Report from the Large Detector Meeting

Ecole Polytechnique, Paris,

January 2005

Andy White

University of Texas at Arlington

David Miller for WWS

Why are we here?

SOME OF THE REASONS

- Because the ILC needs detectors and we have ideas.
- Because many of us worked on the TESLA TDR detector concept, the North American "Large", or the JLC/GLC.

3. Because many of us are working on detector sub-system R&D (TPC, μ-vertex, ECAL, HCAL etc. etc.)

4. Because some of us want to get involved in the ILC for the first time.

5. Because detector design is a bottom-up activity; cannot be planned like the collider by GDE Central Team.

Why detector concept teams?

Optimise performance – against physics benchmarks.

Set requirements on sub-system R&D.

Interface with machine constraints.

Trade off costs against performance.

Produce integrated design.

Encourage new participants.

Involve all three regions.

Prepare ground for eventual competitive proposals.

So what are we going to do?

Set up at least one* concept study team.

Choose some leadership, as inter-regional as possible.

Review technologies, R&D needs, parameters, alternatives.

Network with other concepts on backgrounds, tools, benchmarks.

Maintain momentum from the TESLA and other previous studies.

Bring in new groups.

Prepare for LCWS, Snowmass, costing, Detector Outline, CDR

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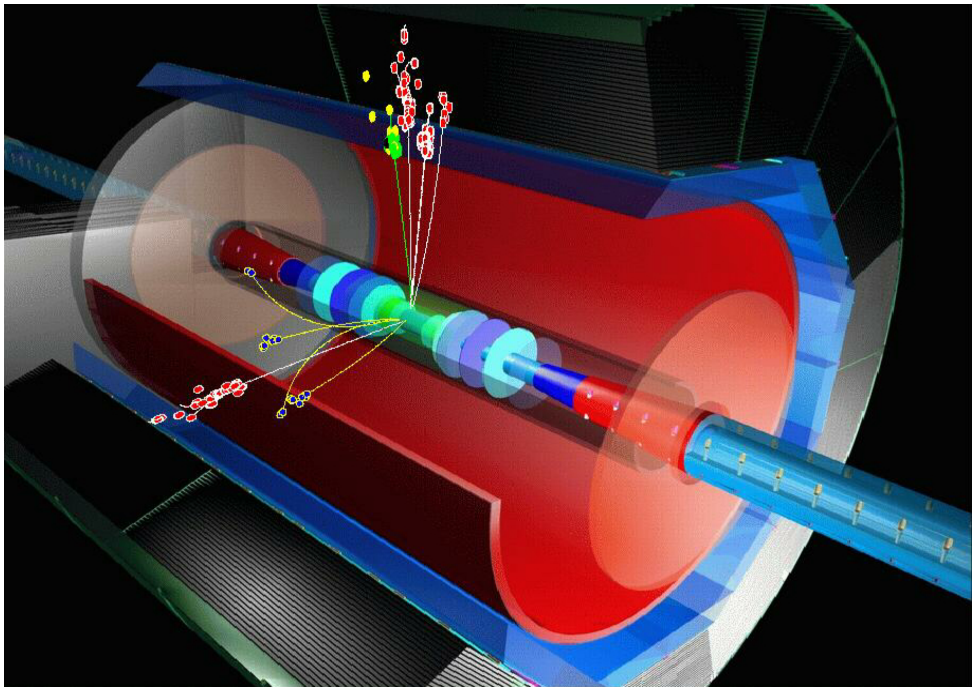
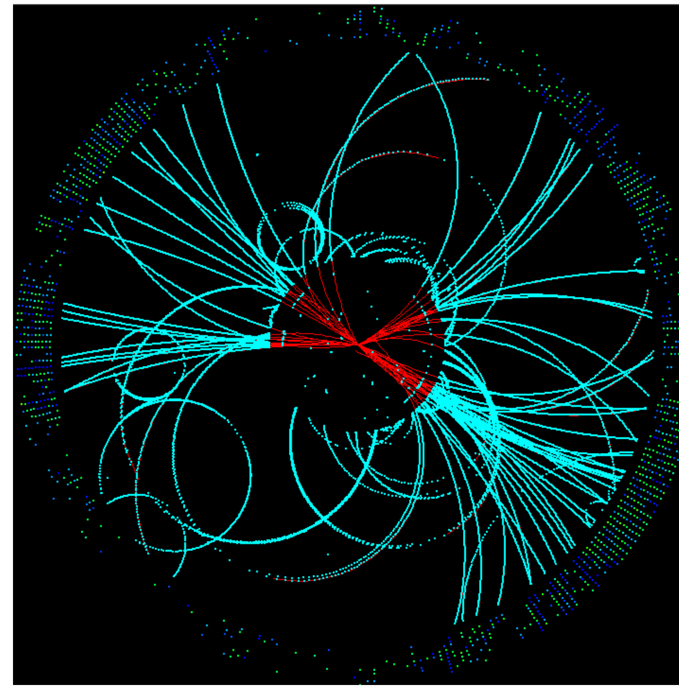
* Ideally one?

Review of the ILC Large Detector Concept

Mark Thomson
University of Cambridge



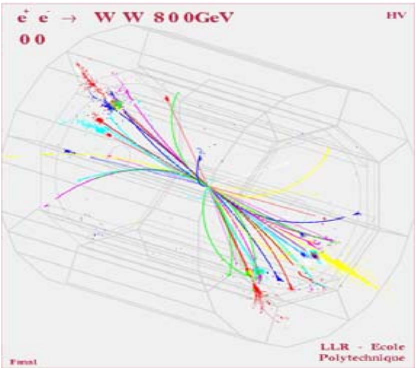


This Talk:

❶ Machine
❷ ILC Physics/Detector Requirements
❸ The Large Detector Concept
❹ Cost and Optimisation
❺ Conclusions

ILC Detector Requirements

- ★ **Momentum:** $\sigma_{1/p} < 7\times10^{-5}$/GeV (1/10 x LEP)
  (e.g. Z mass reconstruction from charged leptons)
- ★ **Impact parameter:** $\sigma_{d0} < 5\mu m \oplus 5\mu m/p(\mathrm{GeV})$ (1/3 x SLD)
  (c/b-tagging in background rejection/signal selection)
- ★ **Jet energy :** $\delta E/E = 0.3/E(\mathrm{GeV})$ (1/2 x LEP)
  (W/Z invariant mass reconstruction from jets)
- ★ **Hermetic down to :** $\theta = 5$ mrad
  (for missing energy signatures e.g. SUSY)
- ★ **Sufficient timing resolution to separating events from different bunch-crossings**



Must also be able to cope with high track densities due to high boost and/or final states with 6+ jets, therefore require:

- High granularity
- Good pattern recognition
- Good two track resolution

★ The "LARGE DETECTOR" concept is a possible design which meets these goals. Is it optimal ? Is it cost effective ?

❸ The Large Detector Concept

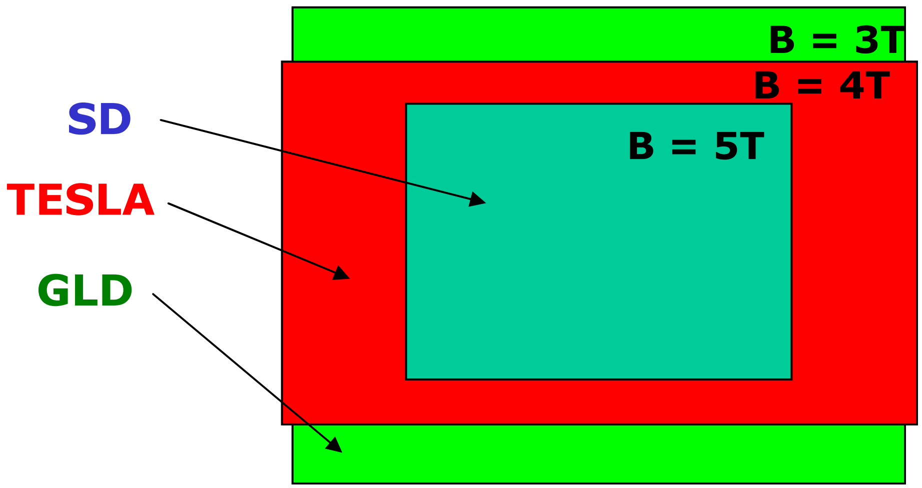
What is the Large Detector concept ?

- **the descendant of the TESLA TDR/US LD concepts**
- **SIZE : "not small and not huge"**

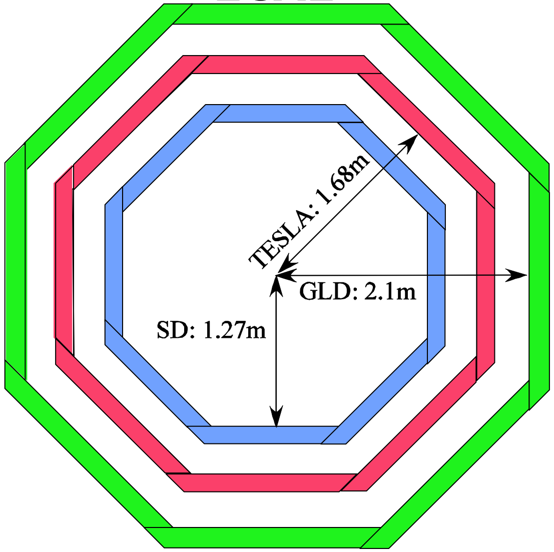
<u>Compare:</u>

- **Small Detector : SD**
- **Large Detector: e.g. TESLA**
- **Huge/Truly Large Detector: GLD**

Tracker



ECAL

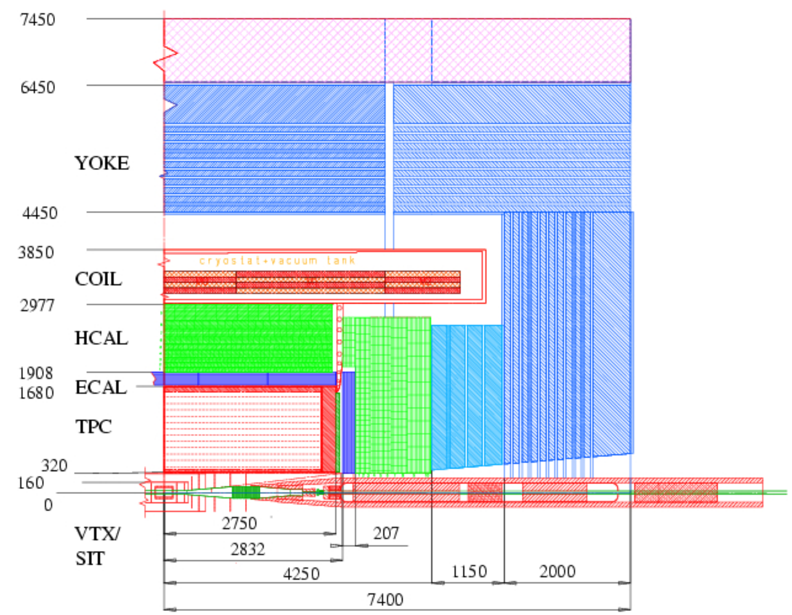


(TESLA TDR Detector a bit long...?)

General Features of Large Detector Concept

- ★ **Large gaseous central time projection chamber (TPC)**
- ★ **High granularity ECAL (SiW generally favoured)**
- ★ **High granularity HCAL (inside coil favoured)**
- ★ **Precision microvertex detector (first layer close to IP)**
- ★ **SC Solenoid with B ~ 4 T**

e.g. TESLA TDR concept:



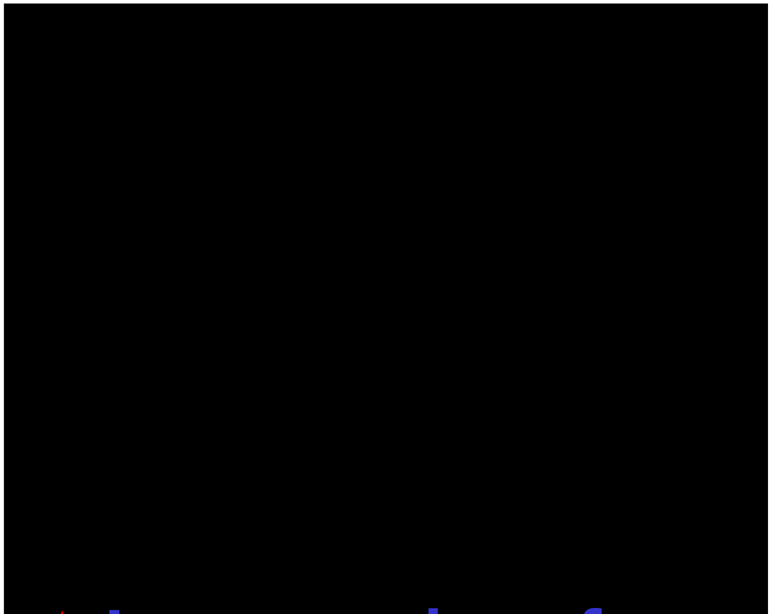
Will briefly review main features of:

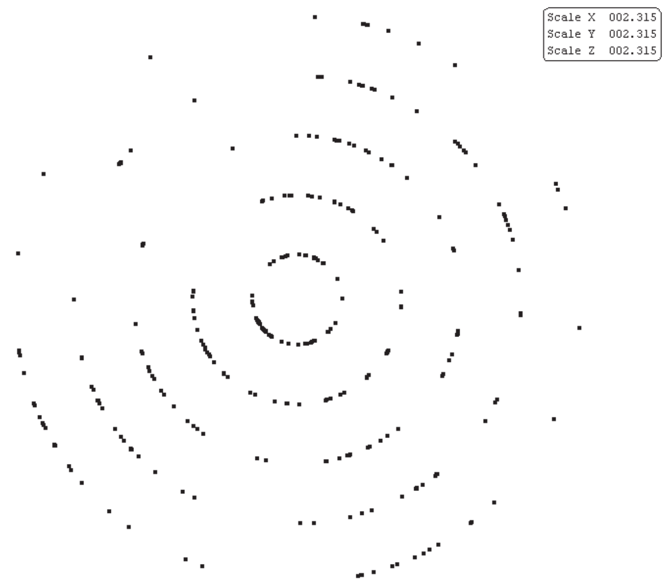
- ★**Vertex detector**
- ★**Tracking**
- ★**Calorimetry ECAL/HCAL**

Won't have time to cover forward CALORIMETERS

TPC or Si Tracker ?

★ **Two favoured central tracker technologies:**
TPC and Si Detector





★ **Large number of samples vs. smaller number of high precision points granularity**

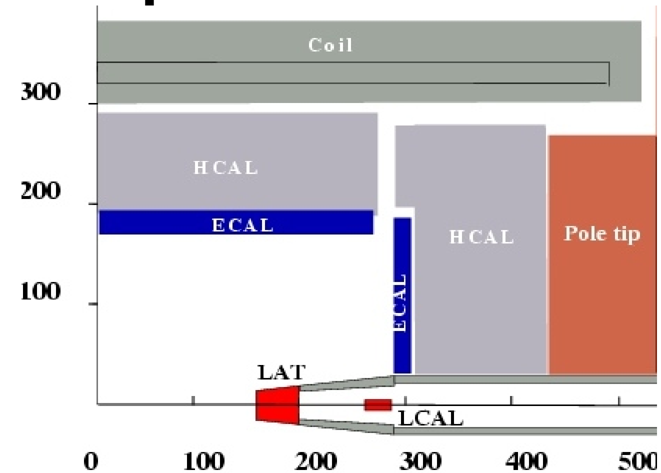
★ **PATTERN RECOGNITION in Si Det looks non-trivial + plenty of additional tracks from two-photon bgnd.**

★ **LD Concept adopts a TPC**
- used successfully in ALEPH/DELPHI

Calorimeter Concept

★ ECAL and HCAL inside coil
can we get away with some/all of HCAL beyond coil ?

