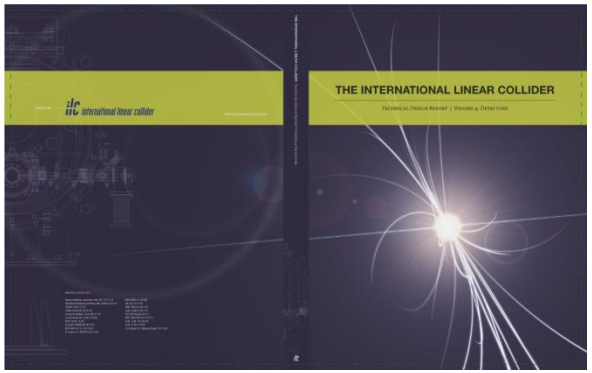
ILD Status

100th ILC@DESY meeting

Ties Behnke, DESY

18.10.2013

ILD: where are we?



2013: delivery of the ILD DBD as part of the ILC TDR

- Fairly sophisticated system design, no complete engineering design
- First “complete” estimate of the cost

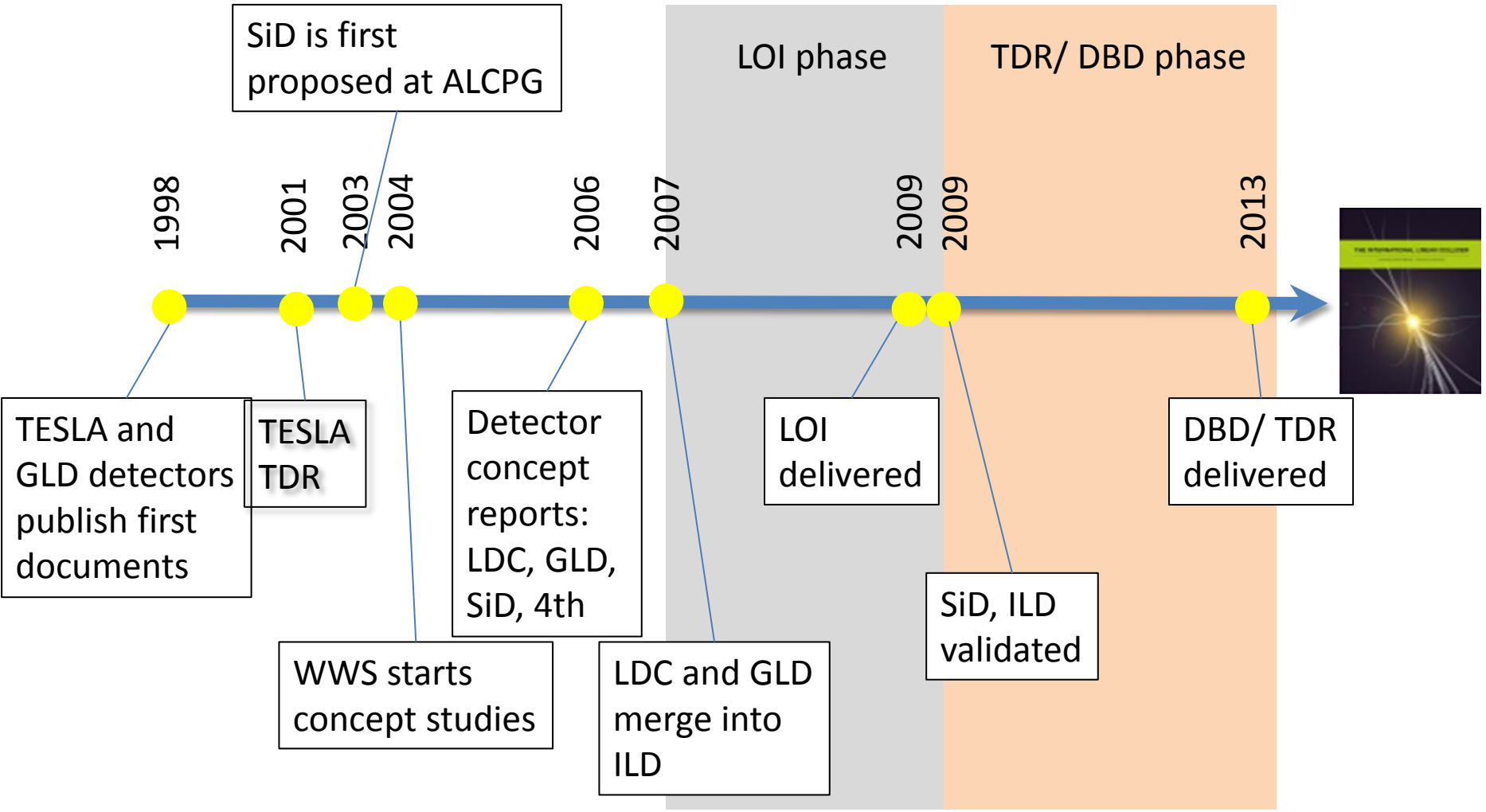
2013: site decision in Japan, but no overall decision yet on the project

2013: positive statements around the world supporting an ILC in Japan,
- European strategy process
- Snowmass process in the US

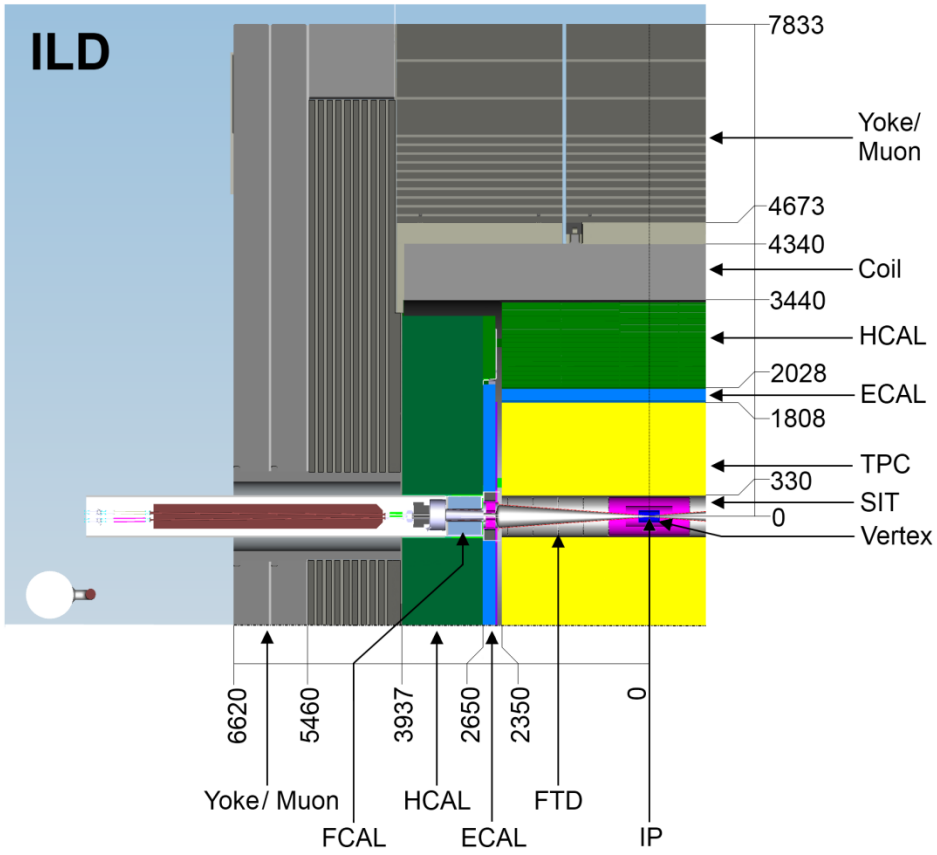
We are in a transition period between pre-project (concept) phase and project (collaboration) phase

For the near future R&D will remain our main goal, but we need to prepare to shift gears rapidly once the project is approved.

