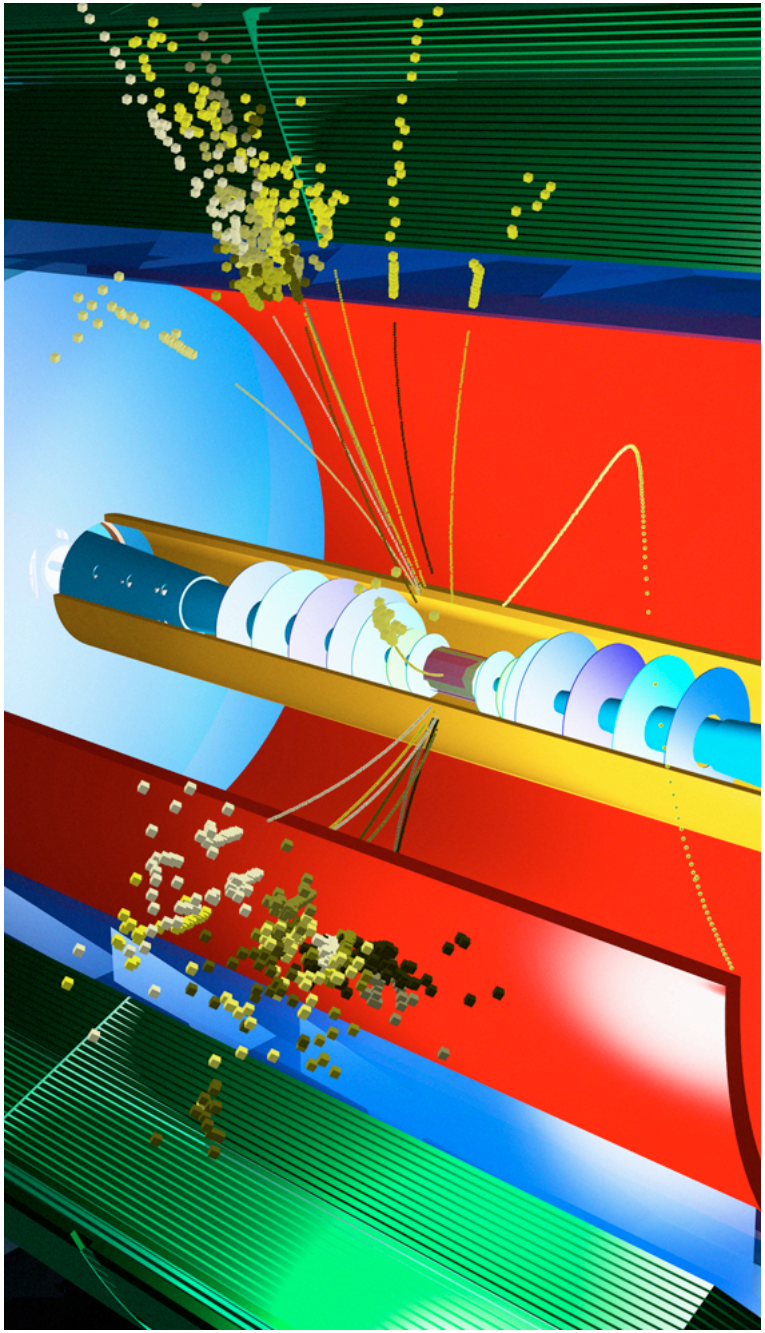
ILD status report

Jan Timmermans (Nikhef/DESY)
(on behalf of the ILD concept group)

ILC PAC meeting, Prague

14 Nov. 2011



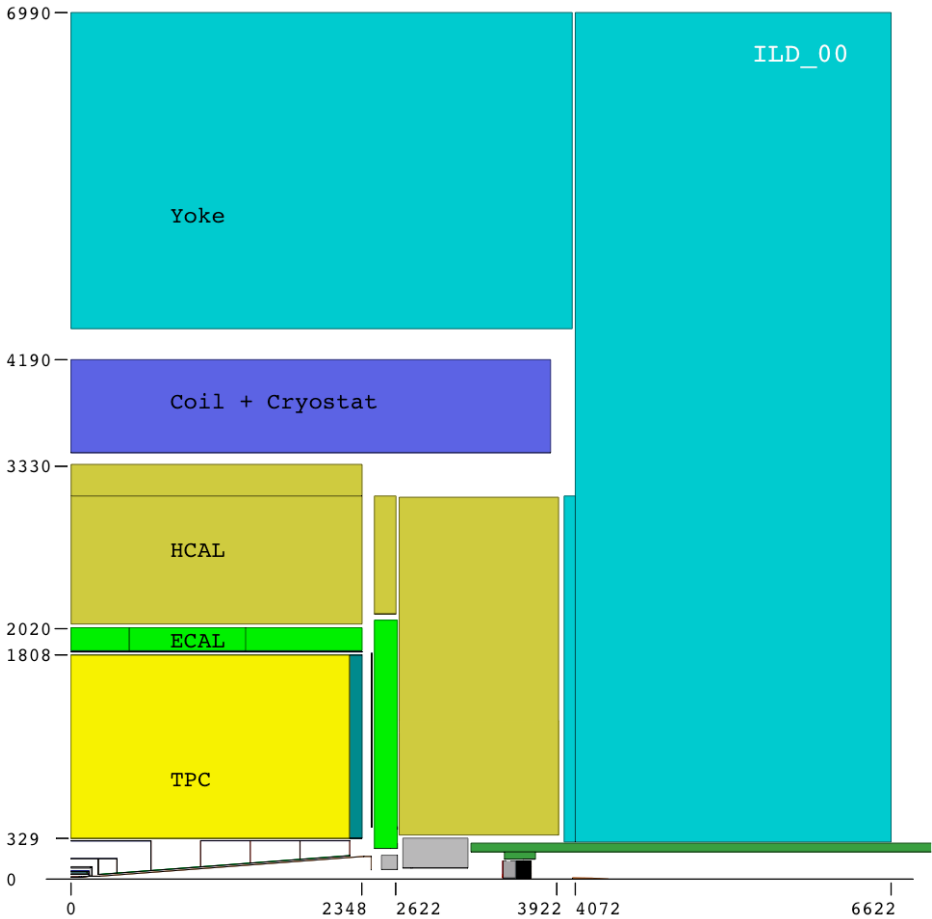
Outline

- ILD detector and group
- Recent meetings and testbeam campaigns
- DBD preparations
  - Baseline detector and strategy
  - Benchmark processes and analyses
  - Detector R&D
  - Detector integration
  - Costing
- Funding situation
- Summary

