Review of ACFA meeting Beijing 2007 Detector and Physics

Ties Behnke, DESY

BILC2007 (Beijing International Linear Collider meeting 2007)

small meeting for the detector and physics part

strong participation by Asian groups

but significant participation by European and American groups (more so than in the past: our effort is really getting international)

A strong component of the meeting:
the tracking review of the R&D panel

(run in parallel to all parallel sessions throughout the complete conference)

Physics Highlights

Focus on Higgs physics and cosmology

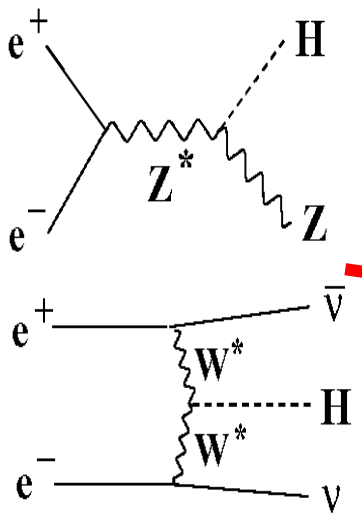
- Stress again the importance of Higgs physics at the ILC

  but: be aware: do not take the indirect predictions too serious.

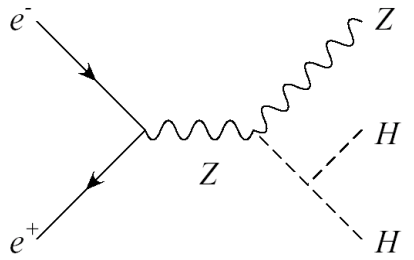
- Cosmology is still very fashionable, and many people try to investigate different models which could be studied at the ILC

Higgs Physics at the ILC:

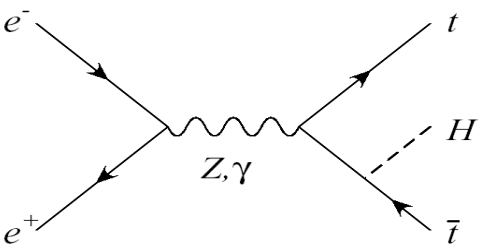
Gauge Coupling



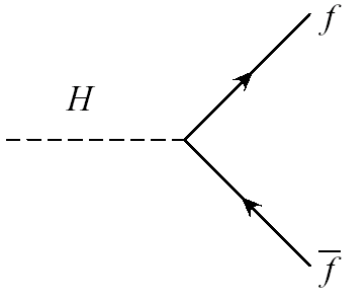
Self-coupling

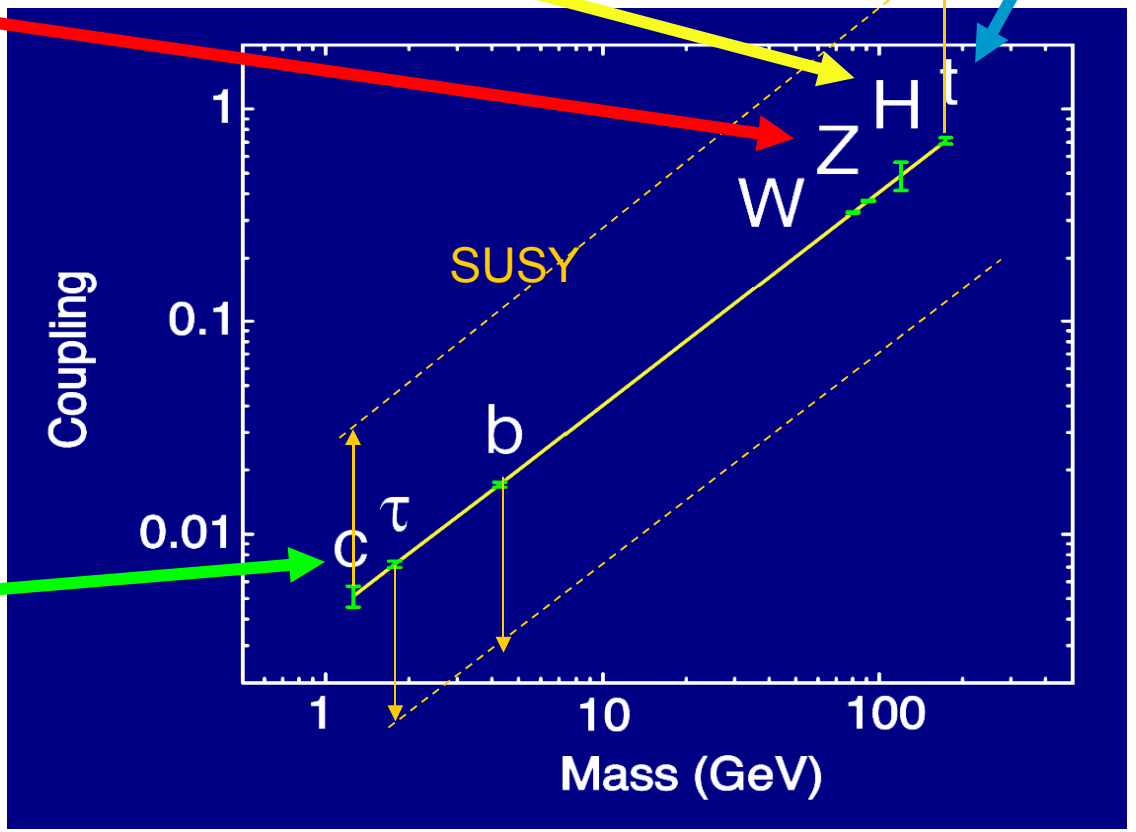


Top Yukawa coupling



Yukawa coupling



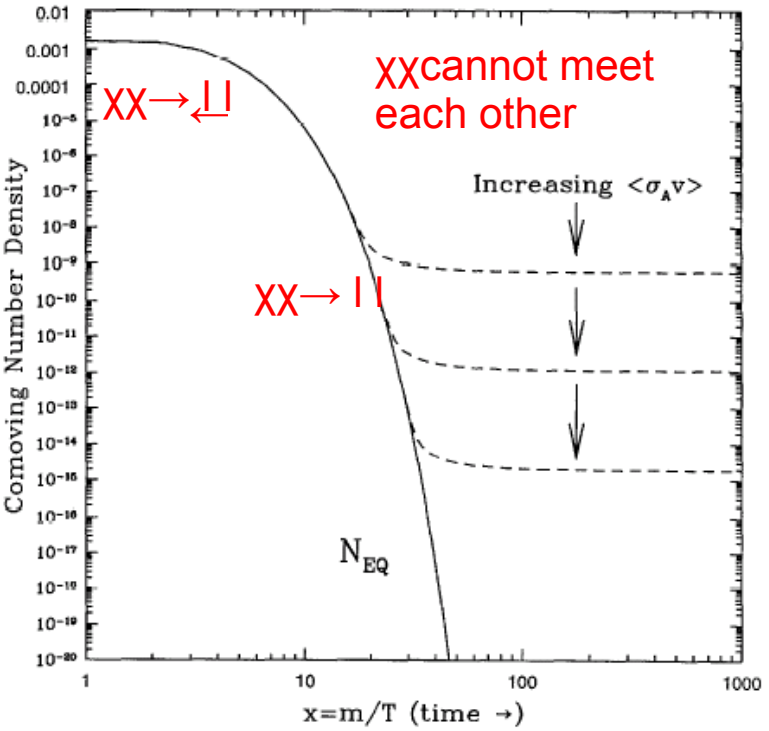


Dark Matter and the ILC

If LSP in SUSY (or LKP in Universal Extra Dimension models, or LTP in Little Higgs models with T-parity) is a Dark Matter, and its masses is within a reach of ILC,
Mass and the couplings of the LSP will be determined at ILC.

⇒ The LSP is identified and the density of Dark Matter in the universe and in Our Galaxy can be calculated.

$a(t)^3 \cdot \rho(t)$ vs time

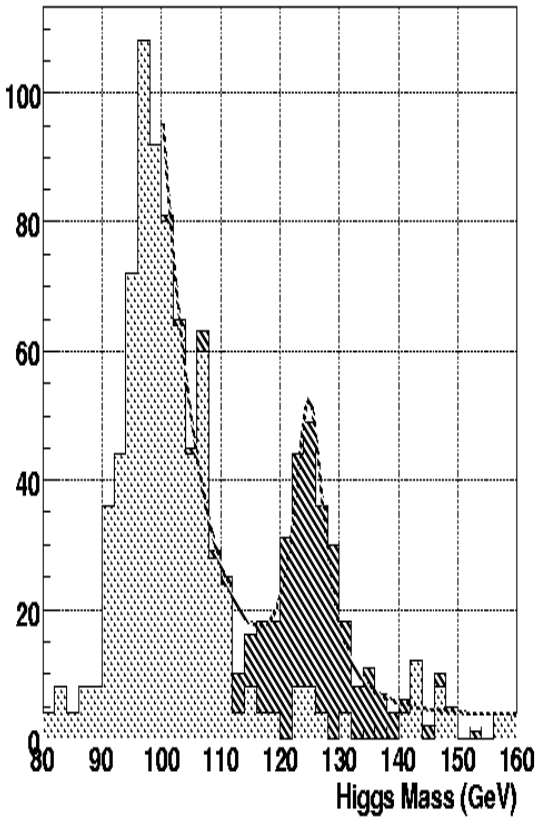


G. Jungman et al. Physics Report 267 (1996) 221

Nice study done on long lived particles by C. Martyn here at DESY

Full Simulation Analyses

In general: attempts to do fully simulated analyses, for realistic results, with full backgrounds etc.



