (202)	AAP-MM ACFA Plenary	AAP- PM ACFA Plenary

#### ATF2 meetings before AAP-review

- Super QD0 R&D, ATF2 commissioning (BPMs, IP-BSM, BBA etc.) Minimum machine (MM) configuration is discussed in BDS session,9-10:30,4/18. Joint with MDI: push pull (platform, pacman, IR hall), longer L\*, IR interface document (IR-doc.)



## TILC09 ACFA MDI program

#### Presentations at MDI sessions

(20 minutes + 5 minutes for discussion)

- 1. 18 April 9:00-10:30; MDI status reports from three Lol groups (304)
- (1) SiD, by Marco Oriunno (Webex)
- (2) ILD, by Karsten Buesser
- (3) 4th, by John Hauptman
- (4) Discussion for common R&D issues (15 min.)
  - experimental hall, beam line etc.
- 2. 20 April 9:00-10:30; beam instruments at around IP (202)
- (1) Current status of Shintake Monitor for ATF2 by Yoshio Kamiya
- (2) Monalisa by Oxford university group, Paul Coe
- (3) Cavity beam orbit tilt monitor, Daisuke Okamoto
- (4) Others
- 3. 20 April 11:00 12:30; forward detectors at IP (202)
- (1) Development of Pair Monitor, by Yutaro Sato
- (2) The far forward region of the SiD detector, Tom Markiewicz
- (3) Forward Calorimetry, Sergej Schuwalow
- (4) Others



Detectors: SiD, ILD, 4<sup>th</sup>

April 18, 2009 (room 304)





#### Joint ACFA / GDE meeting on the International Linear Collider (TILC09),

Tsukuba, Japan, April 17-21, 2009







#### IDAG requests for the LoI vs. MDI

IDAG wishes the proponents of the 3 LOI's to address the following points in their LOI document:

- (1) Sensitivity of different detector components to machine background as characterized in the MDI panel.
- (2) Calibration and alignment schemes.
- (3) Status of an engineering model describing the support structures and the dead zones in the detector simulation

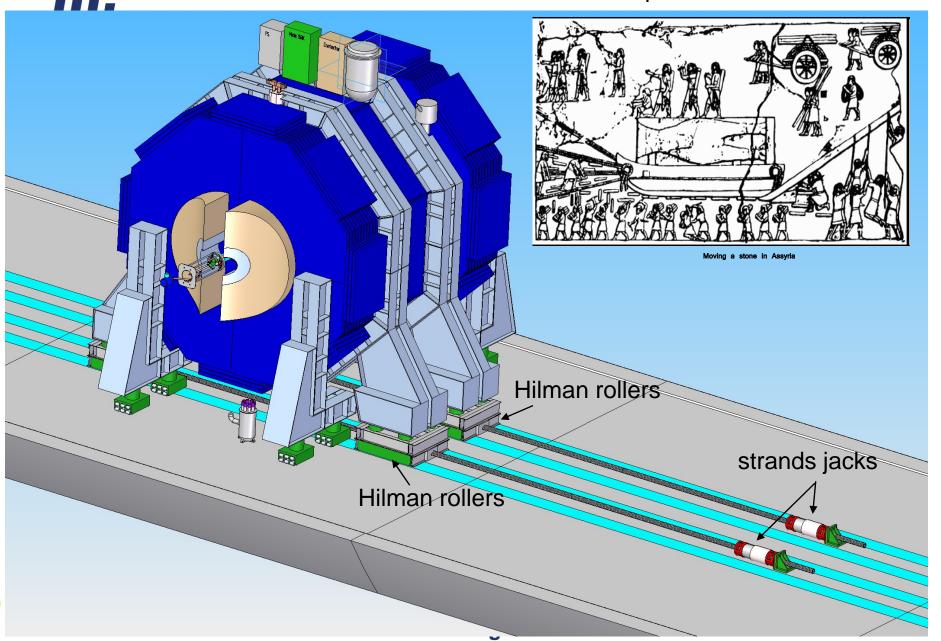


The MDI chapter provides a complete set of answers.

- (4) Plans for getting the necessary R&D results to transform the design concept into a well-defined detector proposal.
- (5) Push-pull ability with respect to technical aspects (assembly areas needed, detector transport and connections) and maintaining the detector performance for a stable and time-efficient operation.
- (6) A short statement about the energy coverage, identifying the deterioration of the performances when going to energies higher than 500 GeV and the considered possible detector upgrades.
- (7) How was the detector optimized: for example the identification of the major parameters which drive the total detector cost and its sensitivity to variations of these parameters.

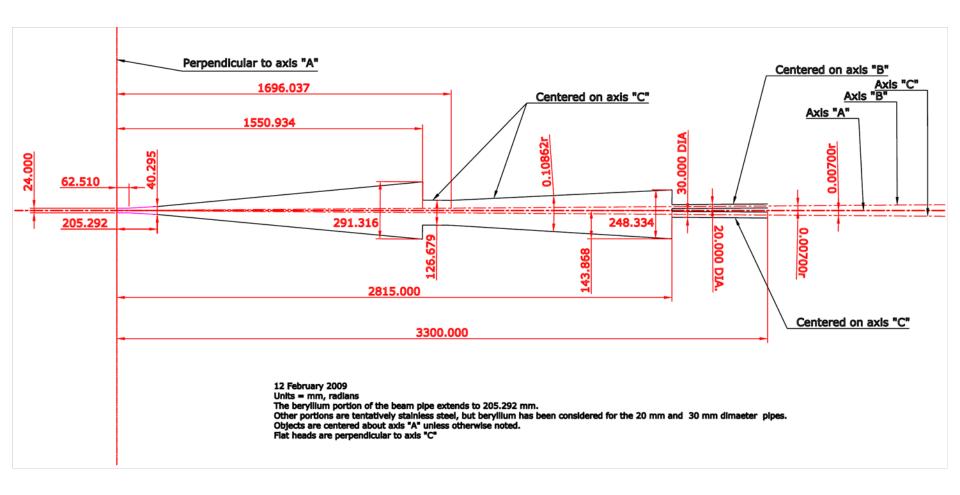


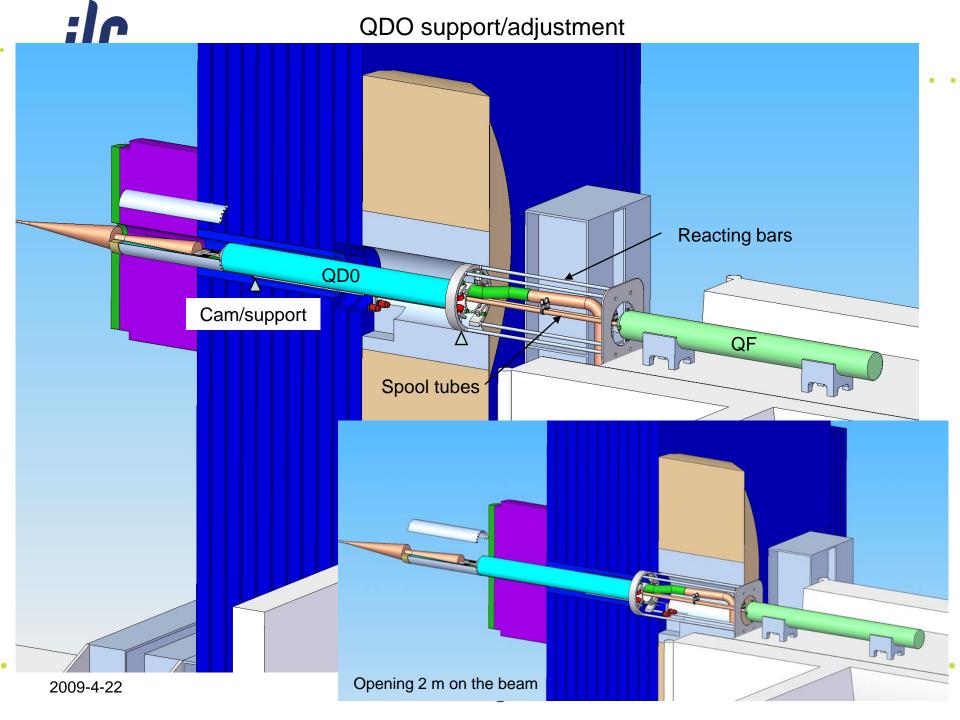
# Push/pull locomotion Dedicated session in this workshop





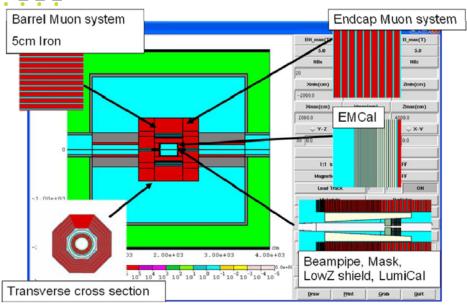
## IP Beam Pipe Design (B.Cooper, FNAL)

