MDI & Integration Overview

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TILC08, March 3-6, 2008,
Sendai, Japan

MDI

Machine Detector Interface

Detector, Physics

requirements

(results)

Impact

compromise

cooperation

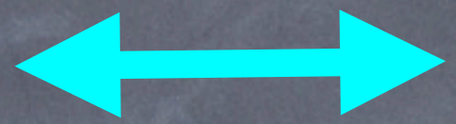
Machine

requirements

(cost reduction)

(1)

Ecm=0.5-1TeV
High Luminosity

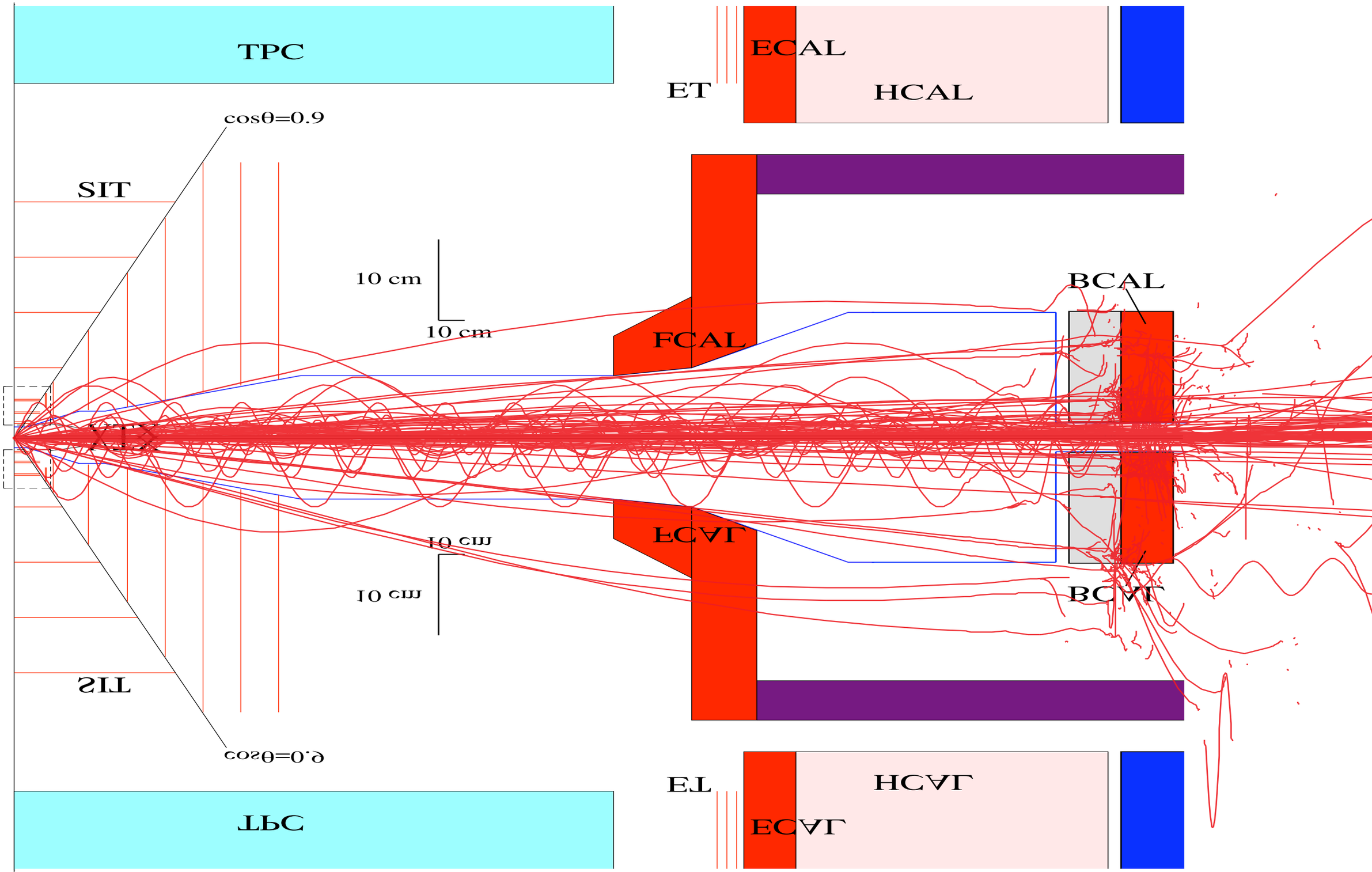


Beam intensity,
Small beam size,
Multi-bunch beam,
QD0 (L*,aperture)

Background

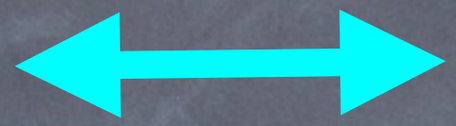
flat beam, 2000 bunch/5Hz, L*=3.5-4.5m, a=20mmϕ
parameter sets : nominal, lowQ, LargeY, lowP, HighLum
IR Design in Detectors

IR of GLD


TPC
cosθ=0.9
SIT
10 cm
10 cm
ET
ECAL
HCAL
FCAL
BCAL
ECAL
BCAL
10 cm
10 cm
SIT
cosθ=0.9
TPC
ET
HCAL
ECAL

(2)

Energy, Polarization
measurements
after collision



Crossing angle,
Crab crossing
Compact QD0

Hermeticity, Depolarization

Detector Integrated Dipole (DID)

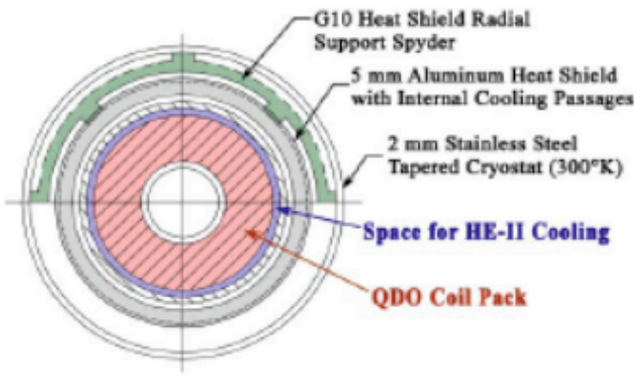
Background

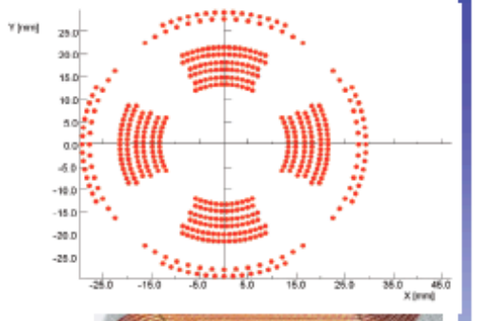
anti-DID, smaller crossing angle =14mr

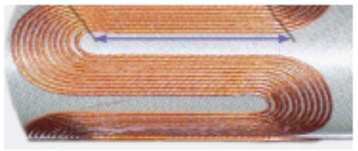
Note : E and P measurements before/during collision with 2mr

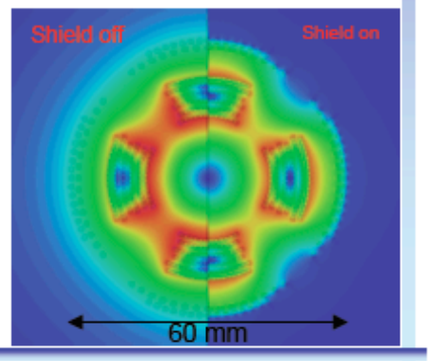
Compact QD0 : superconducting magnets R < 3cm