Concepts at the ILC



The current ILD concept



Started as a combination of GLD and LDC in 2007

(LCWS 2007 at DESY)

Some detailed optimization work done, but main parameter choices were “ad hoc” (politics) as much as physics driven

Now is the time to re-open the box and look at all choices:
There are no forbidden areas
There are no prejudices

Window of Opportunity

Situation in Japan: see talk by Satoru/ Hitoshi later today.

Window of opportunity NOW

We might have some limited time to

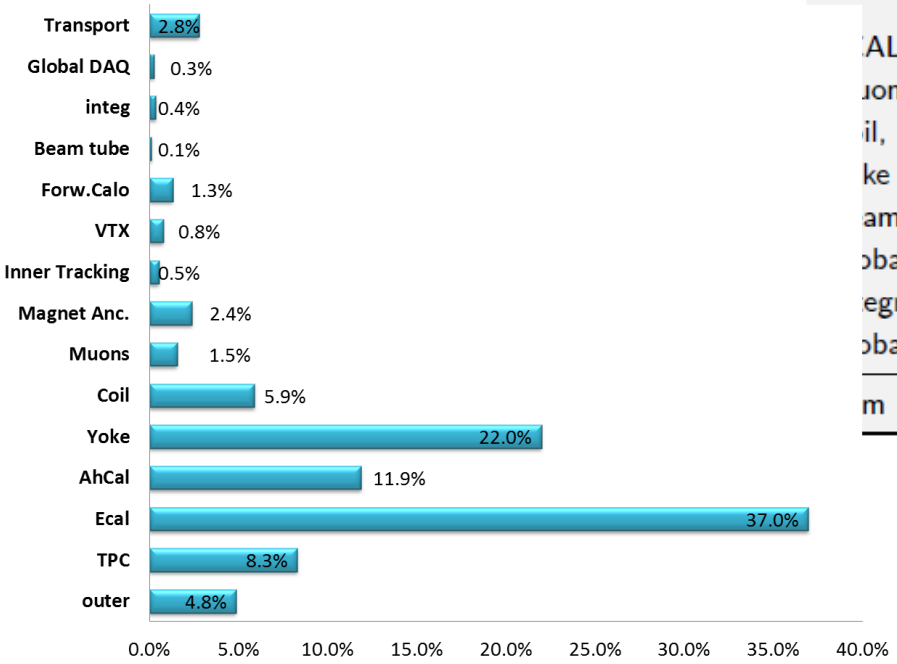
- Look carefully into our fundamental design choices
- Take costs more fully into account than we have done so far
- Question Choices and prejudices
- Do fundamental studies on – in particular – the impact on physics

Once ILC is a real project we might not have this chance again!
Lets use it wisely!

ILD Costs

Costing exercise as part of DBD
Needs significant more work and checking, but main messages are clear.

System	Option	Cost [MILCU]	Mean Cost [MILCU]
Vertex			3.4
Silicon tracking	inner	2.3	2.3
Silicon tracking	outer	21.0	21.0
TPC		35.9	35.9
ECAL			116.9
	SiECAL	157.7	
	ScECAL	74.0	
HCAL			44.9
	AHCAL	44.9	
	SDHCAL	44.8	
AL		8.1	8.1
ion		6.5	6.5
il, incl anciliaries		38.0	38.0
ke		95.0	95.0
amtube		0.5	0.5
bal DAQ		1.1	1.1
egration		1.5	1.5
bal Transportation		12.0	12.0
m ILD			391.8

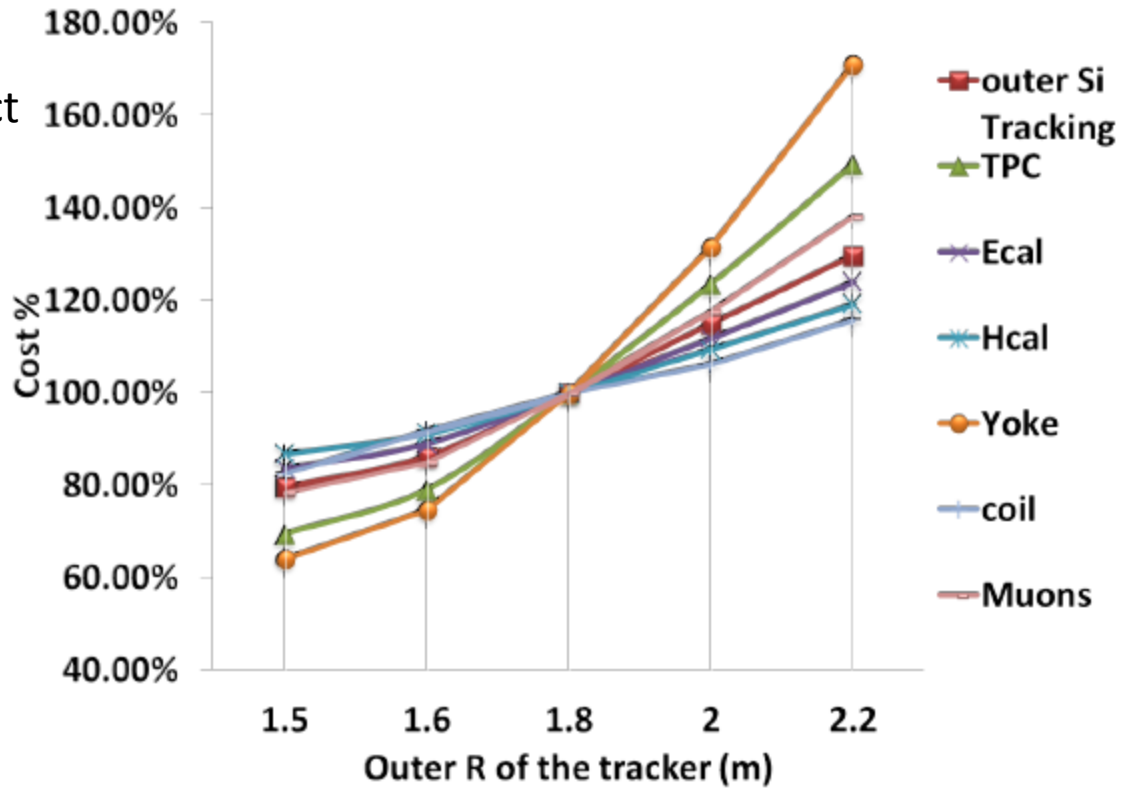


Huge effort by LLR group for the DBD

ILD cost scaling

Cost scaling law with different systems radius

- Potentially large impact on the cost
- Careful optimization of cost –performance benefit is needed



The inner system

Do we understand our performance requirements?