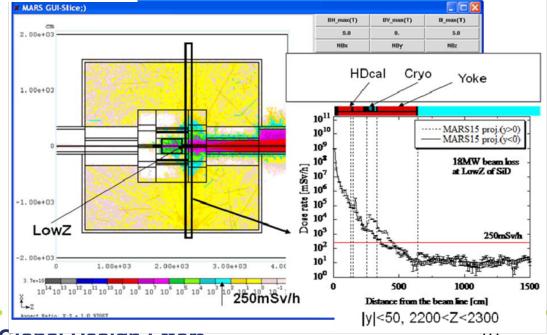






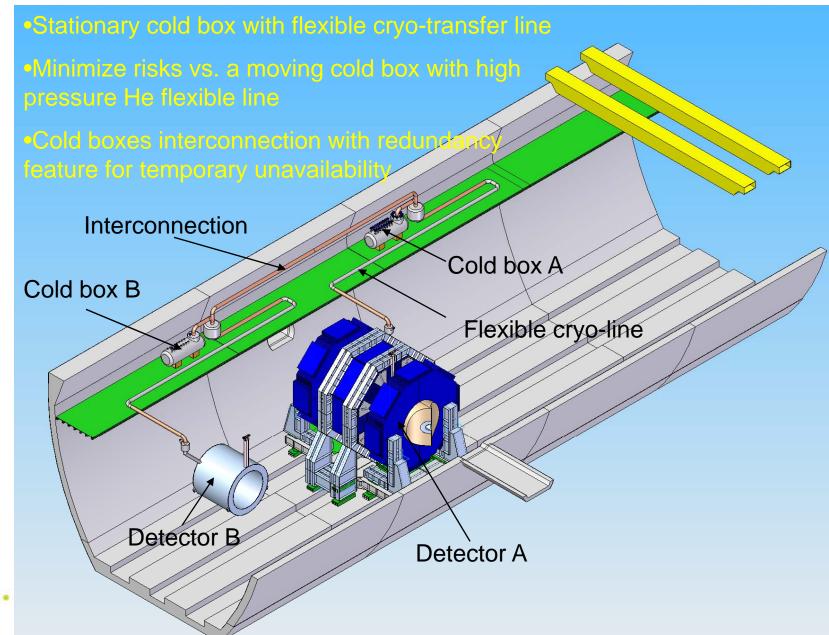
#### **Radiation Environment**



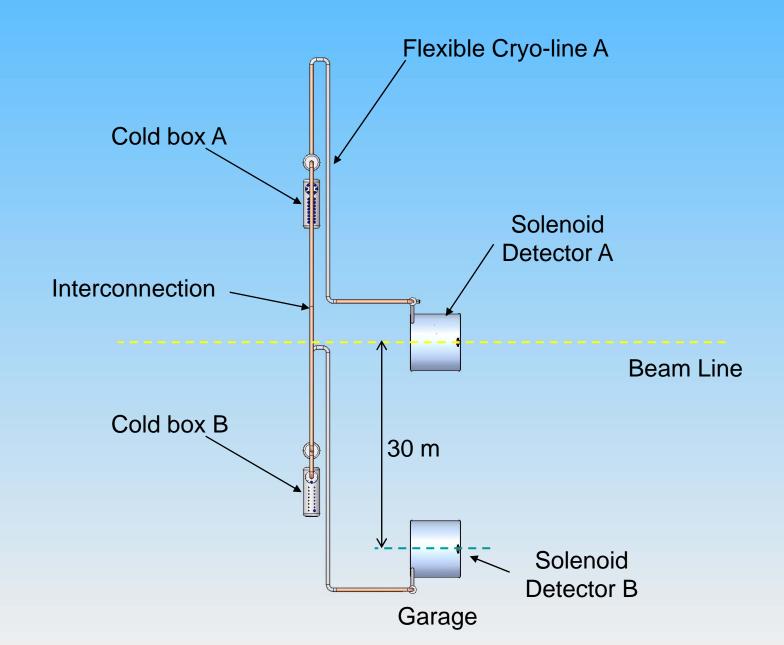




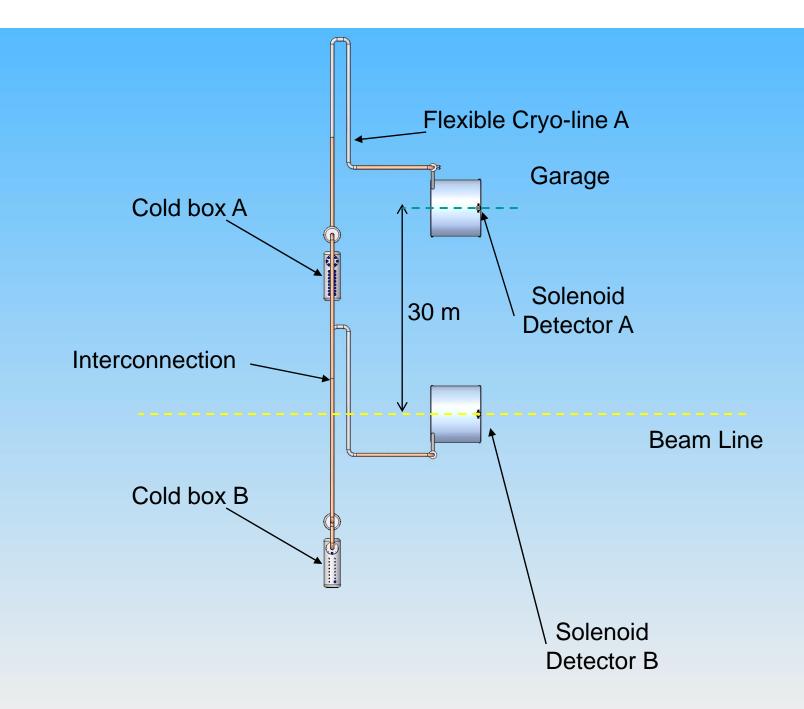
## Cryogenics system design for push-pull

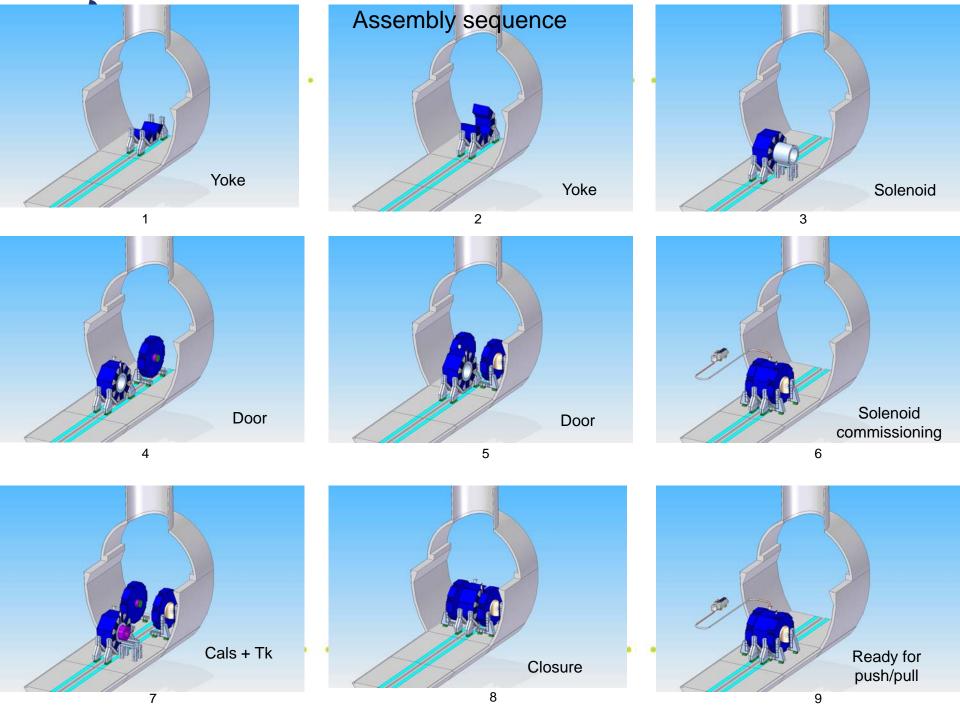












#### Rapid prototyping plotter for assembly and Integration studies





#### **Comments from SiD**

To progress in many of these areas a degree of mutual cooperation and discussion between pairs of detectors who propose to share the IR is required.

Where different, technical solutions adopted by the detector concepts need to be developed and brought at the level sufficient to make a comparison, e.g. platform and QD0 supports

The ILD and SiD concepts which present themselves as "self-shielded" need to discuss which elements of their shielding mate, e.g. rotating vs. sliding pacmen





#### **ILD Machine Detector Interface**

Karsten Buesser



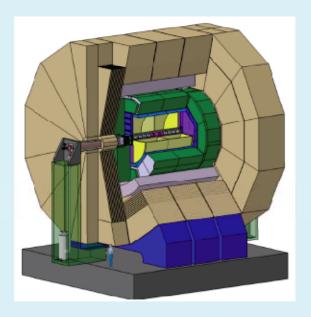
TILC'09 Tsukuba 18.04.2009



### Mechanical Concept



- platform for push-pull
- 3 barrel yoke rings, 2 endcaps
- central yoke ring carries cryostat with coil and barrel calorimeters
- endcap yoke carries endcap calorimeters
- TPC and SET suspended from cryostat
- Inner silicon detectors in support structure (CFRP) supported from TPC
- QD0 magnet and forward calorimeters carried by pillar, suspended from coil cryostat with tie-rods

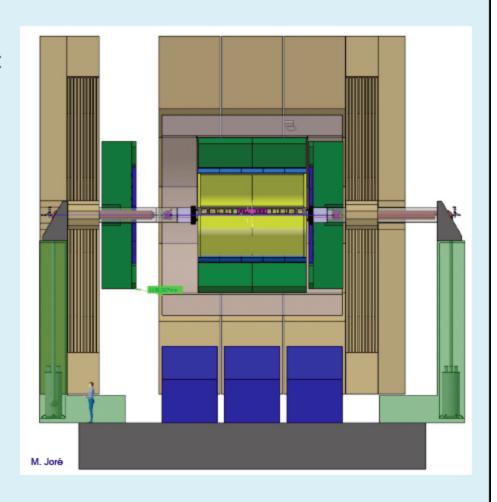




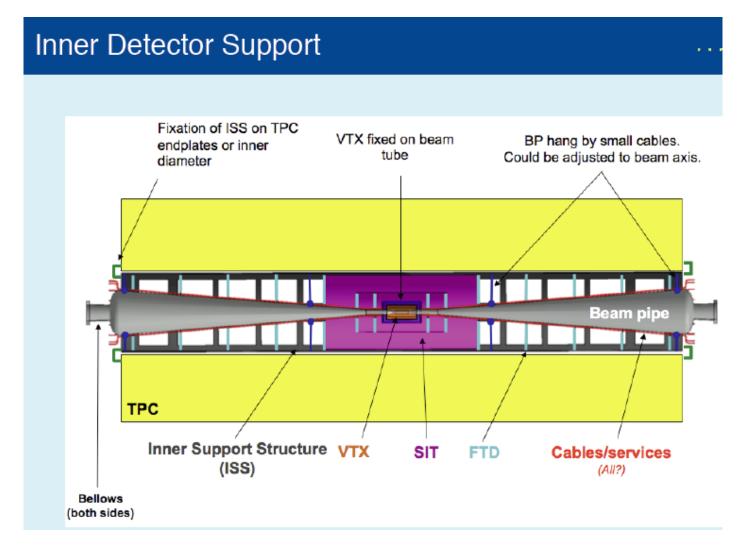
## Opening on the Beam



- Endcap yoke partially split allows ~1m access
- Allows for short maintenance in the beam position
- Every major work will be done in the parking position
- Removing the pillar would allow a non-split endcap
  - · mechanically nicer
  - needs other QD0 support



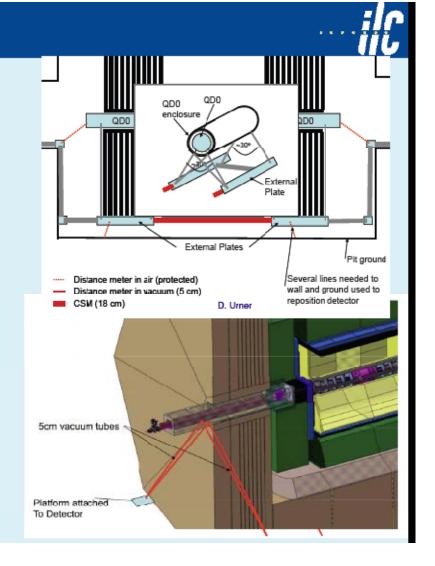






## Alignment

- MONALISA interferometric laser system could be used to align both QD0 magnets with respect to each other and to the beam axis
- Could also be used to align the detector itself
- Conceptual studies have started
- Again, full engineering study is needed to study access of laser beams in vacuum to the magnets (not on LoI timescale!)