Example of analysis :

HZ->nunu bb,
reconstruct the b-hadronic final state

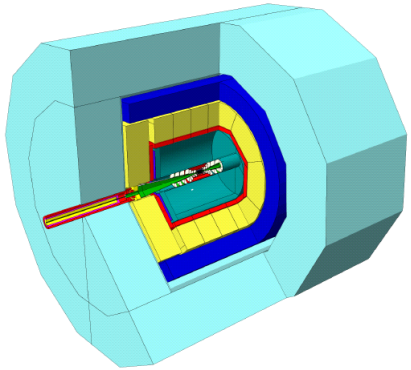
While there has been some progress, the situation overall is still dissapointing:

too few full anlyses, too little activity in this area

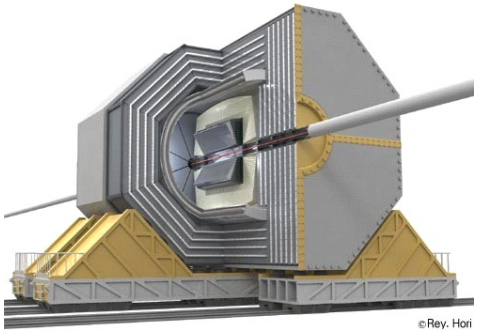
The Concepts

Detector Developments are often reported in terms of the concepts

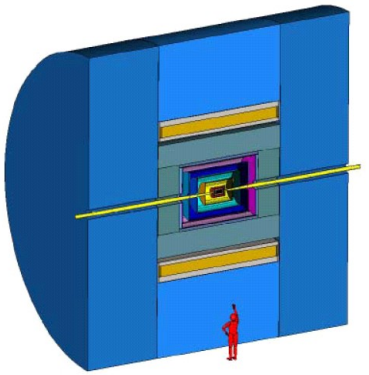
LDC



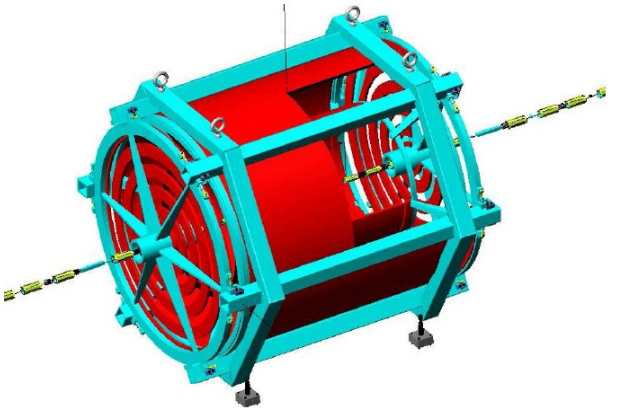
GLD



SiD



4th

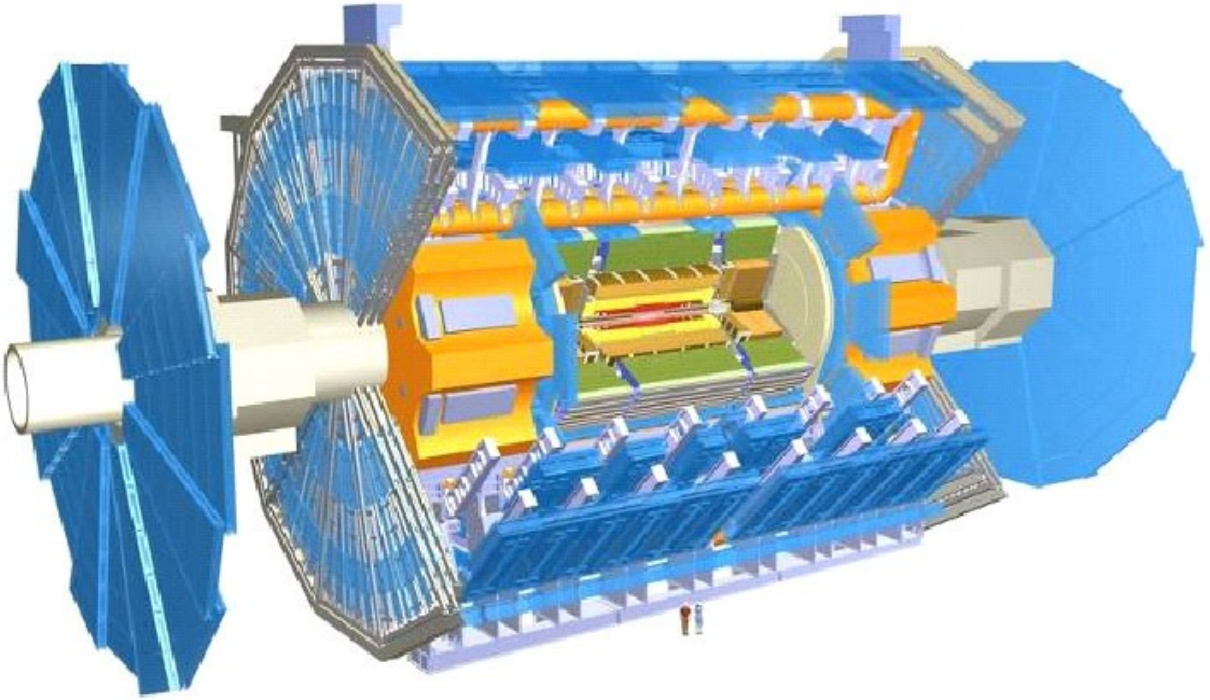


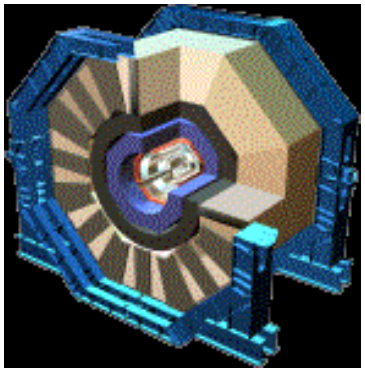
Self shielding detectors with Iron Yoke

Non-self shielding, no classical iron yoke

ATLAS@LHC

Diameter	25 m
Barrel toroid length	26 m
End-cap end-wall chamber span	46 m
Overall weight	7000 Tons
Detector sensors	110M channels





