R&D Coordination for SiD

First thoughts

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LCWS05/SiD

Physics examples driving SiD design

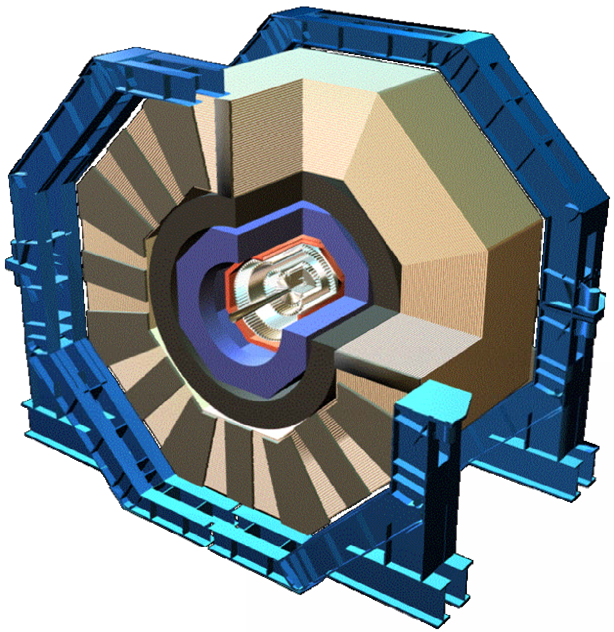
Benchmarks Physics Reactions

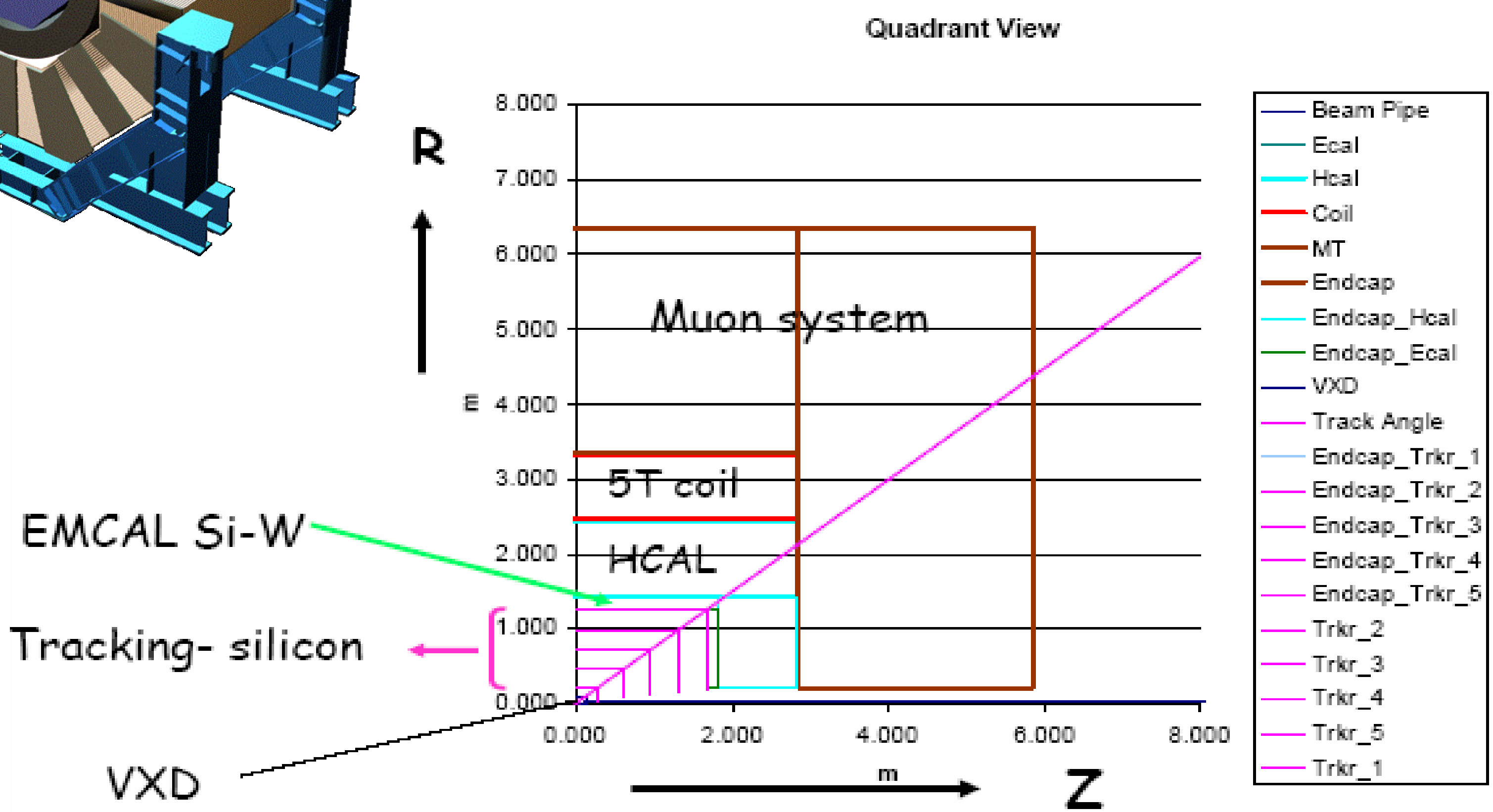
The Physics Matrix

	$\delta p/p$	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

M.Battaglia, LD meeting/Paris 2005

SiD





Quadrant View
R
Z
m
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0.000
2.000
4.000
6.000
8.000
Muon system
5T coil
HCAL
