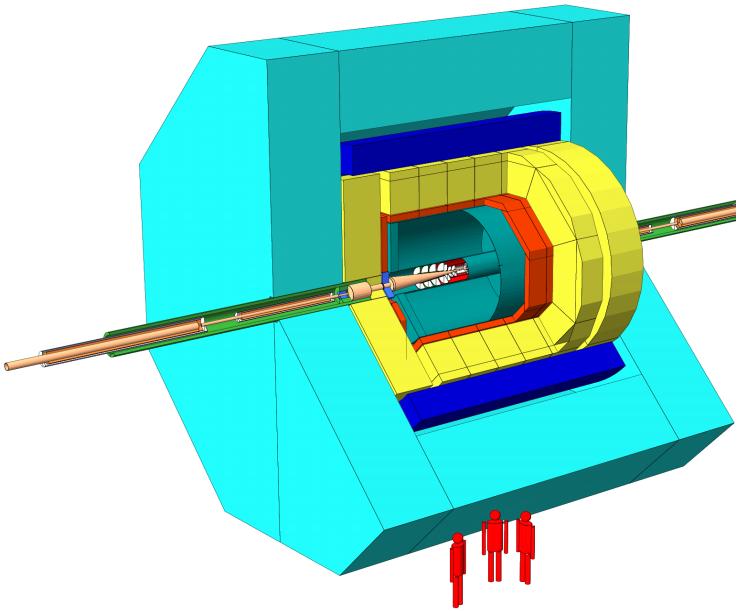
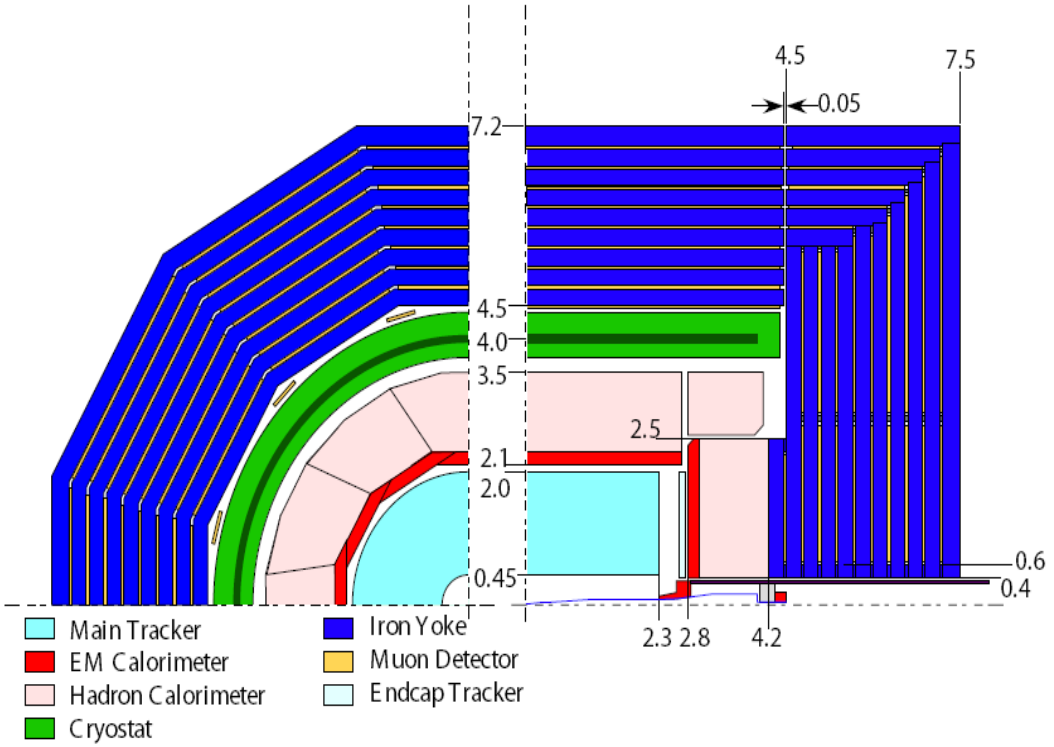
GLD and LDC: where do we start from