(RDR) BNL design





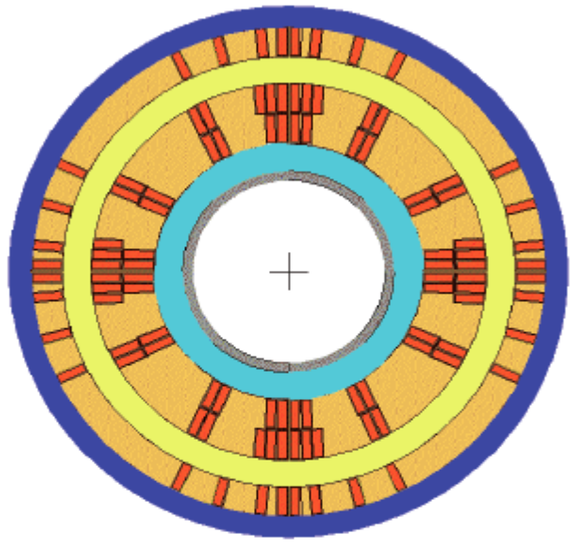


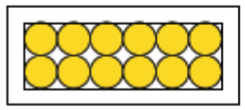


- Well advanced design based on the direct wind technology (BNL)

Issues:
- Works for NbTi strand
- Need inner support tube
- Limited radial and azimuthal thermal conductivity

FNAL concept



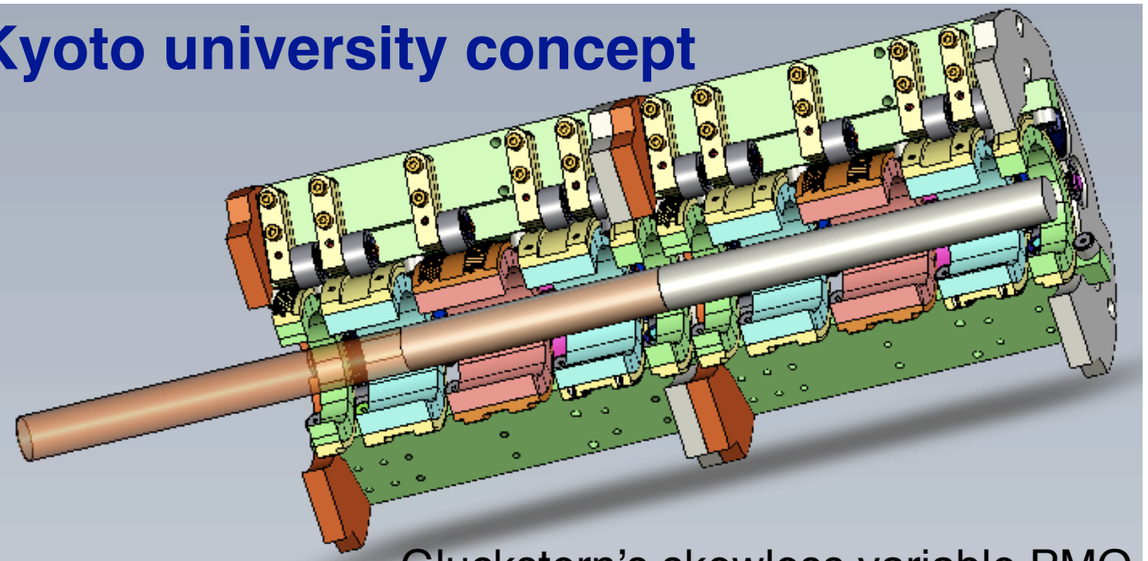


Cable:
N=12, D=0.5 mm
1 x 3 mm

- Use Rutherford cable
  - Self-supported Roman arch
  - Smaller number of turns
  - Better turn position control
  - Low inductance
  - Better radial thermal conductivity
- Thermally decouple beam pipe and coil
- Active shield
- Same beam pipe size
- Smaller coil OD

Compact QD0 : permanent magnets

Kyoto university concept



Gluckstern's skewless variable PMQ

(3)

Detector assembly
in a large hall
for 6 years

CFS studies;
Hall is available
after 3 years
in the 7 years
construction

Delay the schedule

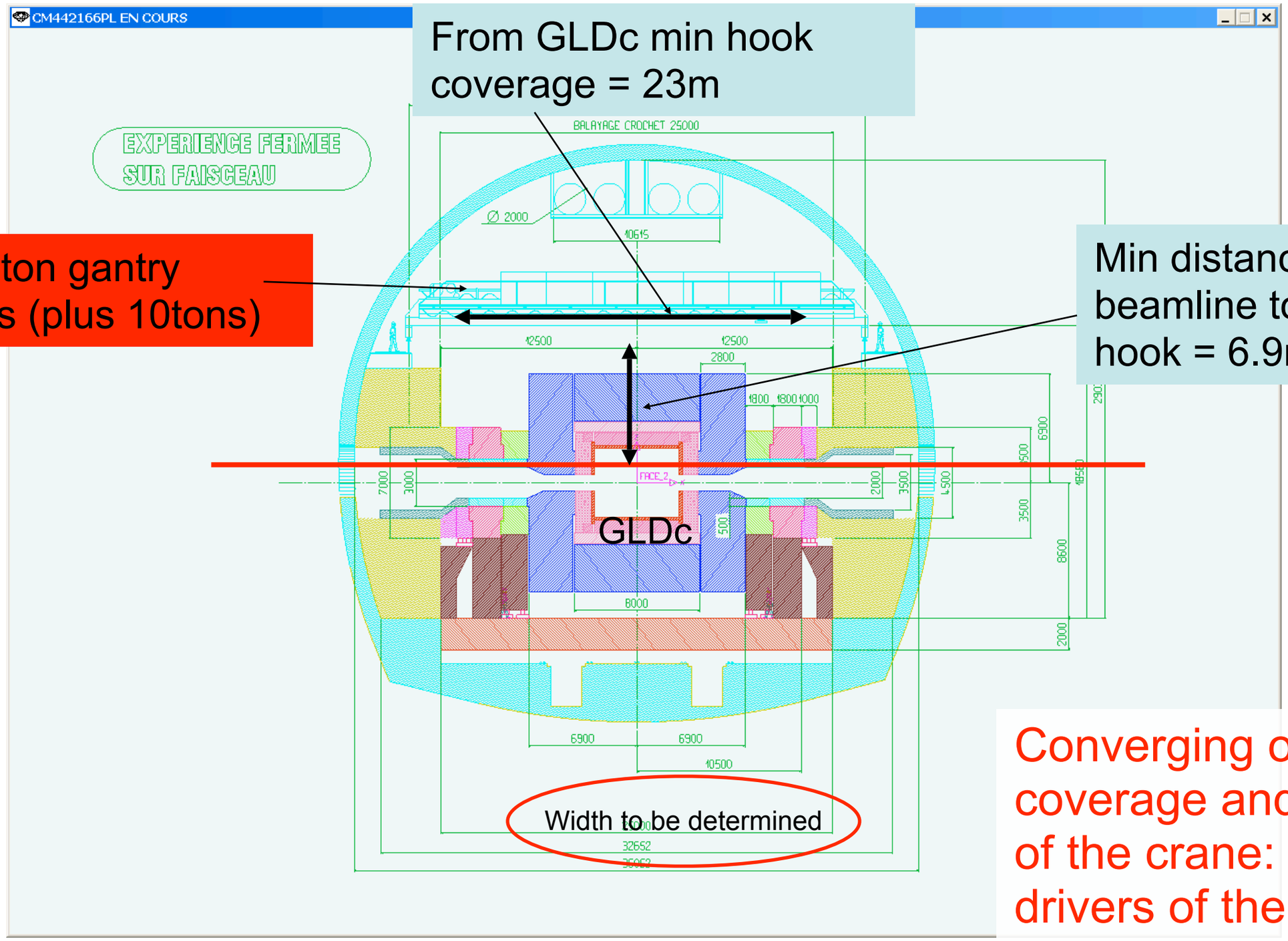
Surface assembly of the detector
size of surface building and hall, crane capacity etc.