EMCAL Si-W
Tracking- silicon
VXD
Beam Pipe
Ecal
Hcal
Coil
MT
Endcap
Endcap_Hcal
Endcap_Ecal
VXD
Track Angle
Endcap_Trkr_1
Endcap_Trkr_2
Endcap_Trkr_3
Endcap_Trkr_4
Endcap_Trkr_5
Trkr_2
Trkr_3
Trkr_4
Trkr_5
Trkr_1

SiD *looks* like most collider detectors, but…

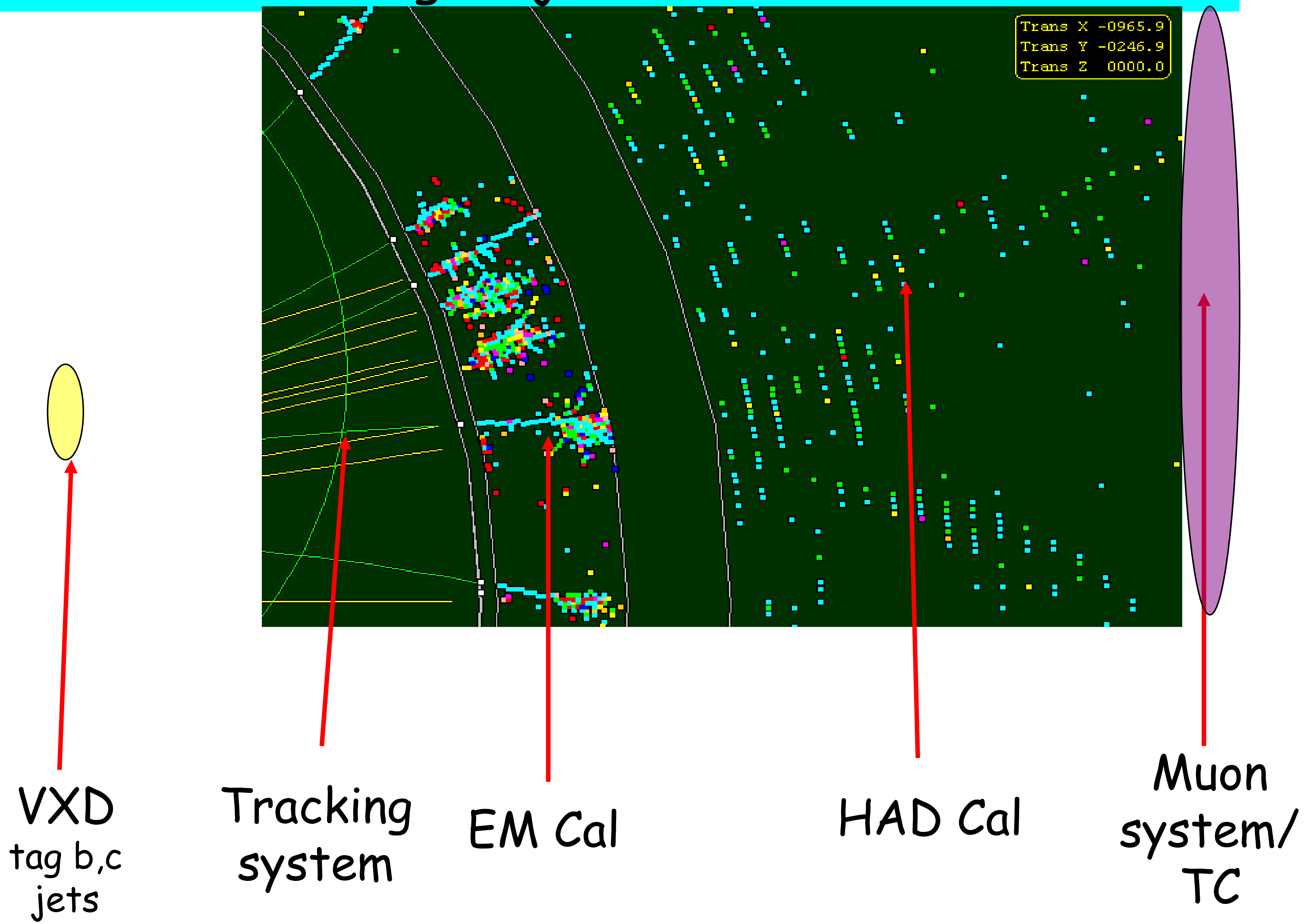
It has a much more integrated approach that other, previous detectors. So we must may attention to the subsystem interactions and compatible compatible technology choices, as well as doing the usual subsystem R&D