## Alignment Requirements



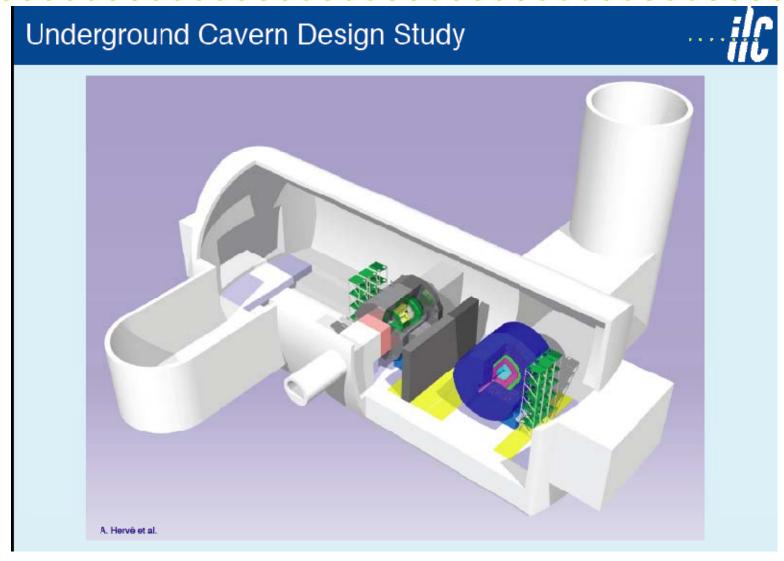
#### Detector axis:

- ±1mm and 100µrad w.r.t. line defined by QF1
- detector height adjustment range: ± several cm, depending on geological requirements

#### QD0 alignment:

- Alignment system:
  - Degrees of freedom: 5 (x,y,pitch,yaw,roll)
  - Range per d.o.f.: ±2mm, ±30mrad (roll), ±1 mrad (pitch, yaw)
  - Step size per d.o.f.: 0.05 μm
- Accuracy before low-intensity beams are allowed to pass:
  - ±50μm (x,y), ±20mrad(roll), ±20μrad (pitch, yaw)
- Accuracy and stability after beam-based alignment:
  - ±200nm and 0.1 µrad w.r.t. line defined by QF1 stable over 200ms between bunch trains
  - QD0 vibration stability: less than 50 nm within 1ms bunch train
- Control of the mover system will remain under control of BDS system and might be adjusted during the run



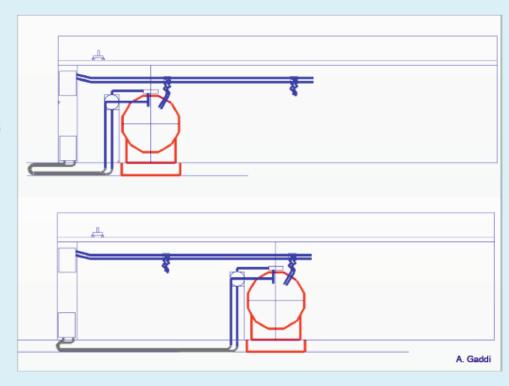




## **Push-pull Operations**



- Detector services are provided using cable chains
- Few on-board services needed (QD0 supply)
- Flexible helium lines needed
  - · either cold
  - · or warm
  - R&D needed in any case!
- Bus bar connection for coil

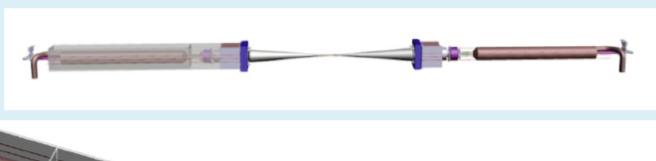


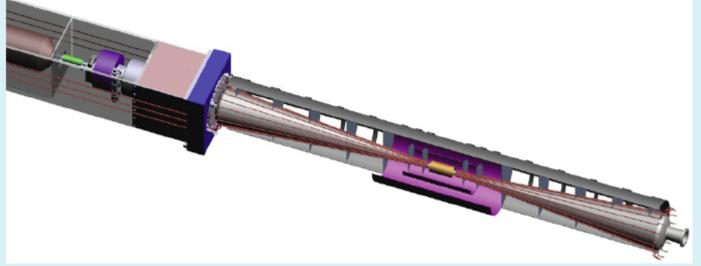


## Interaction Region



- QD0 integration
- Beam pipe
- · Background suppression



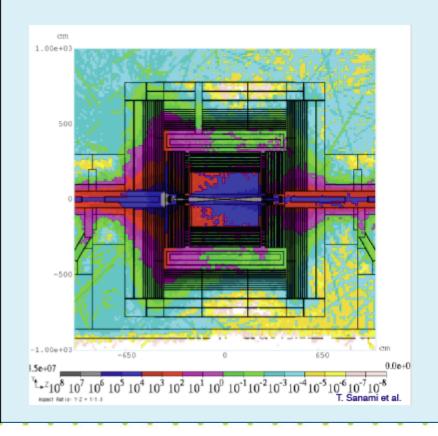


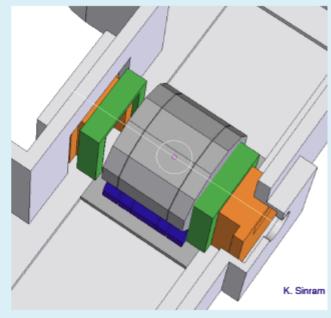


## Shielding



- ILD will be self-shielding (tech. note by T. Sanami et al.)
- · ,Pacman' shielding could be simple concrete portal
- · Detailed studies needed





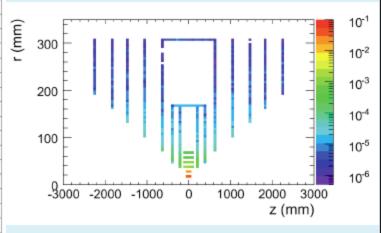


## Machine Induced Backgrounds



- Pair backgrounds have been studied for LDC and GLD in detail
- Needed to re-do simulations with ILD geometries and 3.5T magnetic field
- Low-P (500) backgrounds comparable to 1 TeV nominal

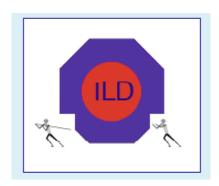
Subdetector	Units	Layer	Nom-500	Low-P-500	Nom-1000
VTX-DL	hits/cm <sup>2</sup> /BX	1	3.214±0.601	7.065±0.818	7.124±1.162
		2	1.988±0.464	4.314±0.604	4.516±0.780
		3	0.144±0.080	$0.332\pm0.107$	0.340±0.152
		4	0.118±0.074	0.255±0.095	0.248±0.101
		-5	0.027±0.026	0.055±0.037	0.046±0.036
		6	0.024±0.022	0.046±0.030	0.049±0.044
SIT	hits/cm <sup>2</sup> /BX	1	0.017±0.001	$0.031\pm0.007$	0.032±0.012
		2	0.004±0.003	0.016±0.005	0.008±0.002
FTD	hits/cm <sup>2</sup> /BX	1	0.013±0.005	0.031±0.007	0.019±0.006
		2	0.008±0.003	0.023±0.007	0.013±0.005
		3	0.002±0.001	0.005±0.002	0.003±0.001
		4	0.002±0.001	0.007±0.002	0.004±0.001
		5	0.001±0.001	0.006±0.002	0.002±0.001
		6	0.001±0.001	0.005±0.002	0.002±0.001
		7	0.001±0.001	0.007±0.002	0.001±0.001
SET	hits/BX	1	5.642±2.480	57.507±10.686	13.022±7.338
		2	5.978±2.360	59.775±8.479	13.711±7.606
TPC	hits/BX	-	408±292	3621±709	803±356
ECAL	hits/BX	-	155±50	1176±105	274±76
HCAL	hits/BX	-	8419±649	24222±744	19905±650





## **ILC Summary**

- 1) The ILD LoI describes the conceptual design of the ILD Machine Detector Interface
- 2) All areas need intense technical studies to converge on an engineering design





## 4th

MDI and magnetic configuration of the 4th detector

John Hauptman, Alexander Mikhailichenko

For 4th Collaboration

TLC09, April 17-21, 2009 - Tsukuba, Japan



#### Document reflecting MDI statements prepared by MDI team; ILC Note-2009-050

- "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)
- -The speed of push-pull operation less than a week.
- Radiation shielding is essential with two detectors occupying the same Interaction Region hall.
- Requirement for the magnetic field outside of detector is an important factor which defines the amount of iron in the detector (or degree of compensation for iron-free design).
- Vibration stability requirements about 50nm.
- Dimensions of the cavern and beam height above the floor of IR cavern.
- For reference, the detector has its own internal alignment requirements, which typically involve measuring vertex position with respect to tracker on micron level, and measuring tracker to calorimeter on mm level.