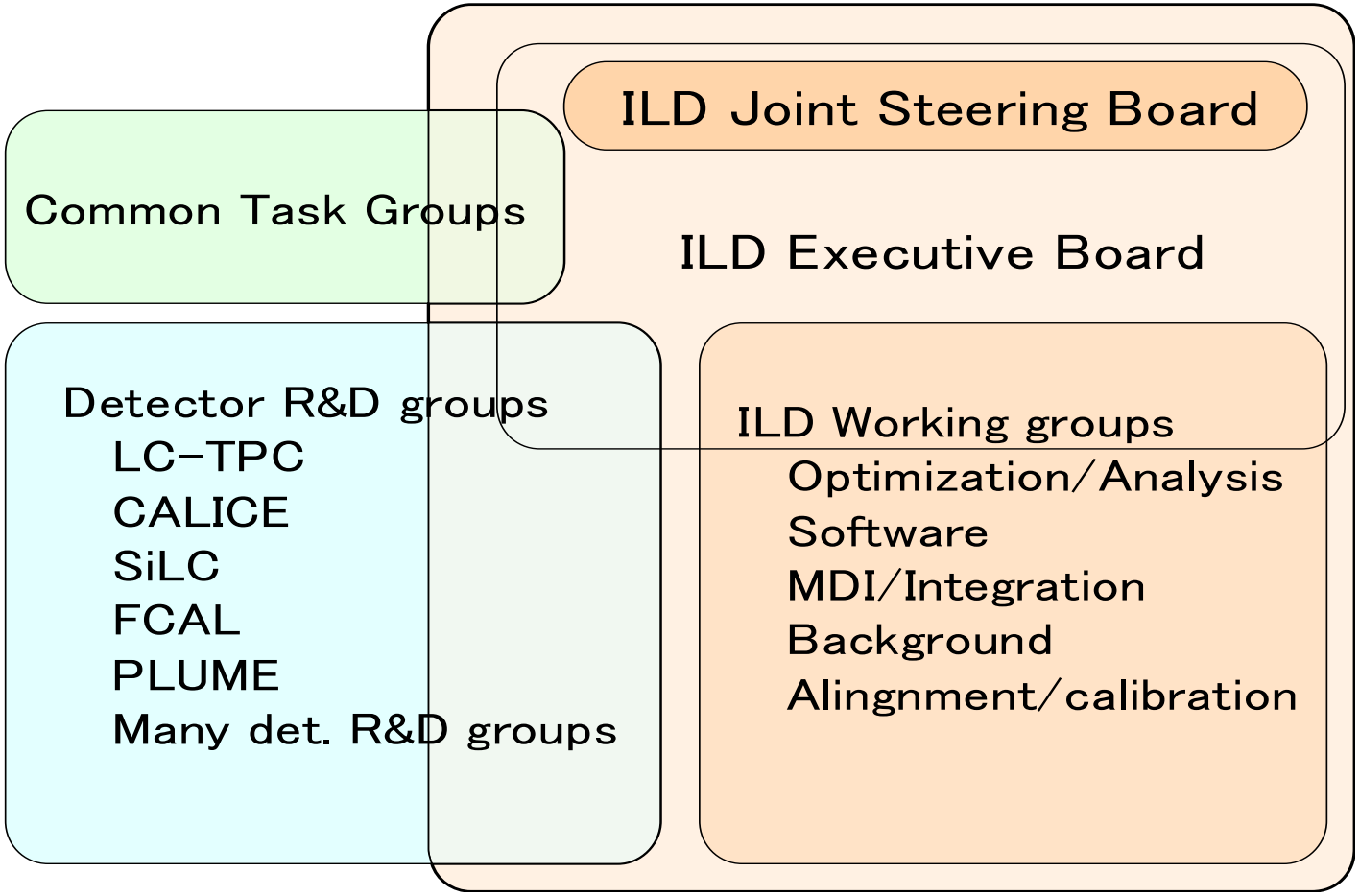
- Backup slides: some R&D results

ILD Detector

- International Large Detector
  - General-purpose large detector optimized for particle flow algorithm of jet energy reconstruction
  - Si-based vertex detector and inner/forward trackers
  - Gas-based central tracker: TPC
  - Ultra high granularity imaging calorimetry at large radius
  - High B field of 3.5 T
  - Hermetic coverage by forward calorimeters



ILD group


ILD Joint Steering Board
Common Task Groups
ILD Executive Board
Detector R&D groups
LC-TPC
CALICE
SiLC
FCAL
PLUME
Many det. R&D groups
ILD Working groups
Optimization/Analysis
Software
MDI/Integration
Background
Alingnment/calibration

ILD since PAC Taipei

ILD meeting in Paris in May 23-25, 2011

http://ilcagenda.linearcollider.org/conferenceOtherViews.py?view=standard&confId=4901

75 registered participants

Dense program

- review overall status
- review in detail
  integration status
- discuss and decide
  on simulation baseline

Common meeting
with ILC CFS people

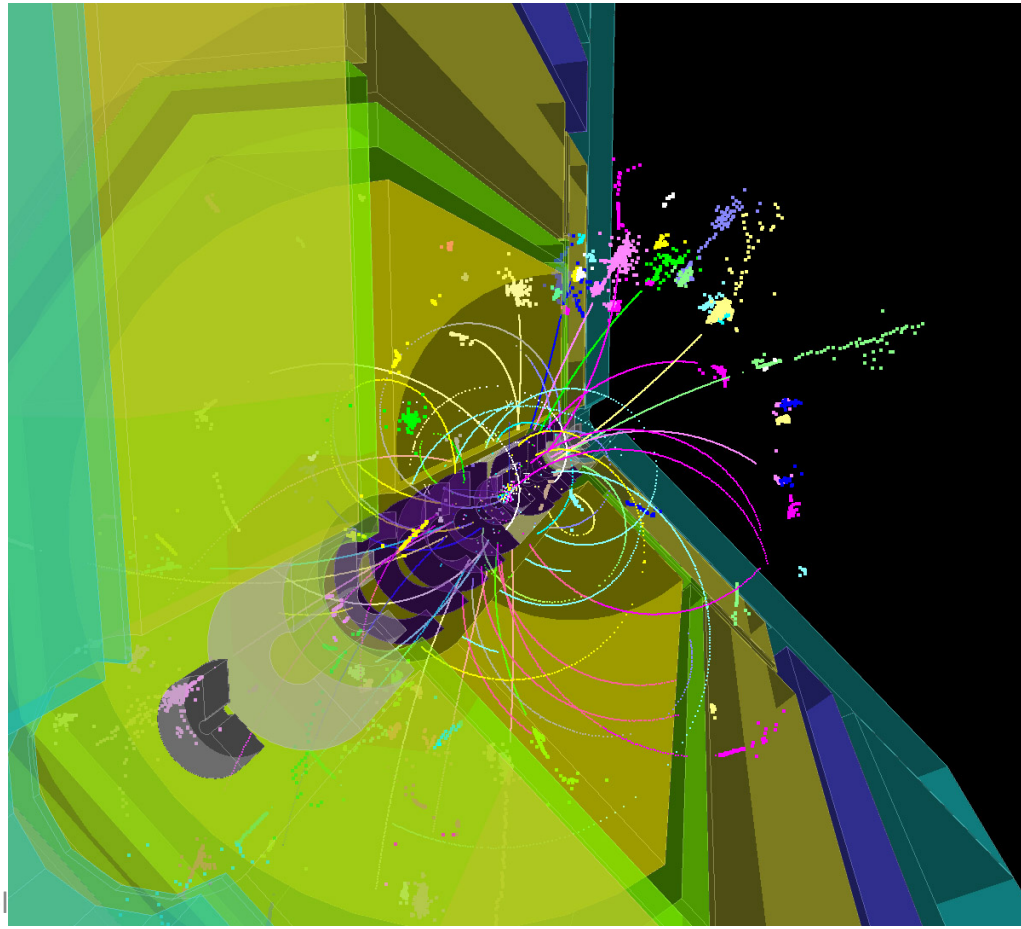
Discussion with ILC PM
to understand better
boundaries from collider

Participation from CLIC study

Many thanks to our collegues at KEK and LAL who worked together closely to move the ILD meeting on short notice from KEK to LAL

http://ilcagenda.linearcollider.org/getFile.py/access?contribId=16&sessionId=1&resId=0&materialId=slides&confId=5134

The ILD concept;
session summary & DBD plans



LCWS11,

Granada,

September 25-30 2011

Marcel Vos (IFIC – U. Valencia/CSIC)

on behalf of the ILD detector concept

Test beams connected to ILD since ALCPG11 Eugene

May/ June/ July 2011: DESY/ KEK: TPC GEM readout module at DESY
Saclay/Carleton integrated Micromegas module at DESY

Summer 2011: CALICE; Digital HCAL at FNAL

Summer 2011: CALICE: Scintillator HCAL with Tungsten absorber at CERN

Fall 2011: CALICE: Semidigital HCAL at CERN

Summer 2011: Si strip detectors at CERN

Summer 2011: FCAL at DESY

…..

Subdetector R&D is progressing within the limits of person-power and funding

Software baseline

Intense discussion at Paris on software baseline and the treatment of options

ILD has a number of options

- Strength of ILD: makes the concept flexible and interesting, leverage latest developments, ensures broad participation

