GLD-MDI Summary

T.Tauchi, GLD Session

25 August 2005, SNOWMASS

Activities

- Background simulation by Jupiter, A. Sugiyama
- DID installation in Jupiter, A. Miyamoto
- Pair background and BCAL in the parameter space, Y. Sugimoto
- LCBDS simulation with L*=4.5m, 2mr crossing angle, T.Abe and University of Tokyo group
- DID effect in TPC, R.Settles
- Pair monitor (3D pixel), H. Yamamoto
- Joint studies with the WG4; replies to the WWS MDI urgent questions, very good communication !

WG4/MDI

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GDE questions (Himel's list) related to WG4

http://alcpg2005.colorado.edu:8080/alcpg2005/program/accelerator/GG3/tom_himel20050820225601.xls

- beam and luminosity parameters
- straight or follow earth's curvature?
- 1 or 2 IRs, if two, run interleaved?
- crossing angle
- gamma-gamma upgrade path
- optimize L*
  - consider range 3.5-4.5m (depend on x-ing angle)
- tail folding octupoles in BDS?
  - yes, included in BDS; collimation must work without them
- collimation strategy - passive? Order of E and beta
  - passive spoiler (survive 2bunch at 500GeV CM, one at 1TeV CM); first beta, then E; detection of E-error by separate chicane in diagnostics section, one bunch (337ns) may go through
- FF optics: traditional/local correction
  - local correction

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beam and luminosity parameters

- Nominal parameters are acceptable
- Parameter sets which have large beamstrahlung, may turn out to be not working from the point of view of extraction line energy acceptance and from background (pairs hitting vertex)
- High Lumi 1TeV set is not working. Alternative set suggested. Need feedback from DR & LET.
- Alternative set for high L 500GeV CM will be suggested
- Some other sets (e.g. Low P) may have the same problems (not evaluated in details)
- Low Q option is good for background (but Nbunches may be concern for DR?)

One or two IRs, crossing angle
Baseline & Alternatives

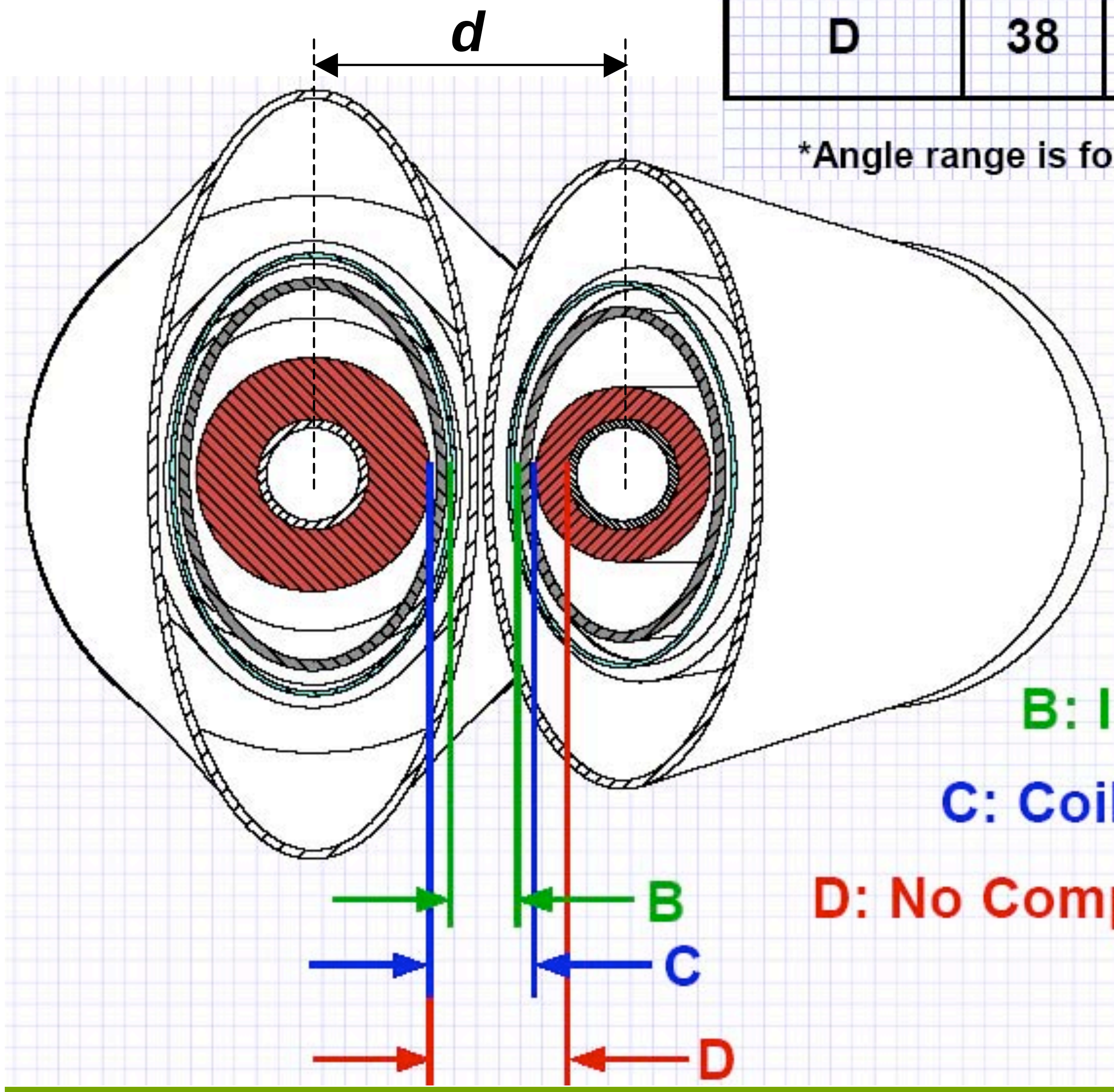
- **Baseline: two BDSs, 20/2mr, 2 detectors, 2 longitudinally separated IR halls**
  - **γγ assumed to work at 20mr**
- **Alternative 1: two BDSs, 20/2mr, 2 detectors in 1 IR hall @ Z=0**
  - **pro: civil engineering savings, no constraints on bunch separation**
  - **con: vibration issues/operational & installation constraints**
- **Alternative 2: single IR/BDS, wide enough for 2 push-pull detectors**
  - **pro: cost savings, no constraints on bunch separation**
  - **con:**
    - vibration issues/operational & installation constraints
    - GG6: γγ may not be feasible since need long & invasive modifications of IR implying very long switch over time
  - **note:**
    - transforms adiabatically into alternative 1, if required by physics
      - build additional tunnels for 2nd IR with desired configuration (small, intermediate or large angle, for e+e- or γγ)
      - optimize 2nd IR using experience gained with 1st IR
    - question of one or two detectors is decoupled
      - study technical feasibility & implication of supporting two detectors (wide IR hall?; FD is part of detector for faster detector exchange?, etc…)
- **Intermediate x-ing angle (10-15mr) is a variant for any of the above**
  - **unlikely to be γγ compatible**