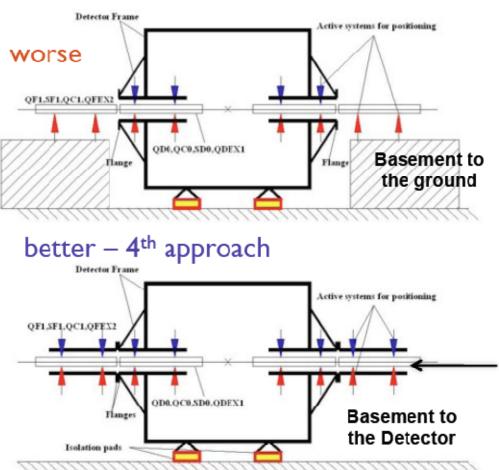
#### BASIC PRINCIPLES OF 4<sup>TH</sup> AFFECTING MDI

- The dual solenoids plus end wall current coils allow:
  - Strict confinement of magnetic field inside limited region; second solenoid closes the flux (minimal configuration).
  - 2) Spectroscopy of muons in magnetic field between solenoids
  - 3) Incorporate FF optics for better stability
  - 4) Modular design which helps in modifications and re-installations
  - 5) lightweight detector having flexible functionality and remarkable accuracy
  - 6) Easiest incorporation of laser optical system for gamma-gamma collisions
- Active alignment-mechanical and electric (tested at FFTB). Vibration of frame and quads could be reduced to the level required by passive and active systems;
- Final lenses incorporated in detector; stability of Final Doublets (from each side) stabilization could be arranged easier as they are installed on the same frame;
- Iron is absent; protection arranged by surrounding (Borated) concrete blocks;
- Light weight detector allows easy transportation and re-alignment;
- Push-pull concept satisfied easily; platform allows even quicker motion;

3



#### CONCEPTS OF FF OPTICS INSTALLATION



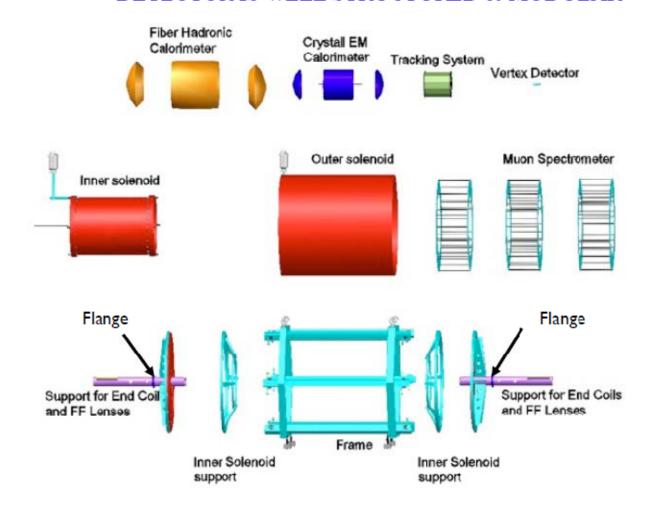
Active systems for positioning include:

- Stepping motor-driven micro-positioning movers (tested at FFTB);
- Piezoelectric fast movers with active feedback;
- Dipole windings in each quadrupole for equivalent shift of quadrupole axis in both transverse directions (tested at FFTB).

Attachment of cryostat with QF1 to the detector frame could be done after positioning detector in place 4



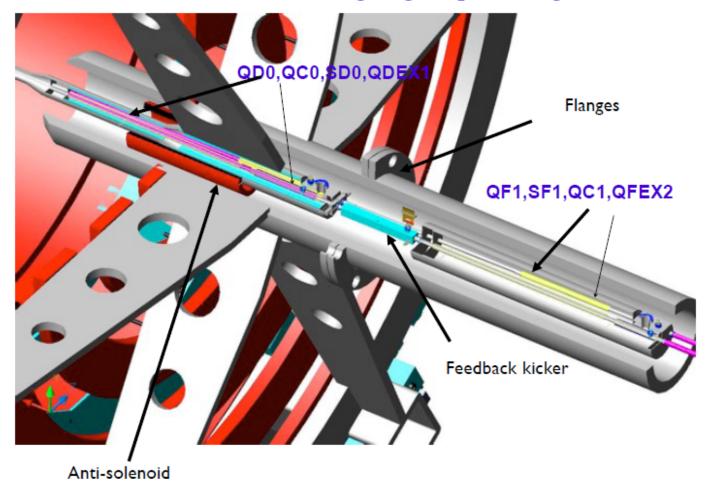
#### DETECTOR IS WELL STRUCTURED & MODULAR



12



### 14 mrad crossing angle optics fragment

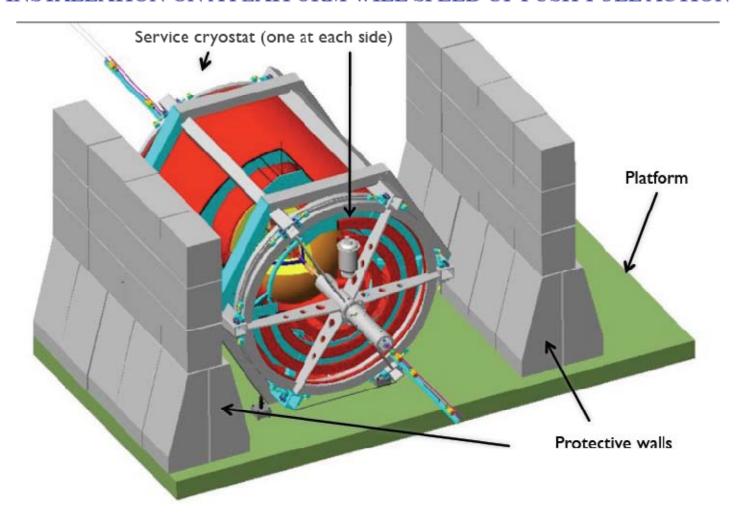


Each quad could be moved mechanically + trim coils

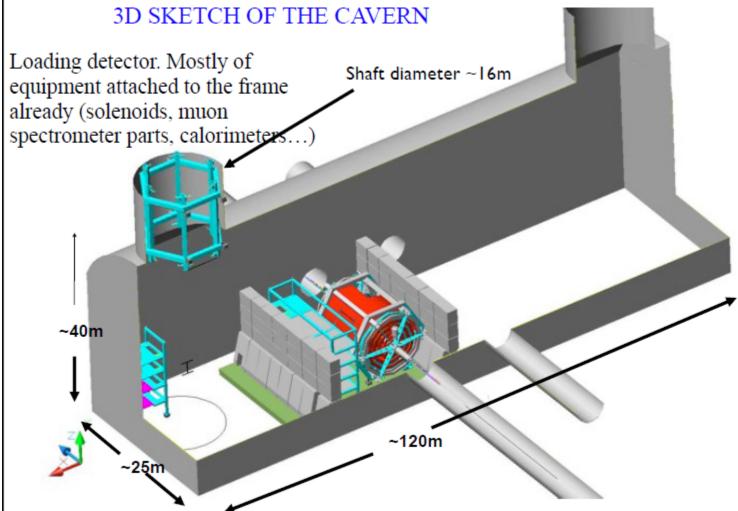
22



#### INSTALLATION ON A PLATFORM WILL SPEED UP PUSH-PULL ACTION







Tunnel shields at the cave entrances (Pacmans) not shown (next slide)



SLAC RADIATION PHYSICS NOTE March 30, 2009 RP-09-08

#### IR hall dose rate estimates with detector concepts

T.Sanamıı) 2, A.Fasso2, M.Santana2, L.Keller2, A.Sery12, S.Rokn12, S.Ban1)

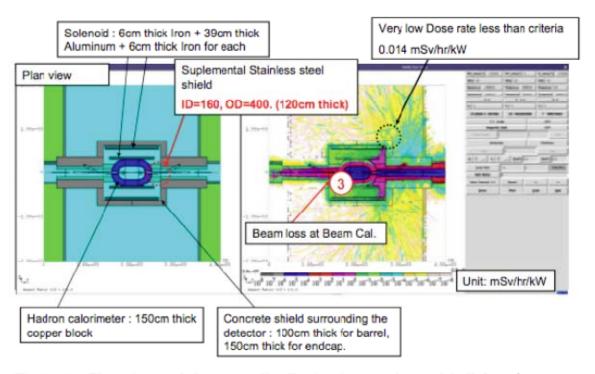


Fig 3-12-2 Plan view and dose rate distribution in experimental hall for 4<sup>th</sup> concept detector with supplemental stainless steel shield. The shield thickness is 120 cm.



#### CONCLUSIONS

- · All MDI questions can be answered;
- 4th detector can easily accommodate any beam optics;
- · It can be easily installed in detector cavern as it has no heavy Iron;
- 4th allows easy motion in cavern for push-pull operation;
- Elements of FF optics mounted on detector frame allow better protection against ground motion; active system against vibrations;
- Field can be made homogeneous to satisfy tracking system request; measured accurately
  as there is no interference from iron (10<sup>-4</sup>);
- · Easy upgrade for gamma-gamma if necessary;
- Modular concept of 4th detector allows easy exchange of different equipment, such as tracking chamber, vertex detector, sections of calorimeter, gamma-gamma hardware, and detectors beyond the calorimeter;
- Current density could be reduced by sectioning to allow NbTi wire by end coil sectioning;
- Engineering stage for coil design must be continued toward practical tests of concept.

30



## IP and Detector Related Instrumentations

April 20, 2009 (9:00-12:30, room 202)



#### Current status of Shintake Monitor for ATF2

#### Outline

Quick introduction of Shintake monitor for ATF2
Expected performance for the 37 nm beam
Commissioning status and schedule

Yoshio Kamiya, Takashi Yamanaka, Masahiro Oroku, Youhei Yamaguchi, Taikan Suehara, Sachio Komamiya, Yosuke Honda, Tatsuya Kume, Toshiyuki Okugi, Toshiaki Tauchi, Nobuhiro Terunuma, and Shintake Monitor group



#### PREVIOUS ACHIEVEMENTS OF FINAL FOCUS DESIGN USED IN 4th DESIGN

Beam delivery system –Final Focus Test Beam Facility- FFTB- was constructed to test FF optics concepts, stabilization, beam size measurements, magnet technology, 1993.

International project with participation of France, Germany, Japan, Russia, USA.

Located at the end of SLAC linac in a specially build extension housing. Total length ~200m; compensation of chromaticity of FF doublet done by sextup des.