Ties Behnke, DESY





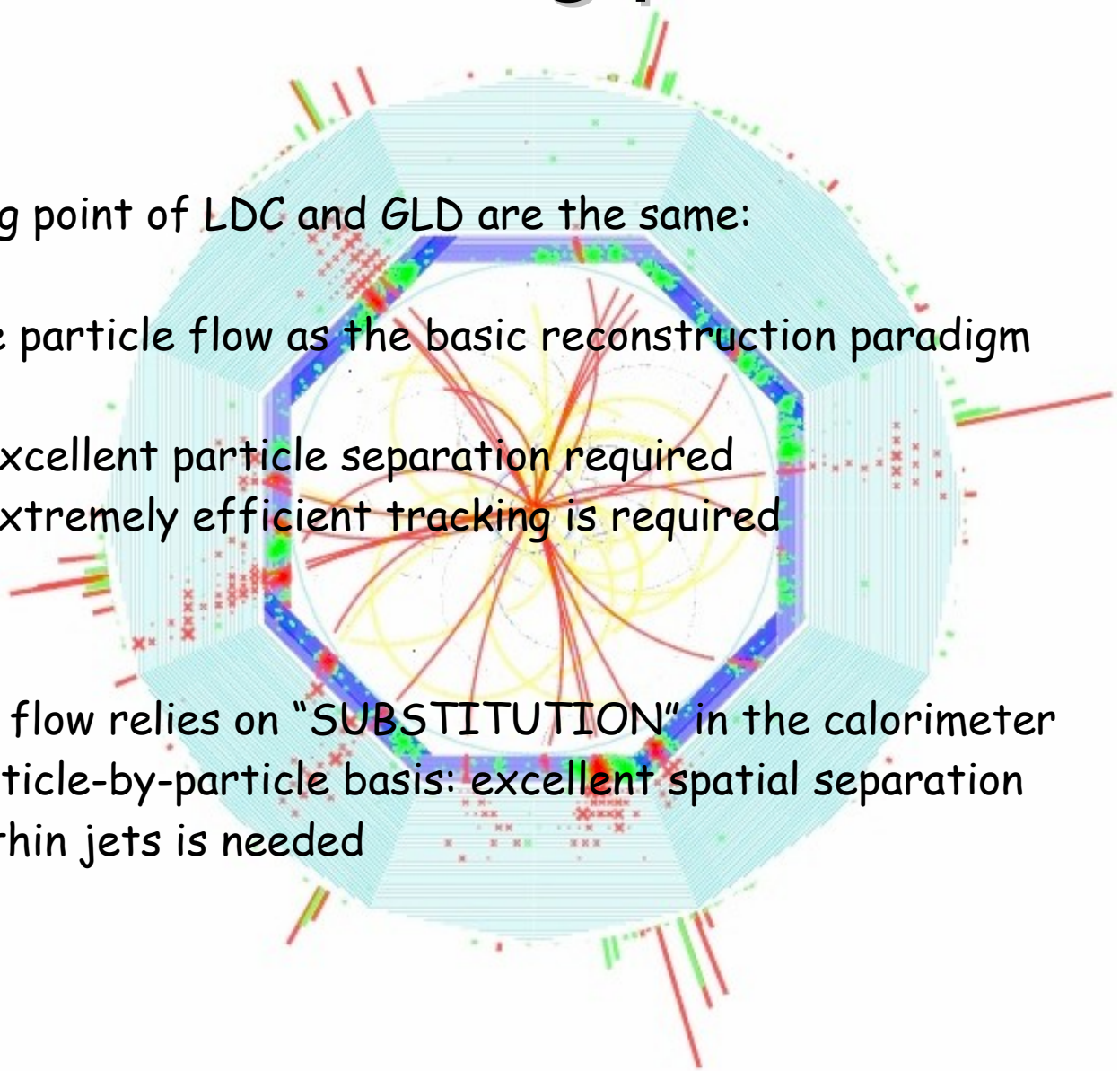
LDC DOD:
see http://www.ilcldc.org

Large Detector Concept

GLD DOD
see arXiv:physics/0607154v1

Global Detector Concept

Starting point



Starting point of LDC and GLD are the same:

- Use particle flow as the basic reconstruction paradigm
  - Excellent particle separation required
  - Extremely efficient tracking is required

Particle flow relies on "SUBSTITUTION" in the calorimeter on a particle-by-particle basis: excellent spatial separation even within jets is needed

PFLOW and DETOPT

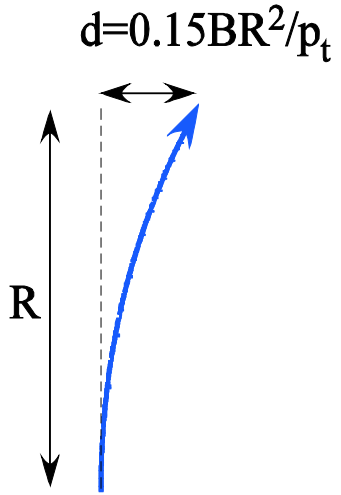
Separation of particles:

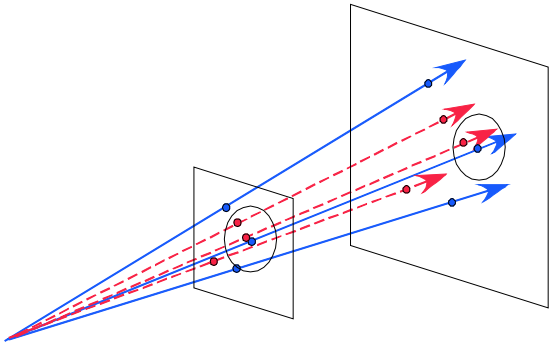
- Charged track separation ∝ $\mathbf{B\ R_{in}^2}$
- Neutral separation ∝ $\mathbf{R_{in}}$

But only applicable in the barrel!

But other issues enter as well:

- Moliere radius (= material)
- Segmentation of CALO

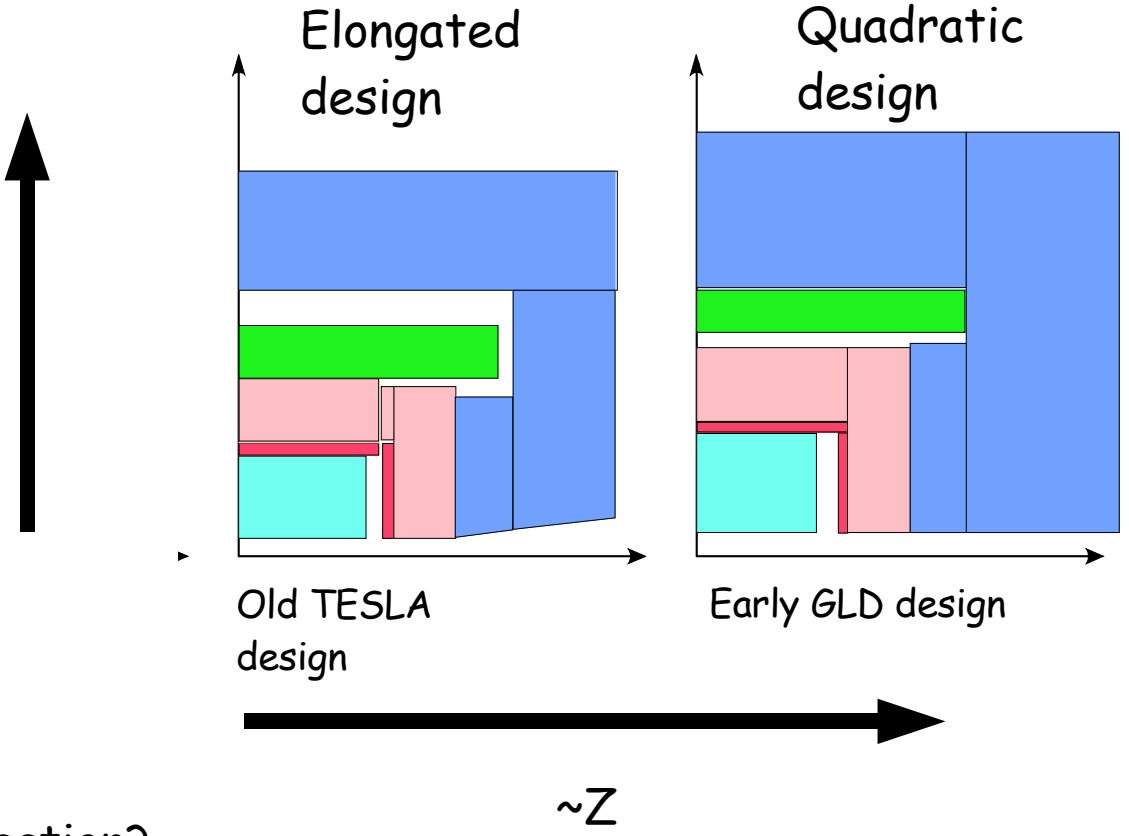




Questions: what is the optimal size? (including aspect ratio)
What is the optimal B-field