A.Seryi, 22 Aug. 2005

Will proceed with studies of 10-12mrad range

Scenario	*d* (mm)	Angle Range* (mr)	Issues	Confidence Level
A	70	20 - 15.5	Standard	Recommended
B	53	15 - 11.8	+ Cold Support	Probably OK
C	44	12.5 - 9.8	+ Stronger Comp'	Needs Study
D	38	10.8 - 8.4	+ Give Up Comp'	Highest Risk

Angle range is for 3.5 m < L < 4.5 m



Brett Parker, BNL

$\theta_{min} = d / L^*$

A: Reference Design

B: Independent Cold Mass

C: Coils Touching

D: No Compensation

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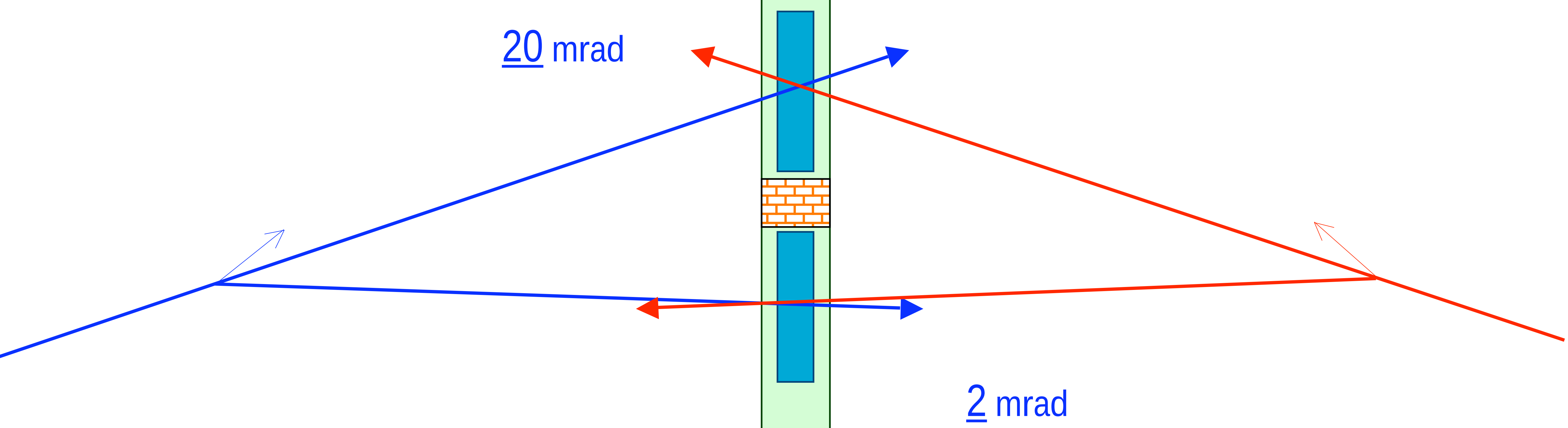
Alternative 1