Vertical beam size ~70nm was measured at IP Phys.Rev.Lett.74:2479-2482,1995

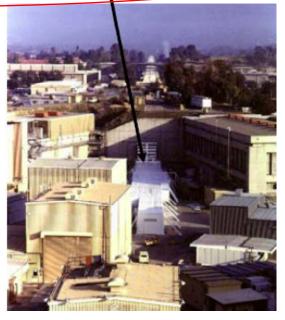
Obtained substantial experience in Final Focus design





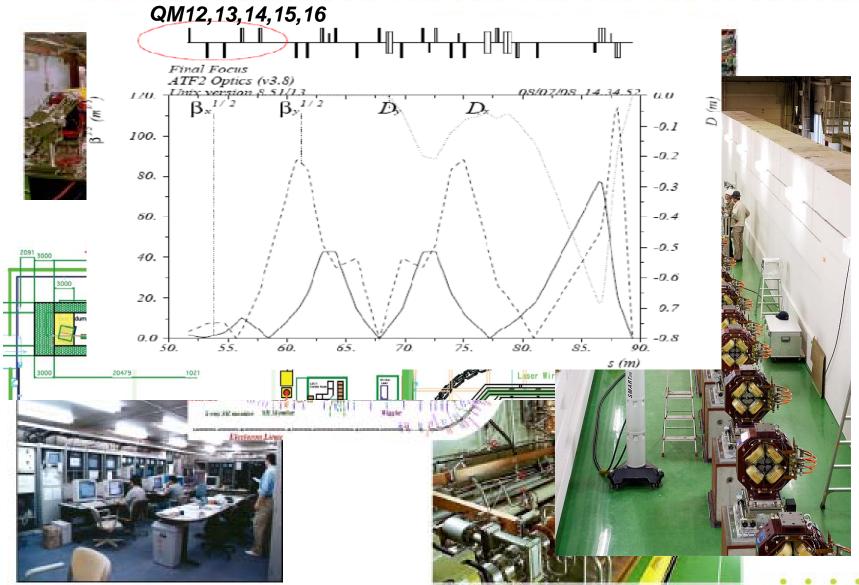
#### In particular,

- Tested stabilization of few long strings of magnets, representing functional electro-optical blocks (such as final telescope etc) with stretched wire.
- Tested active magnet alignment.
- Introduced and tested ballistic method for FF alignment
   Tested new-type of beam size monitor for nm scale





## ILC R&D KEK ATF → ATF2

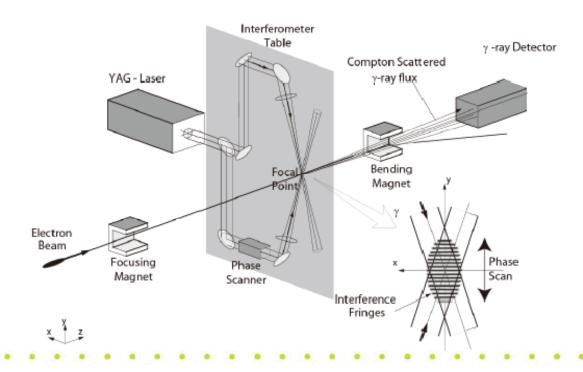




#### Schematic drawing of Shintake monitor

Shintake monitor is currently the only demonstrated monitor that can measure a sub-micron or less beam size.

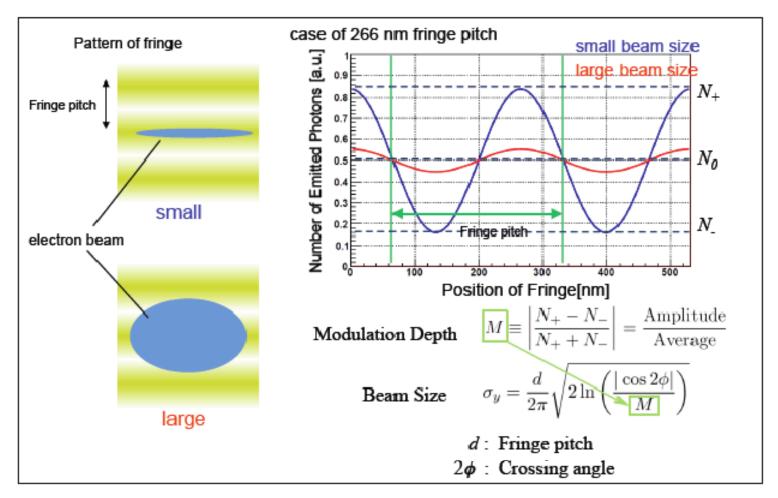
target characteristics laser based target --- non-destructive interference fringes --- very fine, periodical structure





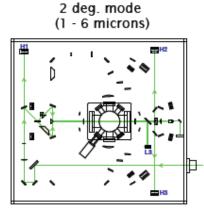
#### How to analyze the gamma-ray intensity

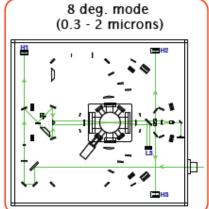
20th Apr. 2009 ATF2 TILC09 3/19





#### Optics design for ATF2 (wide dynamic range, from several micron to 20 nm)

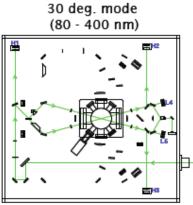


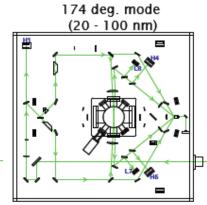


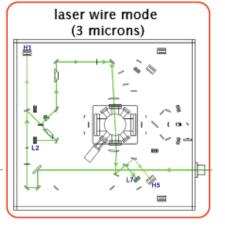
to see small beam size of several tens of nm

four crossing mode for vertical

one laser wire mode for horizontal









#### Laser system

Q-switched Nd:YAG laser (GCR-3 Spectra Physics)

Wavelength:

532 nm (2nd Harmonics)

Pulse duration:

8 nsec (FWHM)

Repetition frequency:

variable (2-15 Hz)

Pulse energy:

400 mJ/pulse

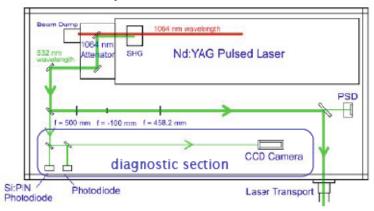
Pointing stability:

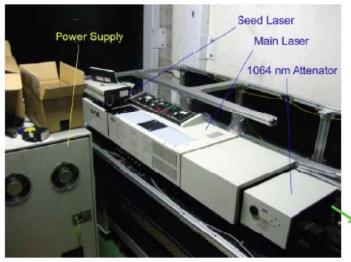
10 micro-rad

Line width:

< 0.003 cm^-1

#### optics in the laser hut







#### Gamma-ray detector

adopted a multilayer structure and a shower shape analysis

Scintillator: CsI(Ti)

Density: 4.51 g/cm^3

Size: 10 x 5 x 33 cm

4 front layers of 1 cm thickness rear block of 29 cm thickness

PMT: R7400U (Hamamatsu)

Photocathode: Bialkali

Photocathode area: 8 mm in diameter

Typical gain: 7x10^5

Directly attached on the Scint.

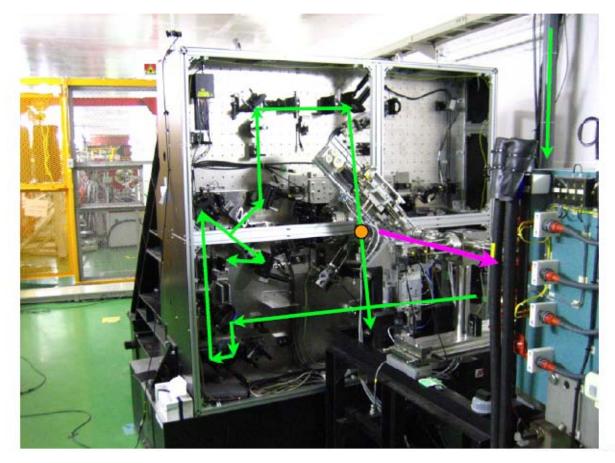


20th Apr. 2009 ATF2 TILC09 8/19



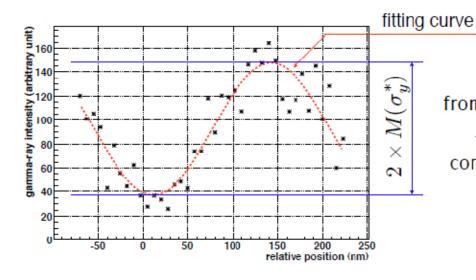
#### <u>Main optical table</u>

Size: 1.7 x 1.6 m^2 Several tens of optical elements





#### Simulated signal modulation (Performance estimation)



from this fitting curve

$$M(\sigma_y^*) = 0.6$$

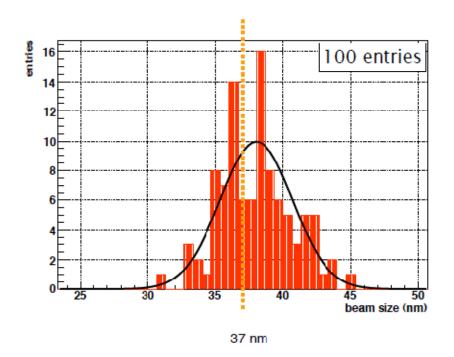
corresponds to  $\sigma_y^* = 38.3 \text{ nm}$ 

Two kinds of error sources:

- A. Jittering along vertical axis (gamma-ray intensity) in the scattered plot (mainly from a detector resolution, electron timing, etc..)
- B. Jittering along horizontal axis (relative position) in the scattered plot (mainly from laser fringe stability, electron position jitter)



#### Simulated beam size disribution with the errors



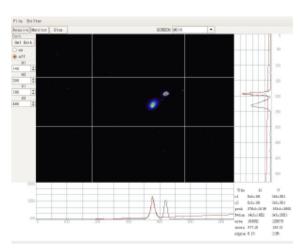
estimated beam size: 38 nm

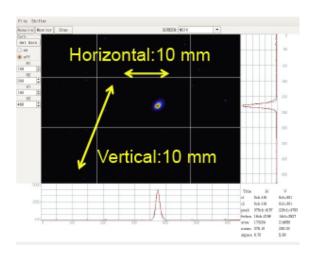
resolution of measurement: 2.7 nm



#### How to collide (laser wire mode in March)

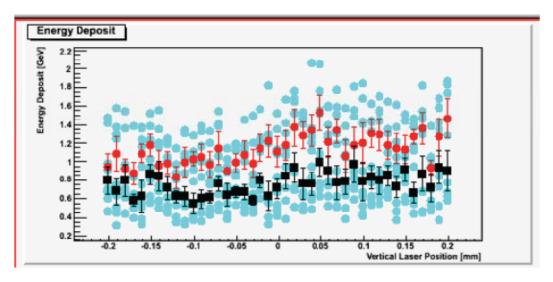
- 1. beam orbit tuning from the beginning of the EXT line (6 8 hours)
- 2. beam angle adjustment using two screens (~ 0.5 hours) (MS1IP@IP and MSPIP@80 cm downstream)
- 3. Dispersion collection using QF1 (~ 0.5 hours)
- 4. Minimize beam size using QD0 (~ 0.5 hours)
- 5. check the angle using the brems. from the MSPIP (~ 0.5 hours)
- 6. laser optics tuning including waist position adjustment (0.5 1 hours)
- 7. move the laser to overlap images on the IP screen (MS1IP)
- 8. scan in horizontal and timing







#### Signal from 8 deg. mode



Red plots are for laser-on, Black plots are for laser-off

The another laser stay at the assumed IP position (pinhole position).