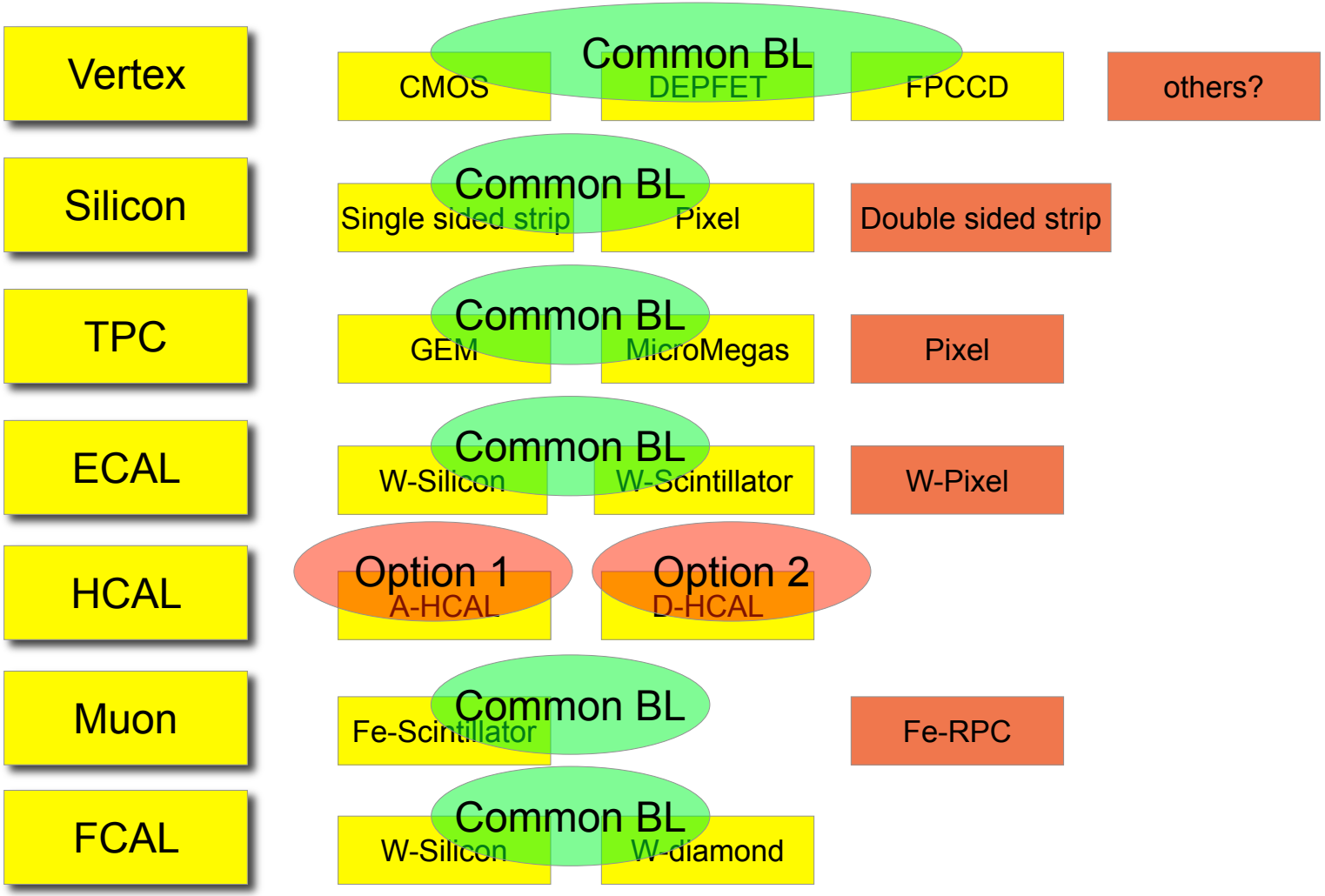
- Potential problem, since any break in the symmetry might be seen as a pre-selection

Status/ agreement at Paris:

- VTX, TPC, ECAL options have agreed on common reconstruction at this stage

- Only remaining option are AHCAL/ SDHCAL which will be treated symmetrically

ILD: baseline detector
The current picture



Strategy of ILD

★ **Software models/reconstruction**

- Push forward with validation of simulation and reconstruction of ILD01 model (SiW + AHCAL)
  - evolution of existing software
  - still, validation is non trivial and may take ~6 months
- Produce MC samples with this model for DBD physics
  - not a full O(50 Million event) SM production
- Guarantees ILD will meet DBD requirements

★ **In parallel**

- Support development of PFA for DHCAL and SciW ECAL
  - ~6 month programme of work
- Once "ILD01" production is safely underway
  - commence validation of full detector models with SDHCAL and SciW ECAL
- Full comparison of PFA perf. on 500 GeV physics
- If time allows, in position to redo 1 TeV DBD study

Analysis for ILD

Analysis Topic	Name	Comment
e+e- → ZH → l+ l- X	Youssef Khoulaki, Hassan II, Morocco	
e+e- → ZH → l+ l- X	Georgios Gerasimos Voutsinas, Strassbourg	for Vertex detector background/optimisation
BR(H→bb/cc/gg) in BR(H->bb/cc/gg) at 250 GeV and 350 GeV and 1 TeV	Hiroaki Ono, Nippon Dental University	
Little Higgs with T-Parity at 1 TeV	Eriko Kato, Tohoku	
Top Physics at 500 GeV	Phillipe Doublet, Roman Poescl, Francois Richard, LAL	
W e nu, ZZ, Z nu nu, nu nu h at 1 TeV	Graham Wilson, Brian van Doren, and Marco Carrasco-Lizaragga, Kan	
ZHH	Junping Tian, Tsing	
H->nu nu, H-> gamma gamma	Not yet covered, but optimistic to cover due to increased Japanese involvement	
ttH	Harjah Tabassam, Edinburgh Ryo Yonamine, KEK	
long-lived staus	Wataru Yamaura and Katsushige Kotera, Shinshu, DESY	
Model-independent WIMP searches in e+e-->ngamma + invis	Christoph Bartels, DESY	
Bi-linear R-parity violating SUSY	Benedikt Vormwald, DESY	
SPS1a' in general, selectrons with small mass-differences	Mikael Berggren, DESY	
TGC:s and polarisation	Ivan Marchesini, DESY	Also at 1 TeV
SUSY "point 5"	Jenny List, DESY	

Detector R&D

R&D continues to be pursued actively by the R&D collaborations in consultation with ILD for the ILD specific issues

- Review within the R&D collaborations early in 2012 concerning inclusion in ILD
- Review of hardware baseline early summer 2012 by ILD (dedicated ILD meeting, probably in Asia)

Major Challenges for R&D for ILD

Of course different systems face different challenges.

But, there are some commonalities:

- Availability of test beam

  test beam time is scarce, and – e.g. SDHCAL tests – problematic
  Will be particularly challenging after in 2013/ 2014, during CERN shutdown
  Appreciate the continued support from CERN and FNAL

- Tests for power pulsing:

  Power pulsing tests are central to the ILC (and CLIC) program
  Facilities with high magnetic field are rare, facility at DESY had to be shut down, recommissioning is uncertain: need to look for alternatives in earnest

- General:

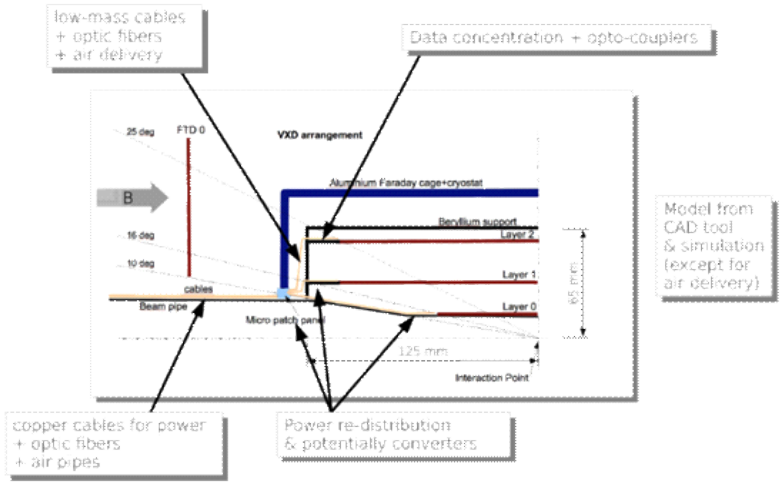
  Personpower is critical and low, in particular engineering support is rather limited.