- VTX detector
- Silicon tracking?

Readout speed might be an important variable to control background and complexity:
Are the ambitious enough in ILD in this respect?

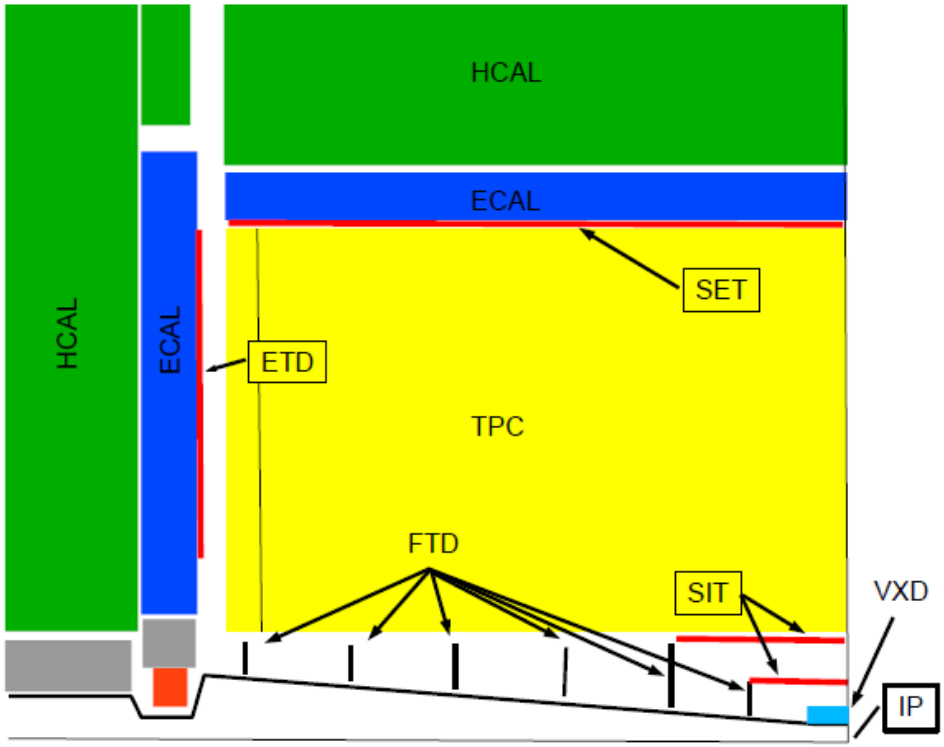
Do we understand / do we have a proper design of the beamtube etc?

We propose a big Silicon system for ILD: are we sure of its parameters?

What about the outer Silicon system? How much of this is baseline?

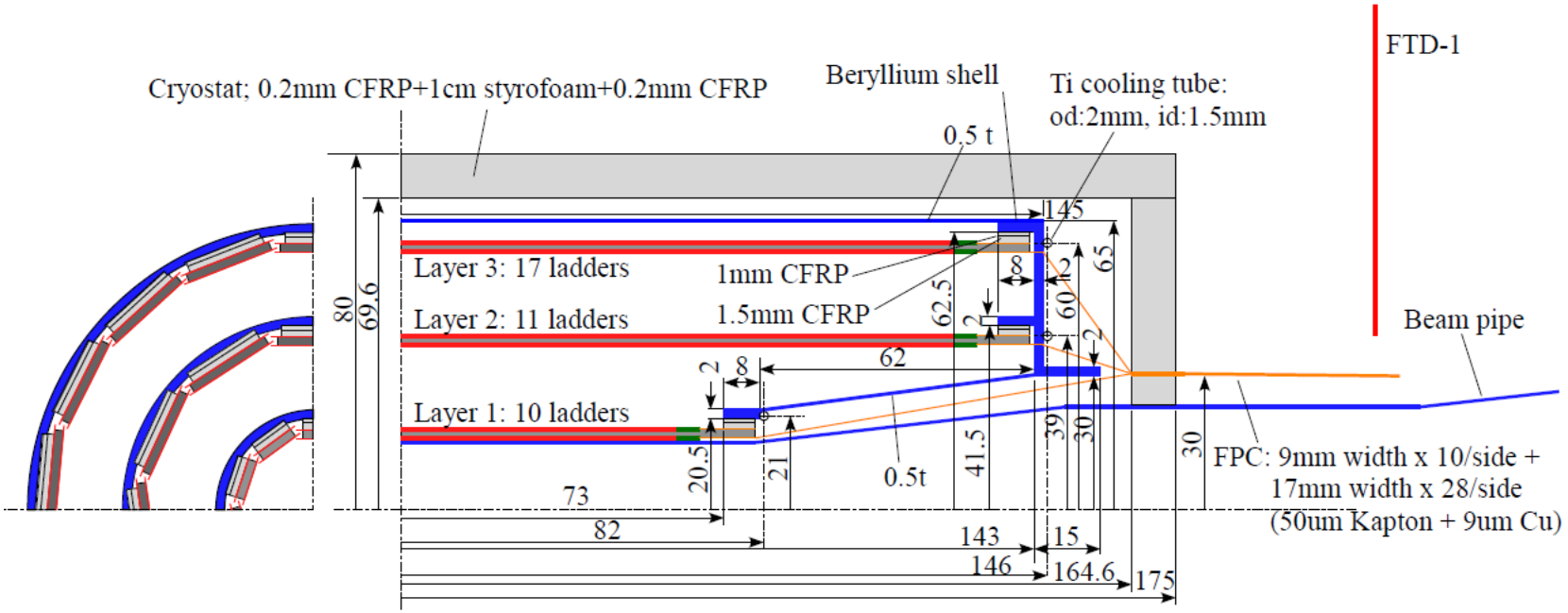
Design of the VTX detector

- Role and merrit of double layer
- Alternative geometries?