IREN07 : Experimental Cavern Criteria

From GLDc min hook coverage = 23m

2*100ton gantry cranes (plus 10tons)

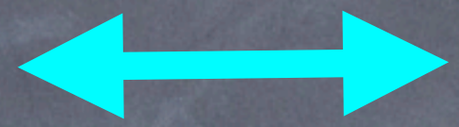
Min distance from beamline to underside of hook = 6.9m+4m = 11m



Converging on required coverage and capacity of the crane: one of the drivers of the hall size

(4)

Two detectors, i.e.
Two experiments
in parallel

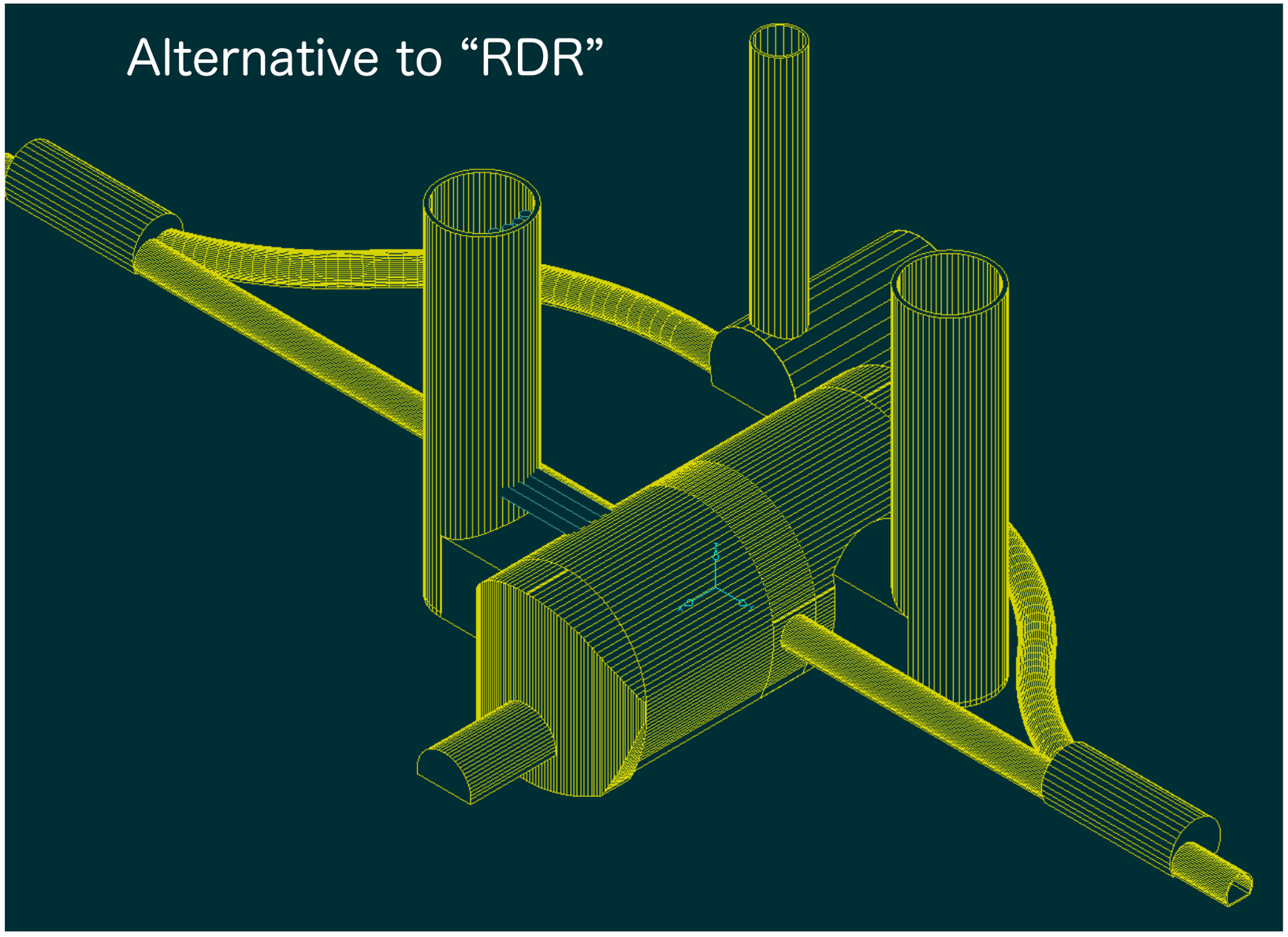


Single BDS/IR

Push-pull scheme in single IR

period of one month, fast push-pull, stability etc,
many engineering issues

To be considered as an alternative for IR layout during EDR: Andrei,Oct.24,2007



Geology
- deep sites at
  FNAL, CERN, Japan
- shallow sites
  JINR-Dubna

Access from surface
- no. of shafts,
- on/offset from
  the main cavern

Surface buildings

Two shafts offset from the main cavern on the diagonal, to address interferences (in safety and schedule) between loading/unloading areas and working areas

MDI/IR Issues

IR Design Optimization with engineering studies

- beam pipes, pumps, wakefields
- innermost radius of VTX and B-field
- outer radius of support tube and inner radius of TPC
- calorimeters, pair monitor and beam instrument

Background Estimation

- pairs v.s. B-field, (anti-)DID
- muons v.s. muon spoilers, collimation depth
- synchrotron radiations v.s. collimation depth, masks
- neutrons from pairs, extraction line and dump v.s. mask

MDI/Detector Integration Issues

Detector assembly on surface

Iron structure ;

- deformation due to B-field
- Field uniformity and Leakage magnetic field

How to support inner detectors and QD0 (39cmΦ)

Opening, closing procedures, etc.

Underground hall requirements ;

- temperature, humidity stability, the gradient
- utility (power, cooling water, gases, cables etc.)
- safety for fire, earth quake