★ SiW ECAL can meet design requirments
BUT it is far from cheap
shouldn't exclude other ideas (yet)



Tesla TDR SiW ECAL:

- Lateral segmentation: 1cm^2 matched to $R_{Moliere}$
- Longitudinal segmentation: 40 layers (24 X_0, 0.9λ_{had})
- Achieves Good Energy Resolution:

$$\sigma_E/E = 0.11/\sqrt{E(\mathrm{GeV})} \oplus 0.01$$

Some COMMENTS/QUESTIONS:

- $R_{Moliere}$ ~ 9mm for solid tungsten
  - gaps between layers increase effective $R_{Moliere}$
  - an engineering/electronics issue
- $R_{Moliere}$ is only relevant scale once shower has developed
  - in first few radiation lengths higher/much higher lateral segmentation should help
- + Many optimisation issues !

❹ Cost and Optimisation

$$$€€€¥¥¥£££:

In Large Detector Concept two main cost drivers:

- ★ SiW ECAL
  - driven by the total area of Silicon
  - i.e. ECAL radius, length and number of layers
- ★ Solenoid
  - cost scales roughly as total stored energy U
  - pdg quotes 50 M$ $(U/GJ)^{0.66}$
    (take with generous pinch of salt, based on pre-1992 data, but ~OKish for CMS)
  - $U \propto B^2 R^2 L$ $(R = R_{coil}, L = L_{coil})$
  - playoff between solenoid volume and field

OPTIMISATION:

- ★ Physics argues for:
  large + high granularity + higher field
- ★ Cost considerations:
  small + lower granularity + lower field
- ★ What is the optimal choice and how to find it ?
  (hopefully easier than finding Amphitheatre Carnot)

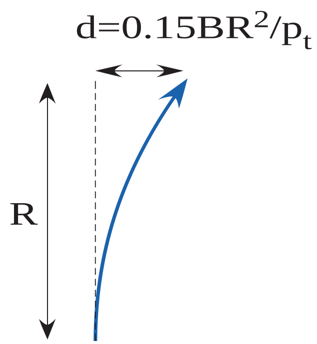
Aside : Size versus Particle Flow

For Particle Flow want:

- ★ **Larger radius ECAL**
  - **- larger transverse separation of energy deposits**
- ★ **Higher Field**
  - **- sweep tracks away from clusters**
- ★ **High granularity**
  - **- resolve nearby energy deposits**

Comment : on useful (?) Figure of Merit:

- ★ **Often quoted F.O.M. for jet energy resolution:**
  BR^2/σ ($R=R_{ECAL}$; σ = resolution)
  i.e. transverse displacement of tracks/"granularity"
- ★ **Does this work ?**
  - compare OPAL/ALEPH (W→qq no kinematic fit)



	BR^2	BR^2/σ	$\sigma_E/\sqrt{E}$	R^2/σ
OPAL	2.6 Tm^2	26 Tm	0.9	60 m
ALEPH	5.1 Tm^2	160 Tm	0.6	110 m

- ★ **No ! Things aren't that simple....**
  - my guess is that R^2/σ is more appropriate (even this doesn't account for neutral hadrons)

★ **Desperately need full simulation studies !**

❺ Conclusions

- ★ The LD concept still looks like an attractive option for an ILC detector !
- ★ However, current designs <u>not really optimised</u>
- ★ Size, COIL and ECAL (Si area) most important cost issues
- ★ Particle flow is probably the major design issue beyond vital detector R&D
- ★ + COIL is important – need to get the real experts involved when trying to optimise cost/perfomance

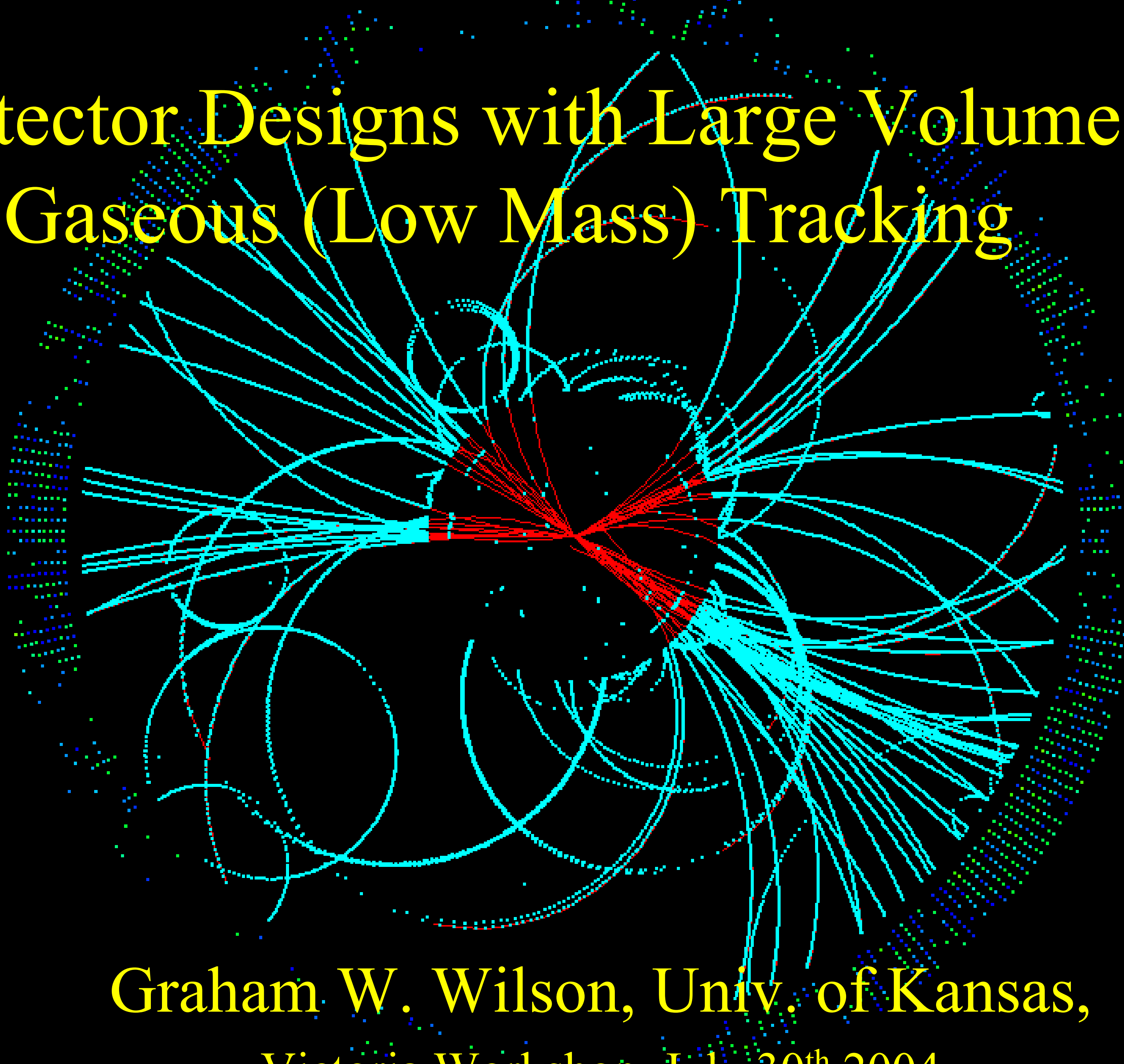
<u>**Personal optimisation hit-list (cf. TESLA TDR design):**</u>

- ★ Investigate reducing TPC length (guess too long in TESLA TDR)
  - reduce Si area, but more "forward" tracks
- ★ TPC outer radius (i.e. optimal size tracking/pflow/cost)
- ★ Vary (i.e. reduce) number of ECAL layers
- ★ Investigate smaller pad sizes in first ECAL layers ?
- ★ Can some/all of HCAL be places outside coil ?
- ★ Digital vs. Analog HCAL
- ★ Don't forget impact of non-zero crossing angle

<u>**Final words:**</u>

- ★ Full simulation studies preferable – this is a tricky business !
- ★ Vital to include backgrounds in optimisation of LD and comparison with other concepts
- ★★ There is a lot of extremely interesting work to be done over the next few years...... it should be fun !

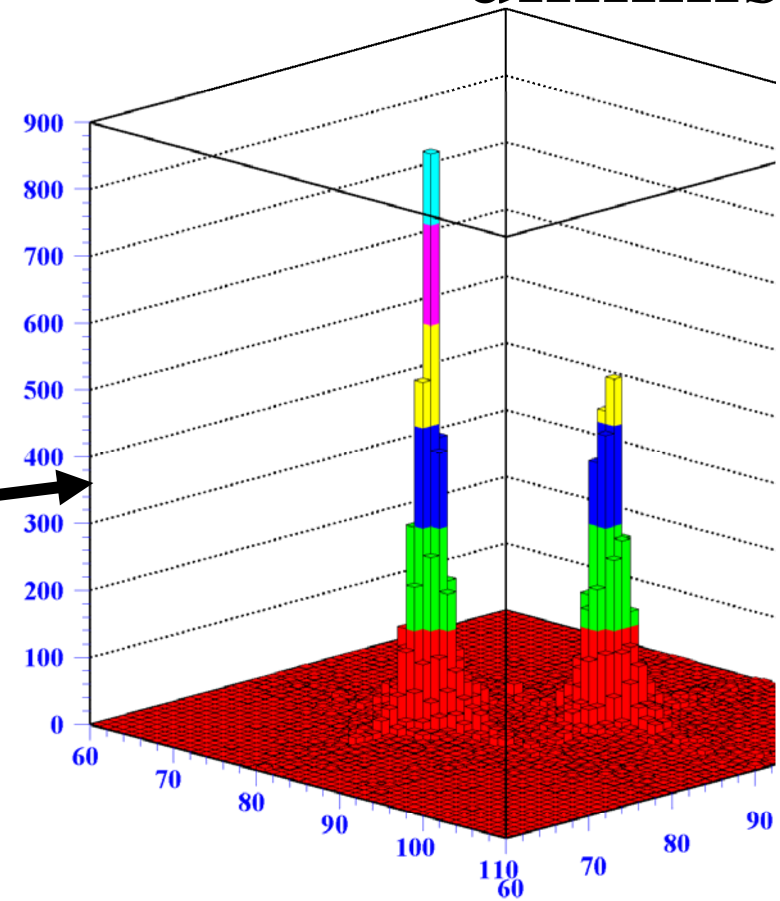
Detector Designs with Large Volume Gaseous (Low Mass) Tracking



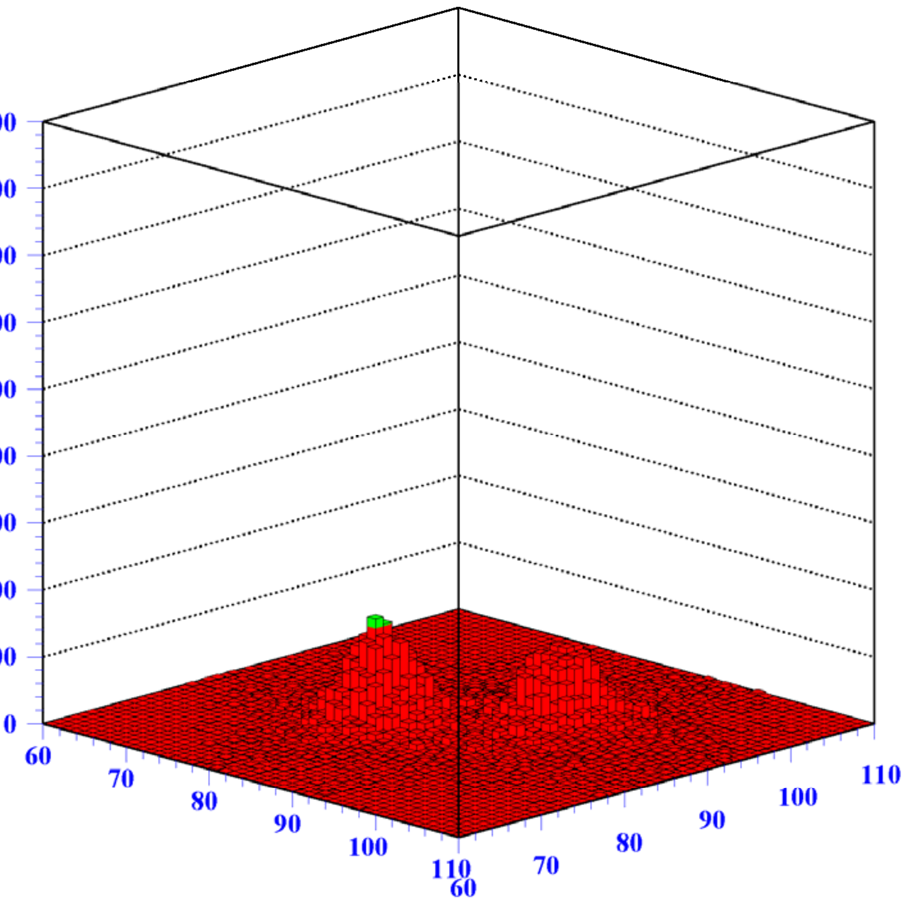
Graham W. Wilson, Univ. of Kansas,

Victoria Workshop, July 30th 2004

But, clearly 30% is far from the point of diminishing returns !



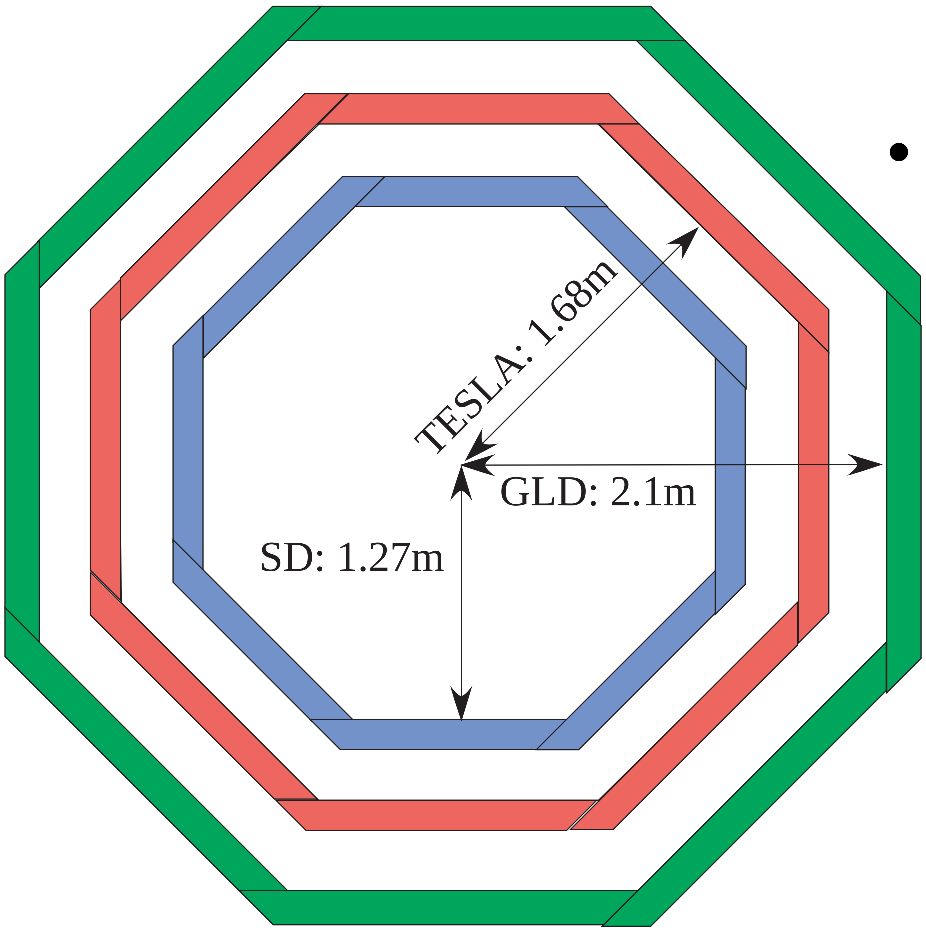
Intrinsic W, Z width only
(perfect resolution)