Integration

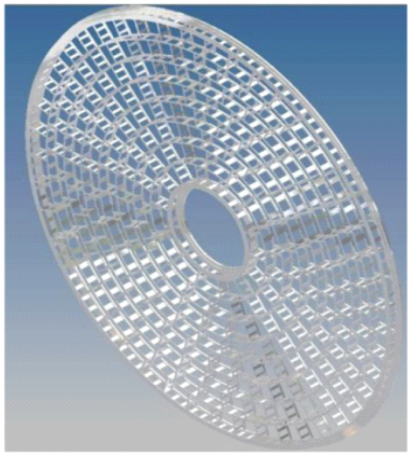
Significant progress on the overall detector integration

- Fairly detailed idea about many subdetectors and their services

Temperature profile of ladder



Detailed vertex design

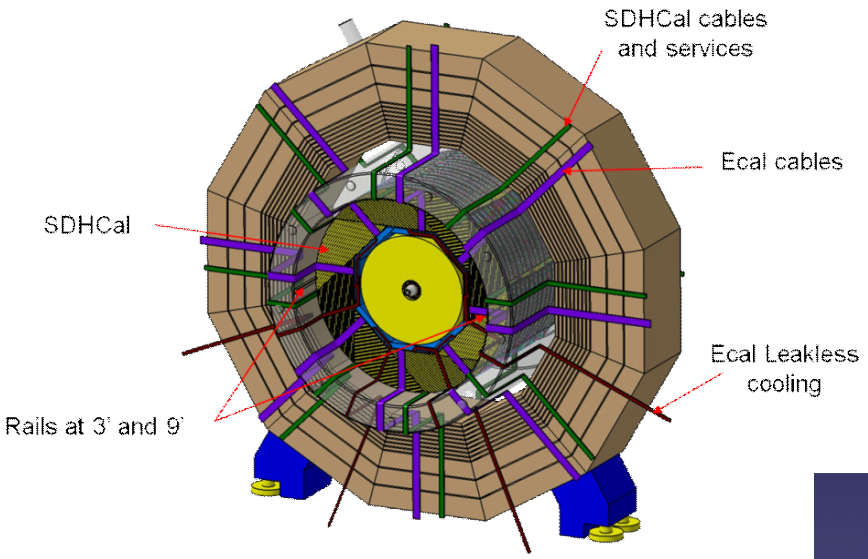


TPC endplate design

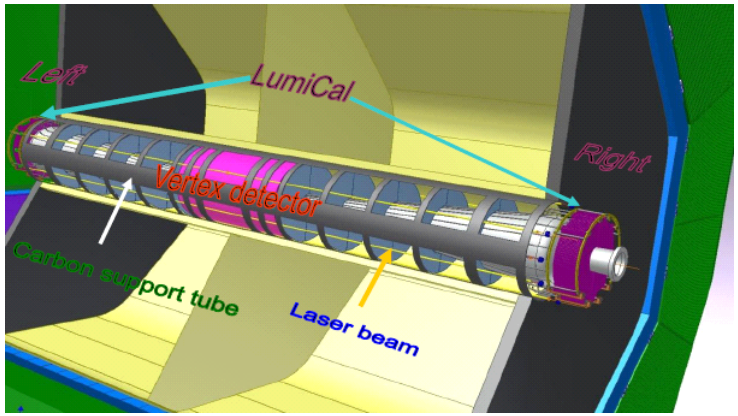
Forward disk design

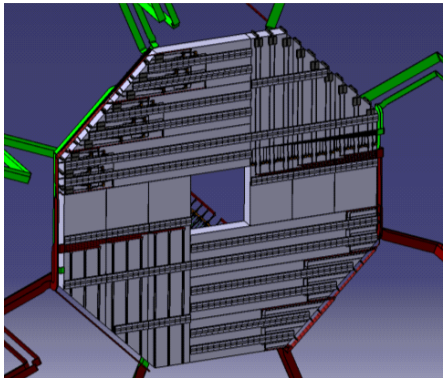
Integration

Concrete plans for the integration are being developed



Cabling and services to calorimeter





Integration of forward
and central detectors:

Critical issue, both technically
and in terms of manpower

Integration: open central issues

Open issues:

- Work on a coherent solution for the central region (in particular Si tracking) is not finished

Forward region might need to be re-optimised

- FT pixel disks are not well developed

- Potential problem with material along the beam line identified, need specific R&D to address this.

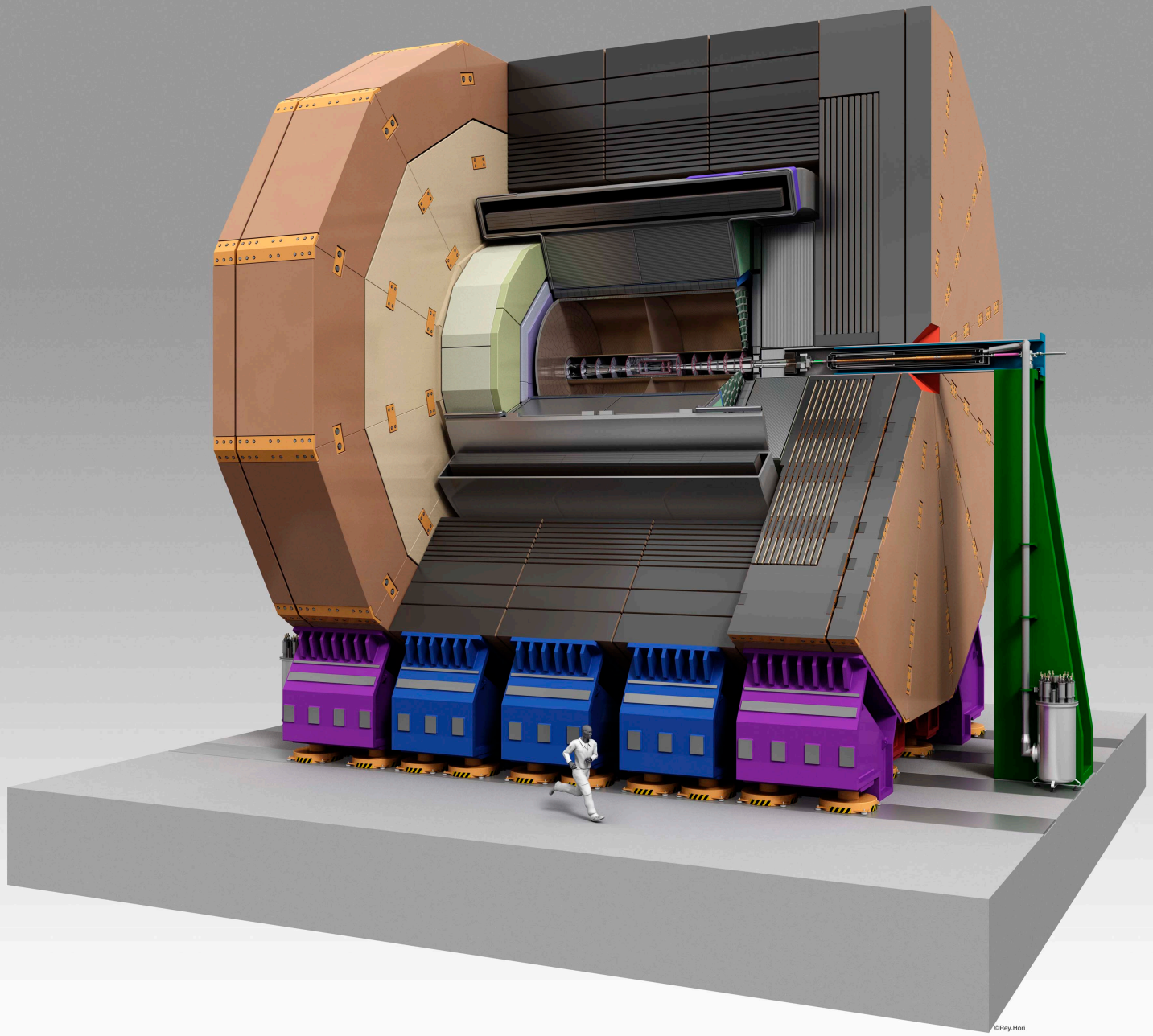
- We do not so far have a common cooling concept

  - Leak less water for ECAL
  - CO2 cooling for VTX and TPC
  - Forced air cooling for VTX

- Power pulsing tests in high magnetic field are central, but problematic

And, of course, continually making sure that engineering and simulation stay in synch