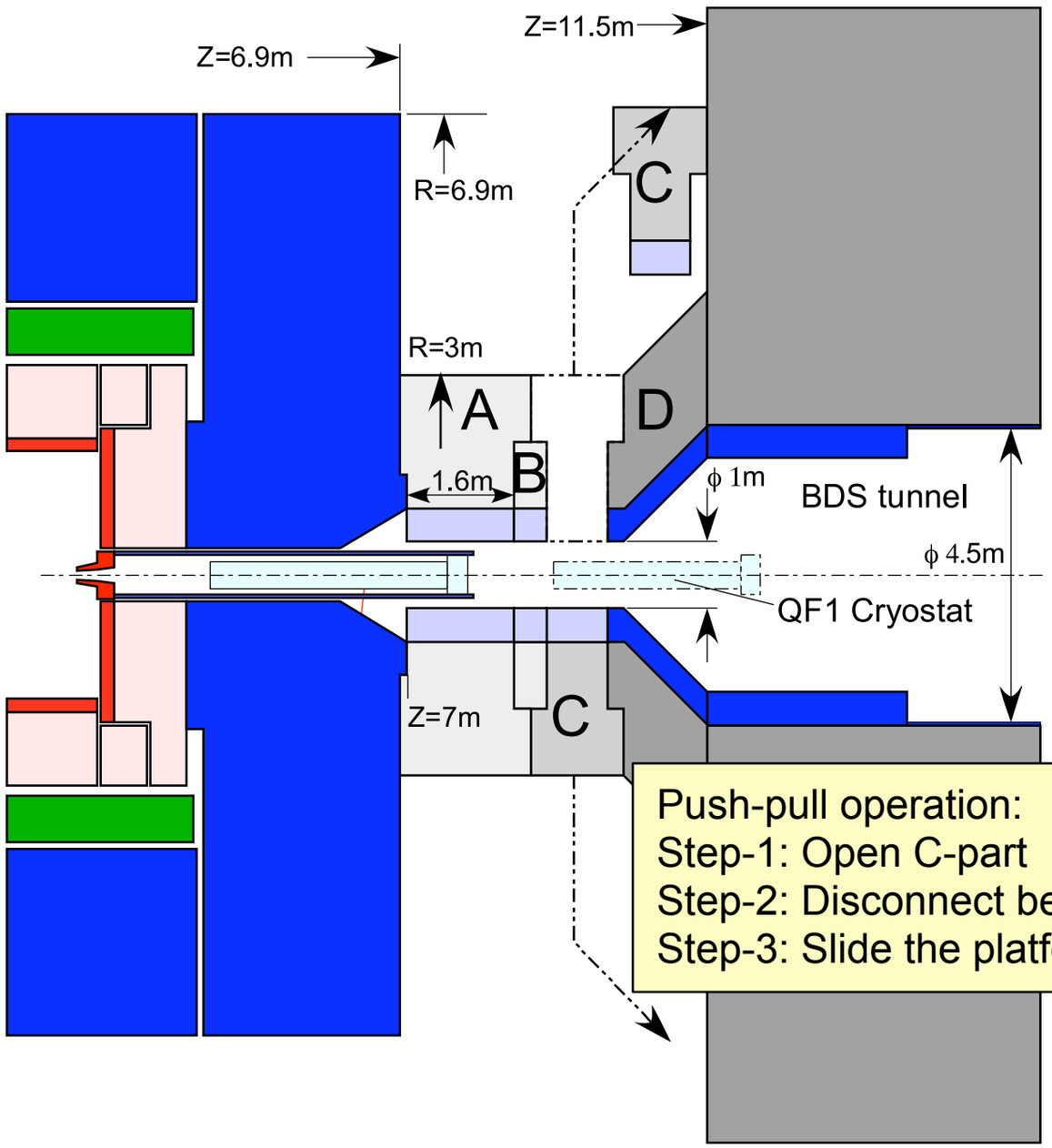
Push-pull issues such as ;

- alignment of VTX and QD0
- slow settlement (100μm/month is tolerable ?)
- Radiation, shielding around beam line
- Cryogenics system for solenoid, QD0