30%$\sqrt{E_{jet}}$

From S. Komamiya

EM Calorimeters



- Area of EM CAL (Barrel + Endcap)
  - SD: ~40 m^2 / layer
  - TESLA: ~80 m^2 / layer
  - LD: ~ 100 m^2 / layer
  - (JLC: ~130 m^2 / layer)

GWW : $BR_{ECAL}{}^2$ = 8, 11.3, 12.0, 13.2 Tm^2

Some opening gambits & possible consequences

- "Physics can make do with $BR_{ECAL}{}^2 < 10\ Tm^2$, Si-W is cost effective"
- "Let's do Si-W"
- How can you build it for just xxx/2 M$?
  - Reduce R_{ECAL}
  - And/or, worsen σ_E/E (less layers)
  - Not enough Rtracker for gaseous tracker.
  - Silicon tracker
    - Add material.
    - Lose PATREC robustness
    - Lose dE/dx
  - Answer: "If proposal A gets xxx/2 M$, we really need zzz M$ to be competitive in energy flow with proposal A"

- "Physics needs $BR_{ECAL}{}^2 > 10\ Tm^2$ and Si-W is probably not the most cost effective solution"
- "can't afford nominal Si-W"
  - Develop ECAL design with lower cost per unit volume and competitive R_M, X_0
  - Increase R_{ECAL}, investigate HCAL outside coil
  - Lots of space for a gaseous tracker
- How can you build it for just xxx/2 M$?
  - Answer: "We really need yyy M$ to meet our revised upward physics specs. With xxx/2 M$, we would reduce R_{ECAL} a little and still do much better than proposal B"

Take with a grain of salt

Mike Ronan (in absentia) - Large Detector

Large TPC Reference Detector

– Design parameters

● Past American Large TPC detector model (~same as TESLA TPC)

● New GLD-TPC model

– Background studies

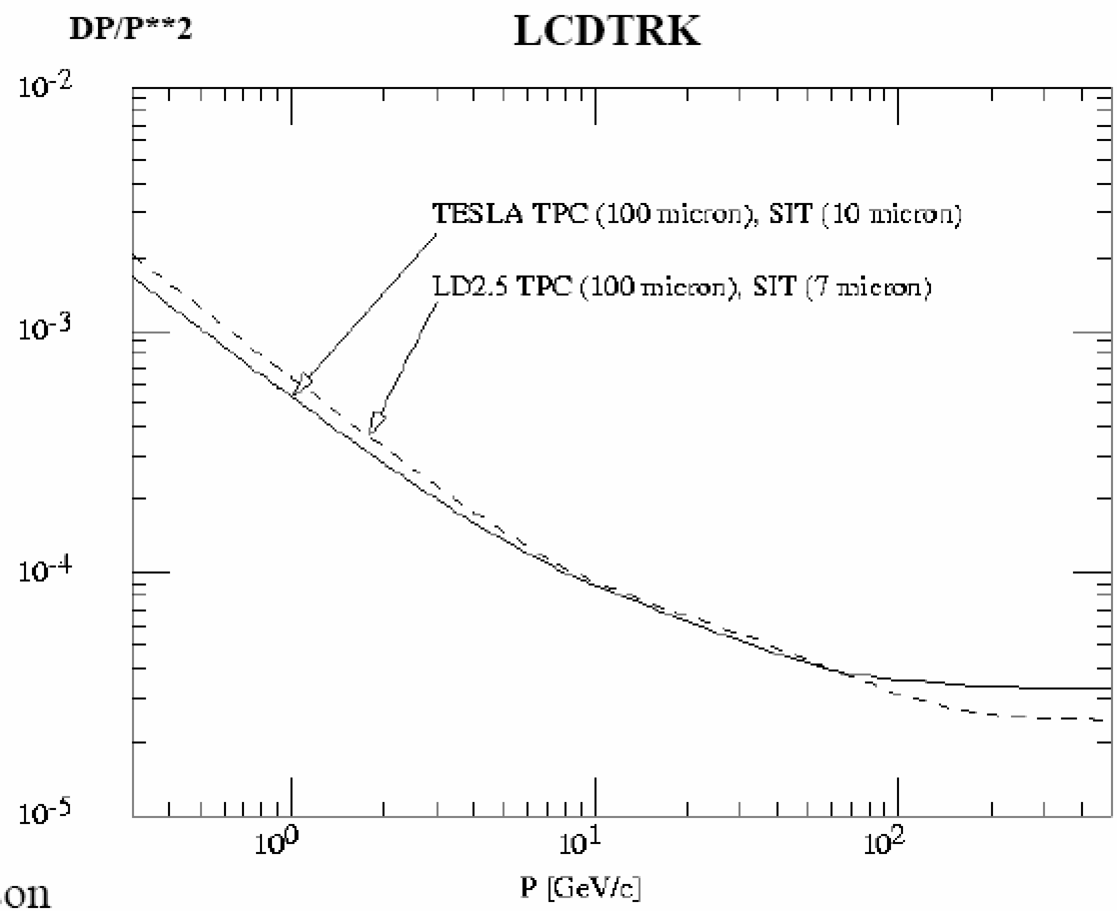
– Multijet event reconstruction studies

● Large Detector Calorimeter Models

– Present American Large “Compensating” model

– Large Thin W-Si ECal model

– Hybrid Calorimeter models



son
overall

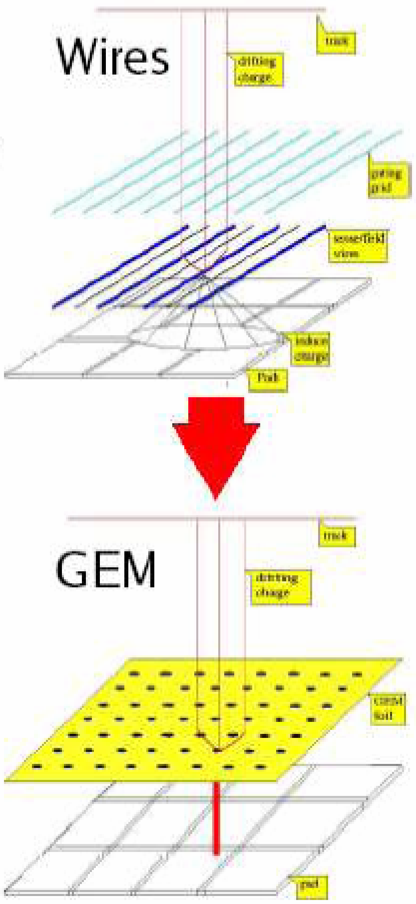
Comparison of TESLA TPC and updated American Large Detector (LD2.5) momentum resolution.

New Gas Amplification Systems

Replace conventional MWPC system (wires) by Micro Pattern Gas Detectors (MPGD):

Most promising examples:

- Gas Electron Multiplier (GEM) (F. Sauli, 1997)
- Micromegas (Y. Giomataris *et. al.*, 1996)



Present LD2 Compensating Calorimeter Model

Jan. 2005

Electromagnetic Calorimeter (ECal)

Lead / Scintillator
40 layers of 4+0.5 mm Pb, 1+0.5 mm Polystyrene

Expected resolution **15 % / sqrt(E)**

Barrel
Inner, outer radii 196, 220 cm Outer z 322 cm
Endcap
Inner, outer planes 297.5, 321.5 cm
Inner, outer radii 29, 187 cm

Hadronic Calorimeter (HCal)

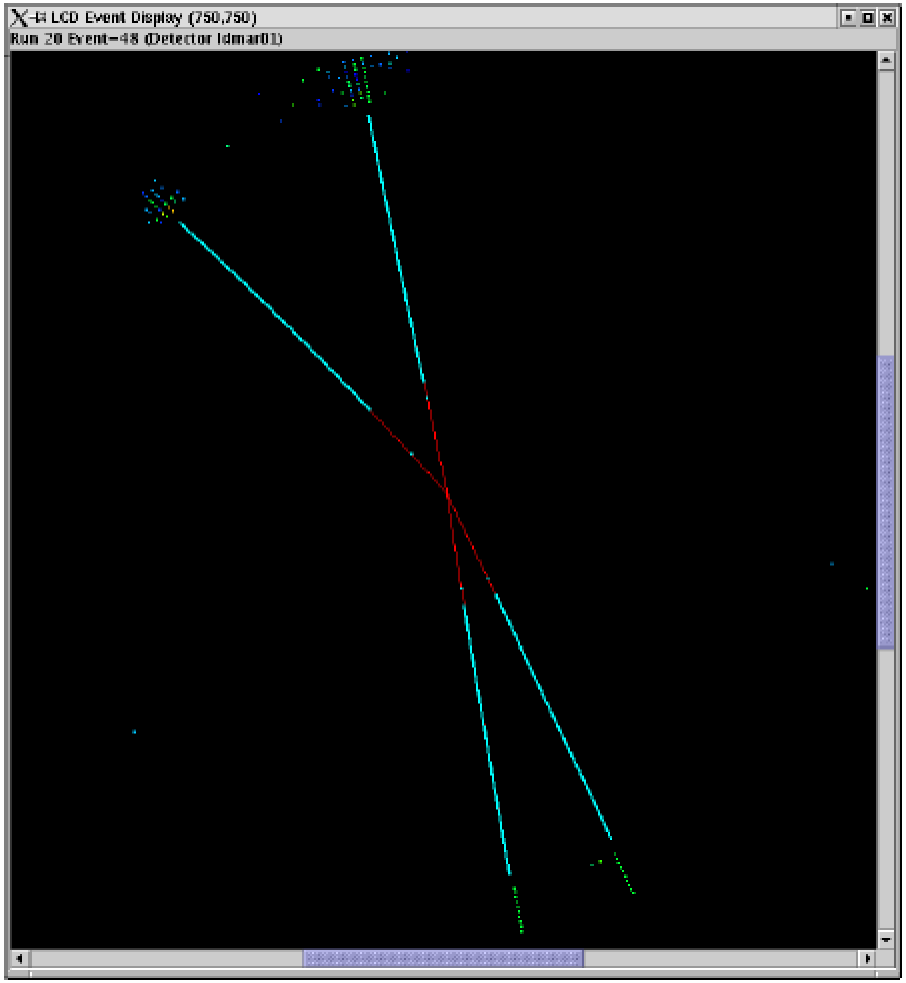
Lead / Scintillator
Stacks of 8+0.5 mm Pb, 3+0.5 mm Polystyrene

Only 3 samples in depth !!!

Expected resolution **40 % / sqrt(E)**

Barrel
Inner, outer radii 233.4, 365.4 cm Outer z 466 cm
Endcap
Inner, outer planes 334, 466 cm
Inner, outer radii 31, 334 cm

Higgsstrahlung event



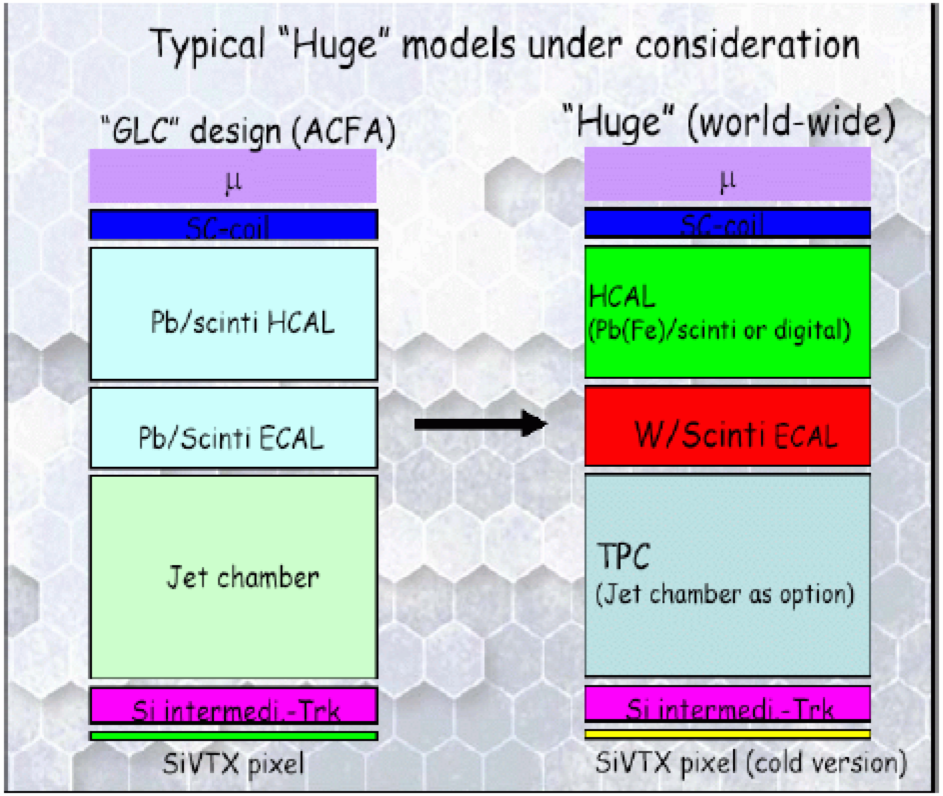
Hits: TPC (cyan), EM Cal (blue)
Tracks (red), Clusters (green)

Large Calorimeter options

Huge calorimeter track / cluster separation in large detectors.

Large (**LD2**) detector

ECal surface area = **90 m²**.

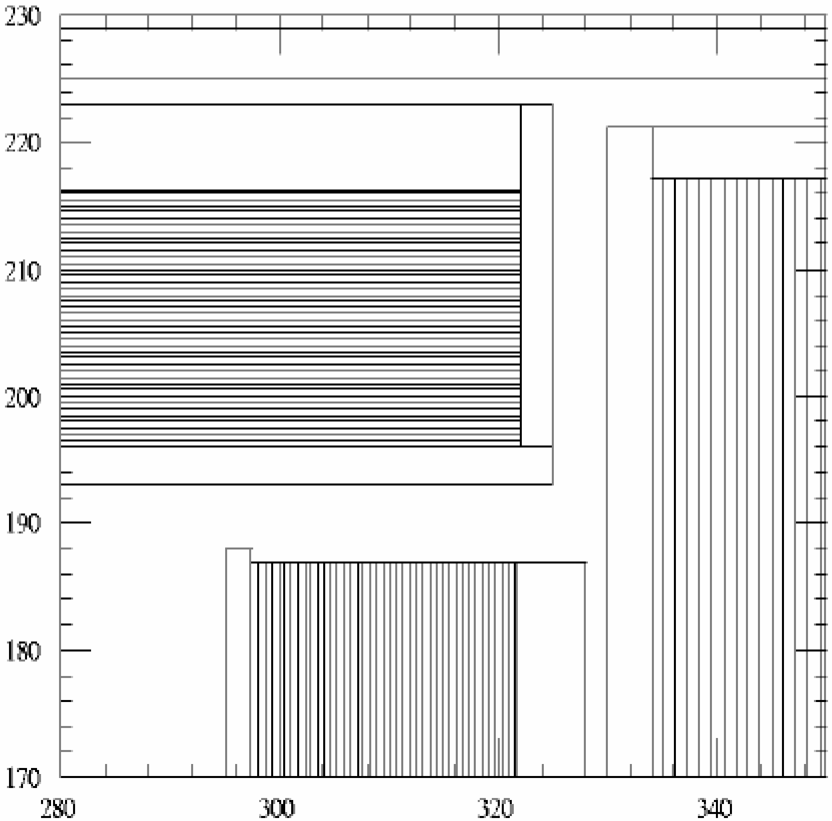


M. Ronan, "GLD Detector Design Studies"

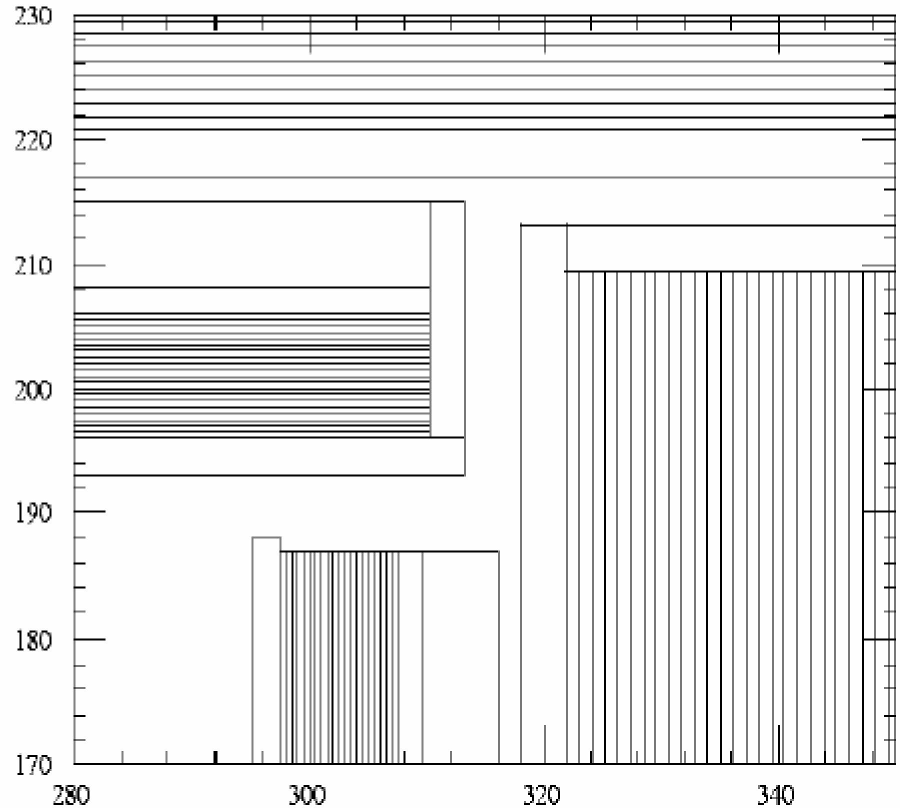
Large SiW Calorimeter designs

Reduce thickness of E Cal to reduce detector cost at some loss for single high energy electrons and photons.