(e.g., found some inconsistencies when trying to make the ILD detector drawing)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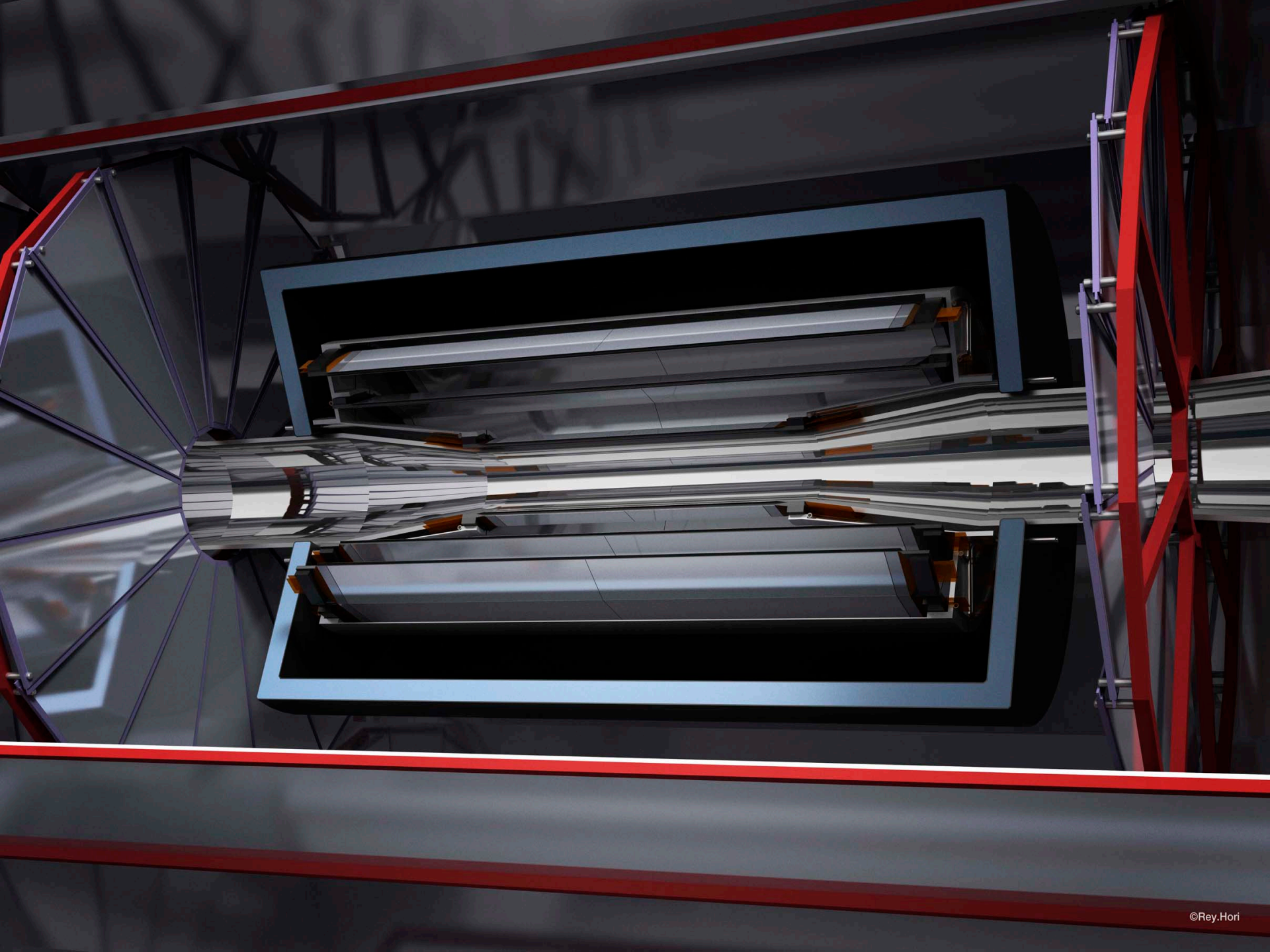
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DBD and EDMS for ILD

Detector Baseline Document

For ILD the DBD might consist of:

- A written document, which will be part of the official TDR/ DBD package
- A common depository for documentation and detailed information, using EDMS
- A collection of backup notes etc, which will give much more detail than the main document

Setup of EDMS for ILD has started:

First test project is TPC, others to follow (supported in part by the AIDA program)

Use EDMS for a central tool/ depository to manage, maintain and publish ILD information

Basic structure in EDMS has been created, Content and users are rather limited at the moment

First example project:
TPC (in particular large prototype project)

Information currently kept in many places:

- DESY Ideas database
- Orsay drawings (CATIA)
- Cornell Web page and drawin (Autocad)
- Private notes and logbooks
- Notes (Icnotes, preprints, papers, conference proceedings)

Try to assemble and concentrate all relevant information within EDMS

Costing ILD for the DBD

Mission:

We are requested to provide for the DBD an estimate of the ILD cost
with an uncertainty on the number
and a clear description of the methodology and the assumptions.

ILD and SID have to be coherent in their numbers.

Organization:

A costing group has been formed in ILC
under the supervision of S. Yamada
with representatives of SiD: M. Breidenbach, K. Krempetz
representatives of ILD: T. Sanuki, H. Videau
and P. Garbincius as expert advisor

In parallel there is a CLIC detector costing group
with the same ILD/SID representatives and K. Elsener.

We have been asked to revisit our estimates
with real consultation and clear agreement
- on some basic costs like tungsten, iron or silicon,

Table 16.1: Assumed unit cost for some materials [1]	agreed unit cost
Tungsten for HCAL	105 $ /kg
Tungsten for ECAL (tighter mechanical tolerances)	180 $ /kg
Steel for Yoke (semi-product)	1000 $ /ton
Steel for Yoke (final product, including assembly supervision)	6000 $ /ton
Stainless Steel for HCAL	4500 $ /ton
Silicon Detector	6 $ /cm^2

- on procedures for accounting,

-The cost is the cost for construction, R&D is not taken into account except specific R&D for transferring to industry.
-We consider that the manpower at the industrial level is already taken care of in the price, then we should focus on manpower which could be provided by institutions.
There we want to evaluate in man*years with few levels of qualification (2 or 3).
-A risk analysis should be performed at least at a certain level and a mitigation for the recognised risks studied.
-No assumptions should be made about future technology impact or demand fluctuations on the unit prices used.

- on exchange rates, the prices being those of 2012.

to escalate the prices we can use the tables provided by CERN for the evolution of material prices

State of the estimate

We are focussing in common (SID/ILD) only on the driving cost items:
Coil and return yoke, calorimeters
currently we work on the coil.

We need to know the model we cost, some choices are still to be made, or their consequences analysed.

Since the LoI estimate has been published,
many sub-detectors have developed rather large prototypes
much closer to the ILD design.
A better estimate of their cost is at hand.
On top of this quite some work has been done on the integration of the detector and services,
understanding how the detector can be mounted and maintained,
tools are better understood.

Then the services and tools costs can be properly included.

Sub-detectors to provide update of their costing by spring 2012

Funding

Dedicated ILD funding: extremely limited

Most funding through detector R&D projects, often in synergy with other projects

Big funding sources:

AIDA: European FP7 detector R&D project (LHC, Neutrinos, ILC)
2010-2015
JSPS: Japanese special funds for ILD detector R&D
2011 – 2016 (?) kickoff meeting 12 Sept 2011 in Sendai, Japan
University R&D program in the US