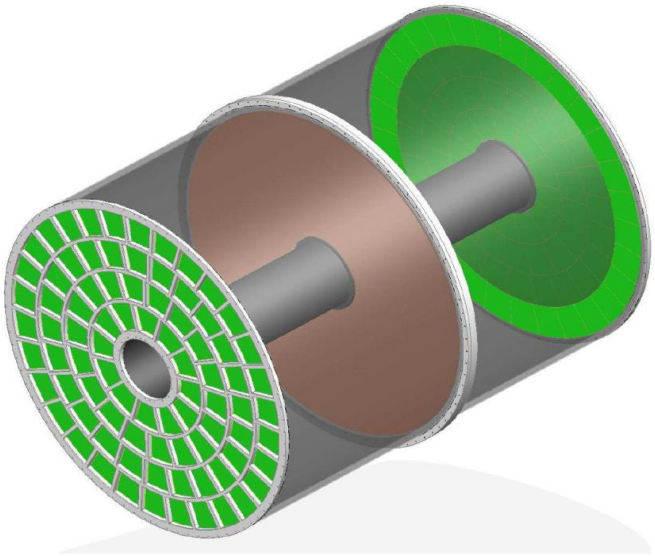
Vertex detector

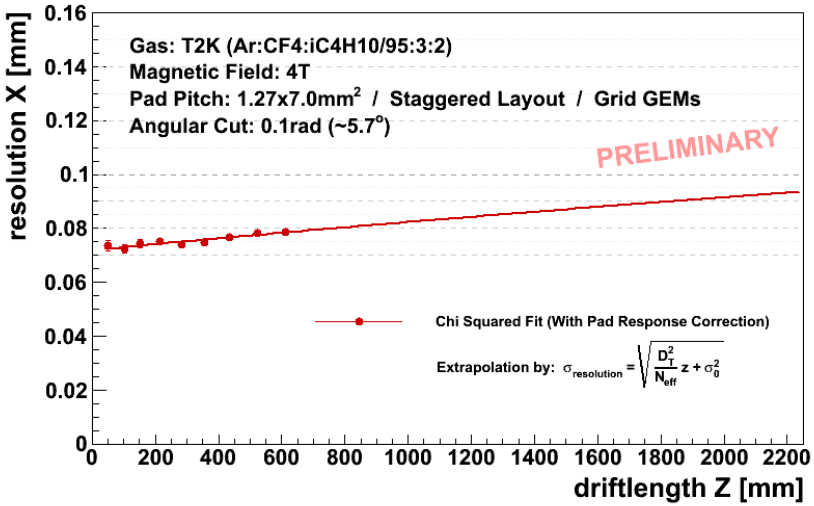
- Excellent impact parameter resolution better than $(5 \oplus 10/p \sin^{3/2}\Theta)$ μm is required for efficient flavor tagging
- 3 layers of double ladders (ca 1 mm apart) (6 pixel layers)
  - Effect on pair-background rejection is expected, but not demonstrated yet
- Barrel only: $|\cos\Theta|<0.97$ for inner layer and $|\cos\Theta|<0.9$ for outer layer
- Point resolution <3um for innermost layer
- Material budget: $0.3\%X_0$/ladder$=0.15\%X_0$/layer
- Sensor options: CMOS, FPCCD, DEPFET, others?



TPC: ILD

- Time Projection Chamber: The central tracker of ILD
- Tracks can be measured with many (~200/track) 3-dimensional r-f-z space points
- s_{rf}<100um is expected for all drift distances
- dE/dx information for particle identification
- Two main options for gas amplification: GEM or Micromegas
- Readout pad size ~ 1x6mm^2 → 10^6 pads/side
- Pixel readout R&D as a future alternative
- Material budget: 5%X_0 in barrel region and <25%X_0 in endplate region
- Cooling by 2-phase CO2
- Momentum resolution: 2 10^-5





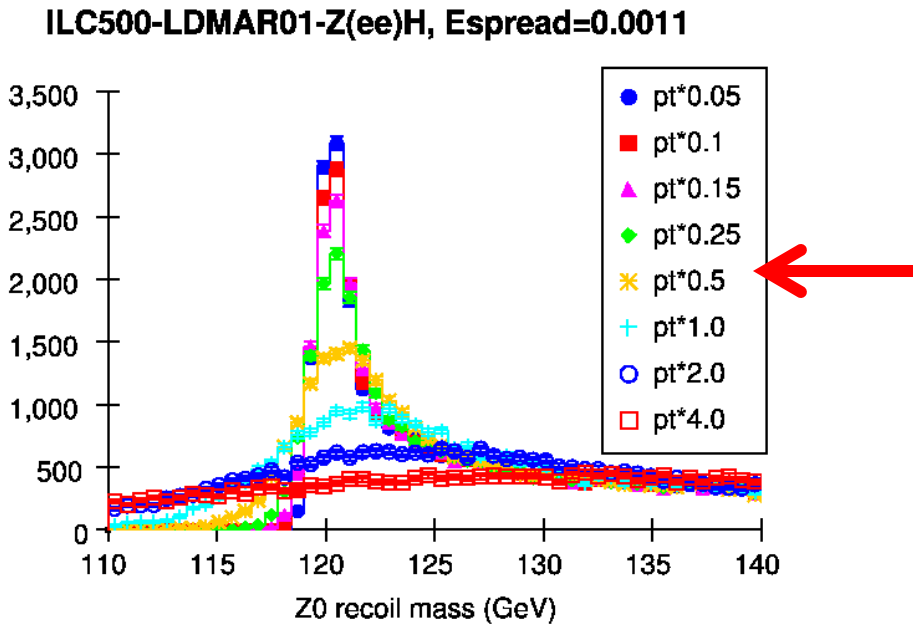
Tracking System

Momentum resolution:

- Current parameter is strongly driven by Higgs Mass measurement:
  are these arguments still valid?
- If we can relax the requirements: what is the impact on TPC/ Silicon?
  - Complex interplay of TPC, inner and outer Silicon

Overall system optimization:

- Aspect ratio
- Outer radius
- Role of Silicon
- Role of material e.g. in the TPC system
- Forward tracking



Tracking System

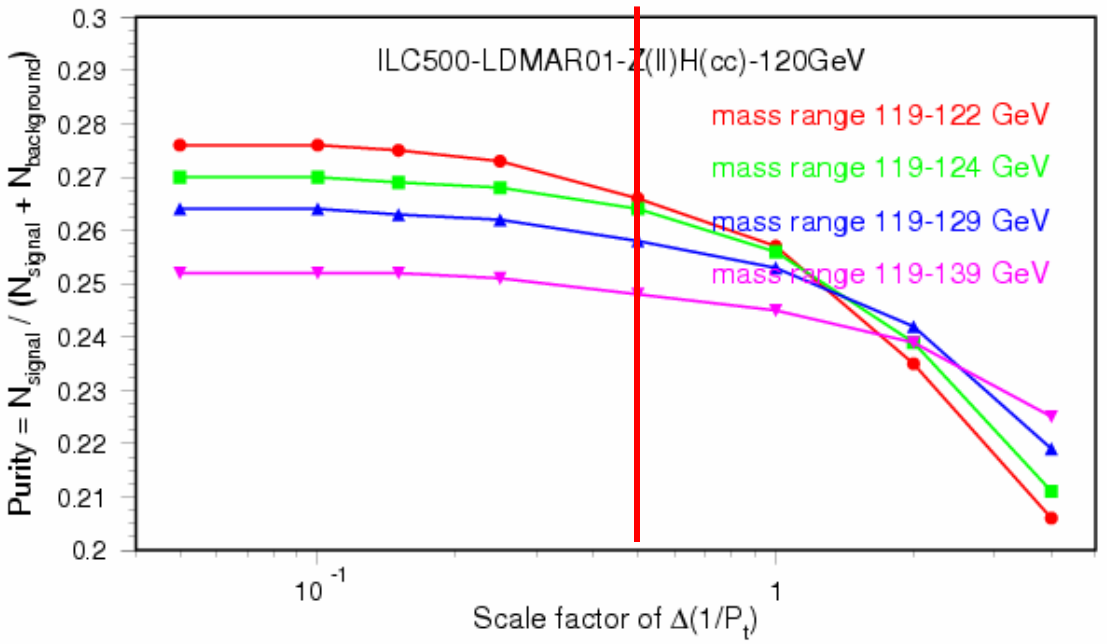
Momentum resolution:

- Current parameter is strongly driven by Higgs Mass measurement:
  are these arguments still valid?
- If we can relax the requirements: what is the impact on TPC/ Silicon?
  - Complex interplay of TPC, inner and outer Silicon

Overall system optimization:

- Aspect ratio
- Outer radius
- Role of Silicon
- Role of material e.g. in the TPC system
- Forward tracking

Purity of ZH->llcc



Material

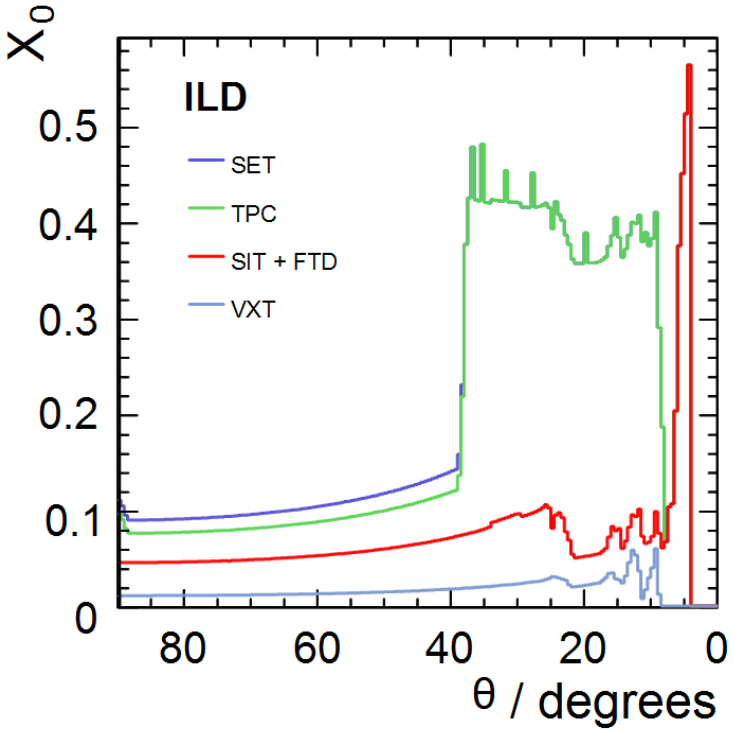
And never forget:

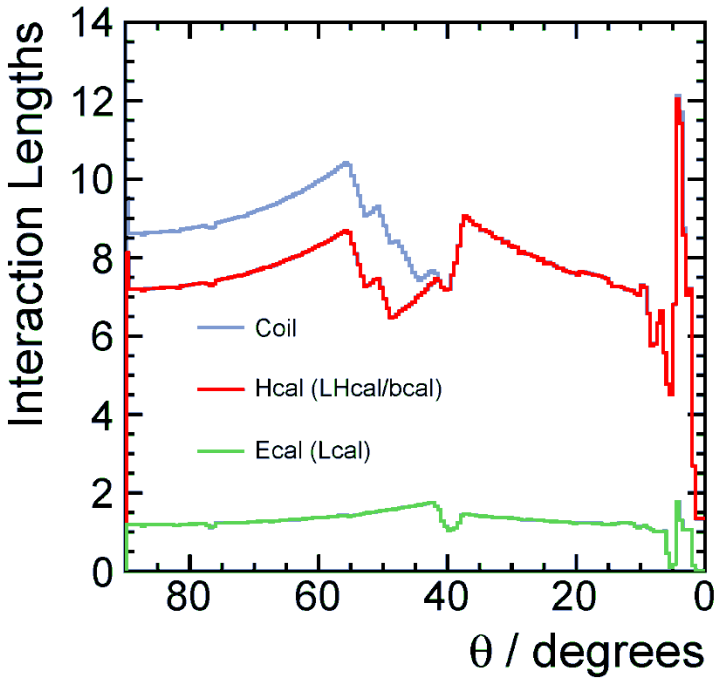
Material issues

- Silicon tracker
- TPC tracker

System thickness

- ECAL/ HCAL thickness
- choice of material?





Material

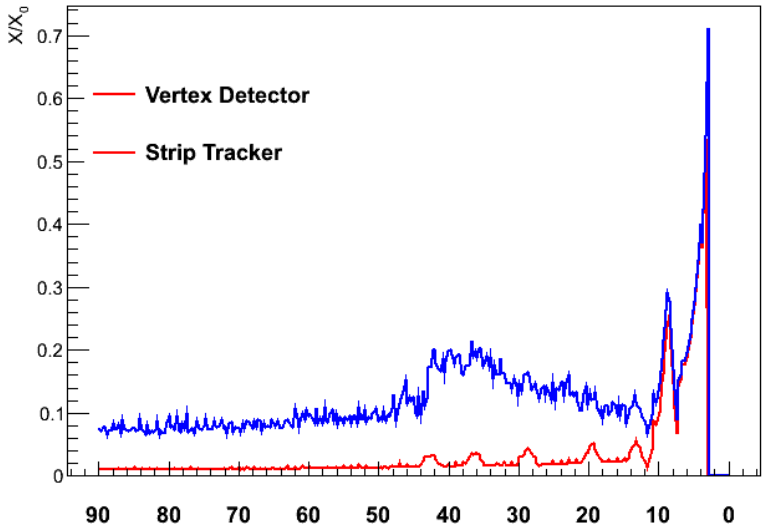
And never forget:

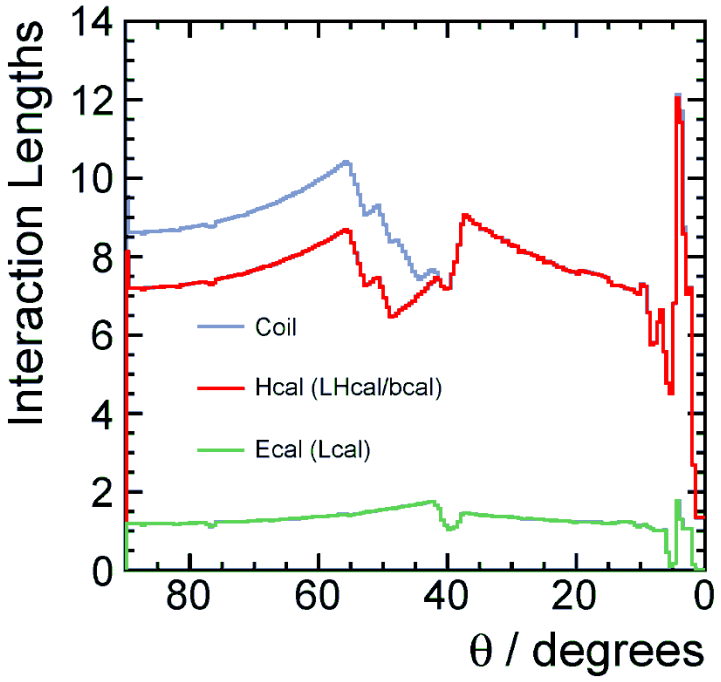
Material issues

- SiD material: this might be aggressive, but we are not better…

System thickness

- ECAL/ HCAL thickness
- choice of material?