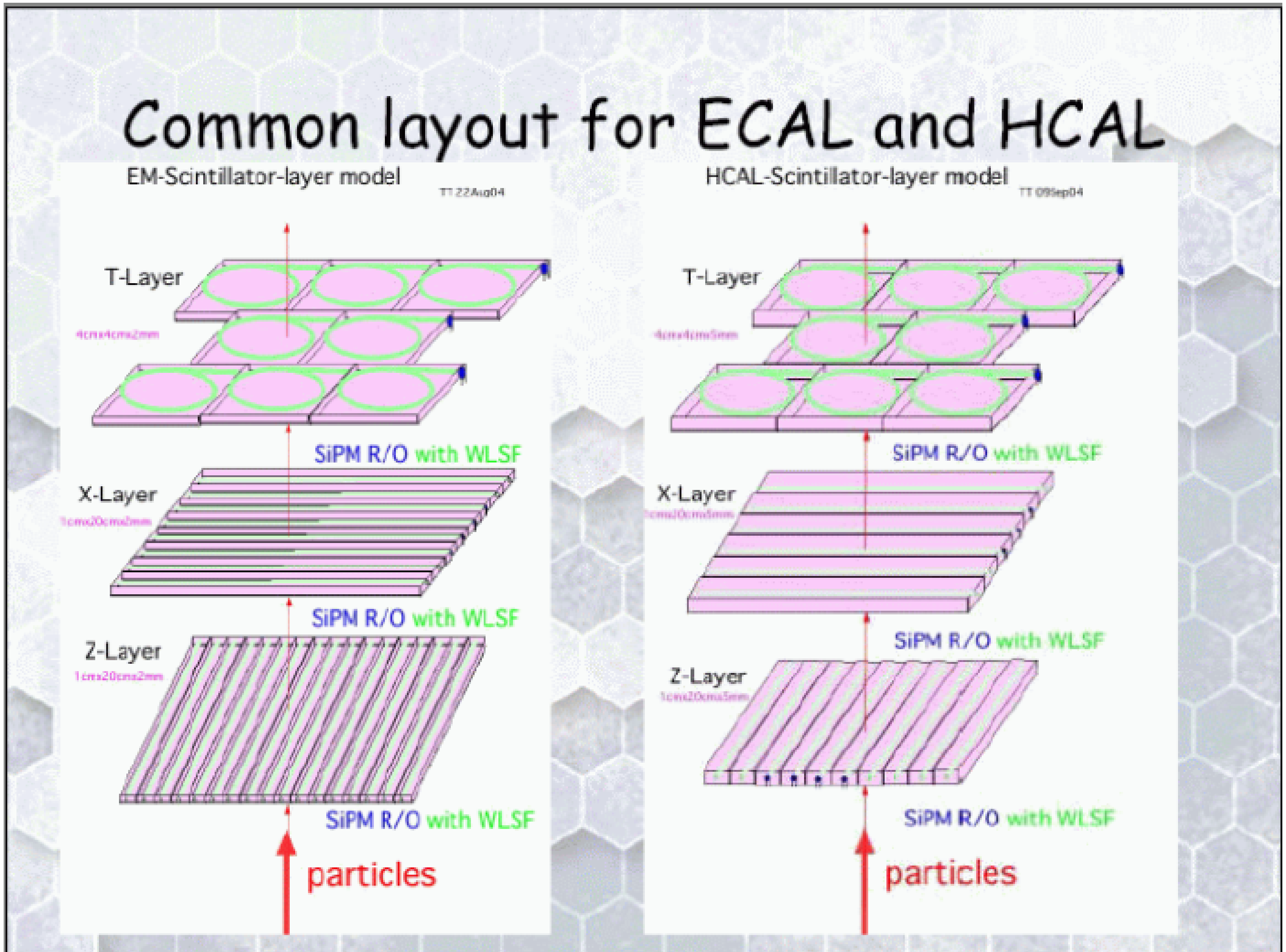
ECal SiW 40 layers



ECal SiW 20 layers

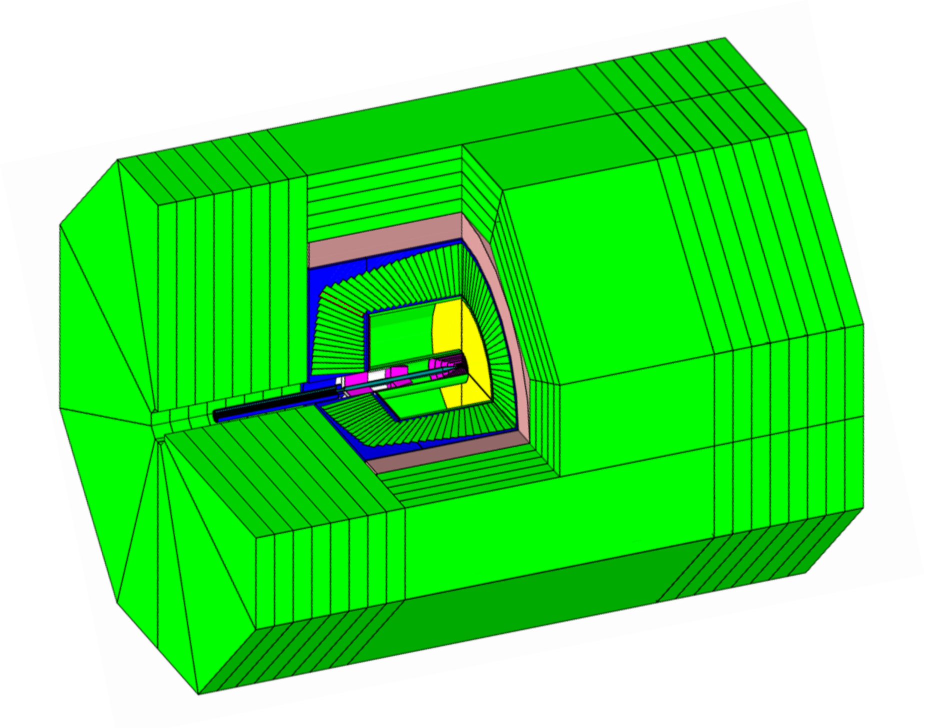


Calorimeter options for a Large / Huge detector



from Kawagoe, Asian meeting 15 Sep. 04

‘GLD’ Detector



Presented by H. Yamamoto (Tohoku U.)

Representing many who work on this study

(Special thanks to Sugimoto)

Paris, January 2005

Basic parameters

(all parameters not final)

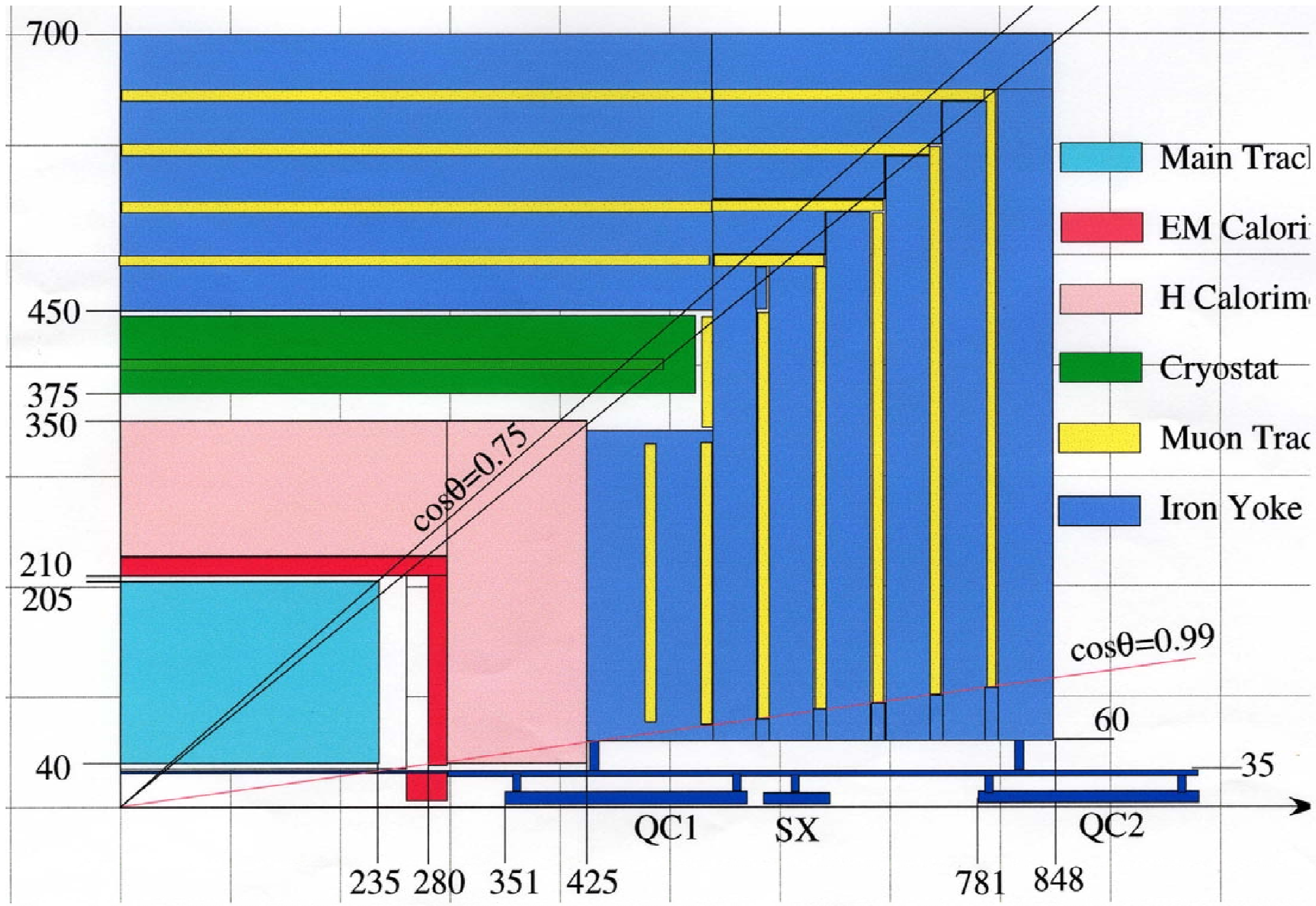
		SiD	TESL	‘GLD
Solenoid	B(T)	5	4	3
	R(m)	2.48	3.0	3.75
	L(m)	5.8	9.2	9.86
	E_{st}(GJ)	1.4	2.3	1.8
Main Tracker	R_{min}(m)	0.2	0.36	0.4
	R_{max}(m)	1.25	1.62	2.0
	σ(μm)	7	150	150
	N_{sample}	5	200	220
	σ(1/pt)	3.6e-5	1.5e-4	1.2e-4

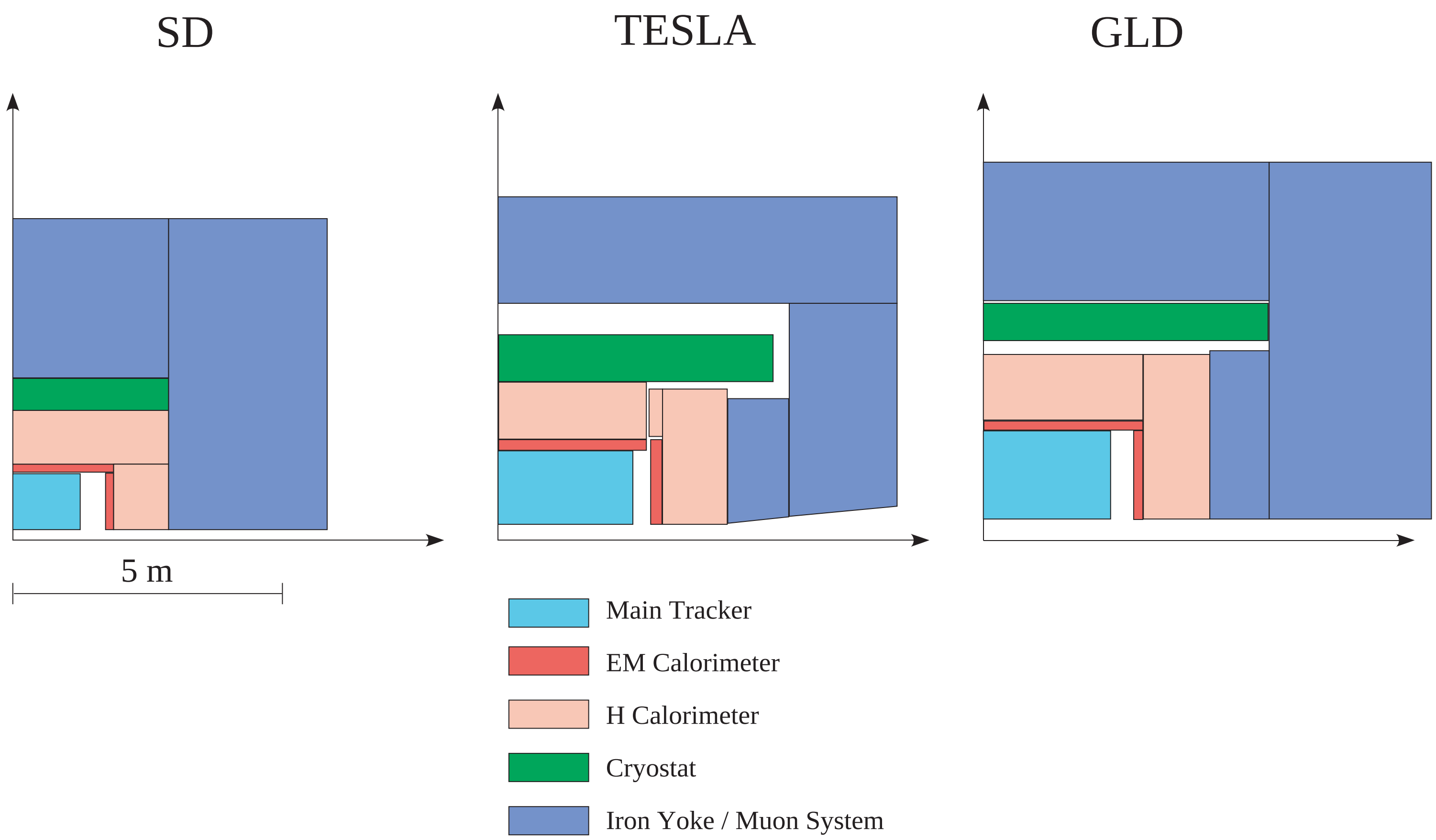
Basic parameters (cont'd)

(all parameters not final)

		SiD	TESLA	'GLD'
ECAL	R_{in} (m)	1.27	1.68	2.1
	BR_{in}^2	8.1	11.3	13.2
	Type	W/Si	W/Si	W/Sci
	R_m^{eff} (mm)	18	24.4	16.2
	BR_{in}^2/R_m^{eff}	448	462	817
	X_0	21	24	27
E+H CAL	λ	5.5	5.2	6.0
	t (m)	1.18	1.3	1.4

Overall Geometry





SD
TESLA
GLD
5 m
Main Tracker
EM Calorimeter
H Calorimeter
Cryostat
Iron Yoke / Muon System

What is the goal of a calorimeter?

catching what a tracker does not catch
and unfortunately it catches also what the tracker catches

could'nt we, one day, get rid of the tracker?