• two BDSs, 20/2mr, 2 detectors in 1 IR hall @ Z=0



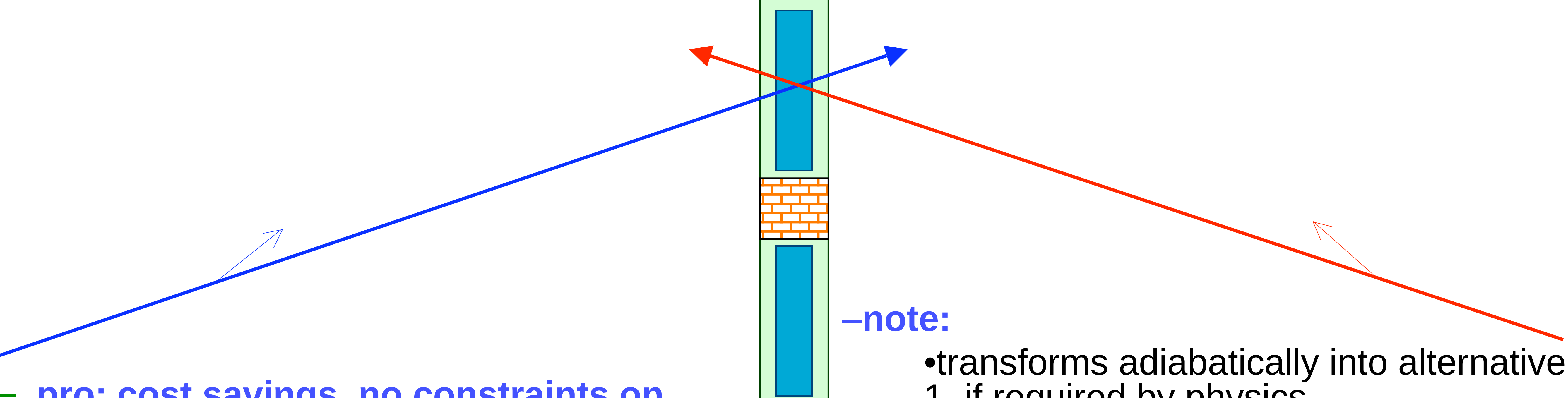
• pro: civil engineering savings, no constraints on bunch separation

• con: vibration issues/operational & installation constraints

A.Seryi, 22 Aug. 2005

Alternative 2

- Alternative 2: single IR/BDS, wide enough for 2 push-pull detectors



– **pro: cost savings, no constraints on bunch separation**
  - **–con:**
    - •vibration issues/operational & installation constraints
    - •GG6: $\gamma\gamma$ may not be feasible since need long & invasive modifications of IR implying very long switch over time

–note:
- •transforms adiabatically into alternative 1, if required by physics
  - –build additional tunnels for 2nd IR with desired configuration (small, intermediate or large angle, for e+e- or $\gamma\gamma$)
  - –optimize 2nd IR using experience gained with 1st IR
- •question of one or two detectors is decoupled
  - –study technical feasibility & implication of supporting two detectors (wide IR hall?; FD is part of detector for faster detector exchange?, etc…)

A.Seryi, 22 Aug. 2005

Crossing angle

- GLD, SID, LDC prefer the smallest angle with tolerable background and L.E.P. measurements.
- Headon will be an option for 2mr. - RF kicker R&D at Kyoto univ. , DC separator+offset Q+septum (L.Keller), simpler geometries than those of 2mr etc. - extraction optics, ... (Olivier Napoly)
- Intermediate angle (10-15mr) is an option for 20mr.

One IR is selected with small crossing angle (<2mr).

How to verify the need of second IR?

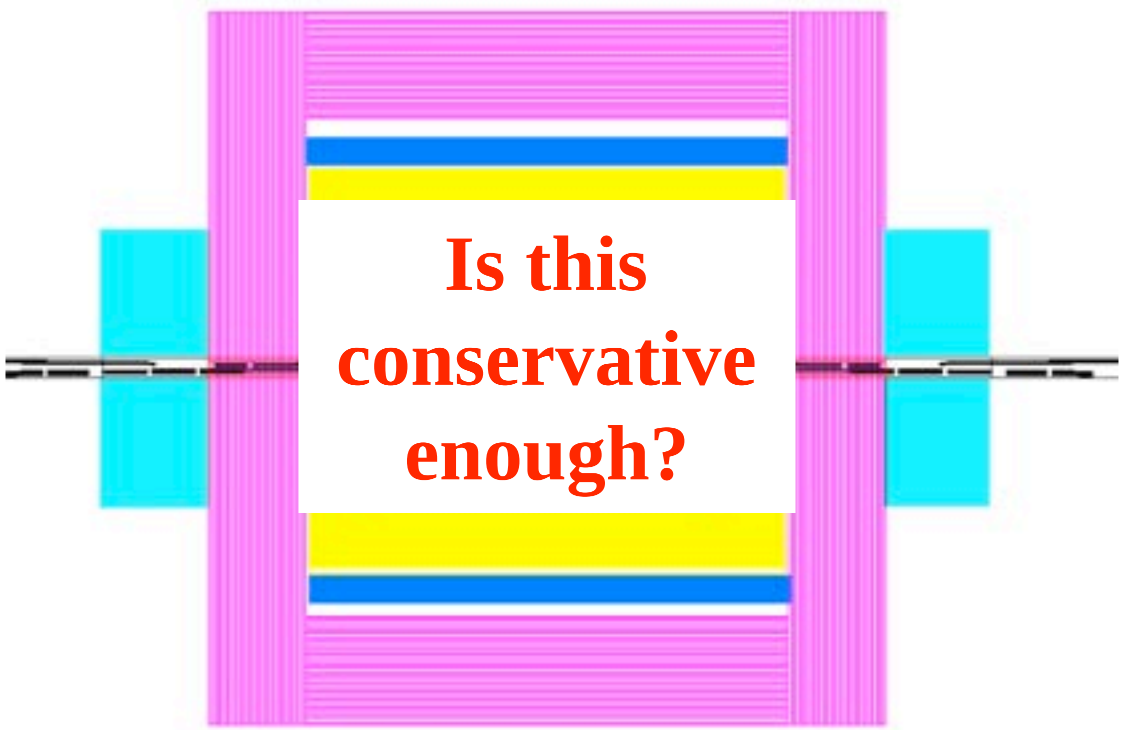
If $\gamma\gamma$ physics is very important, the second one must be with large angle (>20mr), which is totally optimized for $\gamma\gamma$ collisions; detector with laser system and extraction line.