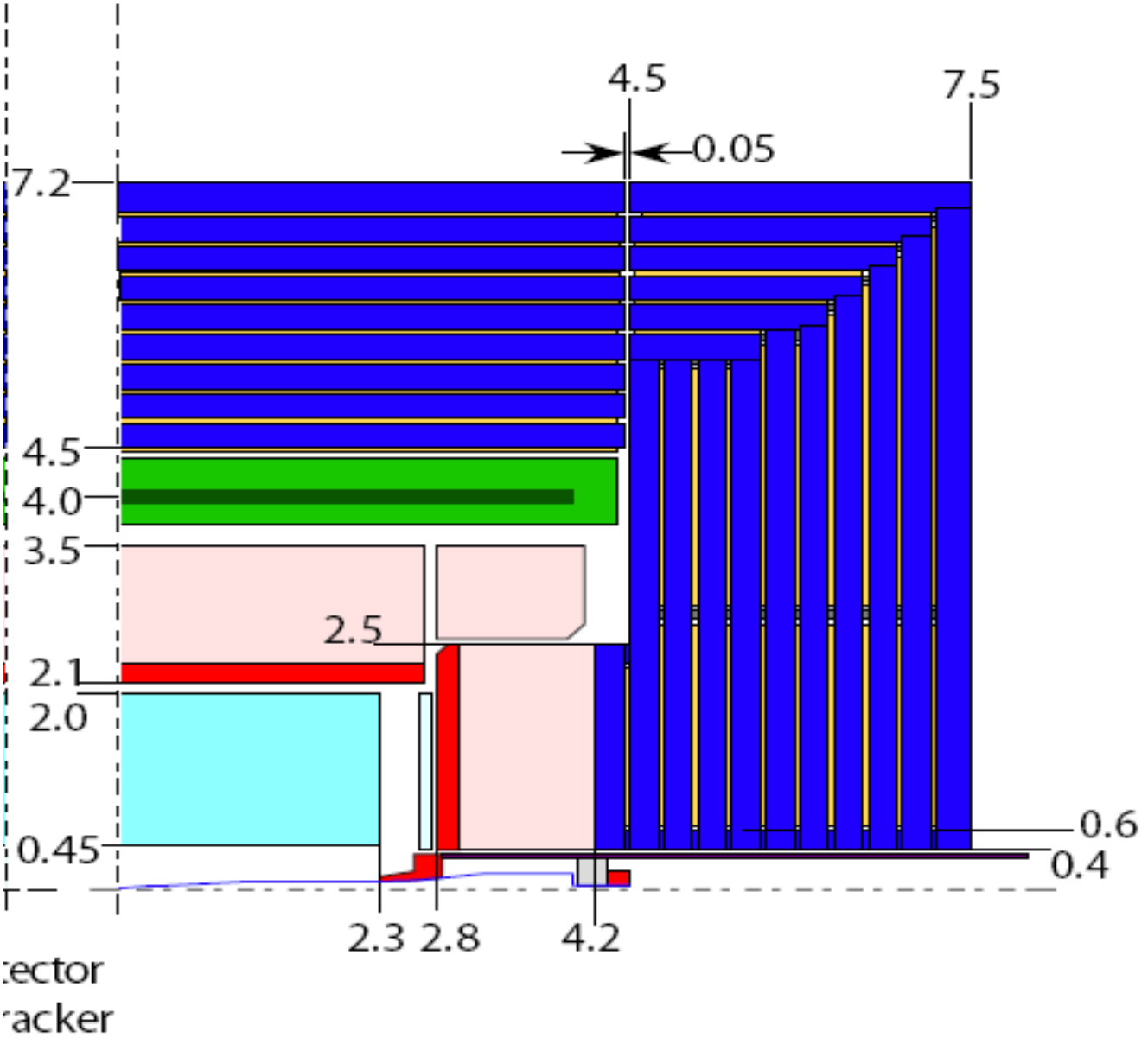
General Layout

GLD: 3 T field
LDC: 4 T field



Question:
how much do we need size
for separation,
how far can we get by sophistication?

Does energy reach play a role?