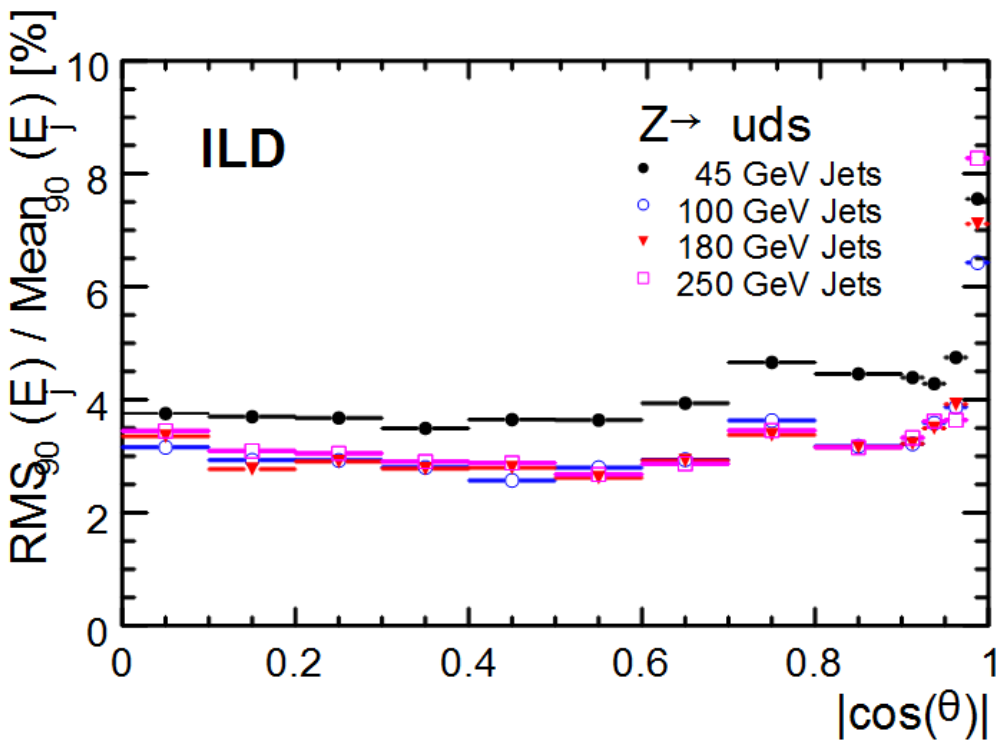
Questions: a possible list

- What is the right outer diameter for the VTX?
- Are we confident about performance in the forward direction
- What is the minimum momentum we need to reconstruct
- Does the data size have an impact on design of the VTX?

- Where do we need highest momentum resolution
  - Higgs mass, invisible higgs, branching ratios?
- How important are systematic effects to the final performance
- Do we understand possible biases in the momentum estimation
- Do we understand the relative roles of TPC and Silicon?

- What is the impact of material on the physics performance
  - Barrel
  - Endcap

Pflow as a driving force



Pflow has been at the core of the definition of ILD

- Size
- Calorimeter performance
- Tracking performance

Pflow: Impact

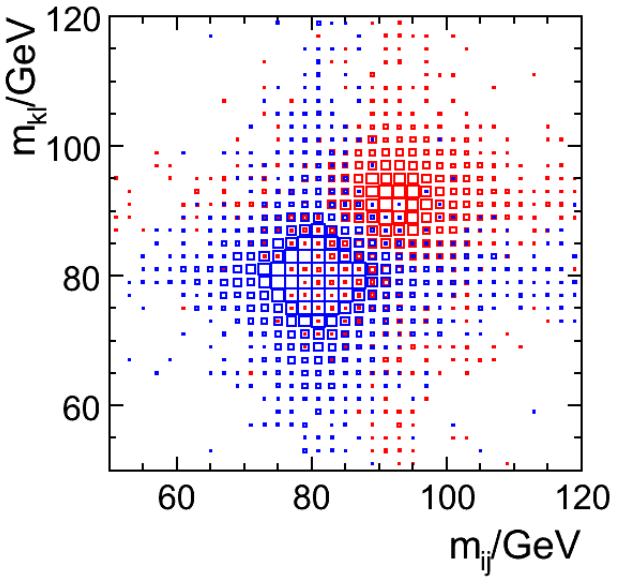
W/Z separation:

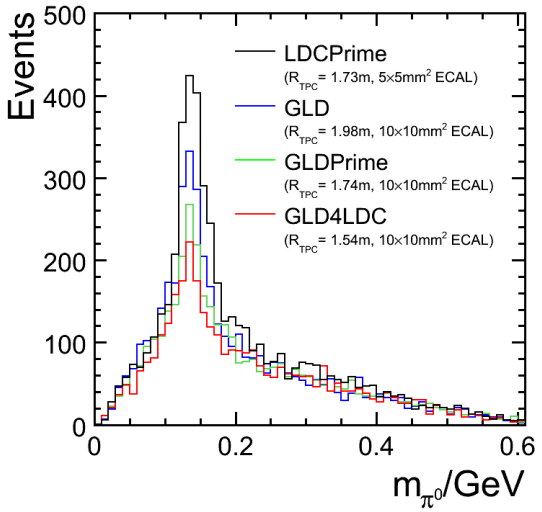
Key ingredient to define the requirement on particle flow performance

Impact on actual physics studies: typically less clear than thought:

Most studies show little to no sensitivity to the exact performance

But: how poorly do we do with a significantly deteriorated particle flow performance?