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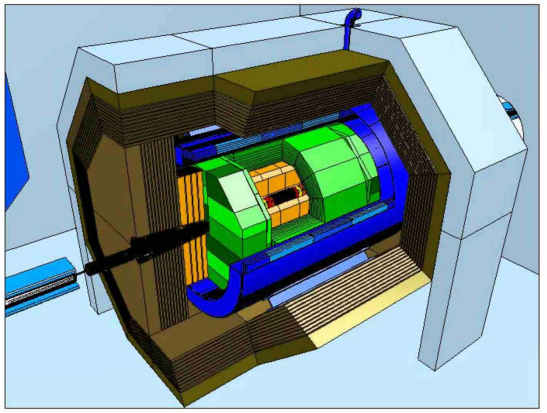
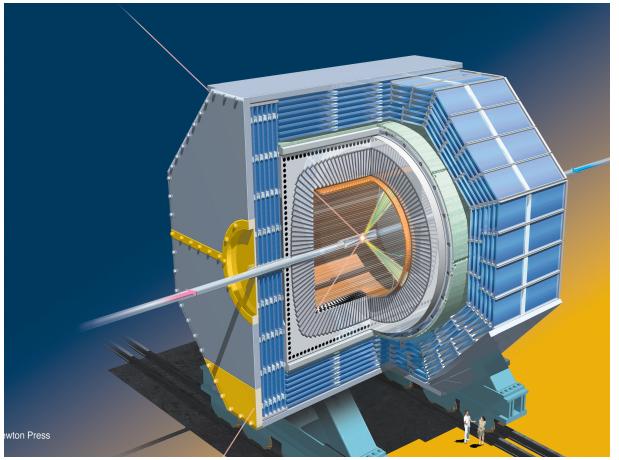


LDC



GLD

Challenges

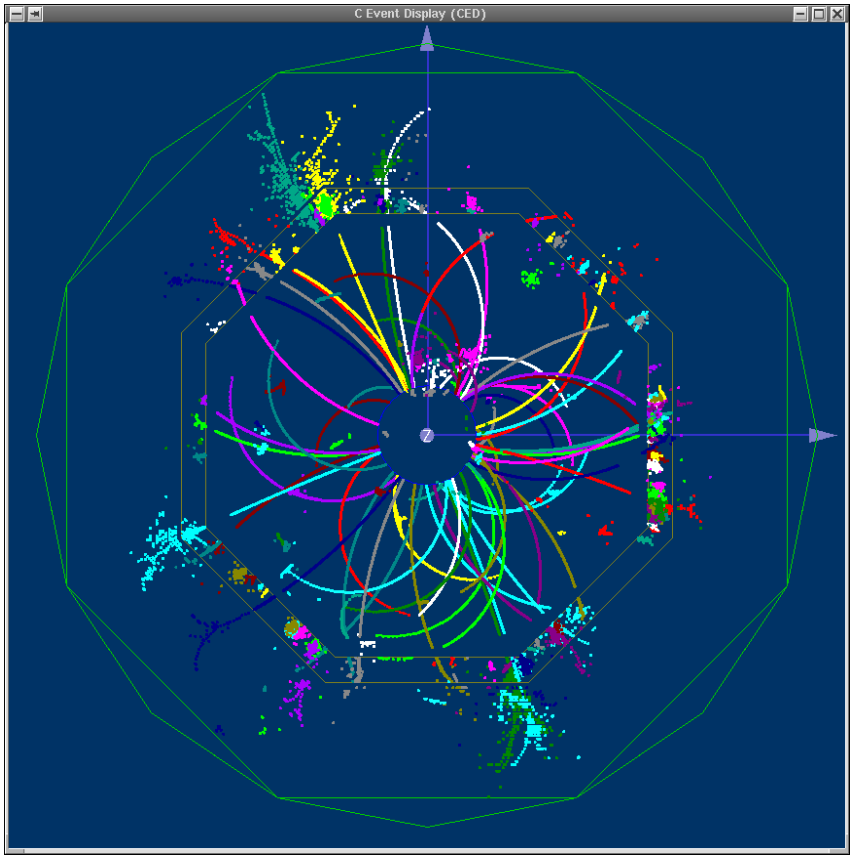
No details will be given in this talk.....

Precision tracking and vertexing:

- excellent precision, unheard of vertexing
- very good efficiency of tracking even in complicated topologies

Particle Flow?

- Impact on calorimeter and rest of detector
- Alternatives to Particle Flow?