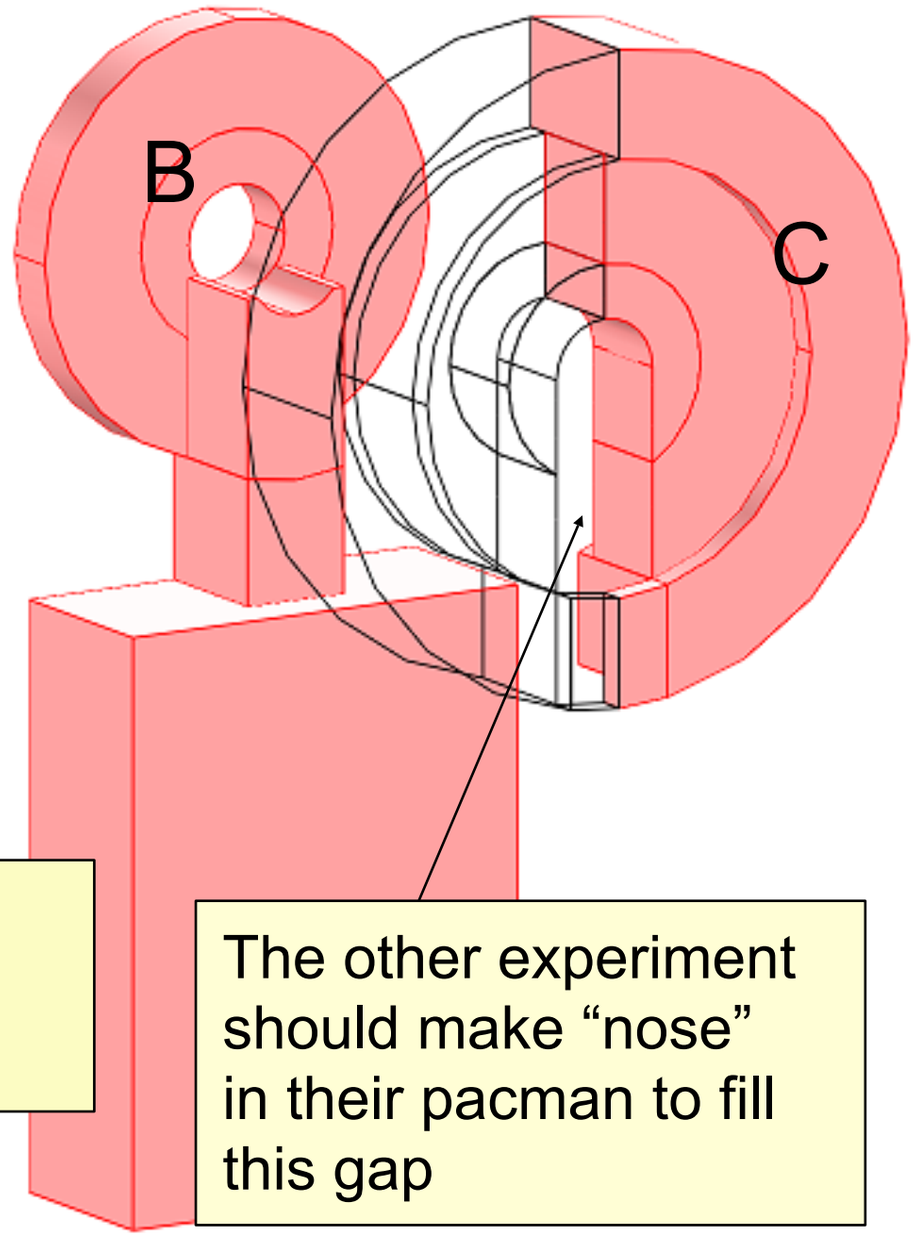
ILD1

Pacman design and FD support

- Plan view



- 3D view

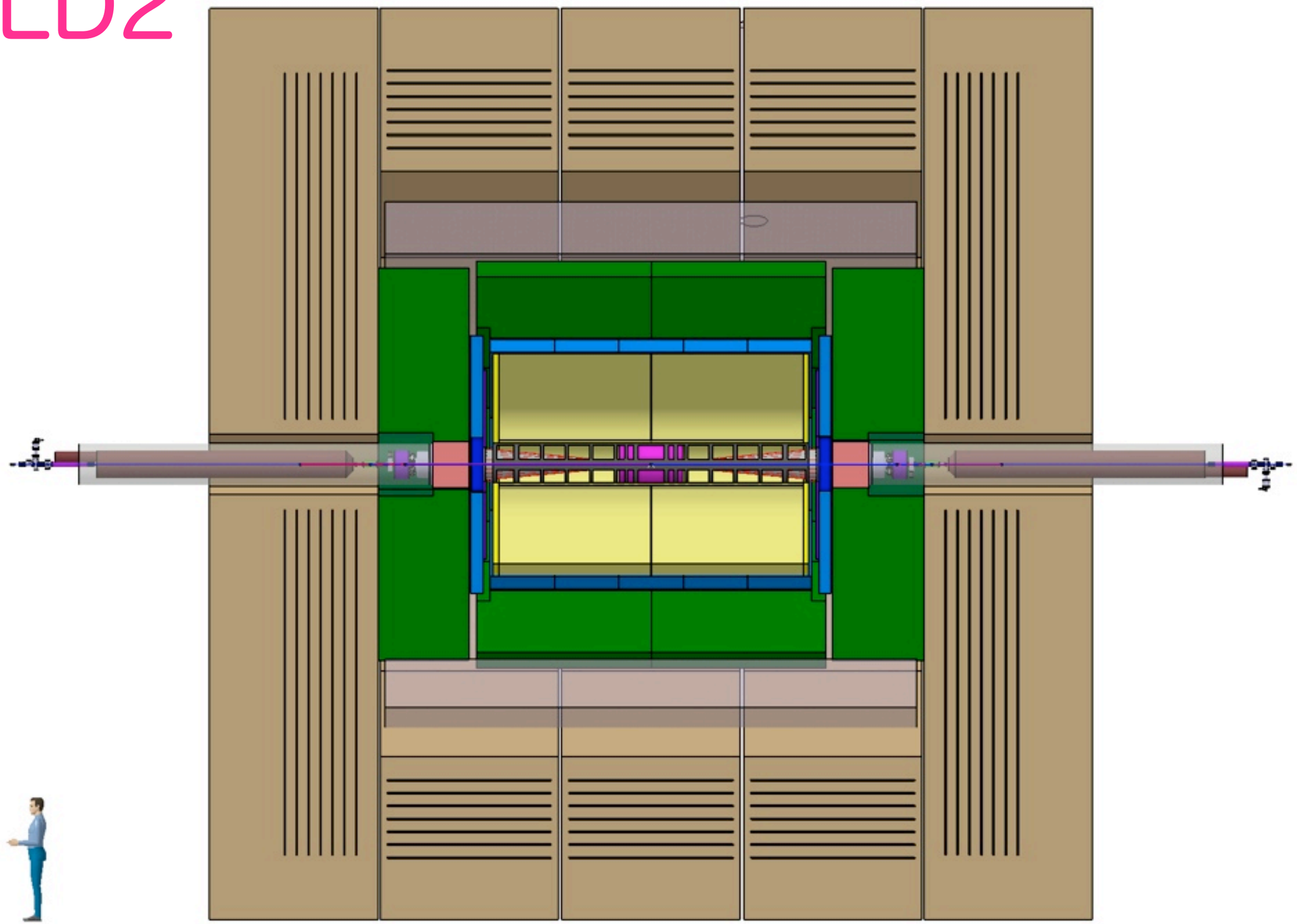


Push-pull operation:
Step-1: Open C-part
Step-2: Disconnect beam pipe
Step-3: Slide the platform