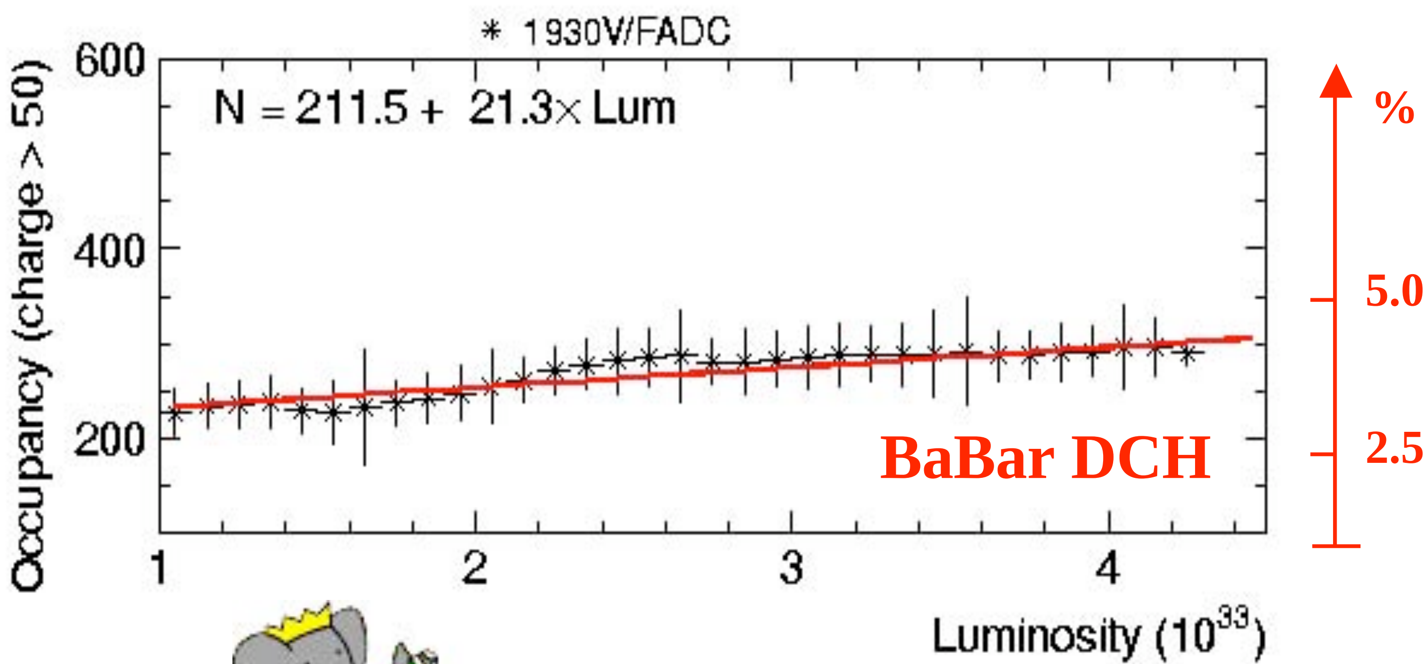
Physics complemetary to e^+e^- collisions

A (very) naive detector-tolerance model

Subdetector	Tolerance criterion
Vertex detector	Rad. damage (worst-case: CCD's) : $< 3\ 10^9$ n cm^{-2} $1\ 10^{10}$ n cm^{-2} (GLD) Occupancy: < 1% (hit density)
Time Projection Chamber	Occupancy: < 1% (hit density) Space Charge Limit ?
Calorimeter	'Occupancy': < 1% (MIPs), or about < 100 GeV
Muon system	< 1 per m^2

Generic LC detector





Detector-response model (*)