Challenges: Event Reconstruction

Maybe the biggest challenge:

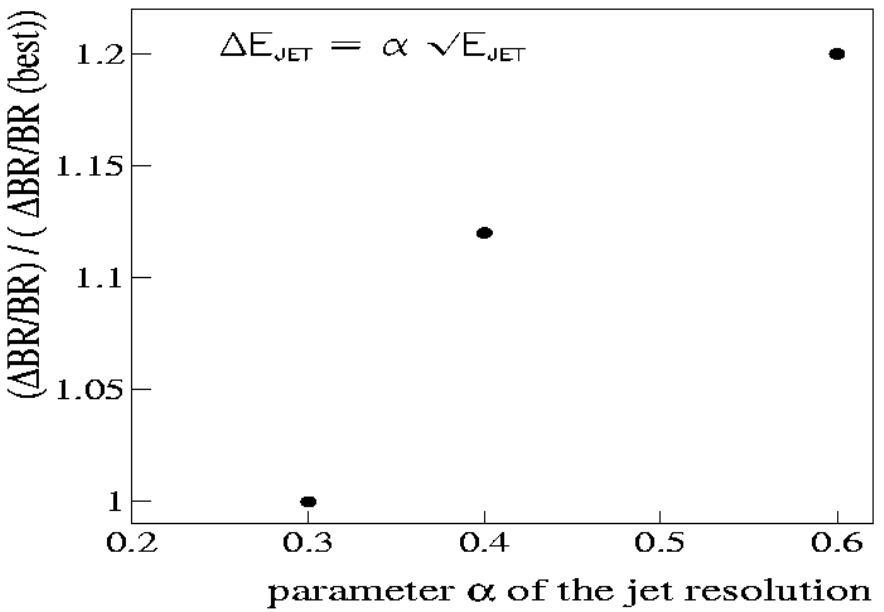
overall event reconstruction

to a sufficient accuracy

Implementation of particle flow?

Other methods?

Change in the error of H->WW
versus Jet E resolution



Calorimeter

Calorimetry plays a central role in the ILC detector

particle flow or compensated calorimeter?

SiD, LDC, GLD

4^{th} concept

Highly granular calorimeters

many samples

stress system efficiency over energy resolution

need excellent linkage to tracker

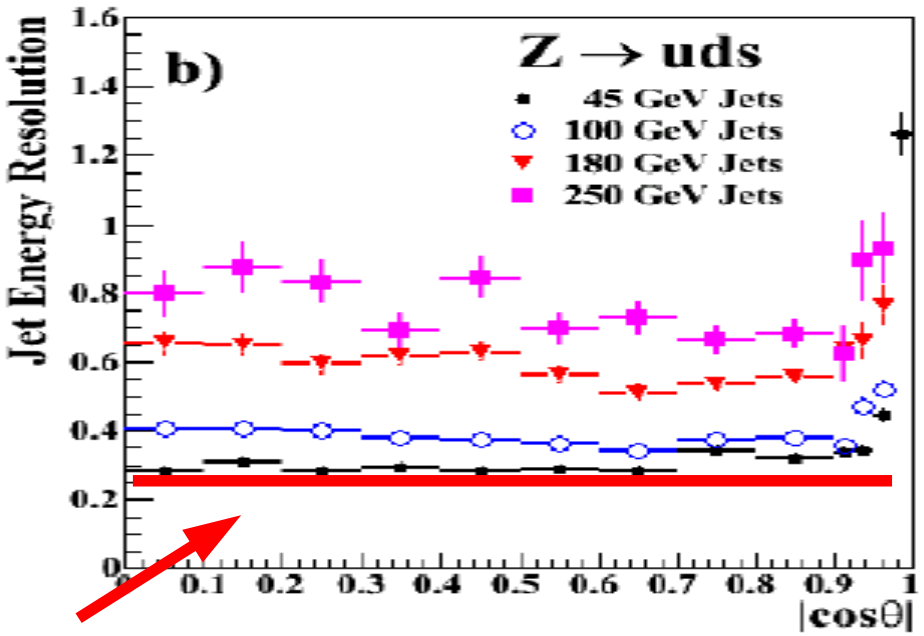
Need compensation

Good energy resolution more important

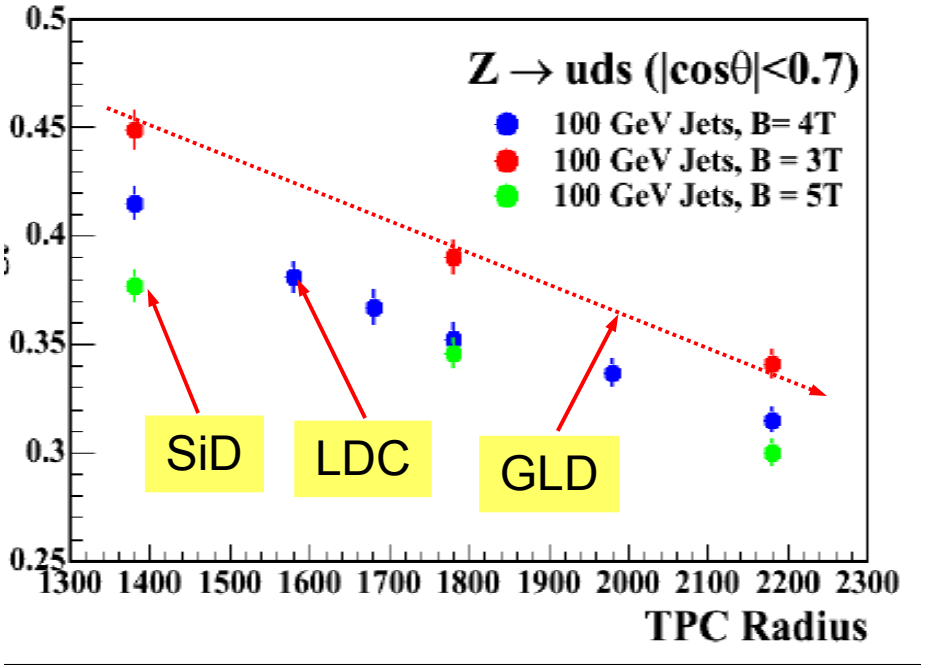
decent granularity (but role not really clear)