The other experiment should make “nose” in their pacman to fill this gap

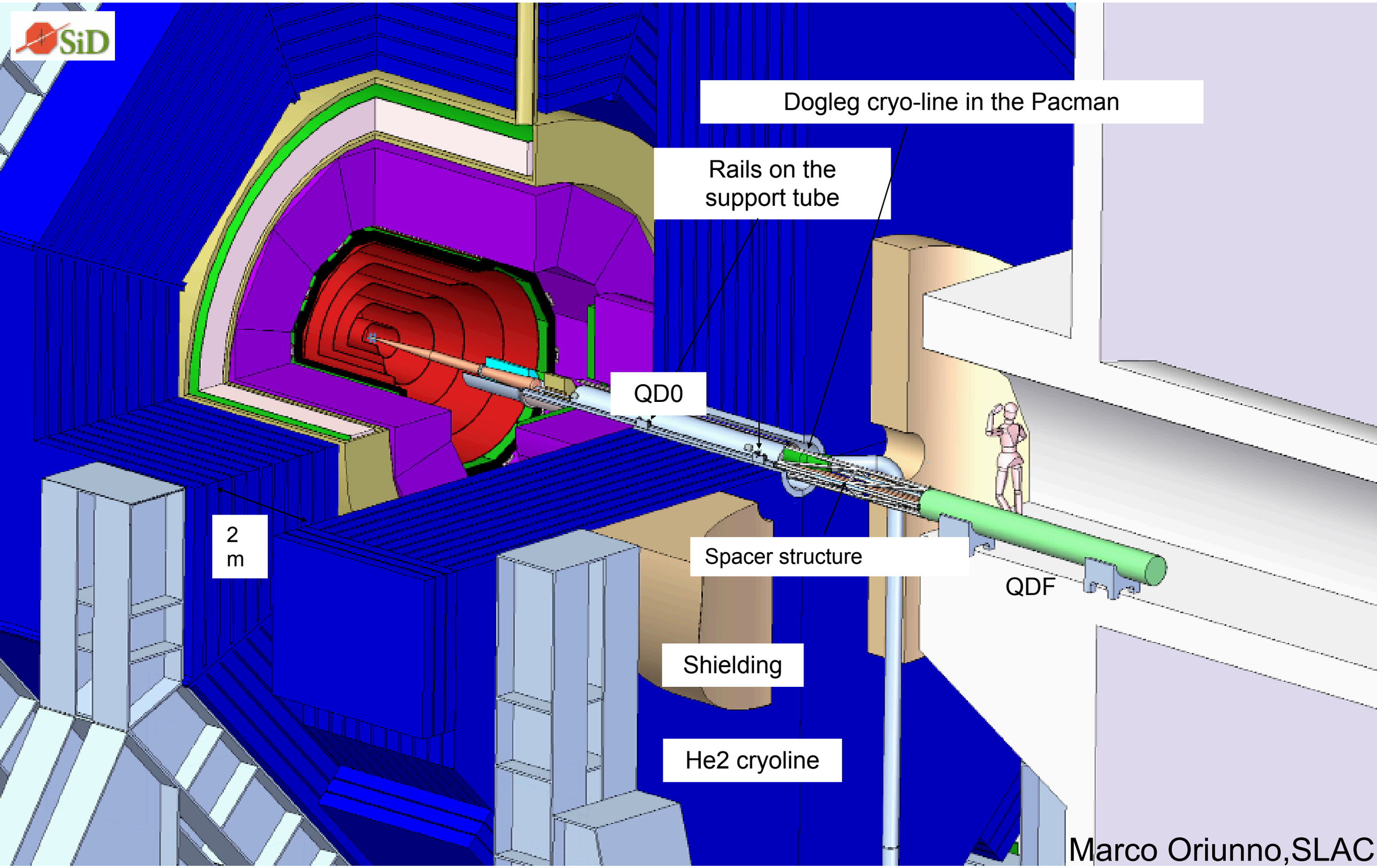
Y. Sugimoto, 1st ILD workshop, Jan.2008

ILD2



M.Jore, M.Anduze, Feb.2008

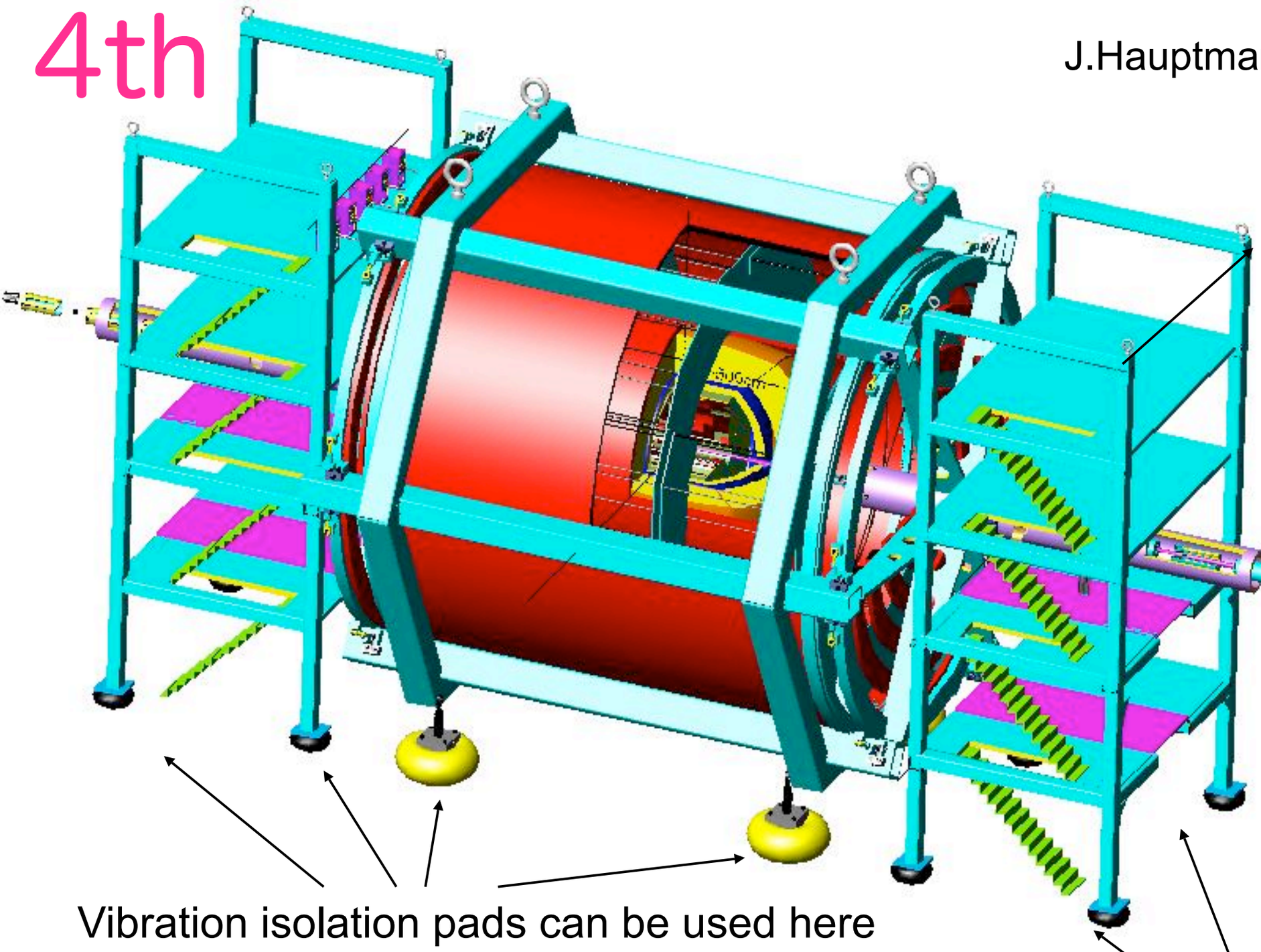
SiD


Dogleg cryo-line in the Pacman
Rails on the support tube
QD0
2 m
Spacer structure
QDF
Shielding
He2 cryoline

It is not clear where to put the humming vibrating electronics houses (ends or sides), but like D0 they will move with the detector

4th

J.Hauptman, IRENG07, Sep. 2007



Maybe “noise cancellation” earphones on the electronics houses; it’s mostly 60n Hz.

Vibration isolation pads can be used here

During movement some restraints can be applied

Console (hut) has anti-vibration footers.

Review of Push-Pull Issues

1. Guideline provided by ILCSC

"Switching between experiments should be accomplished with less than a few percent loss of integrated luminosity. If necessary for design and cost considerations, the two experiments could share a common IR, provided that the detector changeover can be accomplished in approximately 1 week. In this “push-pull” scenario, it would be expected that detector changeovers would occur at predetermined values of luminosity accumulated."

2. Frequency ?

From the experimental competition, two detectors should be changed over as much as possible in a year. However, this frequency must be constrained by the above first sentence of "less than a few percent loss of integrated luminosity" .

So, a question is the frequency as
(1) Monthly, or
(2) A few times in a year, e.g. Push-pull in summer or winter shutdown

If we chose (1), what is the solution ?
If we chose (2), is it acceptable from the experimental competition ?

Note : (2) is more realistic, especially first experiments.

3. Changeover time ?

3-1 Magnet and cryogenics system, A.Yamamoto, Dec. 2006

Assuming that (1) the system moves with magnet power supply (20kA,DC), cold box and control system, and (2) the re-connection point at roon temperature, where the magnet can be cold and the cold-box should be warm-up for safety and reliability.

Possible Move-in/out Time

Days	Day 1	2	3	4	5	6	7	8	9	10
Stop steady op.,B-off, Cryo. cold-box warm-up,										
Seal-off & disconnect pipe and cables										
Move-in/-out										
Reconnect pipes and cables										
Check safety (leak tight, interock)										
Cryogenics re-start cool-down,										
Check safety at cold, & pre-excitation test										
Re-start detector run										

One week would be a reasonable time for such critical operation for high-pressure gas system

3-2 Re-commissioning process and timeline for detectors

keeping warm for stability ;

- supplying powers as the same as experimental period ?
- calibration ?

monitoring alignment among sub-dertectors

- Monalisa system (Oxford university) ?

3-3 Re-commissioning process and timeline for BDS

Process by T. Okugi, Dec. 2007

1) Initial transverse alignment should be less than 1mm within the dynamic range.
2) Beam based alignment, BBA, of QD0 (Rough Transverse Position Scan)
3) IP position scan with the QD0 mover (Two Dimensional Scan)

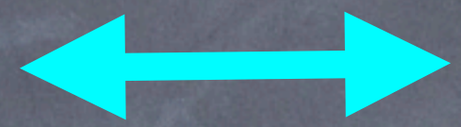
Re-commissioning time depends on the time to establish the first collision.

4) Luminosity (beam size) scan by changing the SD0 transverse position.
(The single scan for both horizontal and vertical directions)
5) Nominal beam size tuning with sextupole tuning knobs.

“Flight Simulator” must be very useful to estimate the timeline.