We observed clear excess signal on the background level.

Offline analysis is going on. The results will be presented at PAC09



#### **Summary**

All the main components of the Shintake monitor system had been installed without any serious problem.

Expected resolution was evaluated to be 3 nm at 37 nm beam.

Gamma-ray signal was observed with the laser wire mode in Feb.-Mar. and convoluted beam size was measured in horizontal.

We also succeeded to observe signal with the 8 deg. mode in April. Commissioning of the 8 deg. mode is going on.









## **MONALISA**

- ILC roles and requirements
- Interferometer measurements
- Recent results
- Highlights 2009/10

M.S. Warden, P. A. Coe, D. Urner and A. Reichold



## ILC detectors

- All 3 concepts call for interferometer system
  - letters of intent mention the idea
  - 19 Apr push pull ACFA and GDE/BDS session
- Later detailed engineering
  - where and how to arrange lines of sight
  - trade off between different options
    - studies at ATF-2 and CLIC will inform this process
  - other outstanding issues would include:
    - monitoring cold mass non-trivial
    - opening / closing lines of sight not yet mentioned in push-pull plans – probably too early to discuss now



## Roles at ILC

- Monitor most position sensitive magnets
  - Final focus quadrupoles
  - Energy chicane magnets
  - Beam delivery system
- Provide independent monitor of position
  - Cross check beam-based measurements
  - Provides measurement when beams absent
  - Help relocation after push-pull



## (Random example) ILD Letter of Intent

## QD0 alignment

#### DETECTOR INTEGRATION

MACHINE DETECTOR INTERFACE

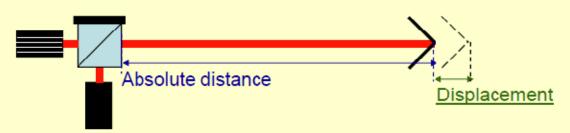
which is suspended from the TPC end flanges. The QD0 magnets reside on actuators in their support structure and are monitored using an interferometric laser alignment system like MONALISA [139]. The service cryostat for the supply of the QD0 magnets on the beam line, in the garage position and during the push-pull operations are located at the bases of the pillars and move with the platform.

The stability of the QD0 support structure has been studied. The vibrations induced by ground motions are at most 2.2 nm at 8.3 Hz which is below the limits of 50 nm defined in the minimum requirements document [137].



## Interferometer: Distance meter

- Operates in two modes
  - Absolute Distance (< μm resolution)</li>
  - Displacement measurement (nm resolution)



- Two modes combined
  - Displacements referred to absolute distance
  - Tolerant to interruption of measurements



## Highlights 2009 / 2010

- Installation at ATF-2
  - July 09 install, test vacuum vessel at ATF2
  - Autumn install, test optics at ATF2
  - Commissioned system by Jan/Feb 2010
- Test magnet at CLIC
  - Simple initial interferometers mid 2010
  - Upgrade to CSM tests 2011
- Laser stabilisation system at Oxford
  - to provide Rb frequency reference
  - commissioning in 2009





QD0

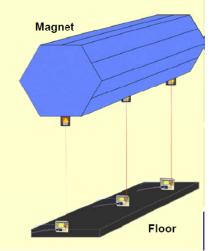
- encloses vacuum in centre
  - high pressure outer



- lines of sight along centre
- reflectors on Shintake
- launch heads on QD0

#### Monitoring CLIC magnet 2010

- Test several points along the magnet
  - at first independent DMs
- Compare readings with accelerometers
  - on the magnet
  - and on the floor





## Summary

- Installation at ATF-2 2009 / 2010
- Installation at CLIC test magnet 2010/11
- System testing / development ongoing at Oxford

Valuable information from this programme feeds directly into ILC and CLIC requirements for interferometric monitoring



# CAVITY BEAM ORBIT TILT MONITOR

Tohoku university Daisuke Okamoto

#### contents

- 1. Motivation
- 2. Principle
- 3. Design
- 4. Expected performance
- 5. Conclusion

TILC09

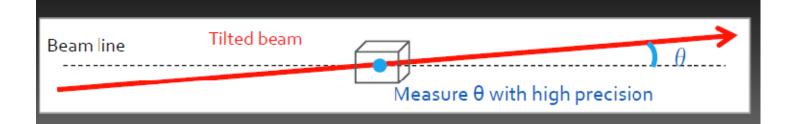


## Motivation

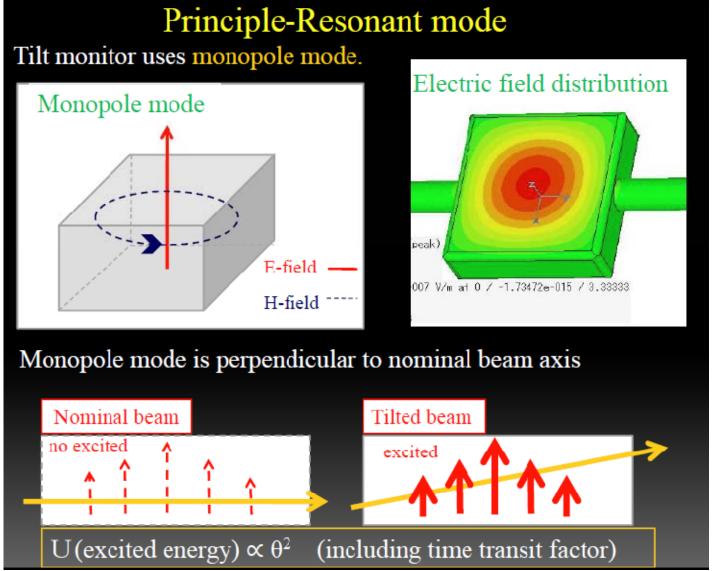
This monitor measures the beam orbit tilt with high precision.

It can be a useful tool to monitor beam in many case.

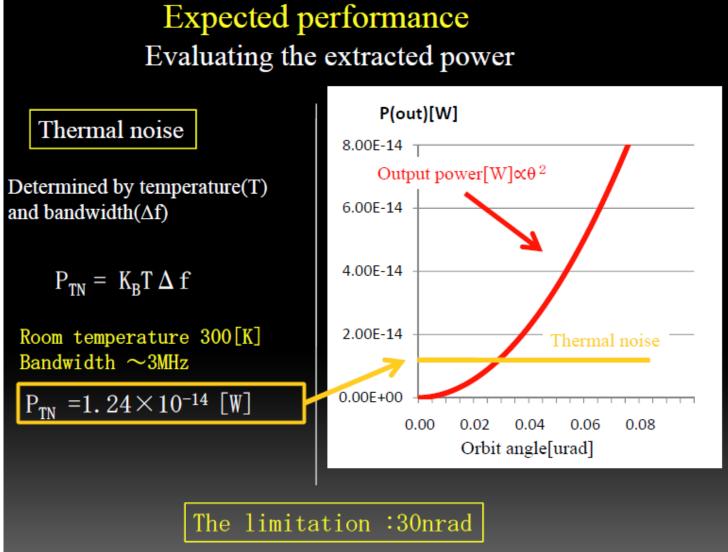
Feature: We can get the tilt date from only one cavity, not necessary two point data.













## Development of Pair-monitor

Y.Sato A, H.Ikeda B, K.Ito A, A.Miyamoto C, T.Nagamine A, R.Sasaki A, Y.Takubo A, T.Tauchi C, H.Yamamoto A : Tohoku University, B : JAXA, C : KEK

#### Outline

- Introduction
  - Pair-monitor
- 2. Development of readout ASIC
  - Design and layout
  - Operation test
- 3. Development of Pair-monitor with SOI technology
- Summary



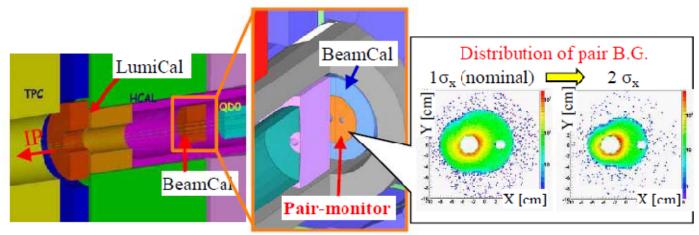


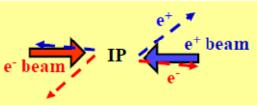


## Pair-monitor

Pair-monitor is a silicon pixel detector to measure the beam profile at IP.

- The distribution of the pair B.G. is used.
  - The same charges with respect to the oncoming beam are scattered with large angle.
    - The scattered particles have information on beam shape.
- The location will be in front of the BeamCal.







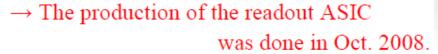
## -ilC

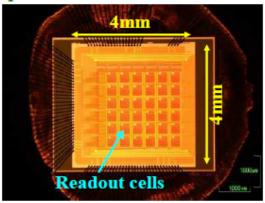
## **Prototype of Readout ASIC**

The prototype of the readout ASIC was developed.

#### **Prototype ASIC**

- Production process: 0.25 μm TSMC
- Chip size : 4 x 4mm<sup>2</sup>
- # of pixel : 36 (= 6x6)
- Pixel size : 400 x 400 μm<sup>2</sup>
- Sensor will be bump-bonded to the ASIC.
- The chip was packaged in a PGA144.







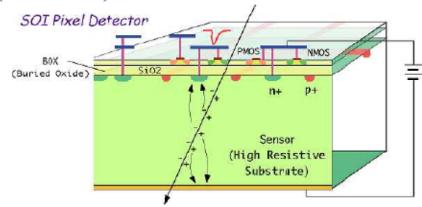


## **III.** Pair-monitor with SOI technology

SOI (Silicon On Insulator) technology will be used for development of the pair-monitor.

#### **SOI** pixel detector

- The sensor and readout electronics are integrated in the SOI substrate. (monolithic)
  - High speed
  - Lower power
  - Thin device
  - Low material



Development of the Pair-monitor with SOI technology was started, participating in MPW (Multi Project Wafer) Run at KEK.

2009-4-22

10



-ilc

Prototype of SOI chip

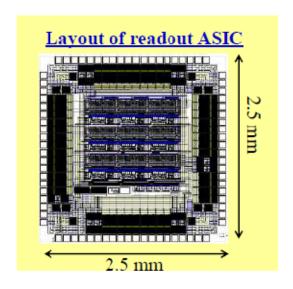
For the next prototype, only the readout ASIC will be developed.

The layout of the readout ASIC was finalized.