No: measuring the charge, asymetries
muons energy
identifying electrons
identifying taus and b's and c's
handling V0's

Enough depth

reasonably contain the showers

the 60% of Aleph was not unrelated to the presence of the coil in the middle of the calorimeter

No dead zone in depth

keep clean in front of the calorimeter,
thin and close
even in front of end caps

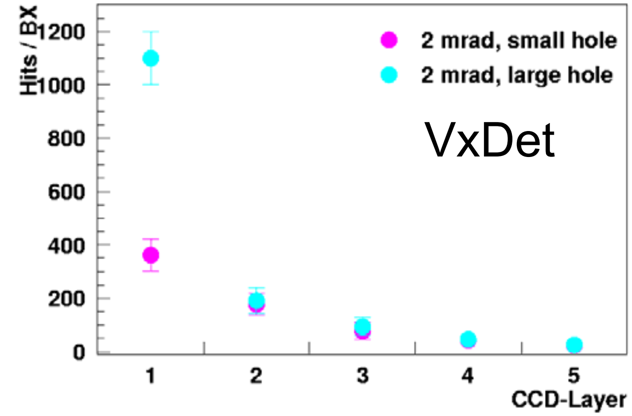
an octagonal tracker!

Optimising a Detector from the Tracking Point-of-View

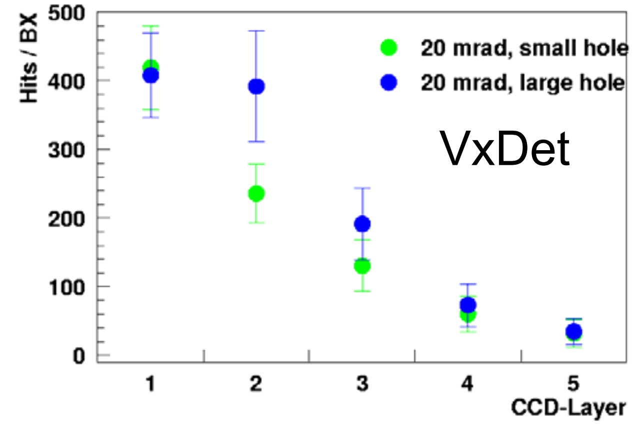
P.Colas, CEA Saclay

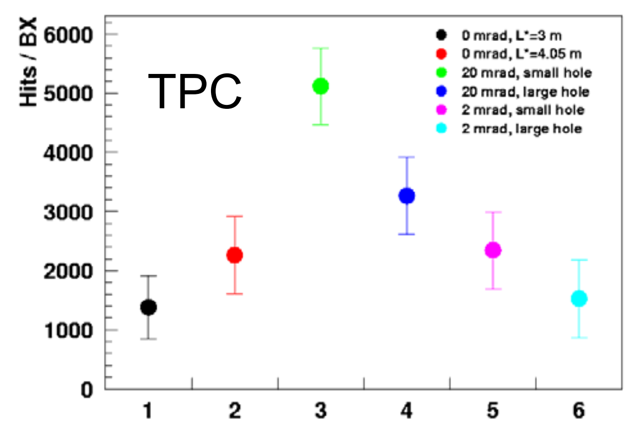
Optimisation : trade-off between **constraints** to help the detector to fulfill its **role** best

Backgrou



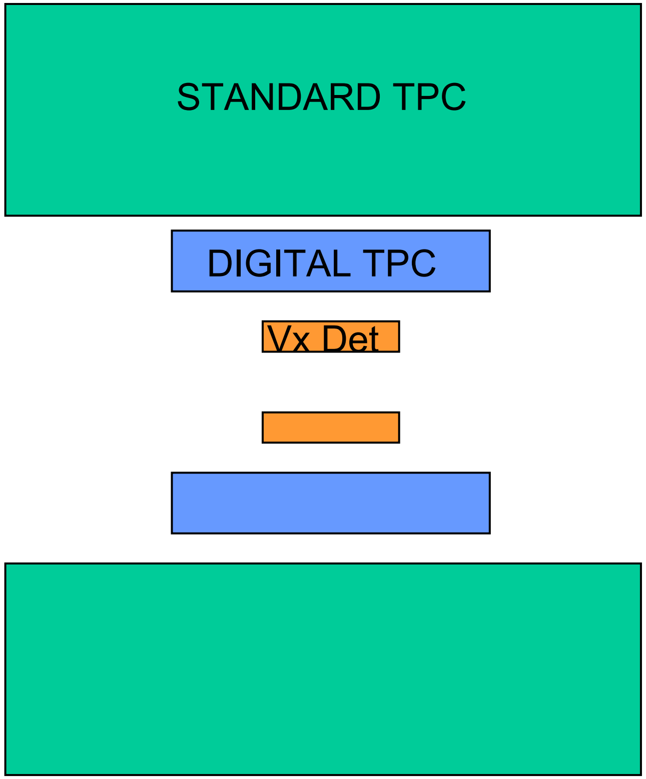
- Effect of the beam crossing angle (K.Büβer, SLAC MDI meeting, 5 jan 2005)
- Head-on ? 2mrad? 20 mrad? Small/large hole?
- Input from the detector to the machine design!





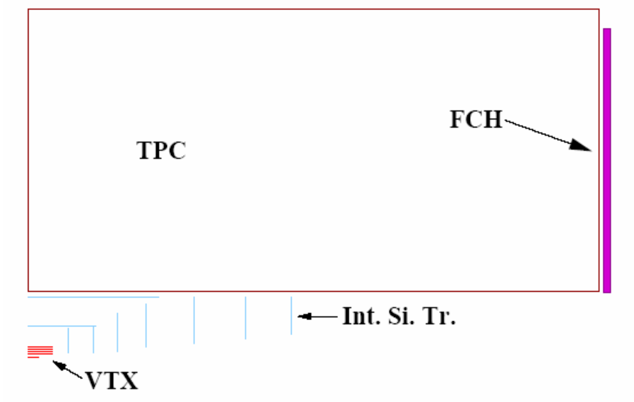
TECHNOLOGY

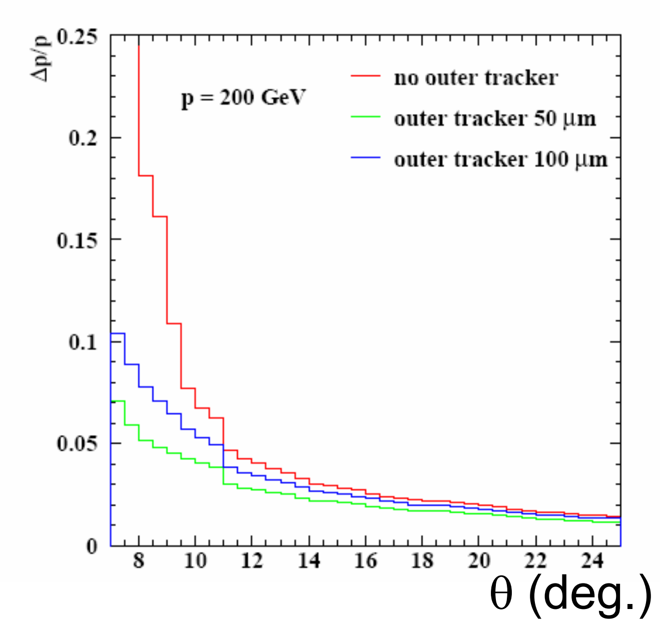
- See talks by S. Aplin and T. Greenshaw
- Digital TPC?
  - Could be used at an intermediate radius between the vertex detector and a standard TPC



LOW ANGLE COVERAGE

- L cannot be infinite. A special device is needed to cover low angles (K. Moenig)

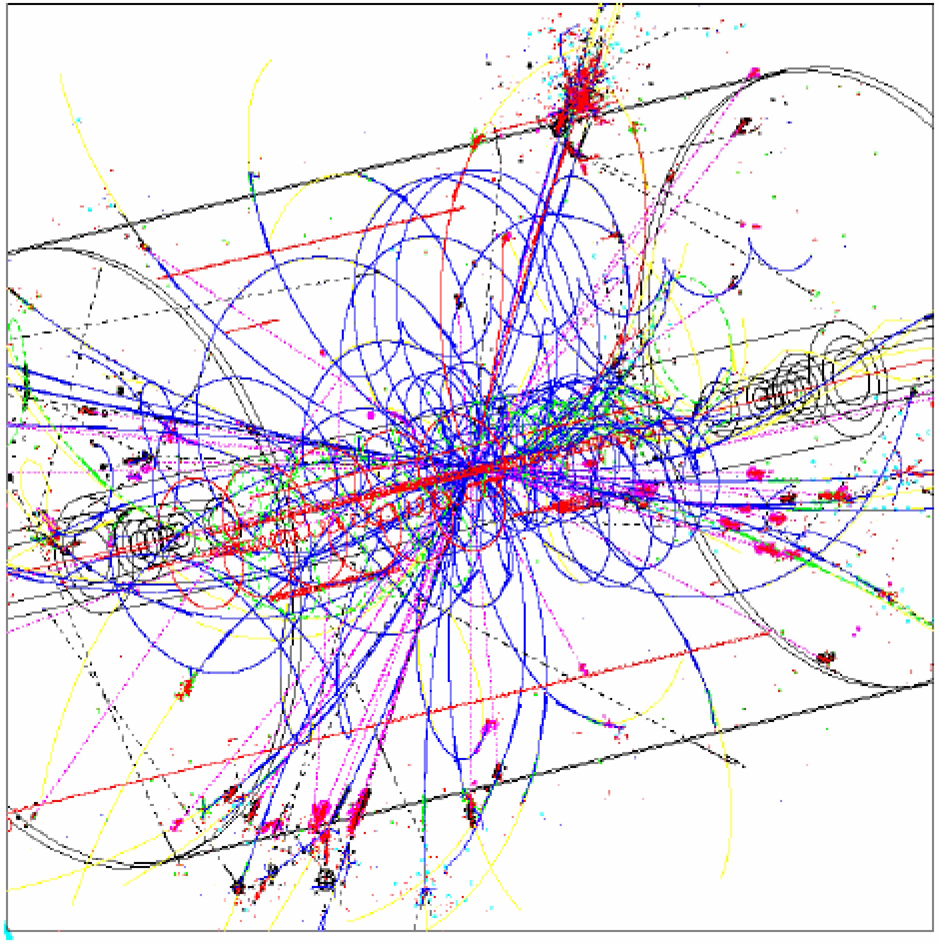




A extended silicon envelope would allow TPC syst. to be corrected (A. Savoy-Navarro). But would not a few % of the surface be enough? Would the first layer of the calorimeter play this role?

Vertex detector optimisation: status and strategies

- Introduction.
- Performance goals.
- Constraints due to machine and detector.
- Conceptual detector design.
- Sensors.
- Mechanical structure.
- Physics performance.
- Summary.



Tim Greenshaw

Performance goals

- Average impact parameter of B decay products ~ 300 μm, of charmed particles less than 100 μm.
- Impact parameter resolution is given by convolution of point precision, multiple scattering effects, lever arm, and mechanical stability.
- Multiple scattering significant despite large √s at ILC as average charged track momentum 1...2 GeV.
- Resolve all tracks in dense jets.
- Cover largest possible solid angle: forward/backward events are of particular significance for studies with polarised beams.
- Stand-alone reconstruction desirable.
- In terms of impact parameter, require resolution in rϕ and rz:

$$\sigma = \sqrt{a^2 + \left(\frac{b}{p \sin^{\frac{3}{2}} \theta}\right)^2}$$

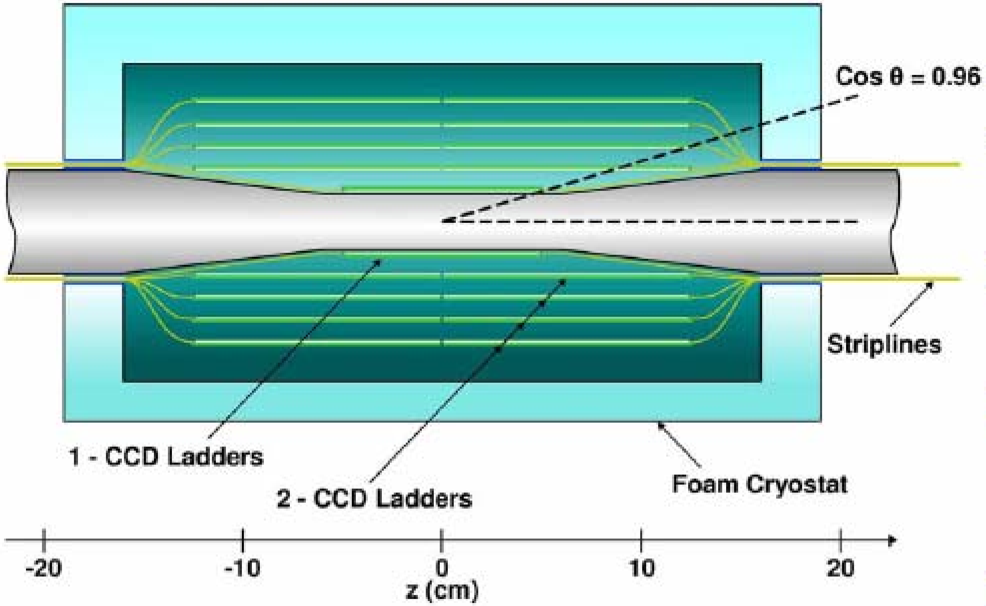
$$a = 5\,\mu\text{m (point precision)}$$

$$b = 10\,\mu\text{m (multiple scattering).}$$

- Implies typically:
  - Pixels ~ 20 x 20 μm^2.
  - First measurement at r ~ 15 mm.
  - Five layers out to radius of about 60 mm, i.e. total ~ 10^9 pixels
  - Material ~ 0.1% X_0 per layer.
  - Detector covers $|\cos\theta| < 0.96$.