(5)

Options :
Giga-Z
$\gamma\gamma$ /e^-e^-
Fixed target



Resources

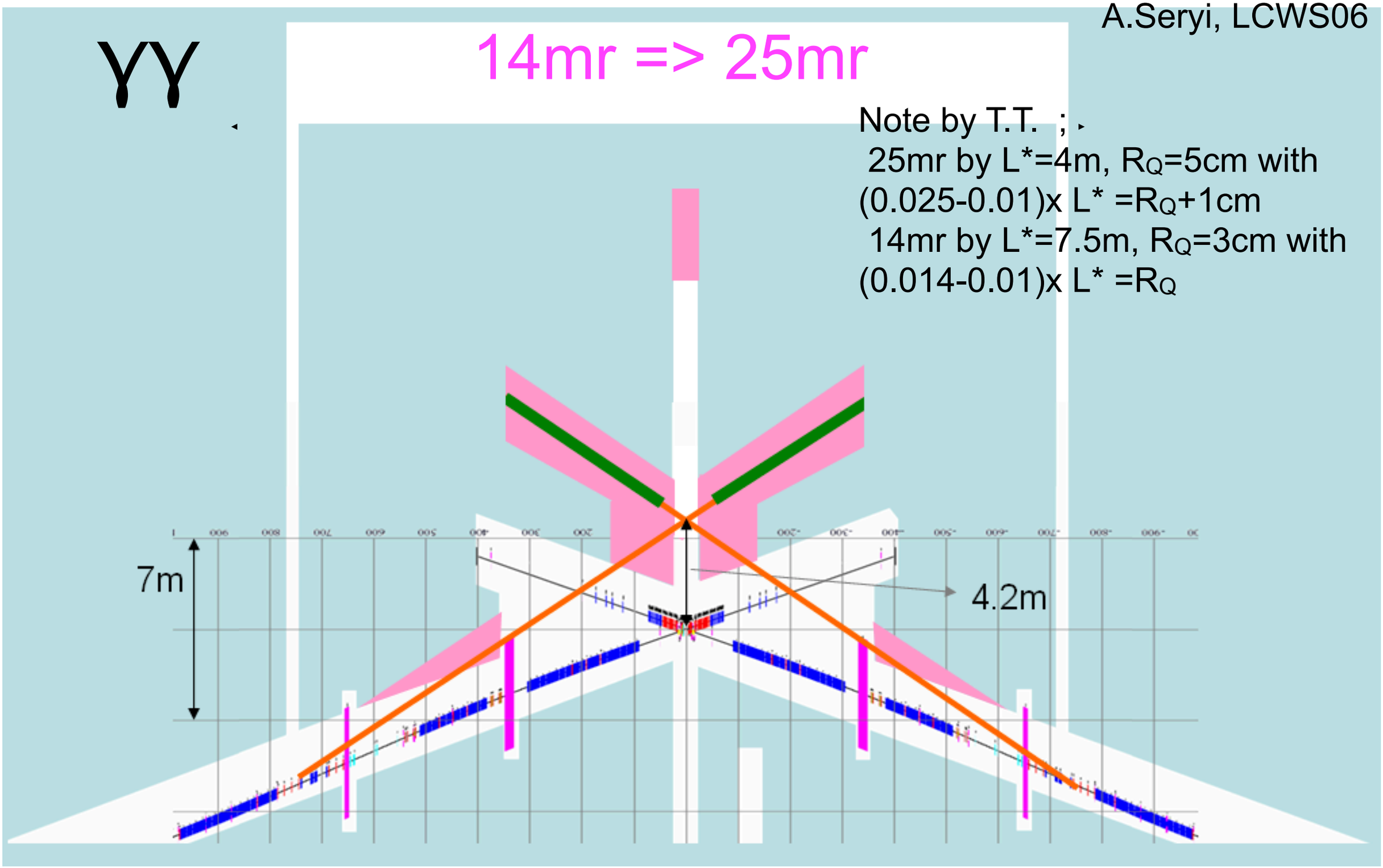
Next phase in future

Open a door for options

YY

14mr => 25mr

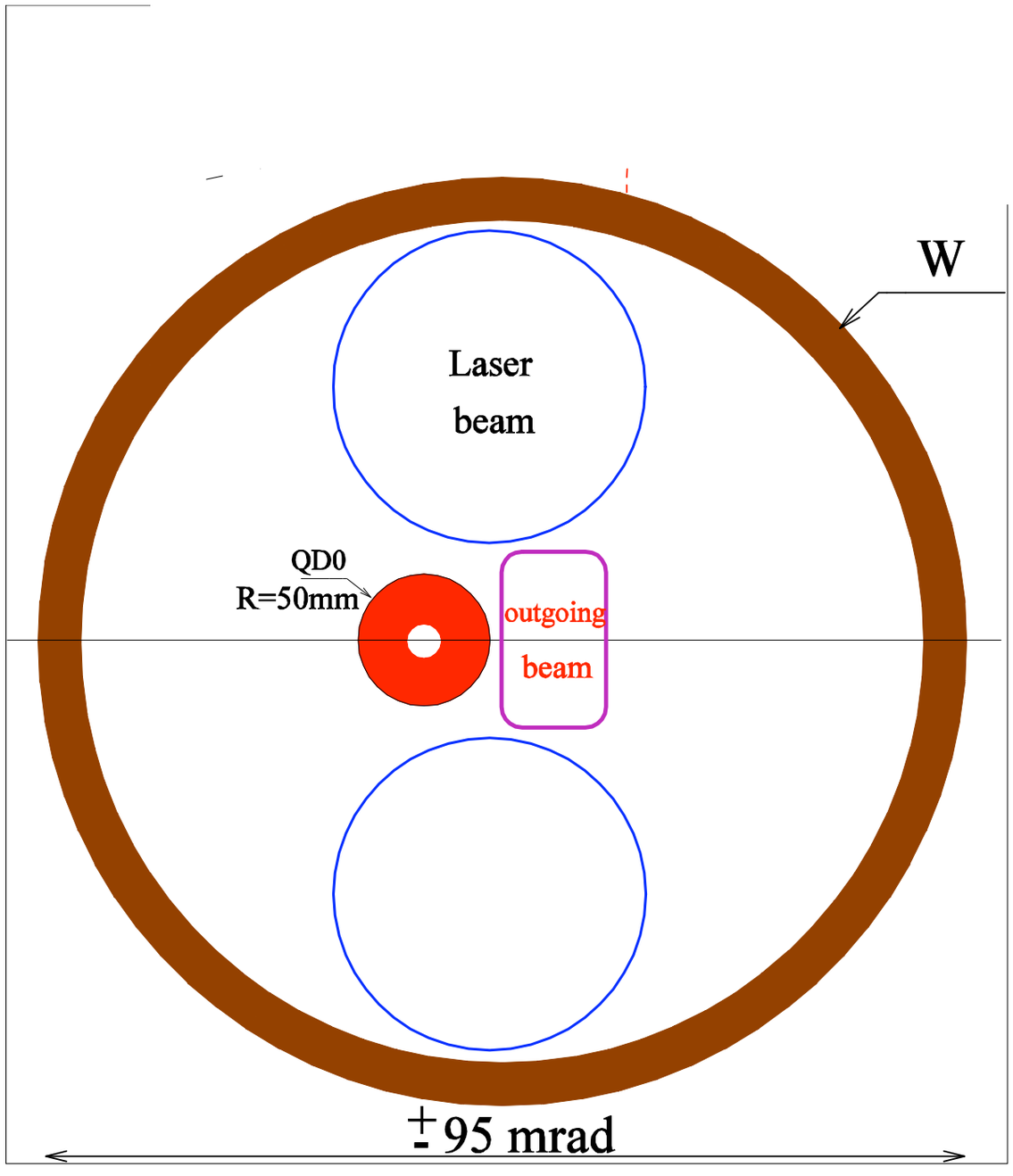
Note by T.T. ;
25mr by L*=4m, R_Q=5cm with
(0.025-0.01)x L* =R_Q+1cm
14mr by L*=7.5m, R_Q=3cm with
(0.014-0.01)x L* =R_Q