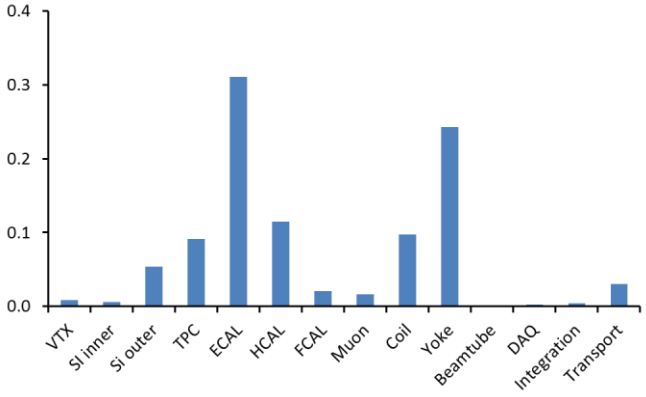


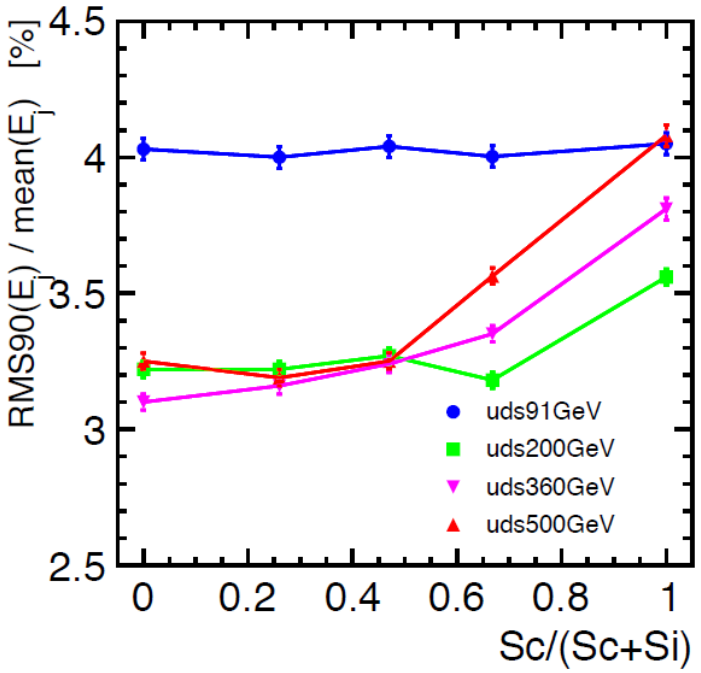


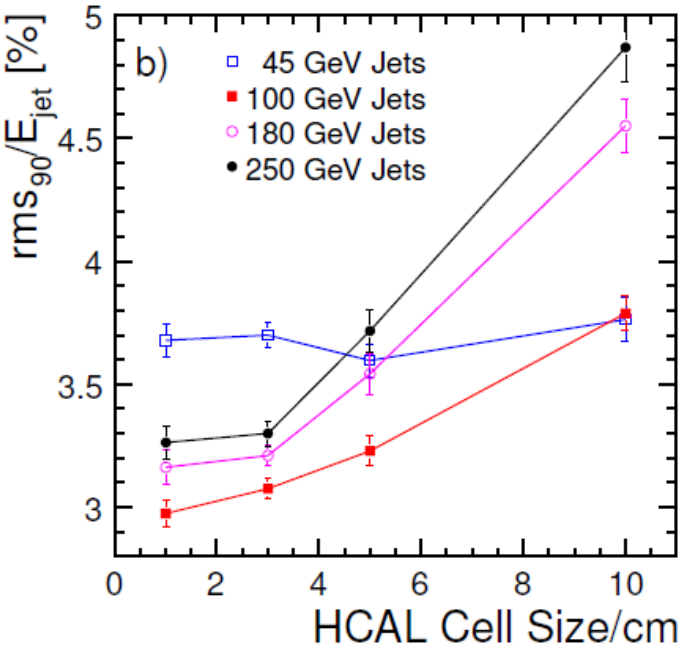
Imaging Calorimeter

Calorimetry is clearly a main part of ILD

- Can we make our calorimeter cheaper?
- Can we make the step from ECAL to HCAL less severe?
- Can we find an intelligent way to stage the system?
- Si for the ECAL is a very attractive, but also very expensive option