Conceptual detector design

- Example using CCDs:

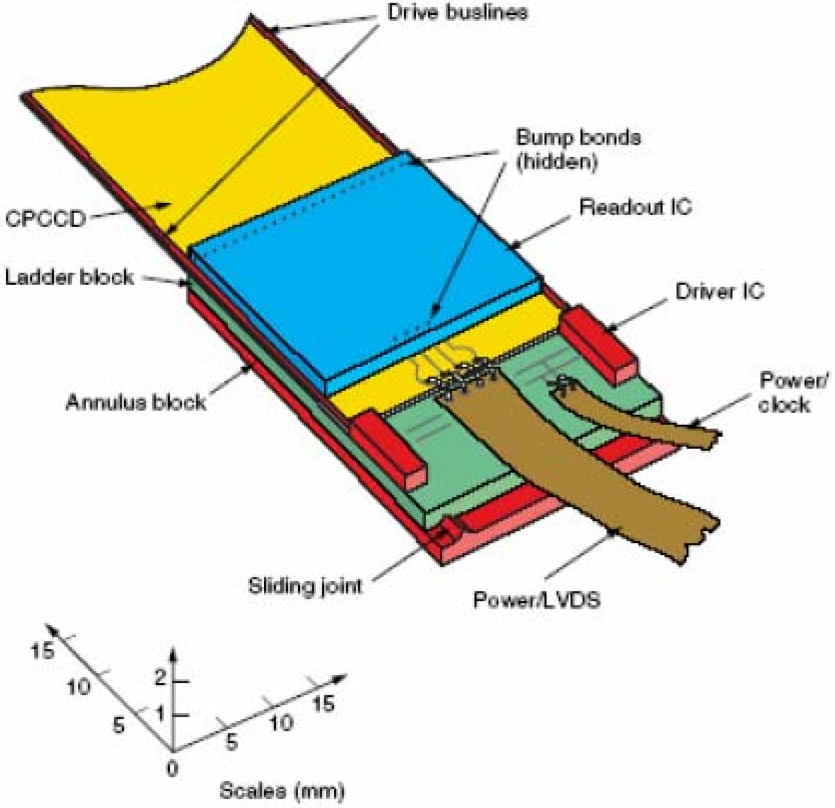


- Surrounded by ~ 2 mm thick Be support cylinder.
- Allows Be beam pipe to be of thickness of ~ 0.25 mm.

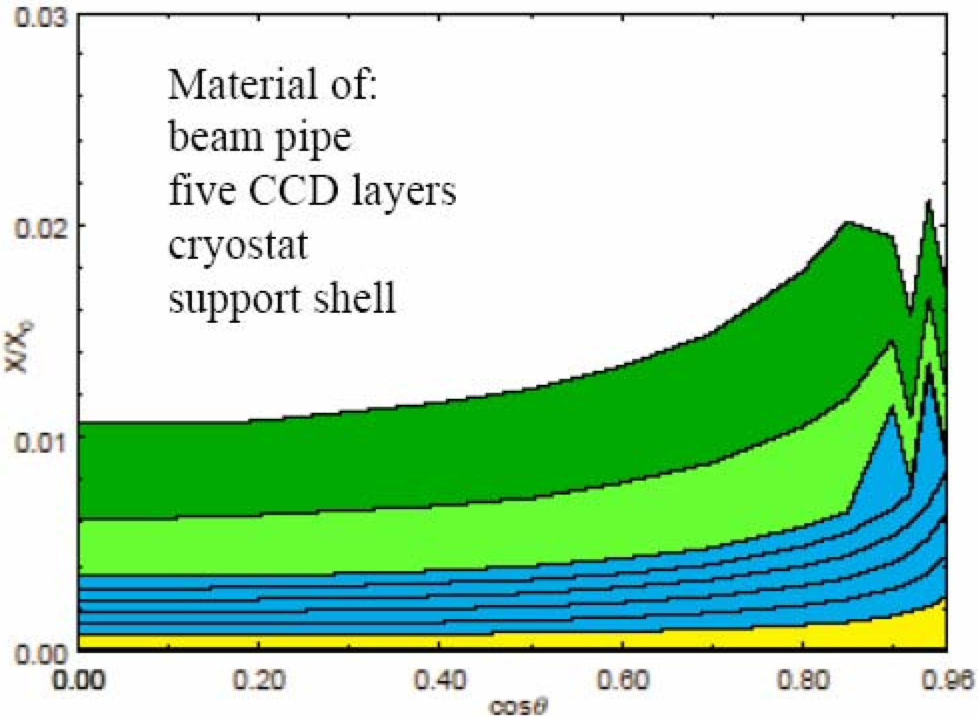
- Pixel size 20 x 20 μm^2, 8 x 10^8 pixels in total.
- 50 MHz readout of inner layer.
- Standalone tracking using outer 4 layers.
- Hits in first layer improve extrapolation of tracks to IP.
- Sensor operation at 180 K, gas cooling, additional evaporative cooling for electronics if needed.
- Readout and drive connections routed along BP.
- Important that access to vertex detector possible, "roll" outer tracker along BP as done at SLD.

Conceptual detector design

- Amount of material in active region minimized by locating electronics only at ends of ladders if possible.

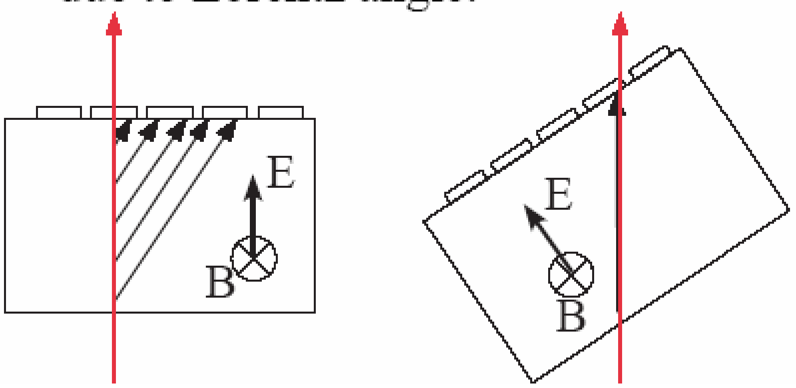


- Resulting material budget, assuming unsupported silicon sensors of thickness ~ 50 µm:

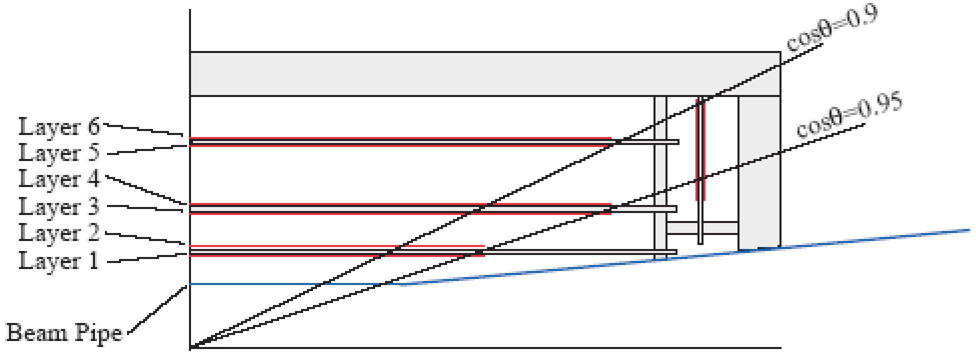


Sensors – FPCCD

- Fine pixel CCD.
- Get acceptable occupancy by increasing number of pixels by factor ~ 20 w.r.t. "standard" vertex detector.
- Pixel size ~ 5 x 5 μm^2.
- Must keep diffusion to minimum so no cluster confusion – deplete full epitaxial layer.
- Tilt sensors to compensate for spread due to Lorentz angle:



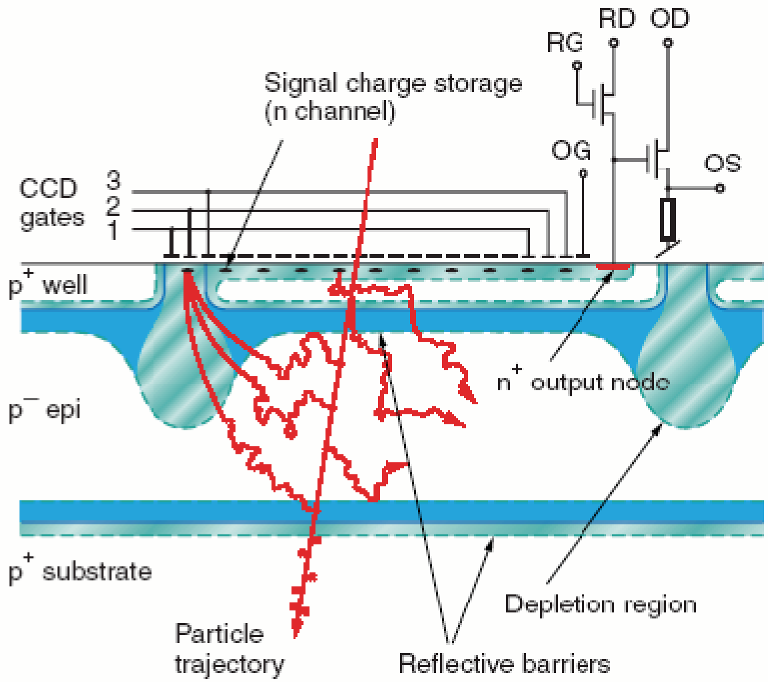
- Signals "in silicon" during bunch train, readout between bunch trains.
- Use two CCD sandwich with foam filling to build vertex detector.



- Hit "doublets" may help in separation of signal from background.

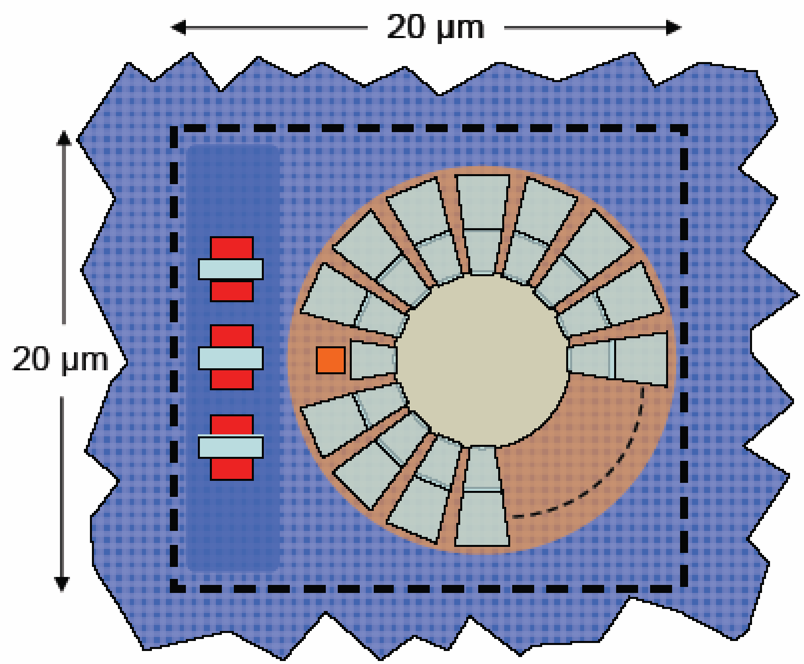
Sensors – ISIS (LCFI)

- In-situ storage image sensor.



- Signal always in buried in silicon until bunch train passed.
- Test device being built by e2v.

- "Revolver" variant of ISIS reduces number of charge transfers needed, increases radiation hardness and also flexibility of readout.



Silicon Tracking in an ILC detector with a central gaseous tracker

Si-tracking: the role in a large detector

Aurore Savoy Navarro,
LPNHE - Université Pierre & Marie Curie/CNRS-IN2P3

Concept

Main components and their Role(s)

Main Issues:

Mechanics, Electronics, Physics Simulations and Integration

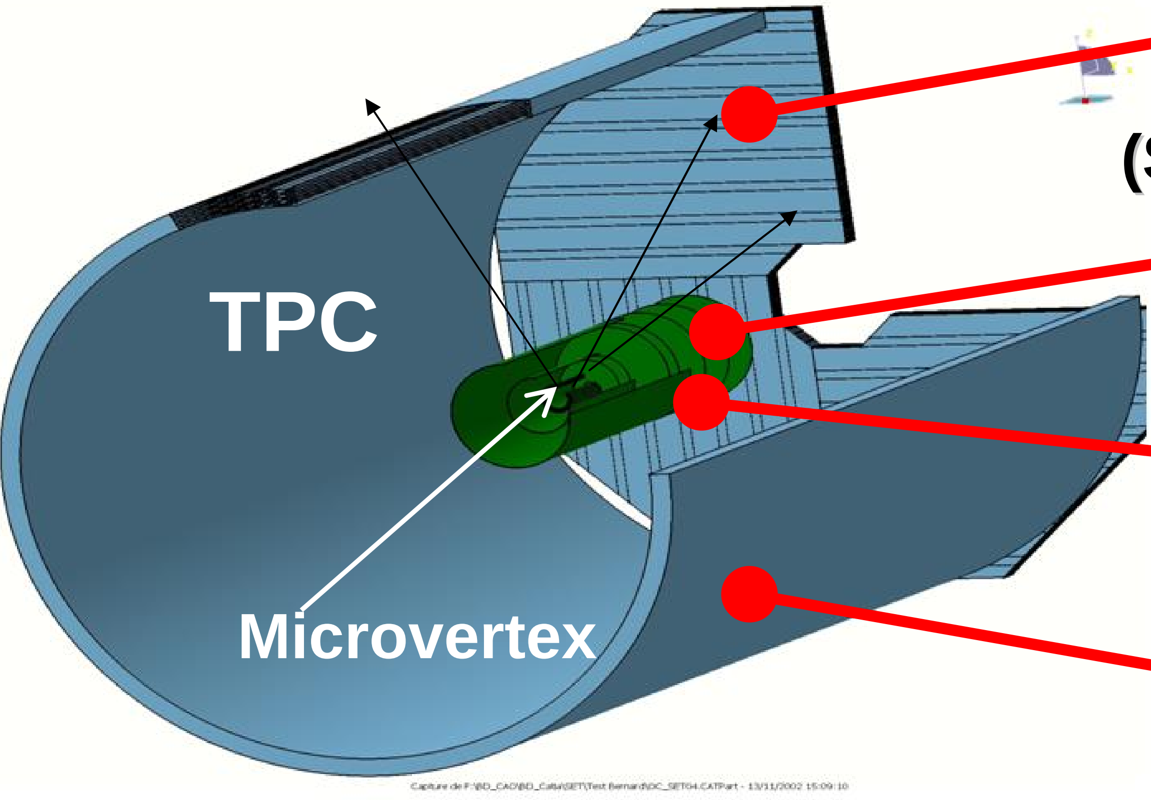
Many thanks to a lot of people in the SiLC collaboration and also ongoing discussions with FNAL mechanical team (Cooper+Demarteau et al.), plus discussions at DESY and SLAC

ILCD Workshop, LLR-Palaiseau, January 13-15, 2005

Can we make it without silicon tracking?