- additional angle is 5.5mrad and detector need to move by about 3-4m

Laser beams in the detector

Layout of the quad, electron and laser beams at the distance 4 m from the interaction point (IP)



(6)

ILC

Ecm=0.5 - 1TeV

CLIC

Ecm=3TeV
& 0.5 - 1TeV

Timeline, resources

Synergy

many common MDI issues

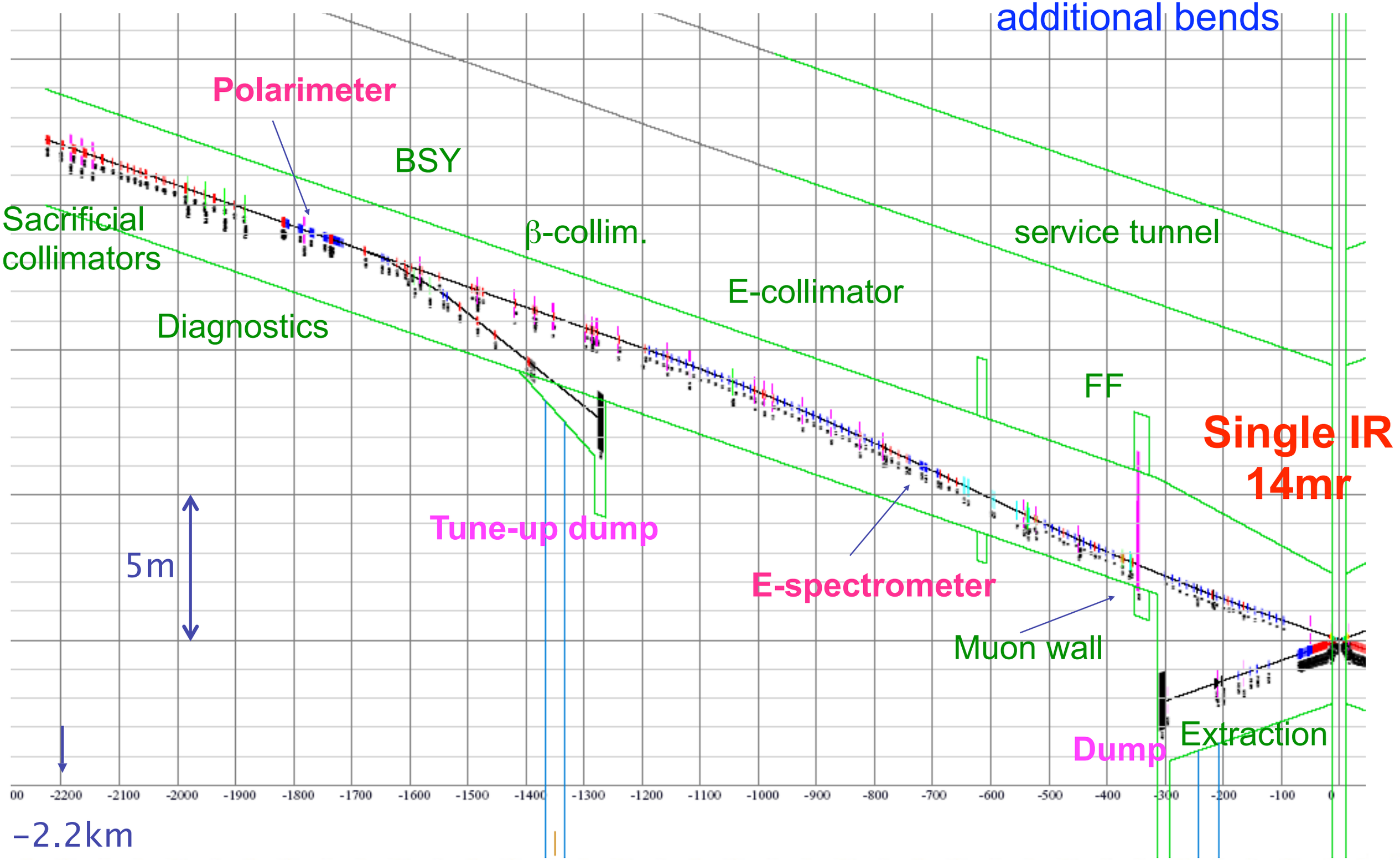
Plan of BDS-MDI sessions at TILC08, Sendai

29 February, 2008

	Program GDE BDS (ACFA MDI)	Talks / lead discussions	Critical and strategic questions, or comments
4th, 9:00-10:30	Strategy, program and planning ACFA plenary in para.	Goals and plans, IDAG -- LOI schedule with RD	How to organize tasks in two phases, 2010 and 2012
4th, 11:00-12:30 MDI-BDS	IR IR integration I IR integration II L* FCAL	Andrei - plan and goals of the meeting Brett -- Updade on FD and IR integration Markiewicz -- IR integration II Andrei-- how L* dep. inclded in det optimiz Grah -- FCAL beam diagnostics	 position adjustment system and correction coils for QD0 and SD0 CMS-style integration and assembling Luminosity as a function of L* Real time feedback from luminosty measurement
4th, 14:00-15:30 MDI-BDS	CLIC-MDI polarimetry γγ crossing angle pair mon.	Schulte -- CLIC IR & MDI and a view to push-pull Kaefer - BDS polarimetry Takahashi - γγ state of the art and research plan, what system tests can be done at ATF2, ESA -- Schulte, Andrei-- CLIC & ILC crossing angle Itoh - Pair monitor performances	Common study items of MDI - push pull at CLIC ? - crab cavity - LHC upgrade ? - collimation - wakefield, survival, crystal channeling - crossing angle 14mr v.s. 20mr Also, the real time monitor
4th, 16:00-17:30 BDS	CLIC-MDI ATF2-FD	Schulte -- CLIC BDS design Andrei -- Approach for solution of CLIC IP stability Parker -- ATF2 SC FD CLIC-ILC work, discussion and planning	Common study items of BDS - intra-train feedback digital v.s. analog - flight simulator to be developed at ATF2 - instrumentation - BPM, laserwire, feedback, luminometers etc.
5th, 9:00-10:30 MDI-BDS	small angle ATF2 nano-monitor@push-pull Background	Bambade - Updated 2mrad design Suehara -- Shintake IR mon. Coe - Monalisa Abe -- GLD background	Alternative BDS BSM at IP for commissioning ? Nanometer monitoring at IP for push-pull Updates of backgrounds in detectors
5th, 11:00-12:30 BDS	IR integration plans cost-reduction	Discuss and prepare detailed IR integration plans Discuss BDS cost saving proposals	Cost reduction - 250GeV, E&P only at extraction line, common dump
5th, 14:00-15:30 BDS	CLIC-ILC work planning Webex to CERN	Draft a work plan	
5th, 1530-16:00 BDS	Joint with Concepts ?	Present and discuss IR integration plan	16-18 : Detector Concept group meetings in parallel : SiD and ILD at MultimediaComplex

BDS beam-line layout

Single IR push-pull BDS, upgradeable to 1TeV CM in the same layout, with additional bends



Summary

- Detector Concept Groups will prepare LoIs in a year, where MDI issues are important for experiment at ILC.
- GDE-BDS group suggested the organization for EDR(TDP2) by 2012, requesting streamline connection Detector to BDS, i.e. MDI .
- These MDI tasks need engineering effort more than ever. We do expect leadership of Research Director and GDE Director as well as Lab. Directors of the world for this effort.