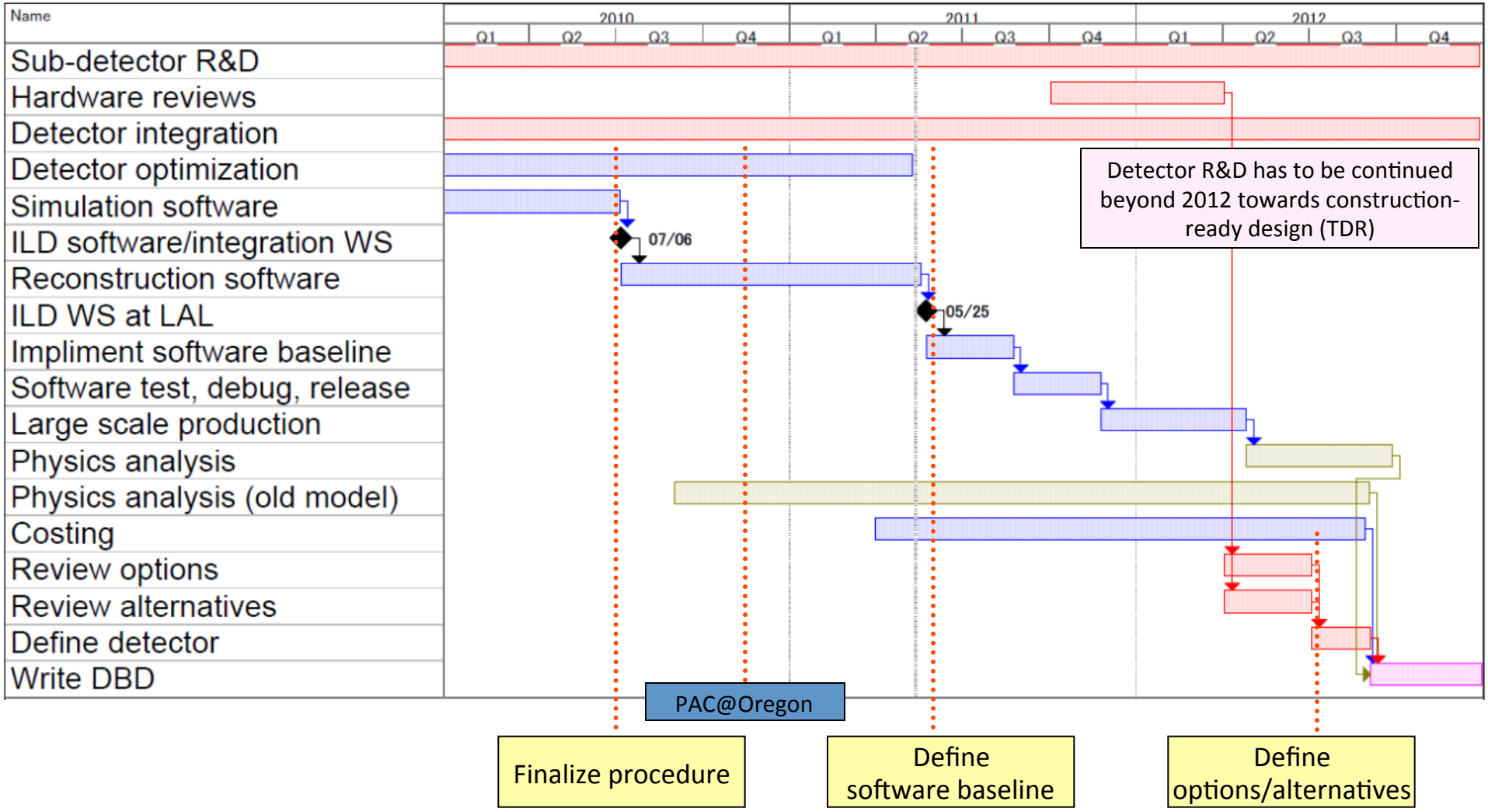
Institutional funds

Spinoffs become increasingly important also for funding

e.g. forward calorimeters: LHC
e.g. Vertex Detector (MAPS) technology: Star upgrade
e.g. SiPM technology: medical imaging and others

Tentative ILD roadmap

As shown at ILC PAC Taipei



Summary

ILD is continuing to move towards the DBD

Significant progress on the side of simulation and reconstruction

Detector R&D is proceeding: expect to be able to freeze the hardware baseline in late spring 2012, as planned

Continuing worries:

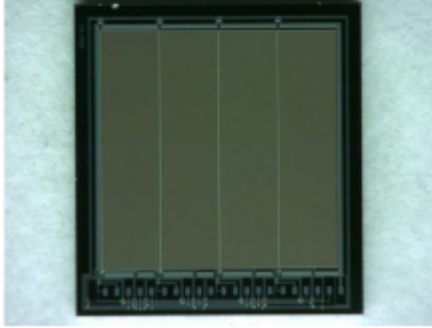
- Person-power
- Availability of test beams
- Overall resources (though JSPS program and AIDA are welcome relief)

Overall: ILD is moving, and expects to be able to deliver the DBD on time

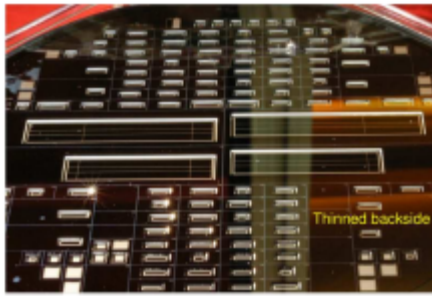
Backup slides

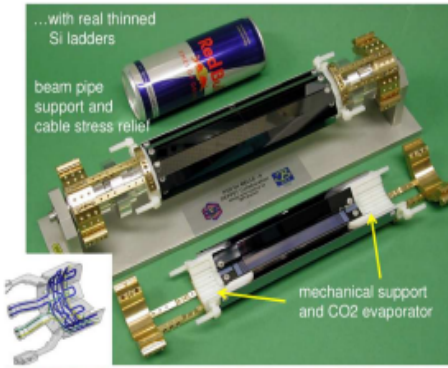
- Some detector R&D results from ILD concept presentation by Marcel Vos at LCWS11 Granada

VXD

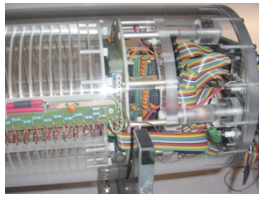


- ✓ **Sensor production:**
  - ➔ FPCCD: 6x6 mm^2, pixel sizes 6x6 to 12x12 mm^2, thinned to 50 µm, tests ongoing. Large area expected FY2012
  - ➔ DEPFET: Belle-II and ILC design sensors thinned to 50 µm and tested with fast read-out (TB next week)
  - ➔ CPS: Development common with ALICE/CBM/AIDA. MIMO30 (resolution) and 31 (power) should attain all VXD specs by summer 2012. Moving to 180 nm in 2012.
- ✓ **Full ladder production/integration:**
  - ➔ PLUME/CPS double sided: demonstrated 3 µm resolution, 100 µs/frame, 0.6% X_0/double layer, to be beam tested in November, aiming to halve material budget in 2012
  - ➔ PLUME/CPS single sided: 0.37 % X_0/single layer for STAR (data taking next year)
  - ➔ DEPFET: 0.2 % X_0/single layer for Belle-II (2015)
  - ➔ Unsupported "ladders" → SERWIETTE
  - ➔ CO_2 cooling project (-40 C) for FPCCD



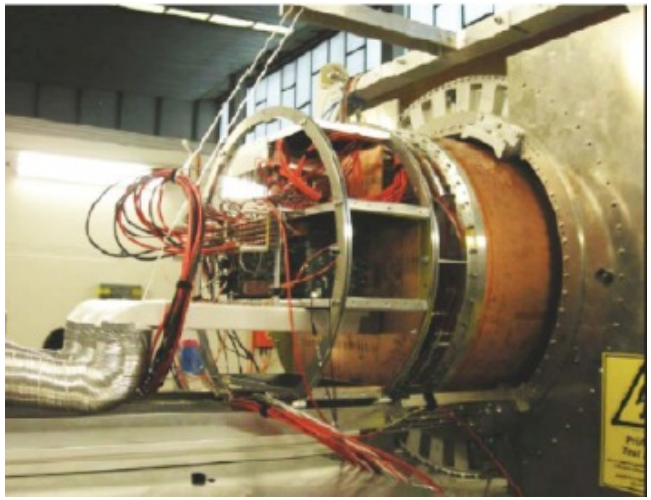


LCTPC



Small TPC prototypes

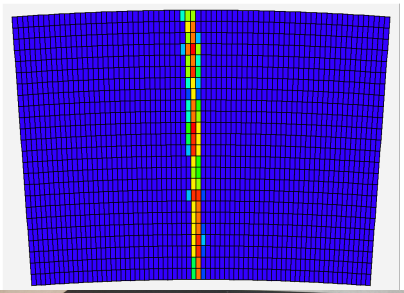
< 2011

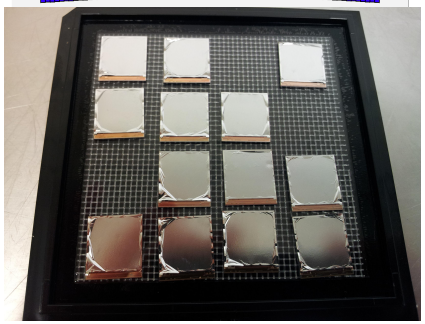


2011

Three read-out schemes:
GEM, MicroMegas, pixels

- The PCmag magnet has been sent from DESY to KEK for adding 2 He compressors
- A first module test with compact electronics has been carried out. The production of 9 modules (7 to fill the prototype plus 2 spares) is starting.
- Working InGrids have been implemented by IZM Berlin on a TimePix wafer and tested.





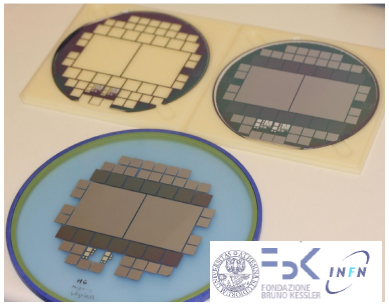
Silicon Tracking

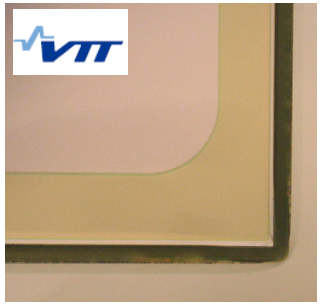
Baseline sensor technology: Single sided strips

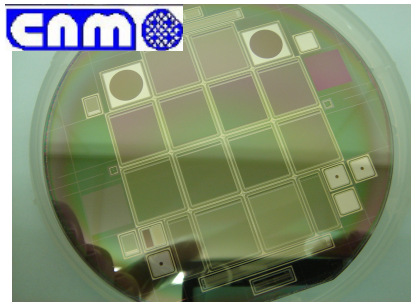
- Interconnection: integrate pitch adapter on second metal layer
- *Follow LHC developments on ways to bring in power*
- *Interesting development on use of charge sharing to measure coordinate along the strip*
- New planar single sided strips technology, large sensors (6”), edgeless and high transmittance (IR laser alignment) options

Benefit from involvement in shorter term experiments for keeping/developing expertise & for funding and from synergy with (s)LHC.