Particle Flow Performance

Performance of particle Flow at different energies (Pandora PFA)



ILC goal: 30%/√E



Lots of progress,

but for high energies still no good enough performance demonstrated

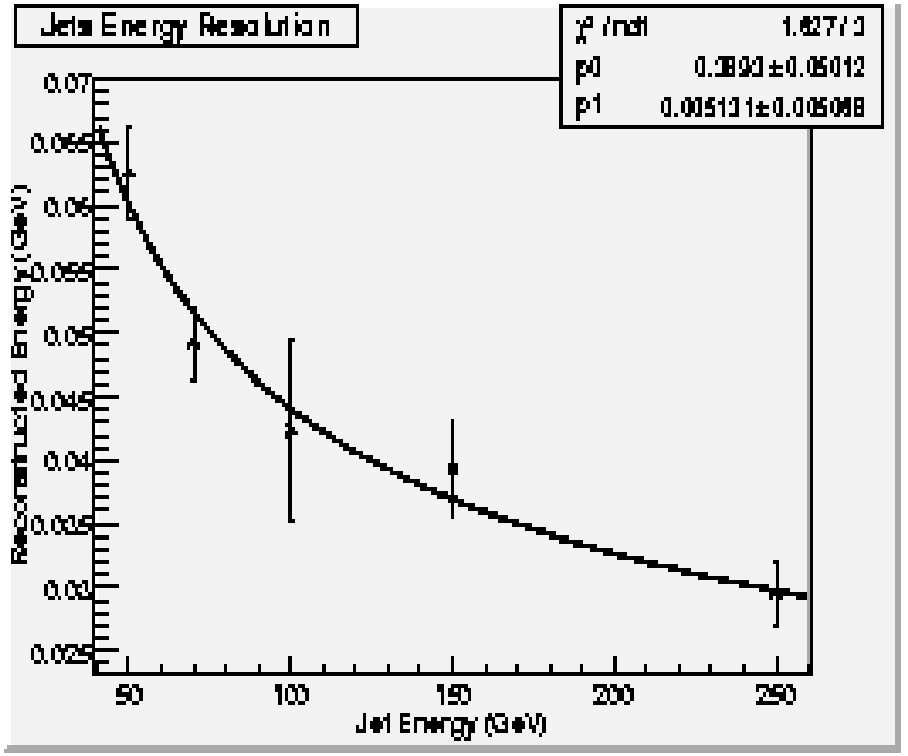
Non PFLOW performance

38%/sqrt(E)

Alternative approach:

compensating calorimeter,
no real particle flow
some topological information

Results from the DREAM calorimeter (4th concept)



Jet energy resolution

Where do we stand

Lots of progress on the particle flow, but not enough

Recent algorithm start to approach the goal of 30%/sqrt(E)

At high energies we are still far from the goal

there is a lack of real physics studies to show the impact of this on physics

we have not yet understood the PFA well enough to really use it for detector optimisation

Interaction with the GDE

In the past there have been problems in communiciting between the GDE and the experimenters.