(*) *As per R. Settles et. al., TESLA St Malo workshop*

Subdetector	Granularity	Sensitivity window	Fract'l sensitivity
Vertex detector (Layer 1)	20 μ x 20 μ pixels = 2500 pixels/mm^2 5umx5um, 40,000pixels/mm^2	Train for FPCCD 50 μs (1 NLC train / 150 TESLA bunches)	Chgd trks: ε = 1.0 (4 pixels) γ: ε = 0.02 (4 pixels)
TPC	1.5 10^6 pads x 10^3 time buckets = 1.5 10^9 voxels		Chgd trks: ε = 1.0 (3 p x 200 r x 10 tb) (PC: 5 tb) γ: ε = 0.02 (3 p x 200 tb) n: ε = 0.01 (3 p x 200 tb) μ: ε = 1.0 (6 p x 1000 tb)
Calorimeter (excluding LAT/LCAL)	44,000 cells	~ 200 ns (or less?) (1 NLC train / 1 TESLA bunch)	E > 1 MIP (~ 250 MeV) Chgd trks: 1 MIP μ: 100 cells
Muon system	~ 1 cm x 5 m ⊥ beam axis	1 NLC train / 1 TESLA bunch ?	Chgd trks: ε = 1.0

GLD MDI Session, 25 August 2005

Place : Janss (Conference center 2F)

8/25 Thursday GLD VTX-MDI session

8:30 - 8:45 10+5 Y. Sugimoto, Vertexing design considerations from MDI -
8:45 - 9:20 30+5 Sonja Hillert, Physics potential of vertex detector as function of beam pipe radius
9:20 - 9:35 10+5 Toshi Abe, LCBDS simulation studies on SiD and GLD

coffee break

10:00 - 10:25 20+5 Karsten Buesser, Update on Backgrounds in the LDC Detector
10:25 - 10:40 10+5 Yasuhiro Sugimoto, BCAL and Pair Background
10:40 - 11:00 15+5 Zhiqing Zhang, Importance of the Low Angle BeamCal
(Experimental Implications for a Linear Collider of the SUSY Dark Matter Scenario)

11:00 - 11:20 15+5 Akira Sugiyama, GLD background study with Jupiter
11:20 - 11:40 15+5 Ron Settles, On the Magnetic-filed requirements for the ILC TPC
11:40 - 12:00 15+5 Hitoshi Yamamoto, Beam Profile Monitor Using Pixel Detector

Y. Sugimoto

Machine param. dependence

- Sum of both sides

500 GeV

Option	θx (mrad)	Edep (TeV/BX)
Nominal	2	20.8
	20	44.3
High Lum	2	119
	20	184
Low Q	2	6.1
	20	15.7

1 TeV

Option	θx (mrad)	Edep (TeV/BX)
Nominal	2	53.9
	20	98.1
High Lum	2	303
	20	416
Low Q	2	16.3
	20	34.9
High Lum-I	2	141
High Lum-II	2	106

High Lum-I / II are Andrei's new param.

A. Sugiyama

Which kind of background we have consider?

IR: beam-beam interaction : CAIN or gineapig

- pair background
- disrupted beam
- beamstrahlung photon

physics process

- two photon -> hadrons
- radiative Bhabha

these e/gamma produce hits in detector directly and after several interactions around detector components.
not only PE,Compton interactions but also e/gamma-nucler interactons

JUPITER
(Det. Full simulator w/ GEANT4)