New edgeless sensors

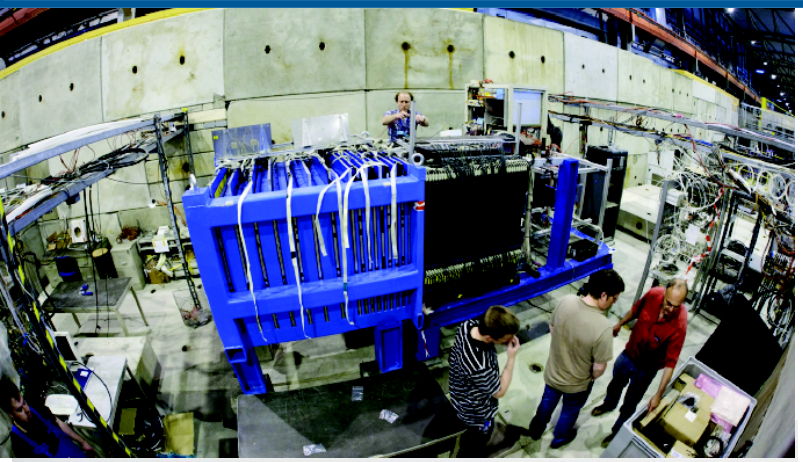


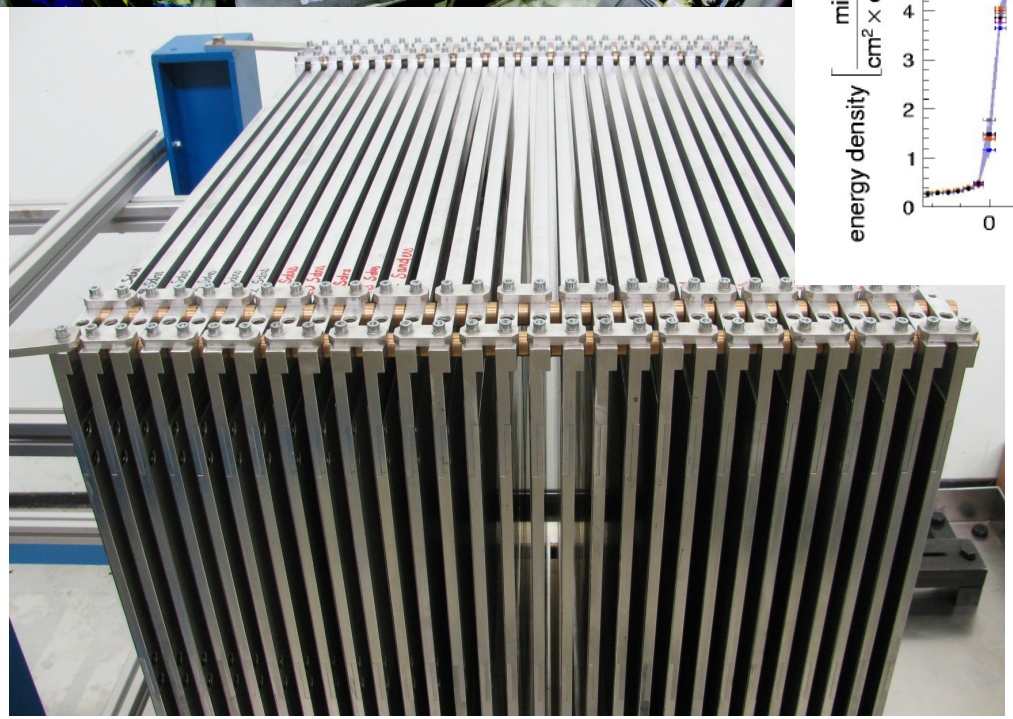


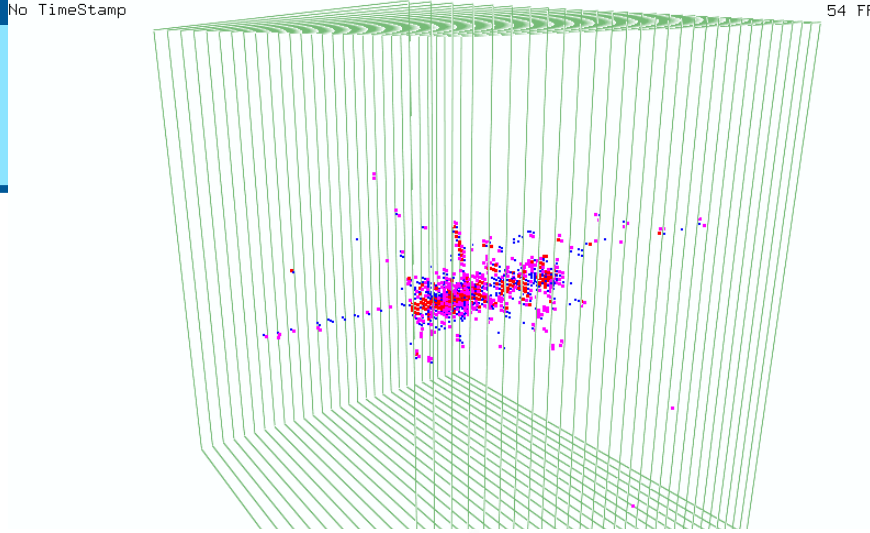


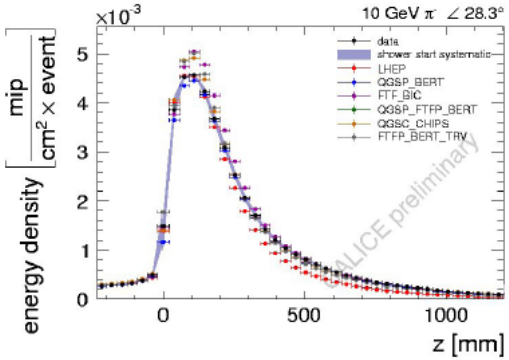
High transmittance sensors
Goal: T~70%; Already now: 50%

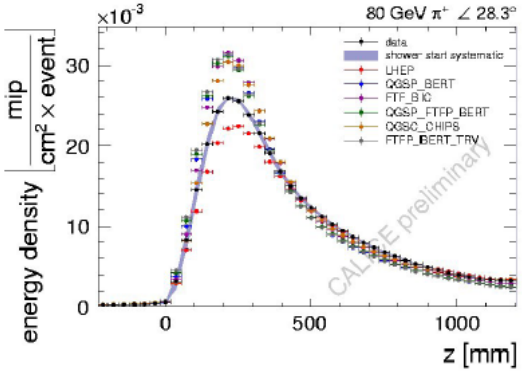
Calorimeter: the 1 m³ era











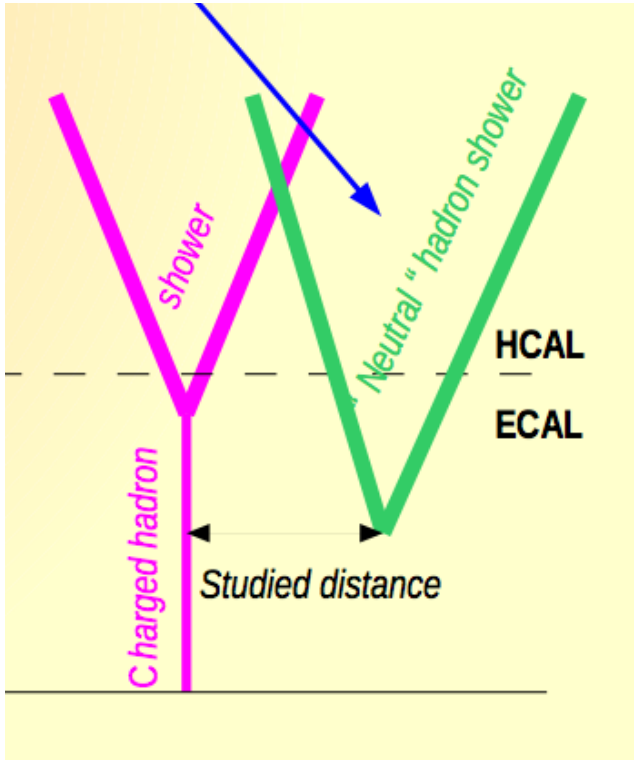
1 m³ tungsten and stainless stacks instrumented with different options in beams at CERN