Silicon Tracking System with a central gaseous detector

The Silicon Envelope concept =
ensemble of Si-trackers surrounding the TPC (LC-DET-2003-013)



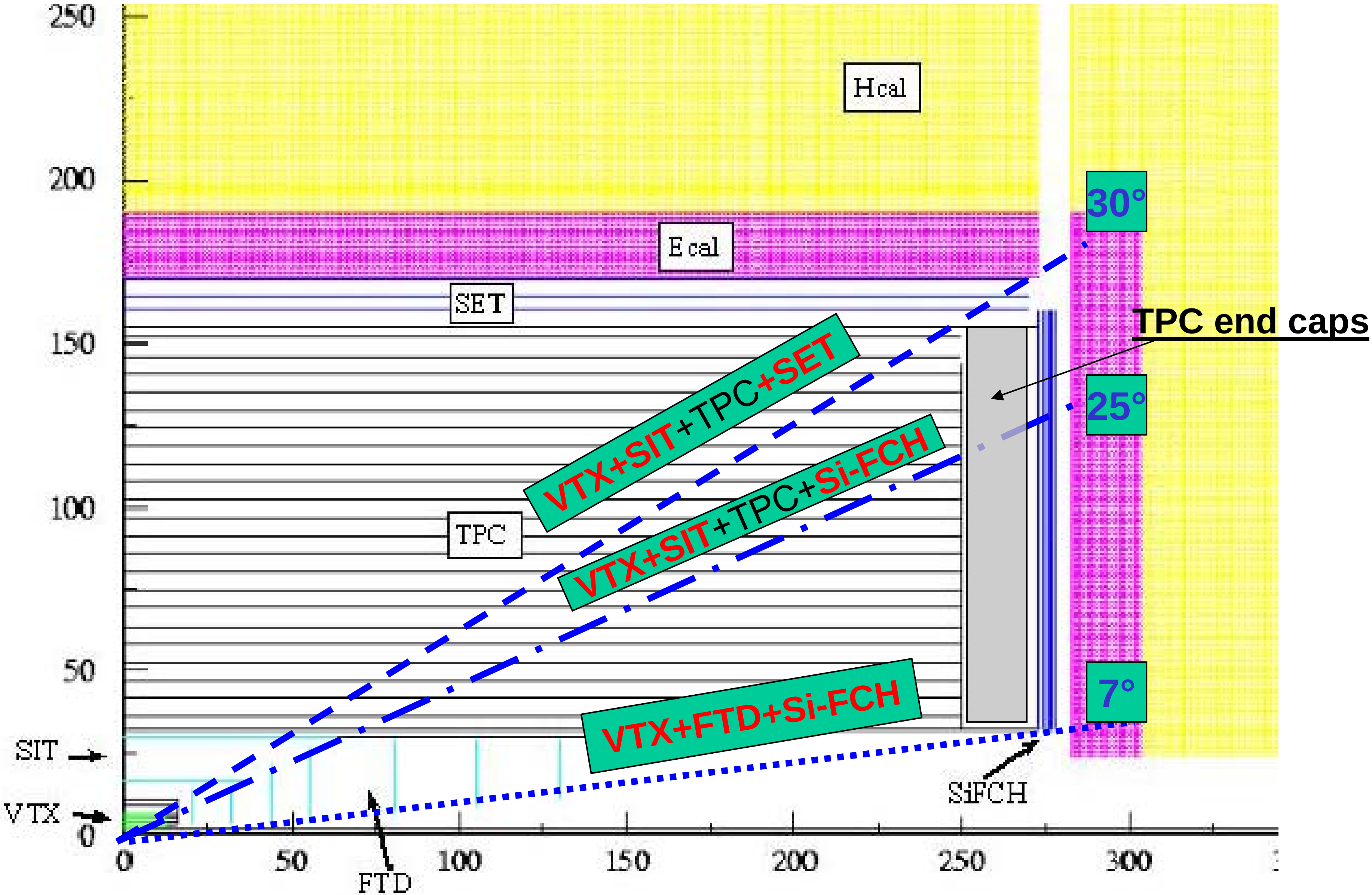
The Si-FCH:
TPC to calorimetry
(SVX,FTD,(TPC),SiFCH)

The FTD:
Microvertex to SiFCH

The SIT:
Microvertex to TPC

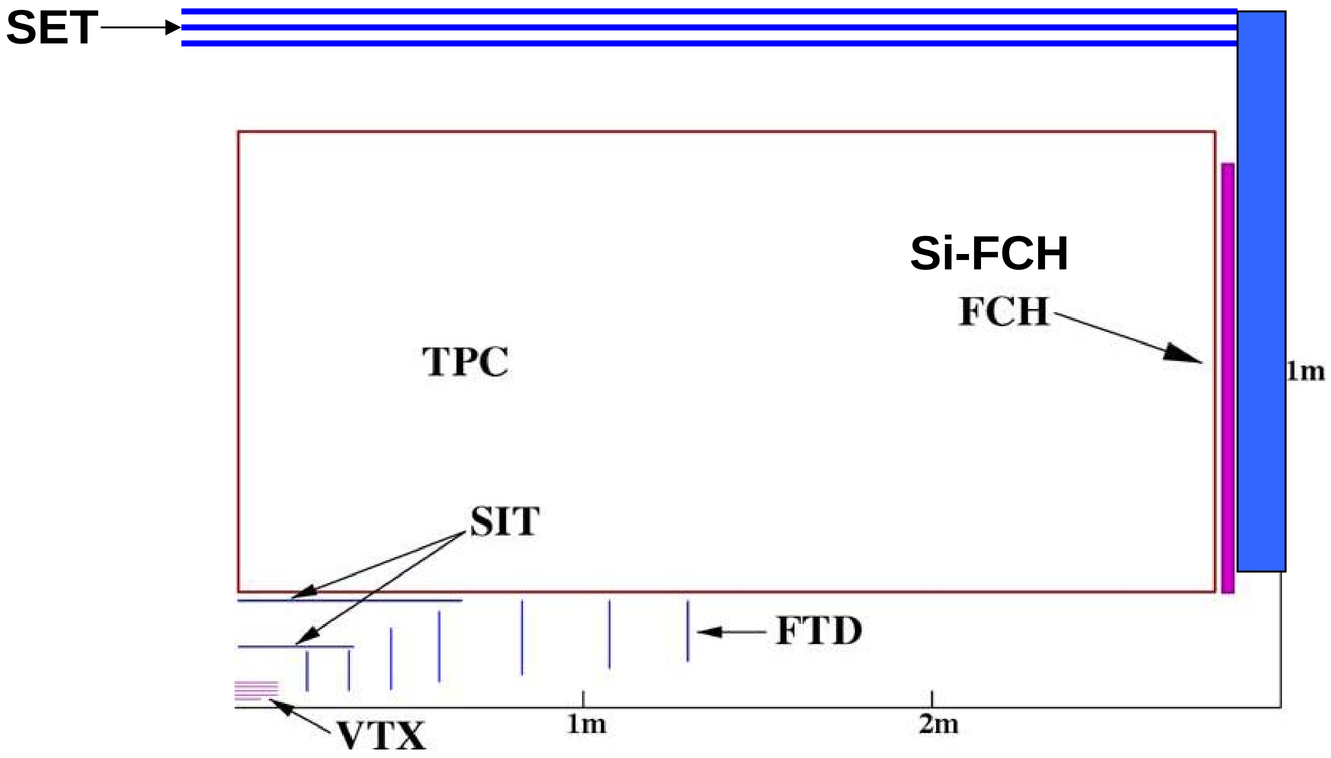
The SET:
TPC to calorimetry
(SVX, SIT, (TPC), SET)

Angular coverage of the overall & Si-tracking: quadrant view



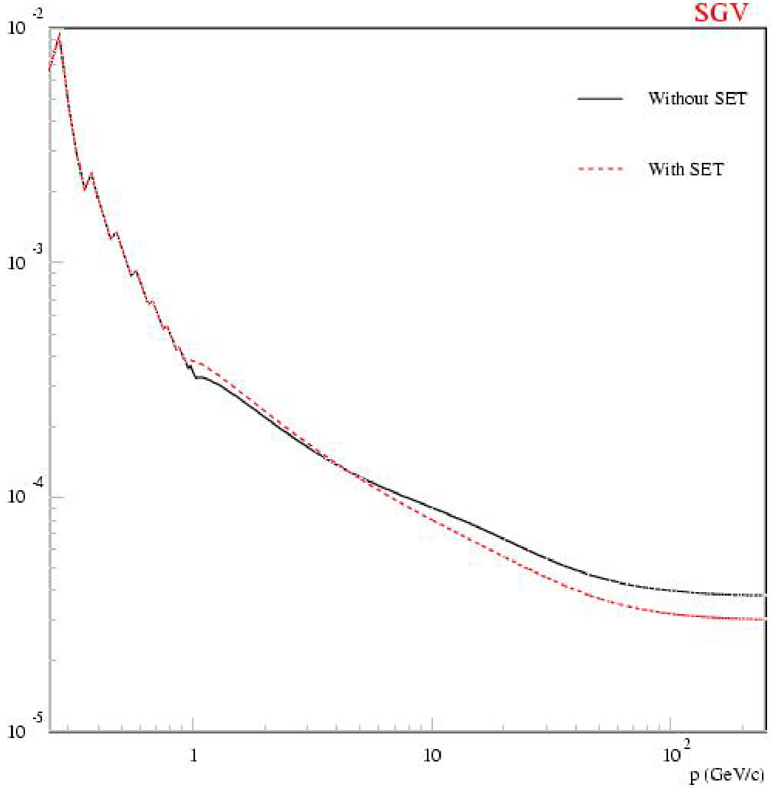
Si-tracking components:

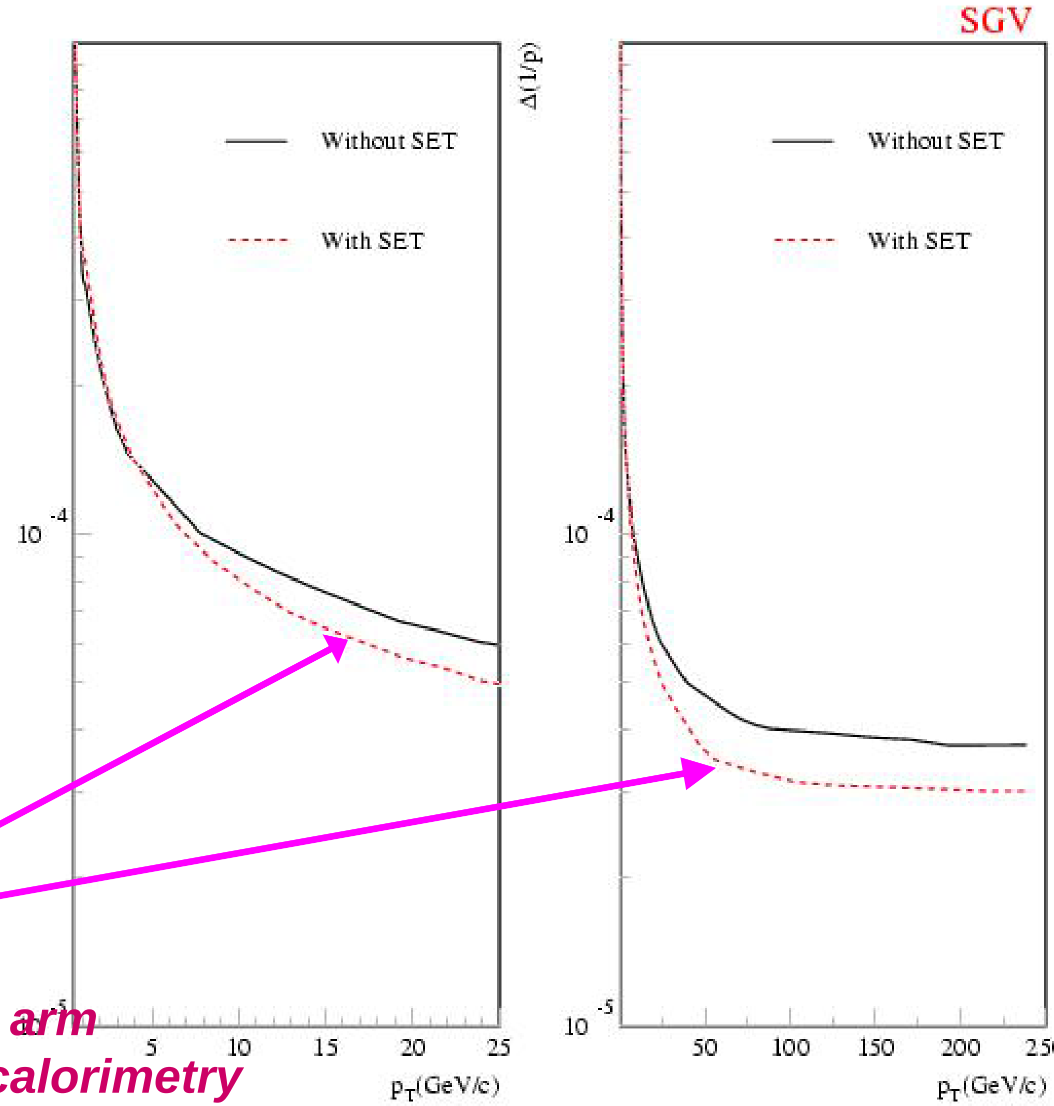
design, role, main issues of each component



Warning:
Note that this presentation starts from the detector design of the TESLA TDR. But this is just to have some basis for the discussion. Dimensions, values of different parameters are totally opened.

Central Outer Si-tracker: role & benefits





Improvement of the momentum resolution by up to 15-20%

Extends Si-tracking to the full level arm
Active interface between TPC and calorimetry
Independent tracking TPC / SET+SIT: alignment, calibration, handling distorsions, and stability.
Redundant tracking ensures reliability (running safety) of the global tracking system