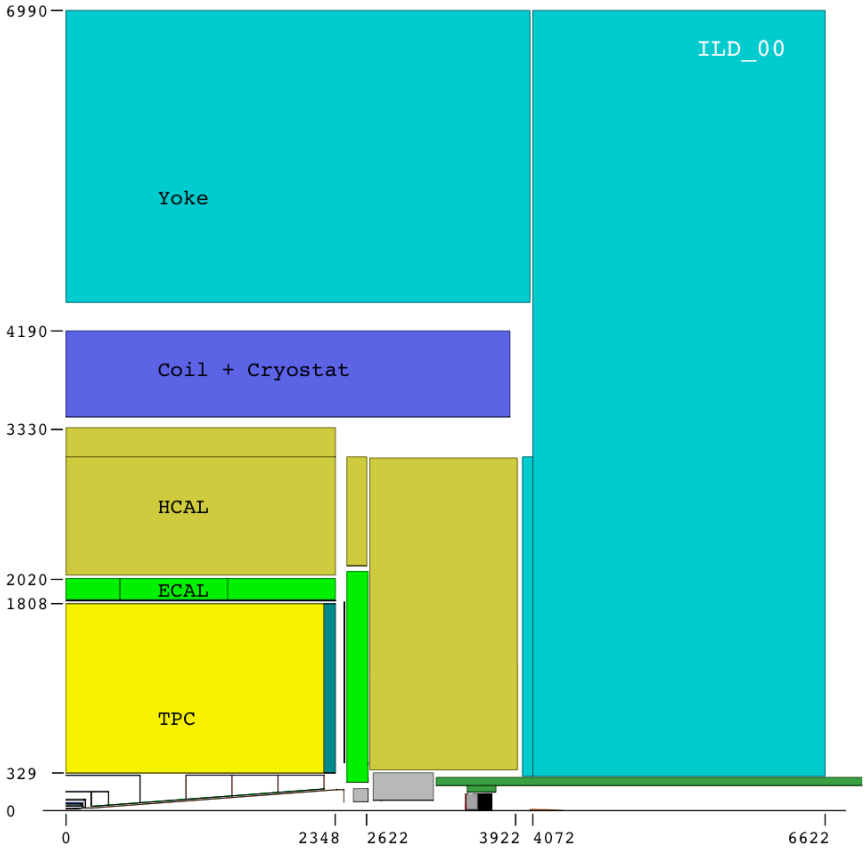






Overall Detector size

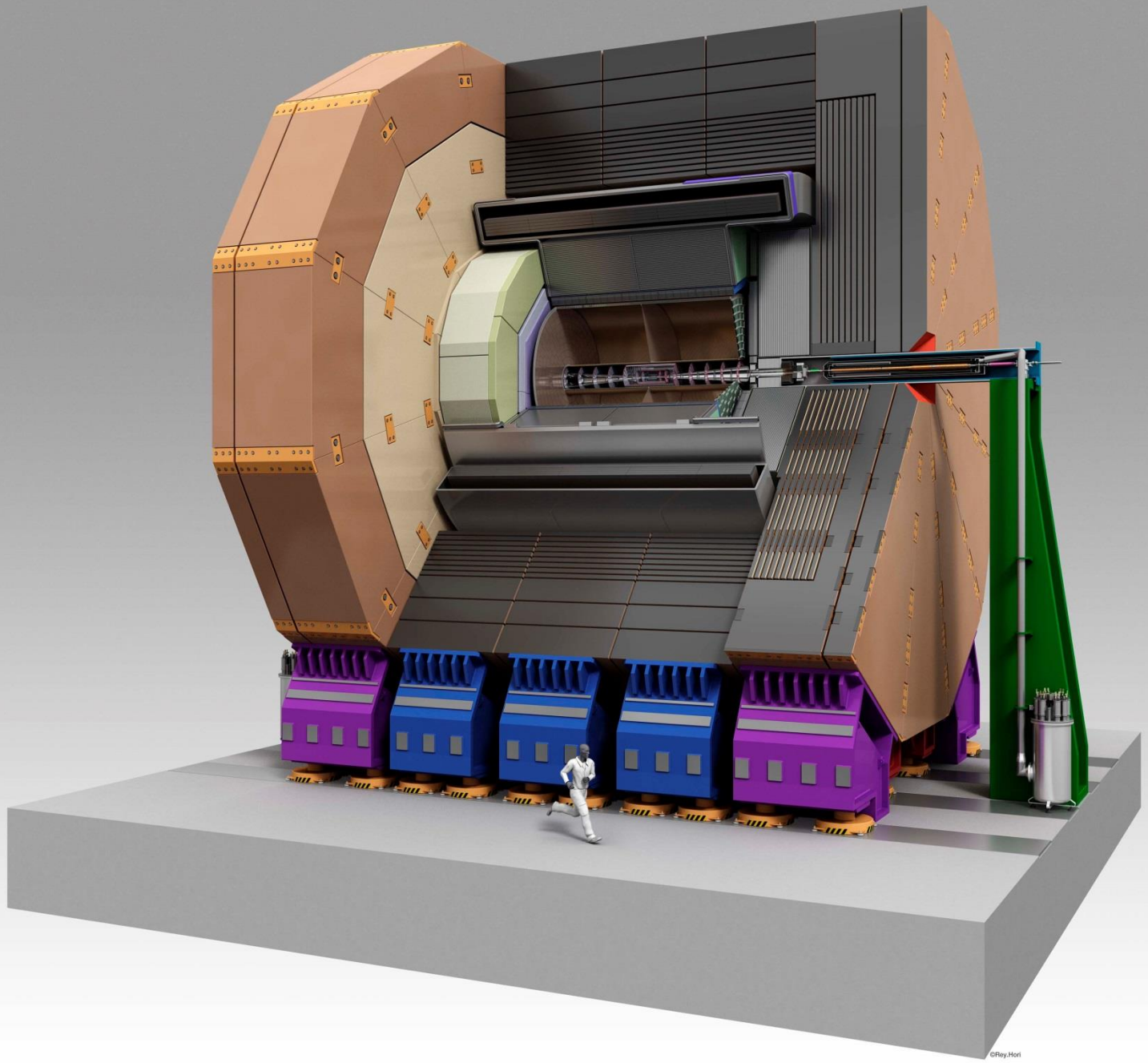
Other constraints:



Outer radius of Yoke:

Defined from push-pull condition on field < 50 mG

- Is this the correct requirement
- Changing this will have a huge impact on size (and cost)


©Rey.Hori

ILD Organisation

The Plan:

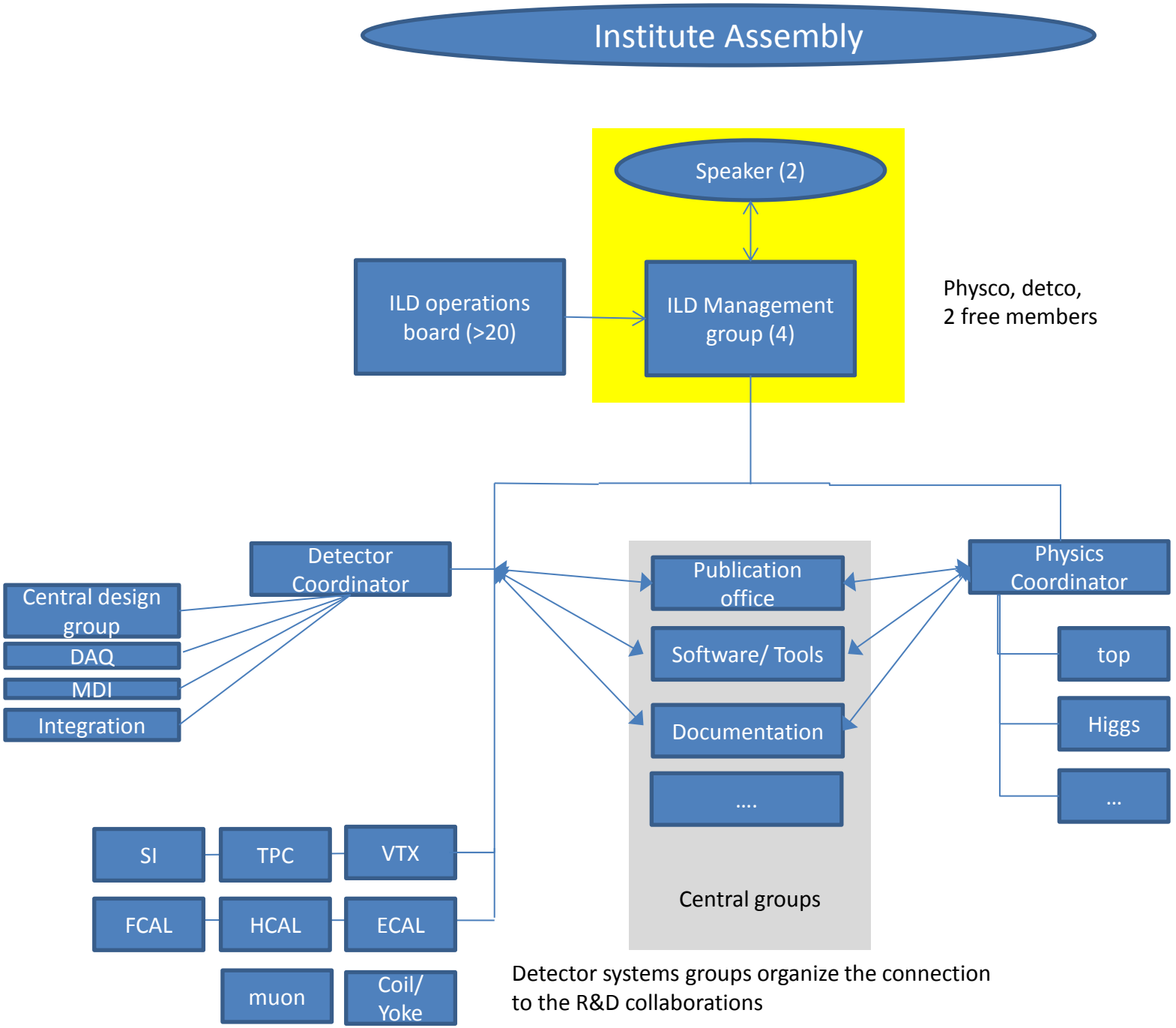
At the ECFA meeting May 2013:

Proposed and discussed new structure for ILD

At Cracow: iterate the organisation structure, further disucssions are needed

LCWS 2013: initiate the new ILD structure formally.

- Document describing the new structure is on the indico WEB site under the Thursday meeting
- Comments are welcome.


Institute Assembly
Speaker (2)
ILD operations board (>20)
ILD Management group (4)
Physco, detco, 2 free members
Detector Coordinator
Central design group
DAQ
MDI
Integration
Publication office
Software/ Tools
Documentation
....
Physics Coordinator
top
Higgs
...
SI
TPC
VTX
FCAL
HCAL
ECAL
muon
Coil/ Yoke
Central groups
Detector systems groups organize the connection to the R&D collaborations

ILD

- We have a good and clear starting point
- The next step will be a re-optimization of the detector
- We will need to make sure that we have an adequate and appropriate structure.