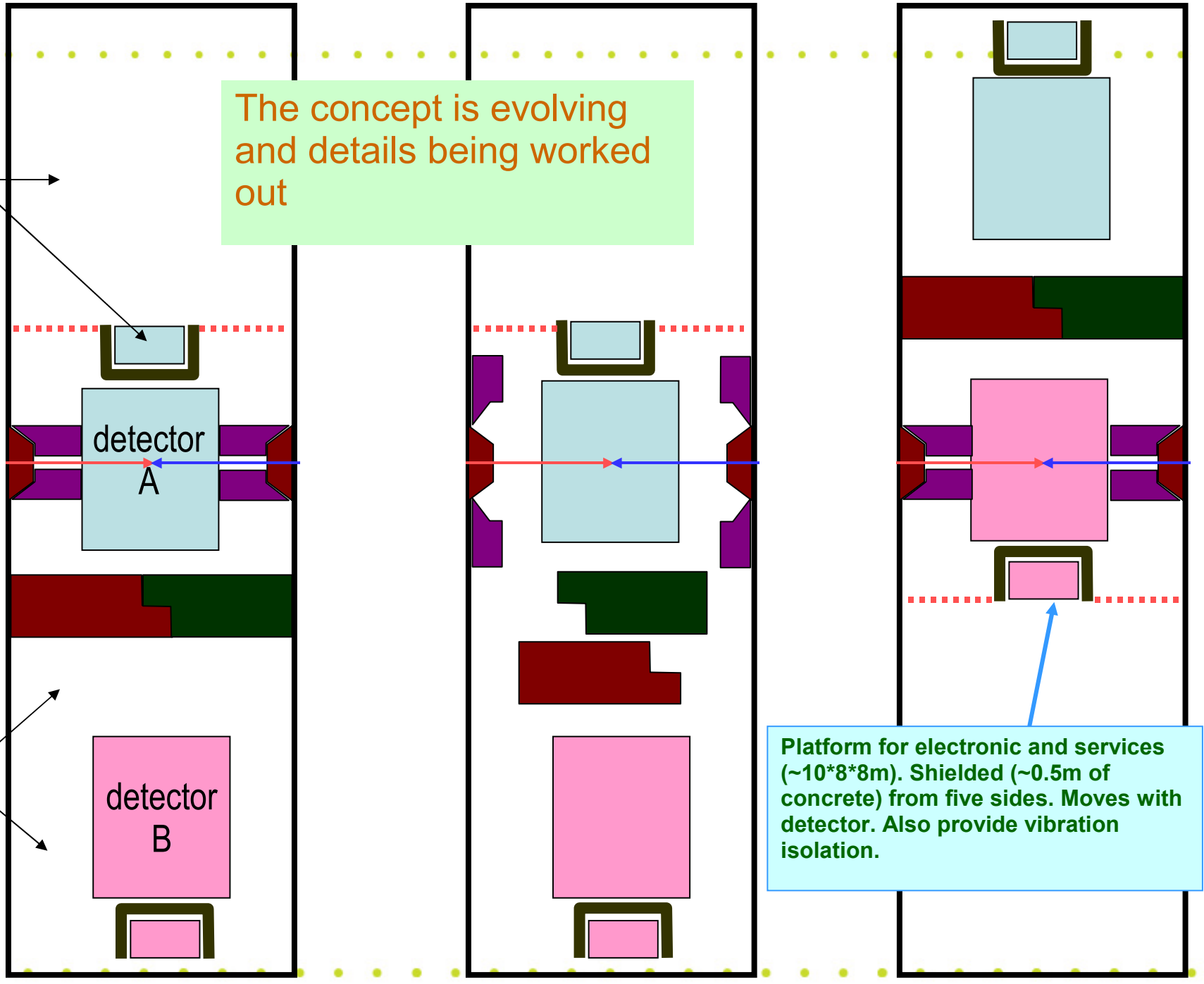
The situation has much improved,

though it is still not perfect.

Concept of IR hall with two detectors

The concept is evolving and details being worked out

may be accessible during run



accessible during run

Platform for electronic and services (~10*8*8m). Shielded (~0.5m of concrete) from five sides. Moves with detector. Also provide vibration isolation.

Andrei Seryi

Slide by Sacchio Komamiya

GDE management's idea of push-pull

Surely, you jest…

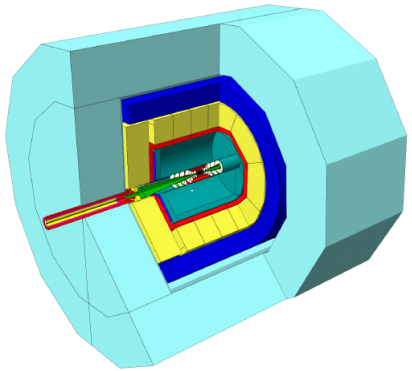
We need to:

- Finalize DCR
  - Time scale: as soon as possible
  - Perform further studies
- Work toward EDRs
  - Strengthen concept studies
  - Strengthen horizontal efforts
  - Form consensus on how to converge to two detectors
- Establish better communications with the accelerator camp
  - Including the push-pull study
- Prepare (brace..) for physics results from LHC
- Involve more people and countries

Hitoshi Yamamoto
Charge of this workshop

Next Steps

LDC



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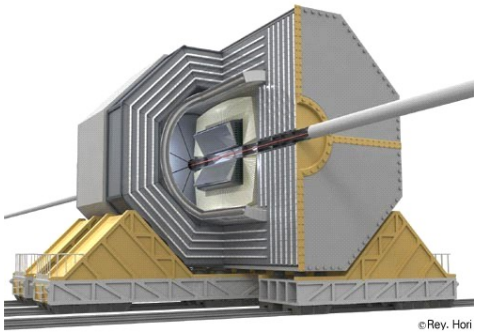

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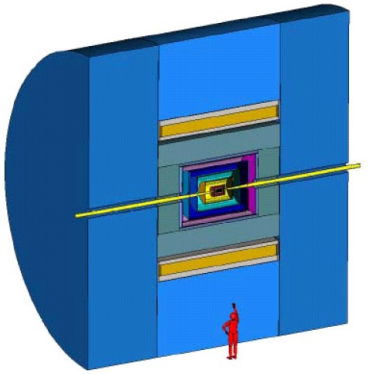