BDS: beam core and halo produce many bkgs

- synchrotron radiations
- muon production at collimators
- neutron productions

LCBDS
(BDS components w/ GEANT4)
Tauchi report for T.Abe

A. Sugiyama

Status of tools

sub detectors provide exact hits : only partial digitization

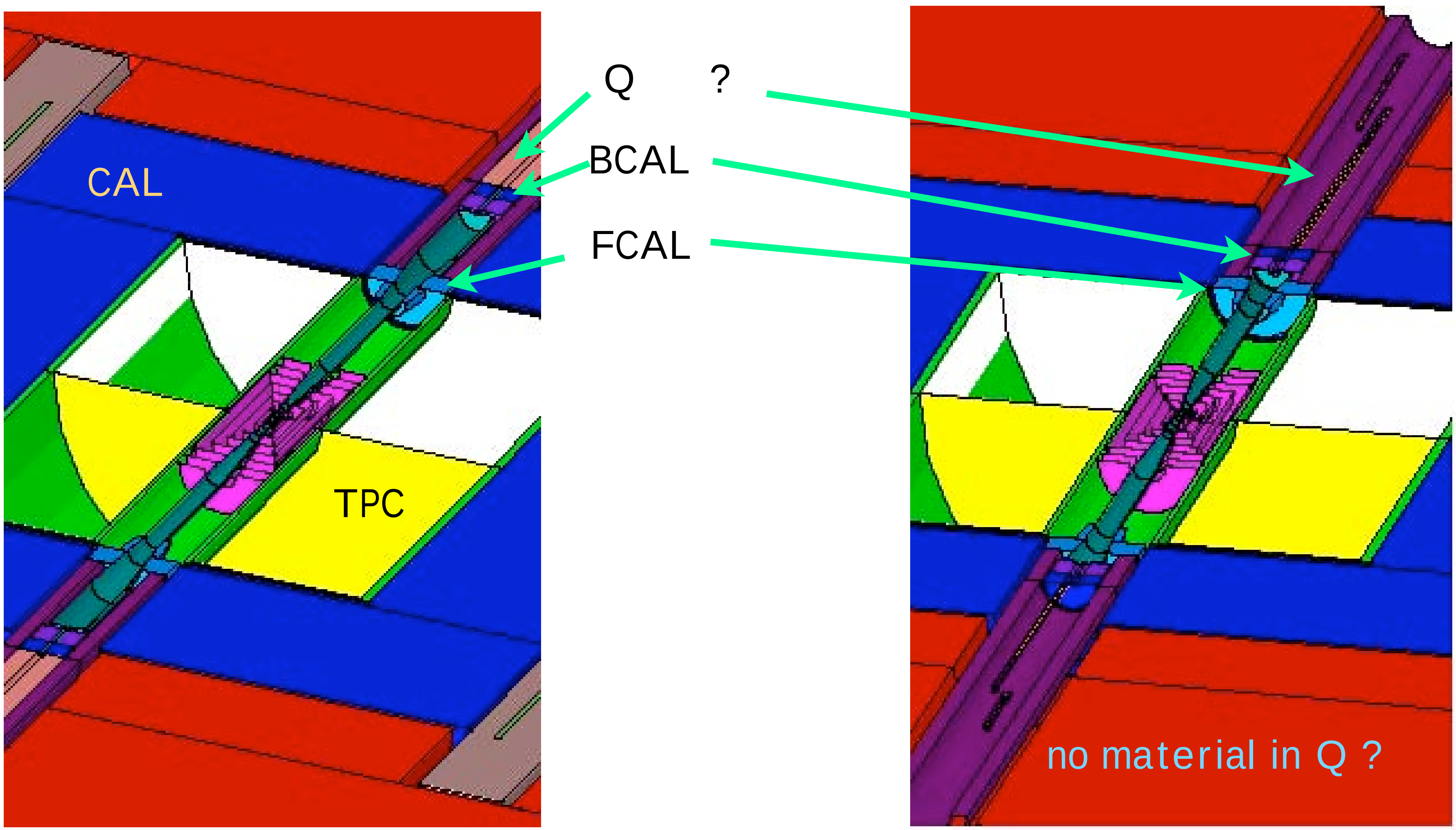
JUPITER

IR geometry X angle 2mrad w/L*=4.5m and L*=3.5m
20mrad w/ L*=3.5m

Hadron crossection default of GEANT4
(few information for neutron)

geometry

2mrad w/ L*=4.5 20mrad w/ L*=3.5



spent two days to get figures

PLAN

A. Sugiyama

Continue study

check suspicious things

fix bugs

use proper Physics List

include DID (almost ready by Miyamoto)

CPU time

Until acc. design be fixed, available time is limited

borrow predecessors results as much as possible

focus into GLD specific points where is it ?

suggestions from experts are necessary

these can be modified after ACC. design fixed ??

Is it better to do LCBDS study now ?

I'm going to recruit one student for this study(CAIN+JUPITER / LCBDS).

Our own IR design is essential to the GLD background.

LCBDS : muons, synchrotron radiation, beam gas, and backgrounds from the extraction line.

Background tolerances are discussed at snowmass

10% occupancy of TPC is considered !!