#### **Prototype ASIC**

- Production process : FD SOI CMOS 0.2 μm
- Chip size : 2.5 x 2.5 mm<sup>2</sup>
- # of pixel :  $9 (= 3 \times 3)$
- Design of the ASIC is modified a little.
  - Pole-zero cancellation
  - One comparator → Two comparators
     TOT circuit → RC circuit

The operation test will be started in 2009.





## Summary

- Pair-monitor is the silicon pixel detector to measure the beam profile at IP.
- The prototype of the readout ASIC was developed.
  - The chip works correctly as designed.
- The next readout ASIC will be developed with SOI technology.
  - The layout was finalized.
  - The operation test will be started in 2009.

12



TILC'09, Tskuba, Japan, 17-21 April 2009

## SiD FCAL

## Takashi Maruyama Tom Markiewicz SLAC

BNL

K. Krempetz

W. Morse

Oregon D. Strom

#### Contributors:

SLAC M. Breidenbach FNAL W. Cooper

G. Haller

T. Markiewicz

T. Maruyama

M. Oriunno

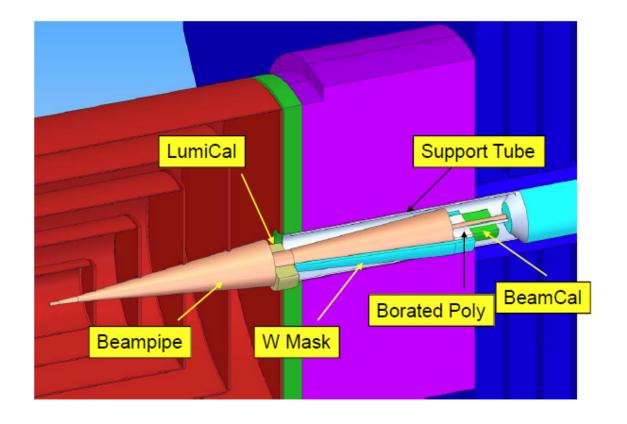
Colorado U. Nauenberg

J. Gill

G. Oleinik

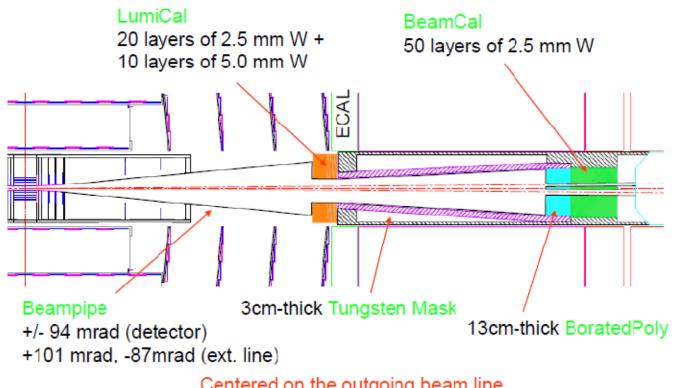


# SiD Forward Region





## SiD Forward Region



Centered on the outgoing beam line

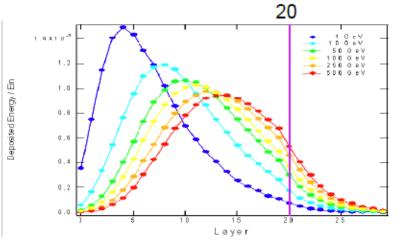
3/24

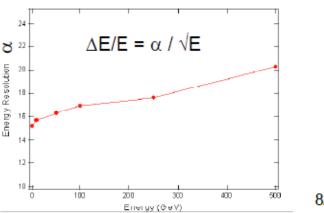


## **Energy resolution**

20 layers of 2.5mm W+ 10 layers of 5.0mm W

- Energy resolution parameter is dependent on energy
  - 15%/√E at low energy
  - 20%/ √E at high energy
- Energy leakage is small even at 500 GeV.





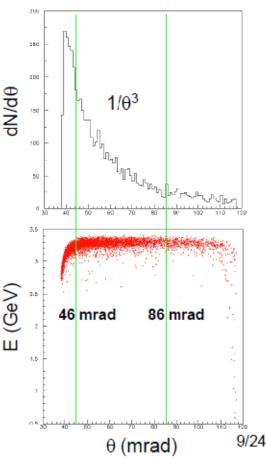
8/24



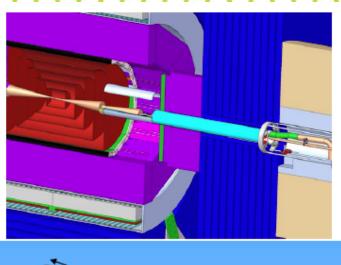
# Luminosity measurement

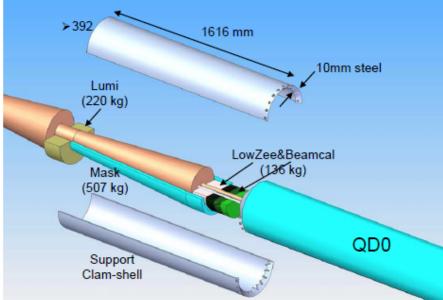
- Luminosity precision goal  $\Delta L / L < 10^{-3}$ 
  - 10<sup>6</sup> W+W<sup>-</sup> events in 5 years (500 fb<sup>-1</sup>)
- $\Delta$ L/L=(N<sub>rec</sub>-N<sub>gen</sub>)/N<sub>gen</sub>
   Bhabha d $\sigma$ /d $\theta$  ~ 1/ $\theta$ <sup>3</sup>

  - $\Delta L/L\sim 2 \Delta\theta/\theta_{min}$ ,  $\Delta\theta$  is a systematic error.
- $\Delta\theta$  must be less than ~20 $\mu$ rad to reach  $\Lambda L/L = 10^{-3}$ .
  - Detector radial location must be know within 30μm.
- Bhabha event rate
  - N<sub>ev</sub> / BX @ILC 500 Nominal= 5.9 [ $1/\theta^2_{min} - 1/\theta^2_{max}$ ] (θ in mrads)
  - 30 ev/sec for  $\theta_{min}$ =46 mrad,  $\theta_{max}$ =86 mrad

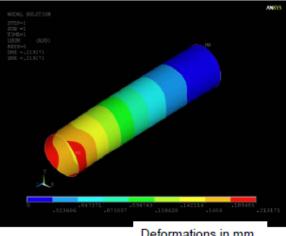




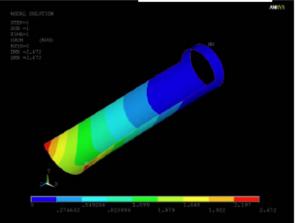




#### Forward Integration



Deformations in mm





### Unresolved Issues

- LumiCal
  - Readout design
  - Petal-to-Petal dead space
  - Reproducible alignment to < 30 um and verification</li>
- BeamCal
  - Choice of sensor
  - Readout design
  - Petal-to-Petal dead space
  - Electronics cooling
- BeamPipe
  - HOM heating, cooling & wakefields due to abrupt radial transitions
- Global FCAL
  - Integration
  - Installation and servicing

22/24

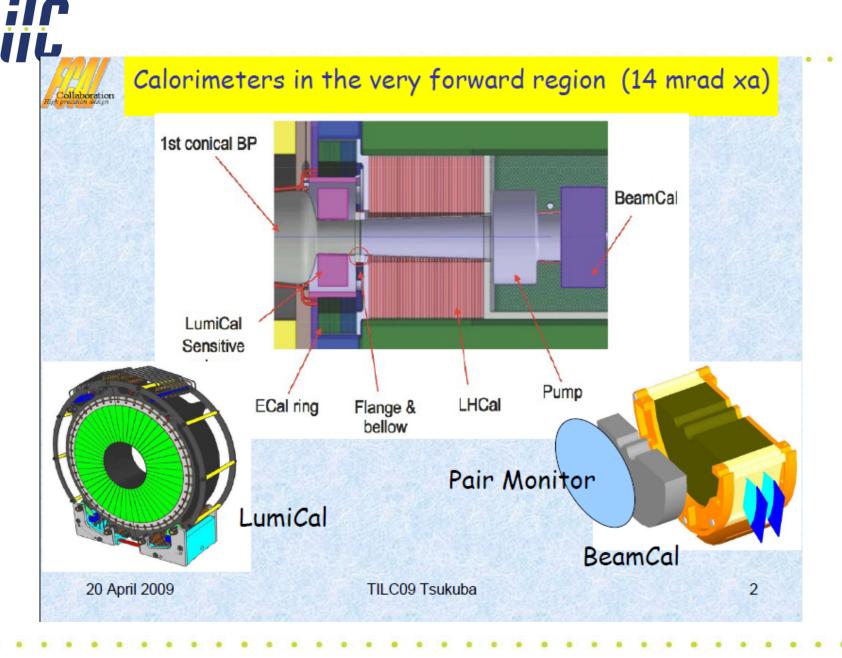


## Forward Calorimetry

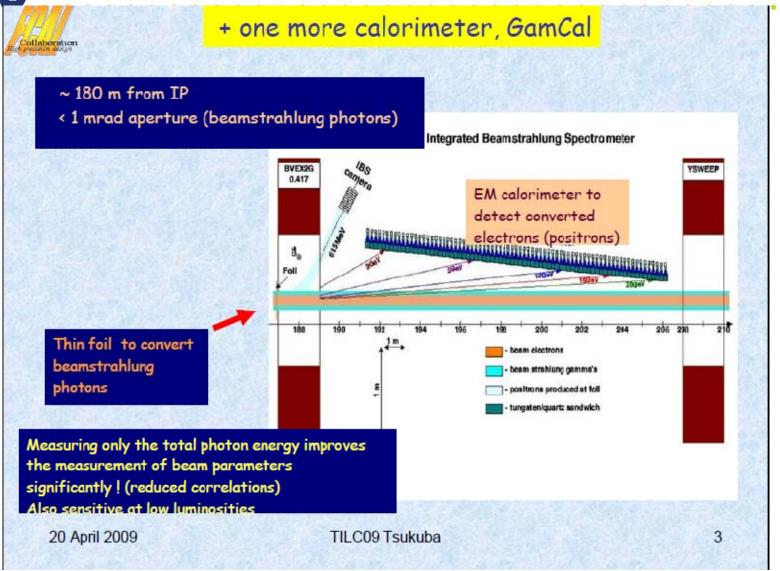
5.5chuwalow, DESY

- · LumiCal
- BeamCal & Pair Monitor
- Data Transfer & Integration
- Priority R&D Topics
- Challenges of Very Forward Detectors