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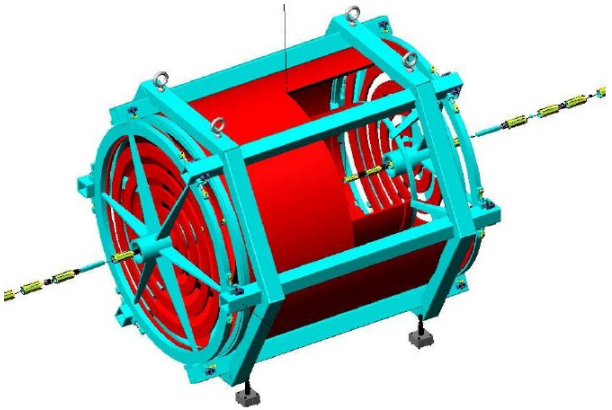
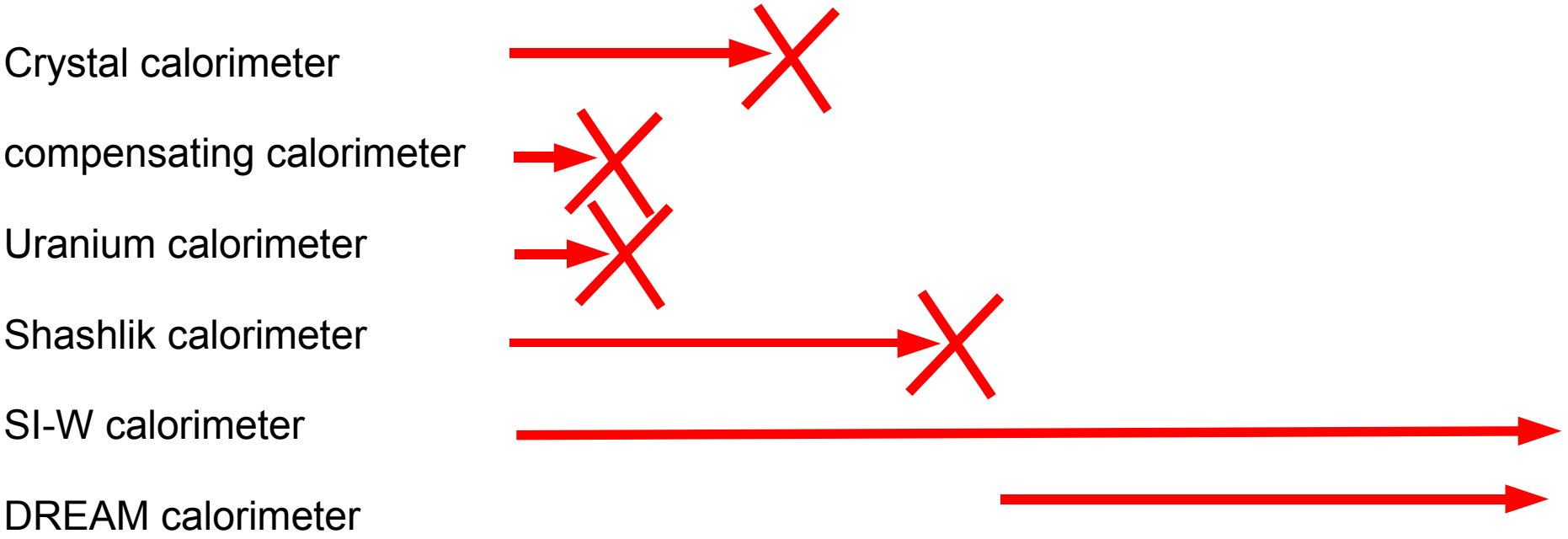


Self shielding detectors with Iron Yoke

Non-self shielding, no classical iron yoke

Chaos?



The down select has and is happening on the technologies at the moment

Next Steps

- Science

First of all, we need to understand the jet-energy measurement
before talking about the choice of concepts.
(The cost driver is the calorimeter).

Putting all the efforts into a single state-of-the-art and truly-international detector concept might be ideal, since we can spend a little more budget on it to add some redundancy.
(Just adequate detector is normally not adequate enough) .

However, in order to cross-check the results at least two detectors are needed (statistics/detector $< \frac{1}{2}$ for the push-pull scheme).
"ILCSC parameter committee"

- Sociology

The ILC physics/detector community is large enough to have two detectors. We need some competition.
ATLAS/CMS, H1/ZEUS, BaBar/Belle, …

How to merge the detector concepts ?

- Methodology

  Spontaneously forming detector collaboration might be ideal and this was the usual method in the past HEP experiments . (……., at LEP, at LHC)

  If a new methodology is needed, the procedure has to be extensively discussed and carefully designed not only within WWS but also among the ILC physics/detector community.

  More scientific studies are needed to have consistent overall concept of detectors.
  Two equally good detectors, two complementary detectors, …

  We have to be fair to all the parties. We should not make losers in the community.

- Timing for the merge
  too early detector concept will not be optimal
  too late miss the accelerator commissioning

  We should not be too hectic. We need to see the accelerator R&D development and development of international consensus.

- (One collaboration with two detector concepts might be the ideal case.)

Conclusions

BILC2007 was a nice and interesting conference, with a large participation of the Asian ILC community

It is nice to see that the number of Asian countries who are interested to participate is increasing

Clear problem for detectors: need to understand the reconstruction much better, particularly the jet energy resolution (particle flow)

The Roadmap for detectors is now being discussed internationally

clear: be in step with the machine time line

not so clear: what does this mean, and how are we best proceeding