We have to make sure it does work or not using

full sim. + recon. + ZH event + background data

T. Abe

LCBDS simulation studies on SiD and GLD

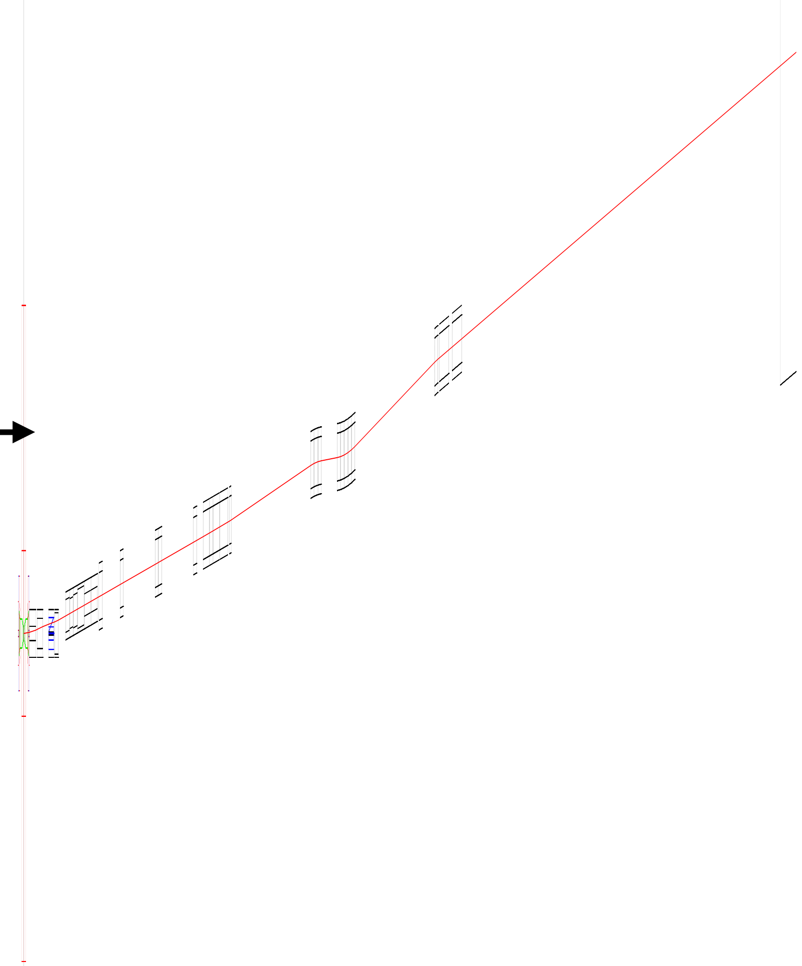
Aihara group
University of Tokyo

T. Abe

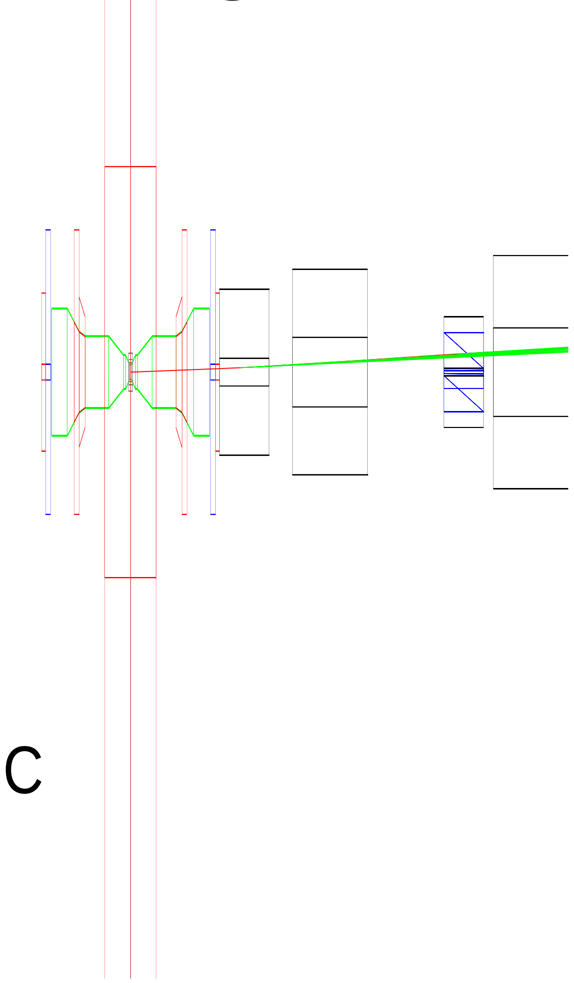
2mrad beam line with LCBDS

Extraction line
L*=3.5m

GLD TPC →



Extraction line
L*=4.5m



GLD TPC

(Z,X) plane and X axis is enlarged

T. Abe

Pairs in 2mrad (cont.)

	GLD	SiD	SiD(Takashi)
BCAL	17mW	13mW	29mW
QD0	94mW	97mW	147mW
SD0	11mW	11mW	11mW
QF1	16mW	18mW	15mW
SF1	0.4mW	0.3mW	1mW