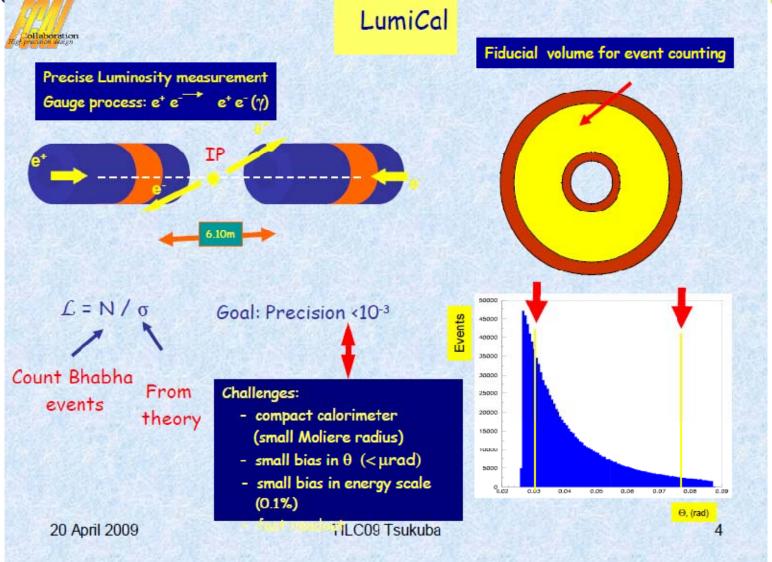
20 April 2009 TII C09 Tsukuba 1



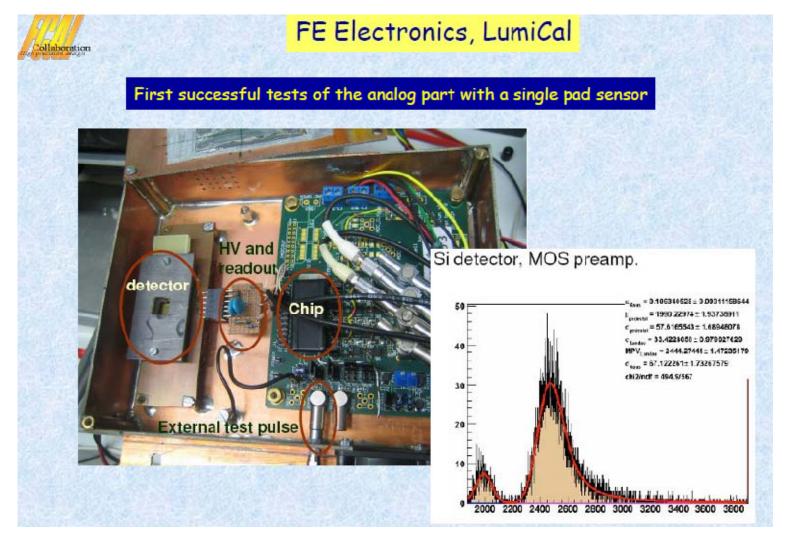




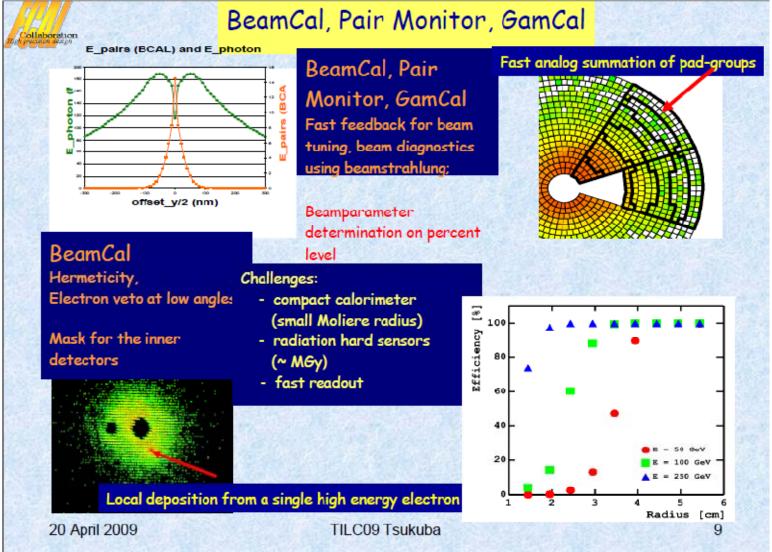




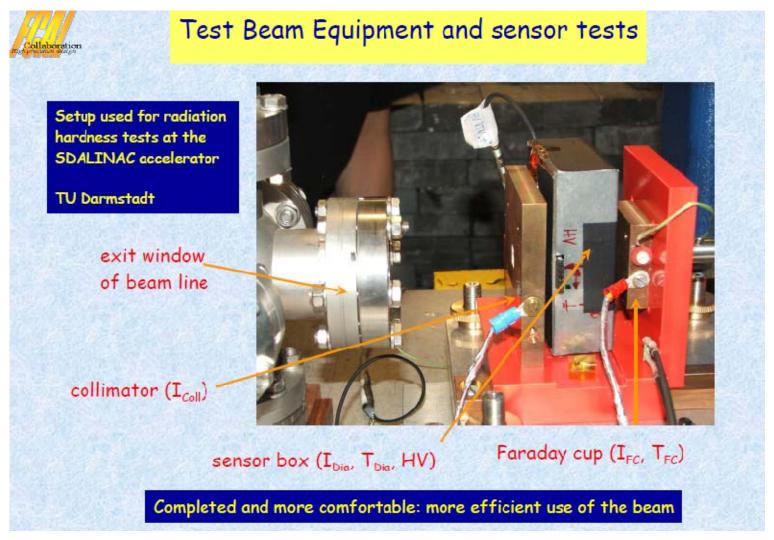




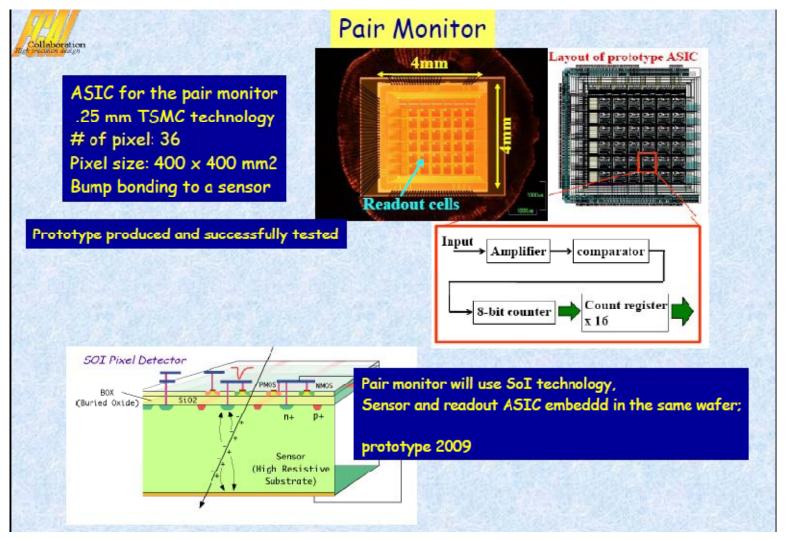




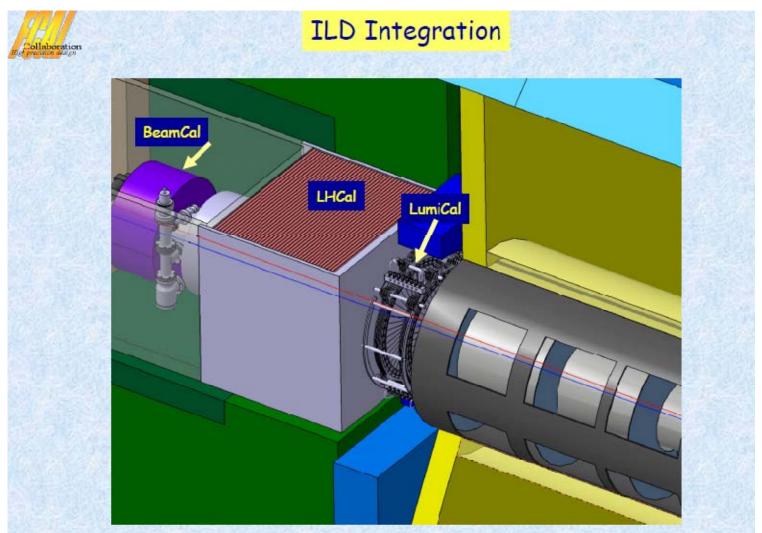




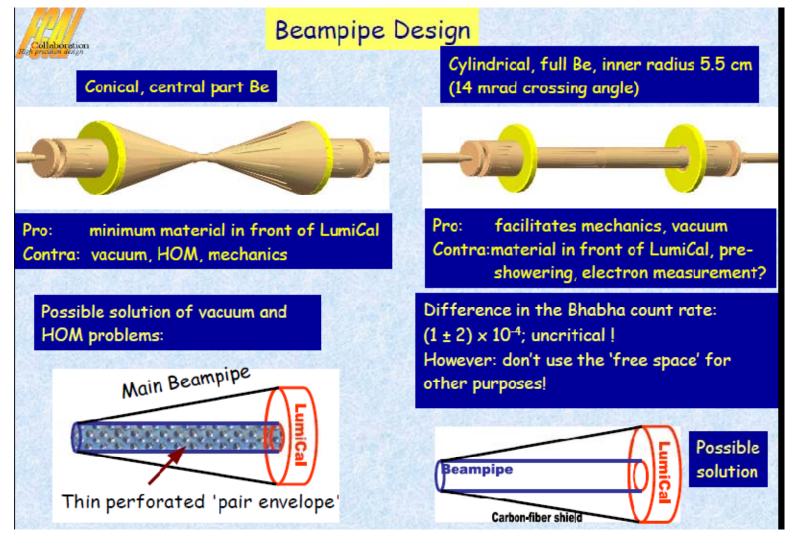
















### Conclusions

### Priority topics within FCAL:

- · Large area radiation hard sensors for calorimetry (BeamCal)
- Precise position measurement of electromagnetic showers (Sensors for LumiCal, position monitoring)
- ASICS with high readout speed, large dynamic range, large buffering depth and low power dissipation, allowing fast feedback for luminosity optimization
- Prototyping and test of more complex subsystems to prepare compact sampling calorimeters



## Final Conclusions

ILC MDIs have progressed in 3 detectors push-pull schemes, radiation environment simulations, IP beam pipe designs,... also, in IP beam dimensional properties' instrumentation and beam physical characteristic's measurement technique developments....keep going!

Thanks to MDI speakers, participants and conveners to this summary!