It also poses some significant challenges:

What is the true performance of a tracker with a small number of layers, but with very high point resolution (~10μm)?

What is the best calorimeter technology for Energy Flow and how well can we actually reconstruct jets/measure jet energies?

Integrated Detector Design - elements contributing to jet i.d./measurement



Integrated Detector Design

So now we must consider the detector as a *whole.*

Examples:

The tracker not only provides excellent momentum resolution (certainly good enough for replacing cluster energies in the calorimeter with track momenta), but *also* must:

- efficiently find all the charged tracks:

Any missed charged tracks will result in the corresponding energy clusters in the calorimeter being measured with lower energy resolution *and* a potentially larger confusion term.

So tracking efficiency affects calorimeter resolution

Integrated Detector Design

Energy leakage from the calorimeter:

- If a small percentage of energy is unmeasured in the calorimeter, energy is absorbed in the coil (~1λ); how is the residual energy best treated in the tail-catcher (depth, granularity,...?)

Muon tracking through the calorimeter:

- If we have a digital calorimeter with MIP finding at ~1cm spatial resolution over 40 layers, how does this feed into the muon system design?

SiD R&D needs

All subsystems will require R&D:

- Vertex detector
- Si Tracker
- ECal
- Hcal
- Superconducting Coil
- Muon/Tail-catcher
- Forward systems ?

SiD R&D needs

- Some R&D has already been done:

  LCRD, UCLC, ADR, Lab. supported,...

- Resources are limited – roughly FLAT LC Detector R&D budget over several years.

- FY2006 budget has significant increase for LC R&D...but mainly for accelerator development. Possible re-evaluation of the need to have detector development keep pace with the accelerator work??

SiD R&D needs - timescales

-It is now becoming clear(er) that:

- the LHC will start with an "engineering" run in late 2007, but detector elements will not be complete

- we should expect some initial perspective on the TeV energy scale from LHC by 2010

- any "go-ahead" for the LC will, at least partially, be tied to the LHC results

- it will take ~10 years from the "go-ahead" to build the accelerator and the detector(s).

So...we have ~5 years to build, test, and understand, subsystem technologies for the Linear Collider.

SiD R&D needs

In any plausible scenario, we will have to prioritize detector R&D:

- which are the most critical R&D tasks?
- which R&D tasks will take a long program to understand, and therefore should start early?
- what are the necessary sequences of subsystem development prior to combined tests?
- which subsystems must be tested in beam?
- which are the essential combined tests that we must perform as part of developing a baseline SiD design?

SiD R&D Coordination – Next Steps

- Survey what has been done so far
- Survey what is proposed for the next round
- Understand subsystem plans (which technologies, who is involved in SiD R&D, levels of effort, resources,…)
- Understand in the context of overall SiD design what is needed by when.
- Interact with WWS R&D Panel to understand what will be requested this year/beyond.
- Start now to develop SiD R&D plans – refine through the next few months/Snowmass

SiD R&D Coordination – fact finding

Need to establish –from WG leaders:

- what R&D is needed for subsystem
- what has been done so far – is it good enough
- who is involved – do you need more people
- what is planned in short term
- what is funded and how
- what is un-funded – how much
- timescales for R&D components
- what are the critical R&D questions that must be answered before detector design choices can be made

(continued…)

SiD R&D Coordination – fact finding

- what can be deferred
- resources – available, foreseen, needed but not available
- test beam needs
- interaction(s) with other subsystems
- combined beam tests
- any new ideas – not yet heard from