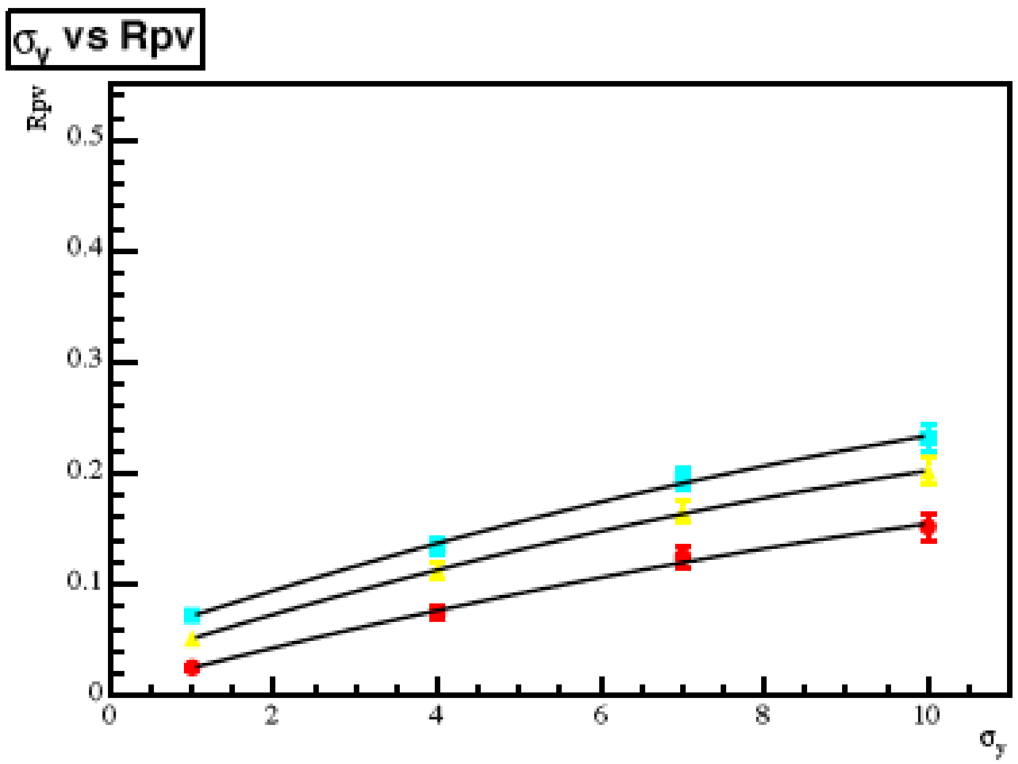
One side

Two side?

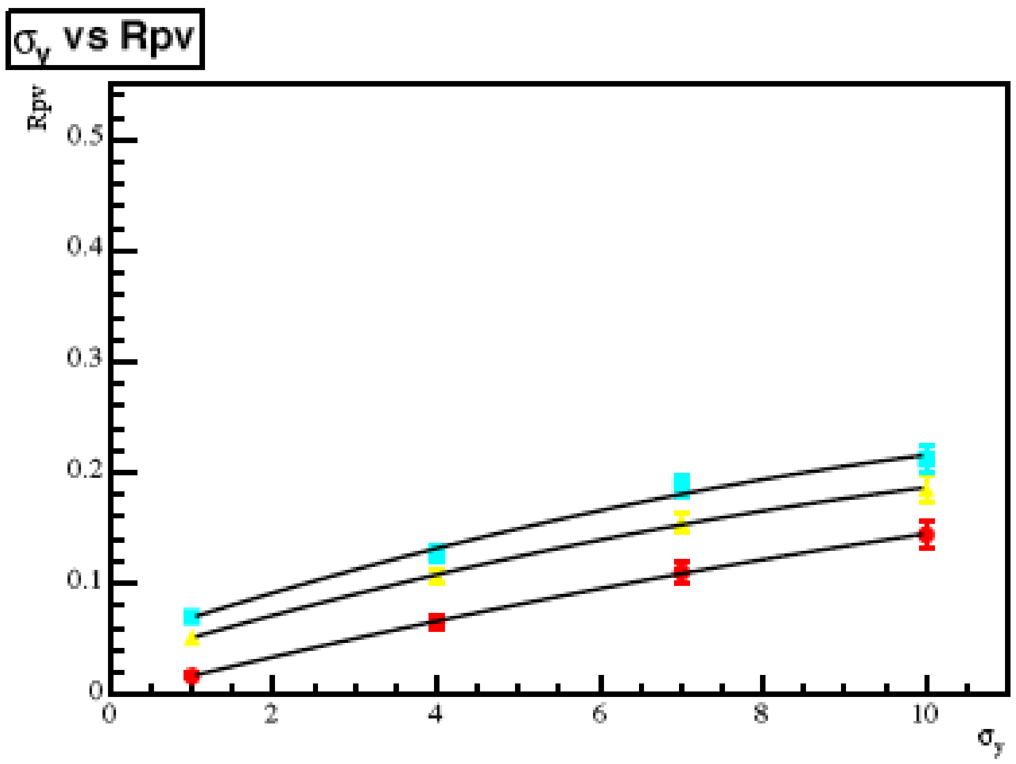
Pair Monitor (pixel device), H. Yamamoto

Effect of Tail (beam halo)

- First preliminary look -



No tail
ILC beam params
0mrad crossing
z = 400cm



0.1% tail (y)
(adding a gaussian with
$10 \times \sigma_y$ core)

No significant difference.
Further study to be done.

Please hear following summaries related to the MDI issues

<u>Summary Talks – Friday and Saturday 8/26 and 8/27, with Speakers</u>

<u>Friday 8/16/05</u>

8:30 AM ILC Accelerator Baseline Document 55″ + 5″
Nick Walker

Very few activities in Asian region !

9:30 AM (IPBI/MDI) IP Beam Instrumentation/ Interaction Regions, Backgrounds 20″ + 5″
Eric Torrence

Conclusion

- IR design to be optimized at $0<\Theta_{xing}<20$mr, $L^*=4.7$m
  - R_{VTX} and BCAL(min.veto angle with SUSY analysis)
- Background simulations by Jupiter and LCBDS
- Background tolerances for sub-detectors
  - tracking efficiency/resolution, radiation damage.. , performance of PFA
  - muons, synchrotron γ, pairs, back-scatterd γ,n...
- Other MDI issues; e.g. L.E.P. , joint studies with WG4 on final-Q, RF kicker (headon optics) ...