The forward region, backgrounds and crossing angles

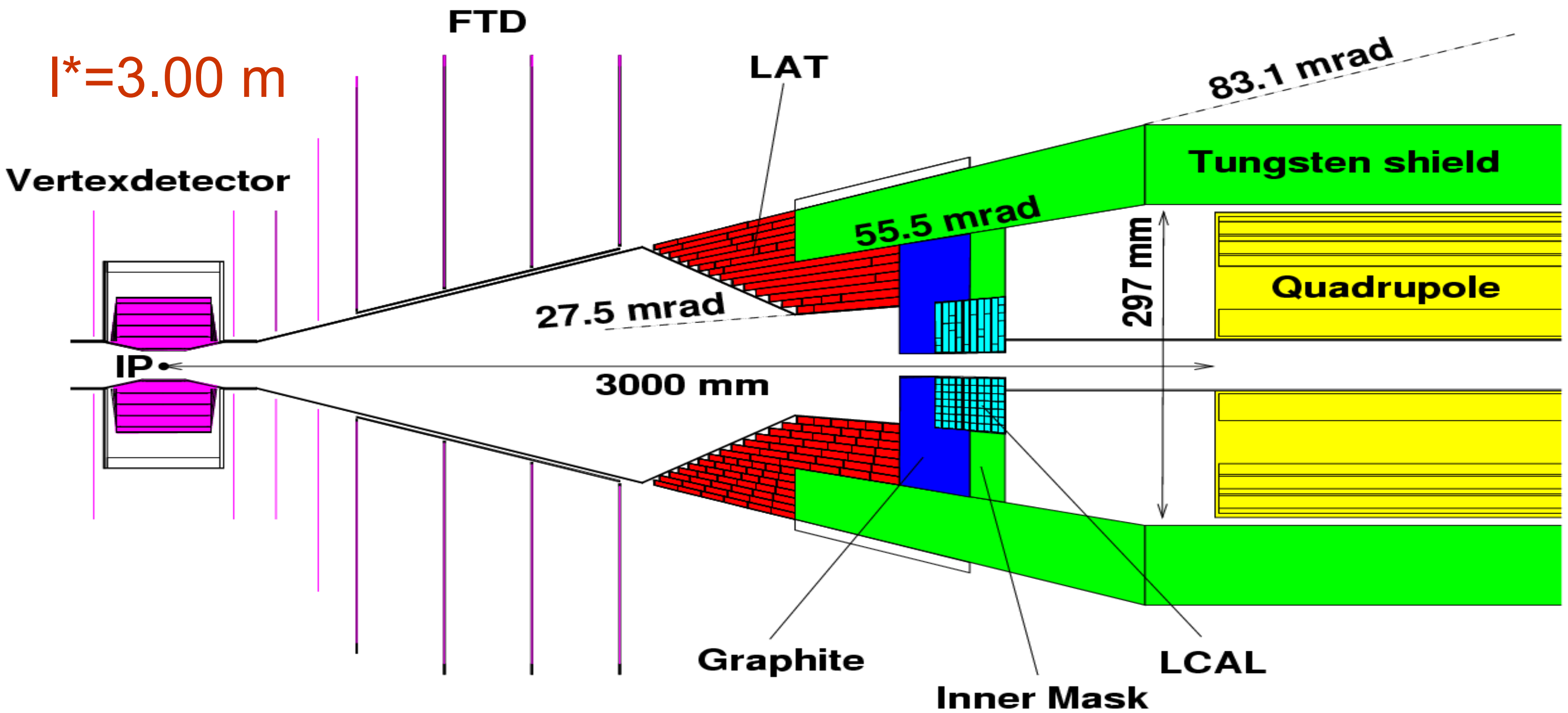
Karsten Büßer

Meeting on ILC Detectors with Gaseous Tracking

Ecole Polytechnique

14 January 2005

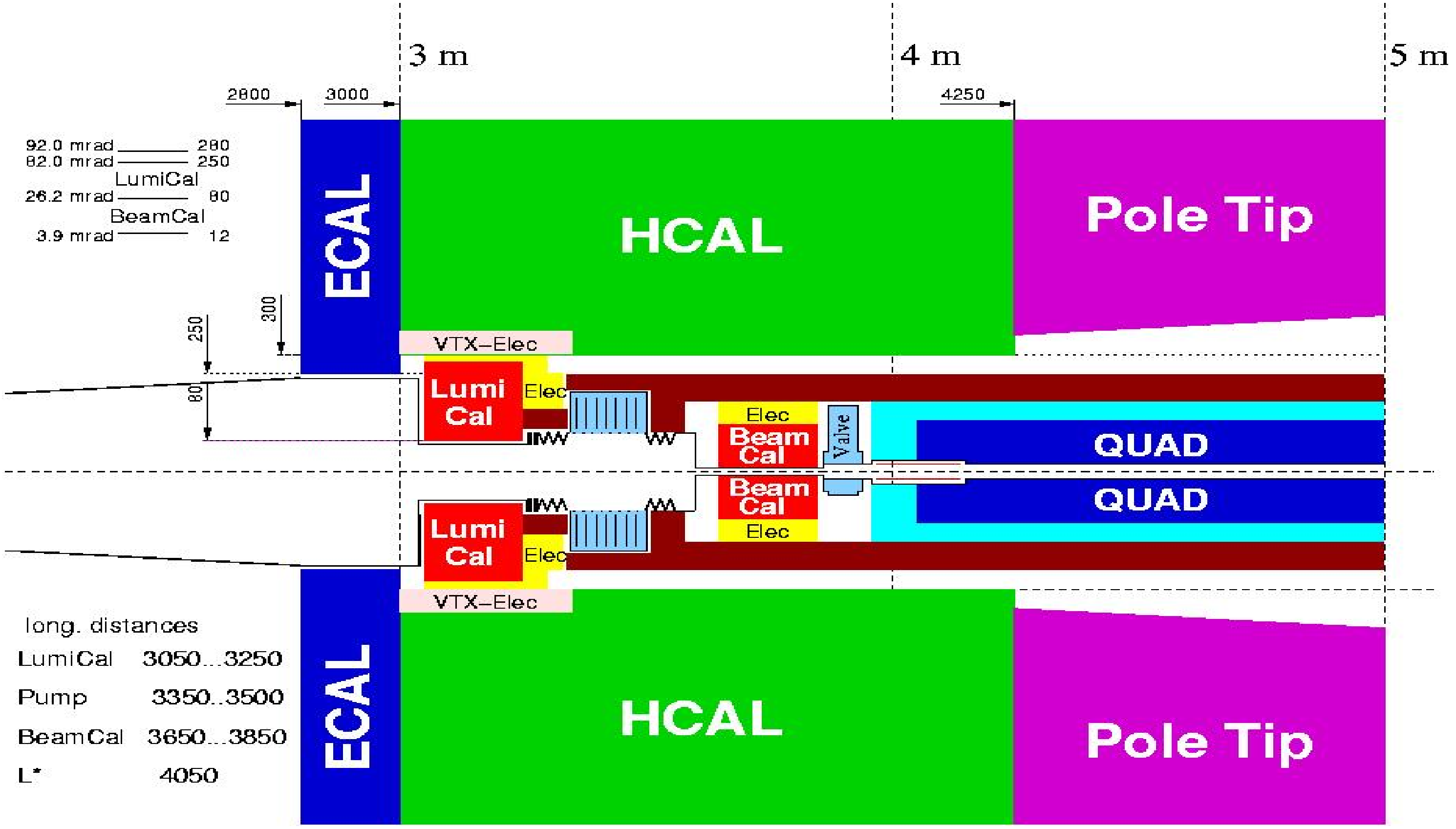
l*=3.00 m



Tasks:

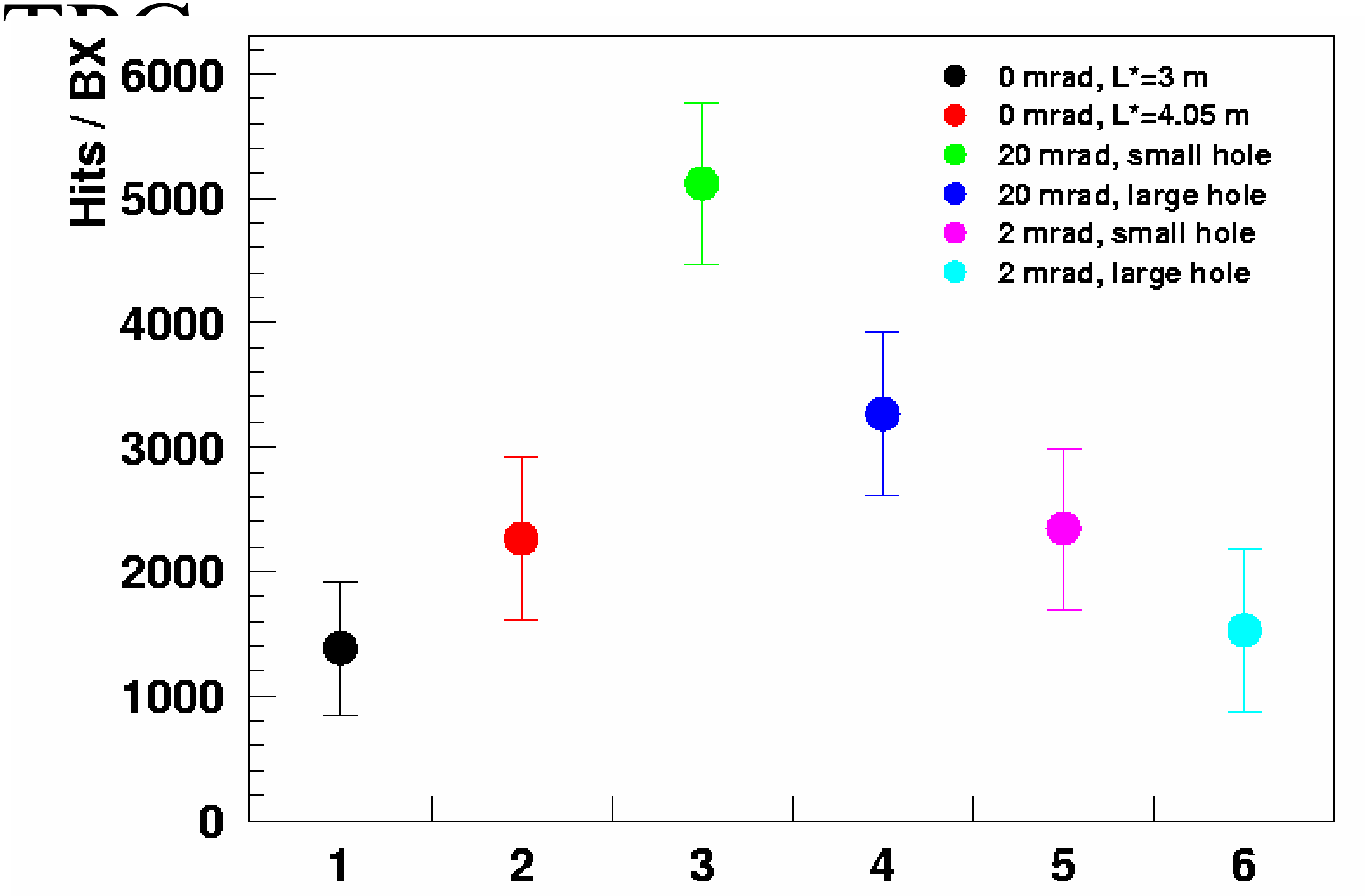
- Shielding of the detector from direct and backscatterd beam induced backgrounds
- Provide instrumentation for luminosity measurement, fast feedback system and hermeticity

Proposed Design for L* ≥ 4.05 m



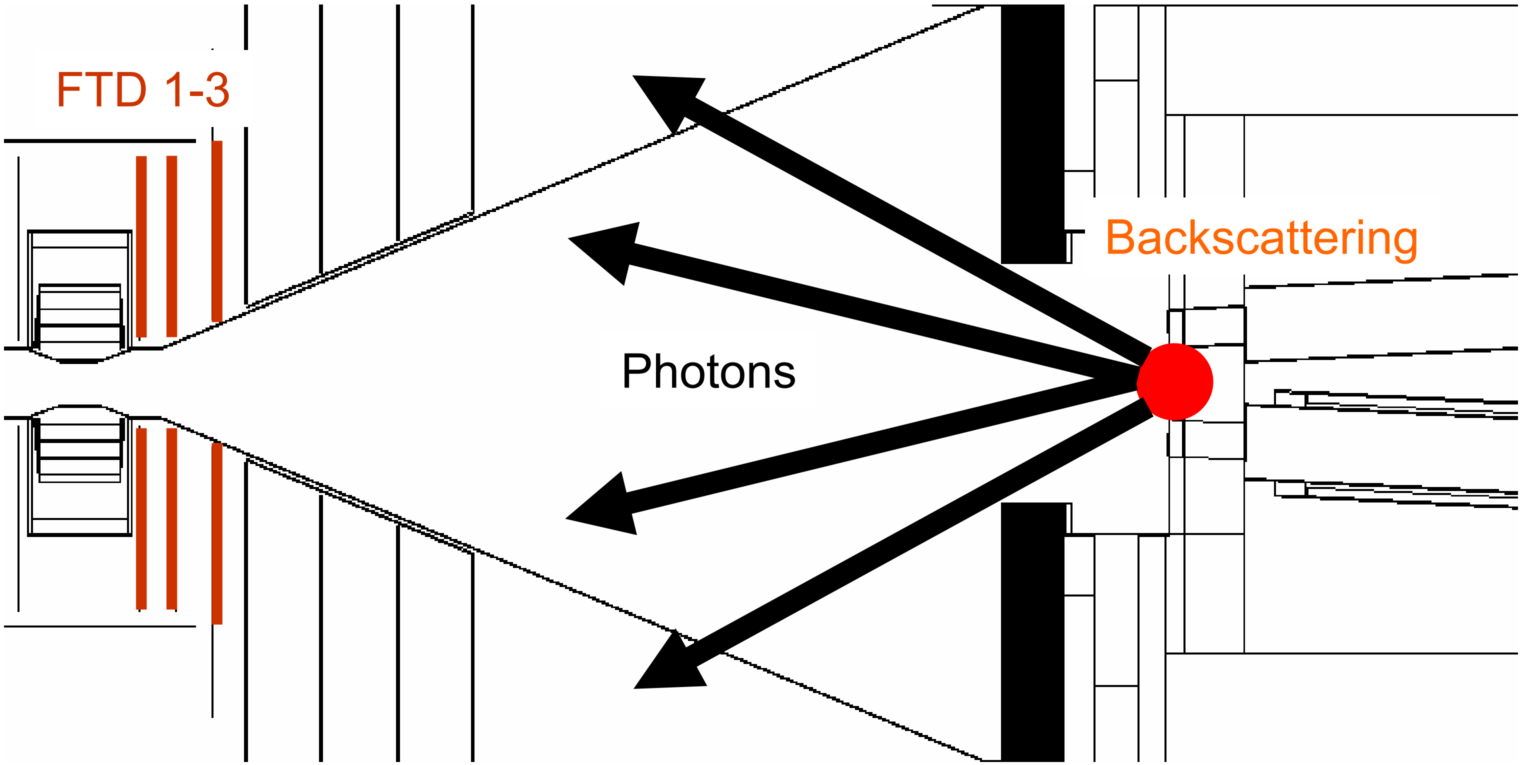
Design by Achim Stahl

TPC



Increasing the exit holes decreases backscattering into TPC volume

TPC Backgrounds



- TPC backgrounds are dominated by backscattered photons producing charged particles in the gas
- Photons from the frontside of the BeamCal are scattered back (more or less) isotropically
- Larger exit hole reduces isotropical backscattering (→TPC) but increases collimated backscattering (→VTX)

THE COIL AND THE FLUX RETURN
:
ITS ROLE IN THE DETECTOR

F. Kircher

DSM/DAPNIA/SACM
CEA/SACLAY

- In term of magnet design, the most important parameter for me is the factor $B^2_0 R_i$ (T^2.m) (representation of the forces)

Detector design	SiD	TESLA	LD	CMS
B_0 (T)	5	4	3	4
Coil int. radius (m)	2.5	3	~ 3.8	3
Coil length (m)	5.4	9.2	10	12.5
$B_0 R_i^2$ ($T m^2$)	31.2	36	43.3	36
$B_0^2 R_i$ ($T^2 m$)	62.5	48	34.2	48

Marco Battaglia

Benchmarks Physics Reactions

The Physics Matrix

	$\delta p/p$	σ_{IP} (μm)	$\frac{\delta E_{jet}}{E_{jet}}$	e-id	μ-id	h-id	low-θ veto	$E_{missing}$	Q_{vtx}
$ee \to H\ell^+\ell^-$	$< 5 \times 10^{-5}$	-	-	x	x	-	-	-	-
$H \to c\bar{c}/H \to b\bar{b}$	-	$< 10 \oplus 30$	x	-	-	-	-	-	-
$H \to \tau\tau/H \to b\bar{b}$	x	x	x	x	x	-	-	x	-
$ee \to HHZ$	x	$< 10 \oplus 30$	x	-	-	-	-	-	x
χ_1^0 DM $\tilde{\tau} - \chi$	x	-	-	x	x	-	$<$ 10 mrad	-	-
$e^+e^- \to WW/ZZ\nu\nu$	x	$< 10 \oplus 30$	x	-	-	-	-	-	-
$ee \to ee$	-	-	-	x	-	-	x	x	-
$ee \to q\bar{q}$	-	x	x	x	x	x	-	-	x
Single Particle	x	x	-	x	x	x	-	-	x

✧ Consensus set of benchmark reactions for of large detector design:

$e^+e^- \to H^0Z^0$, M_H = 120 GeV at 0.35 TeV

$e^+e^- \to e^+e^-$ at 0.35 TeV

$e^+e^- \to H^0H^0Z^0 \to b\bar{b}b\bar{b}q\bar{q}$, M_H = 120 GeV, at 0.5 TeV

$e^+e^- \to \tilde{\ell}^+\tilde{\ell}^- \to \chi^0\ell^+\chi^0\ell^-$, cMSSM, low $\tan\beta$, $M_{1/2}$=500-800 GeV at 0.5 & 1 TeV

$e^+e^- \to q\bar{q}$, $\mu^+\mu^-$, E_{jet}, A_{FB} at 1 TeV

$e^+e^- \to W^+W^-\nu\bar{\nu}/Z^0Z^0\nu\bar{\nu}$ at 1 TeV

Single $e^\pm$, $\mu^\pm$, $\pi^\pm$, π^0, $K^\pm$, K^0_s, γ, $0 < |\cos\theta| < 1$, $1 < p < 100$ GeV

✧ Prepare brief memo and circulate to ILCD05 mailing list to get feedback, discuss these benchmarks with SiD and GLD detector study groups;

✧ Prepare stdhep files of signal events by LCWS05 and have discussion in SLAC, engage physics groups;

✧ Aim for first results at Snowmass ALCPG meeting.

Choosing Contact persons for LDC

Recommendation from subgroup which met yesterday afternoon;
(Ties Behnke, Andy White, Hitoshi Yamamoto, Marco Battaglia, H.Videau, DJM.)

1. We recommend a group of 6 contactpersons: 2 per region.
2. Nominations (from groups or individuals) by end January:
   from Europe to R-D Heuer + DJM
   from N. America to J.Brau + M.Oreglia
   from Asia to H.Yamamoto + S.Komamiya:
   invited from all who wish to participate in this concept team:
   invitation to be emailed to all of European, N.American, Asian lists.
3. Consult with each other and arrive at a list of well supported nominees with balance of sub-detector skills.
4. Ask chosen nominees if willing to serve. If not, re-consult.
5. Whole contactperson group must be ready to meet at LCWS.

---

*LDC is Large Detector Concept; starting from this meeting.
Others are SiD and GLD.

David Miller

Responsibilities

Suggested initial responsibilities of contactpersons:

- Set up contacts with individual participants in the concept, with R&D collaborations and with physics studies.

- Plan work.

- Co-ordinate responses to be requested by WWS, for example:
  - List of critical R&D, missing R&D; by summer 2005.
  - 1st costing ideas; for Snowmass
  - Prepare concept presentation (for Snowmass? ½ day?)
  - Written Detector Outline, by Spring 2006