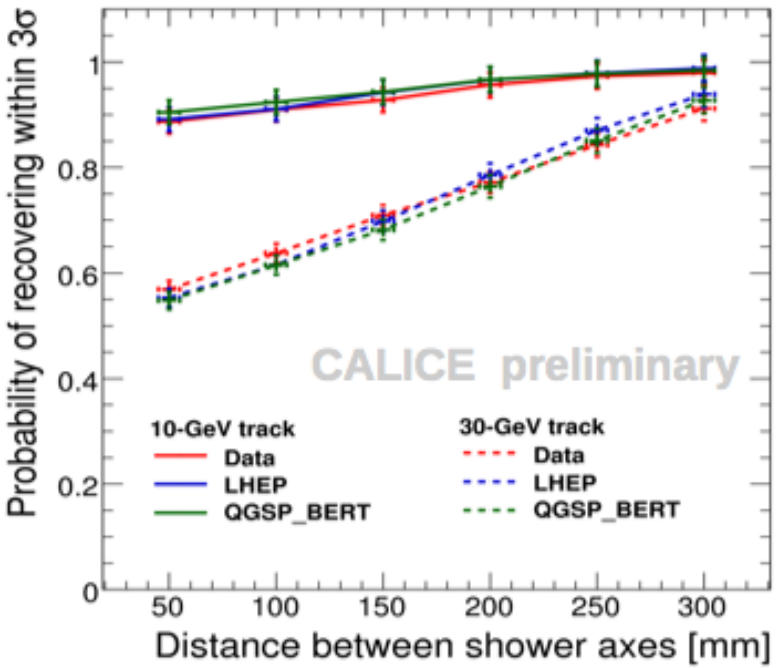
http://arxiv.org/pdf/1003.1394

http://arxiv.org/pdf/1105.0511

Calorimeter: testbeam results

CALICE **Data** mapped onto ILD detector to test PFA





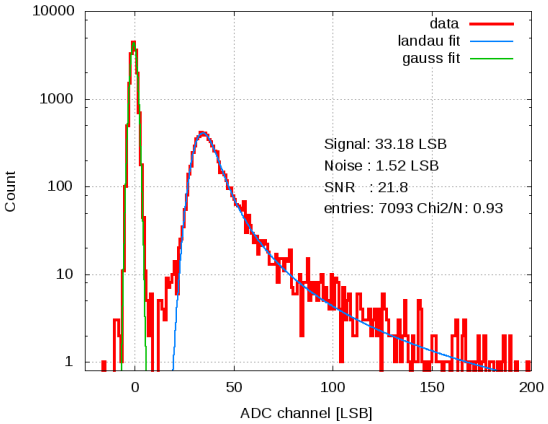
Transport of beam test data into physics studies

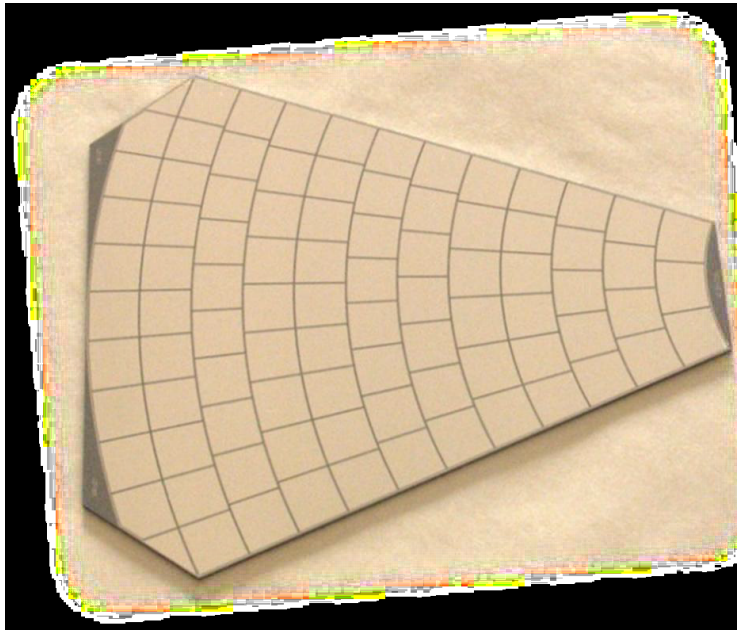
Successful application of PFA to real data with highly granular calorimeters

LumiCal TB DESY: July 2011

LumiCal Sensor +
32 Channels of ASICs

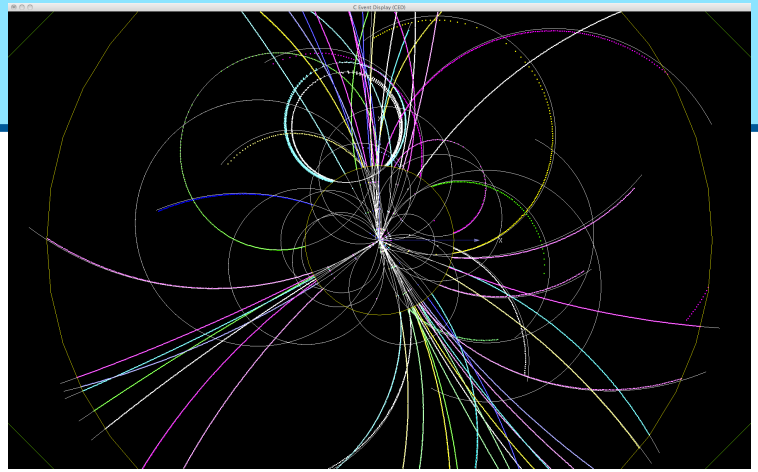
(incl. ADC – first time complete chain !)





BeamCal: GaAs sensor pads will be read out by the full Cracow electronics chain - as LumiCal (FE ASICS plus ADC ASICS)

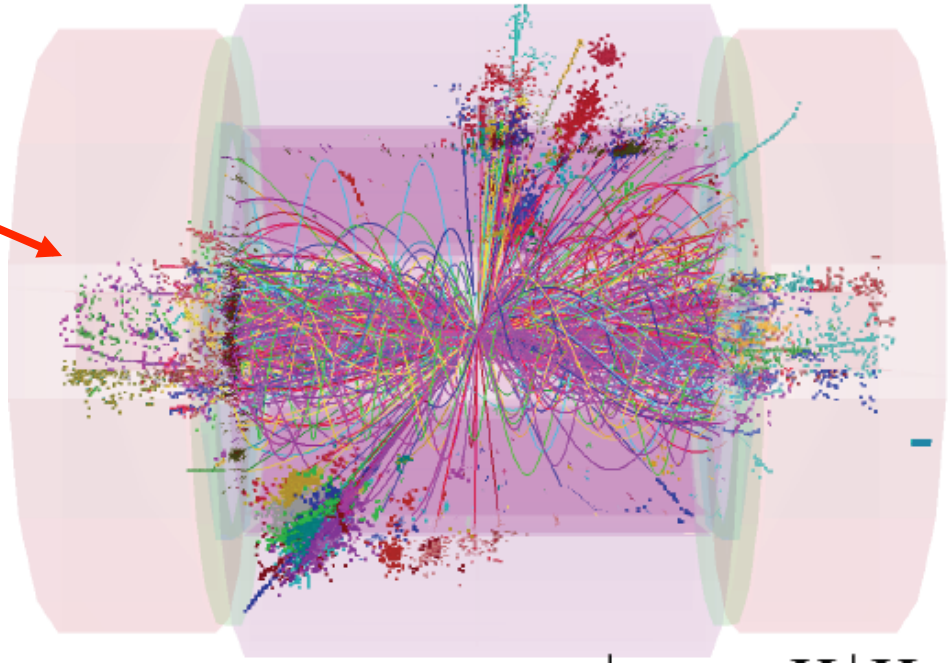
Software



t-tbar 500 GeV

A LOT of progress:

- ✓ LCIO2
- ✓ Detector drivers to cope with detailed geometry
- ✓ New tracking code (Fortran-free)
- ✓ PandoraPFA expected to work at 1 TeV
  - ✓ Shown to work at 3 TeV
  - ✓ Possibly some calibration/tuning
- ✓ LCFIVertex greatly improved



The major developments for the DBD are completed. Faster than anticipated!