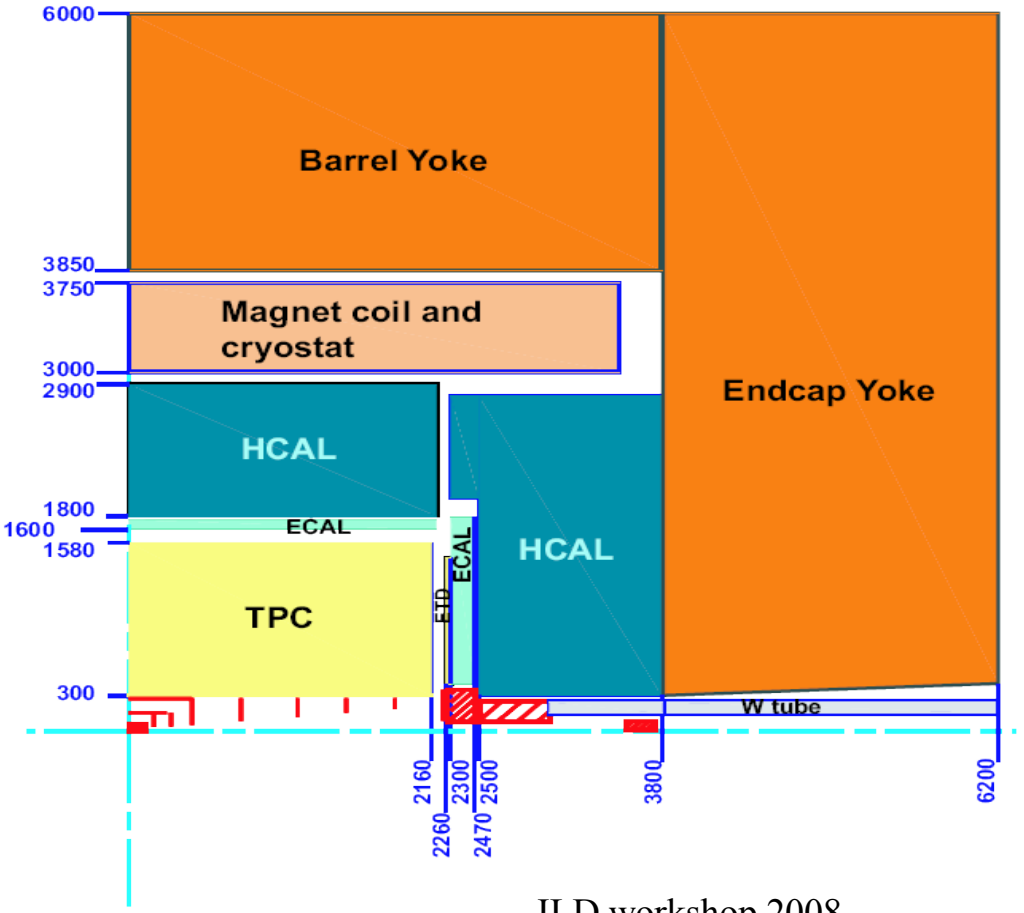


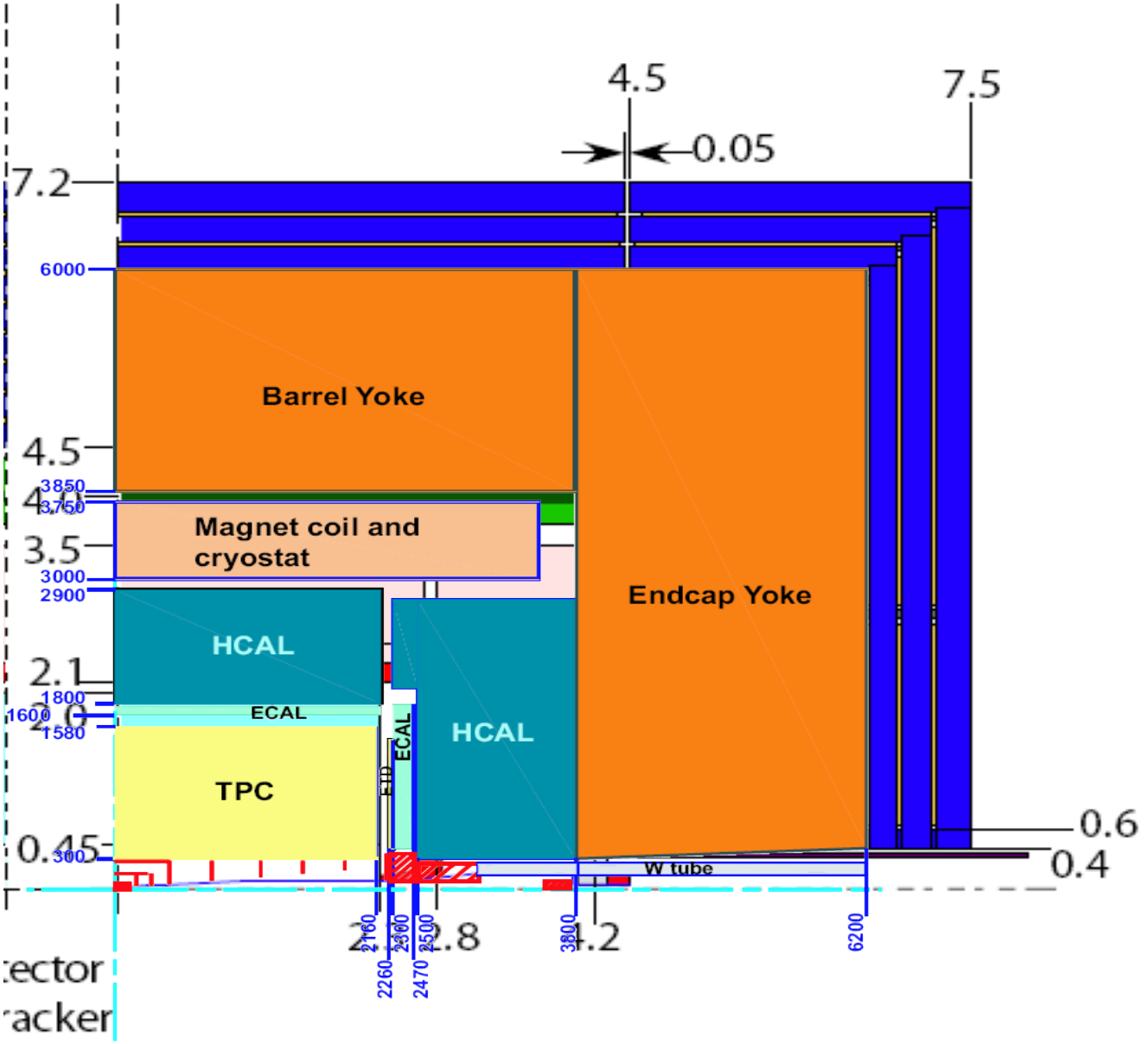
GLD

(source: RDR)

LDC

source: RDR





Comparing both

First Conclusion

Globally LDC and GLD are not that different

Size does matter, we need a real optimization strategy to understand the best optimization

(see Marks talk later today)

Particle Flow performance will dictate in the end the overall size

together with energy reach and cost considerations.

VTX detector

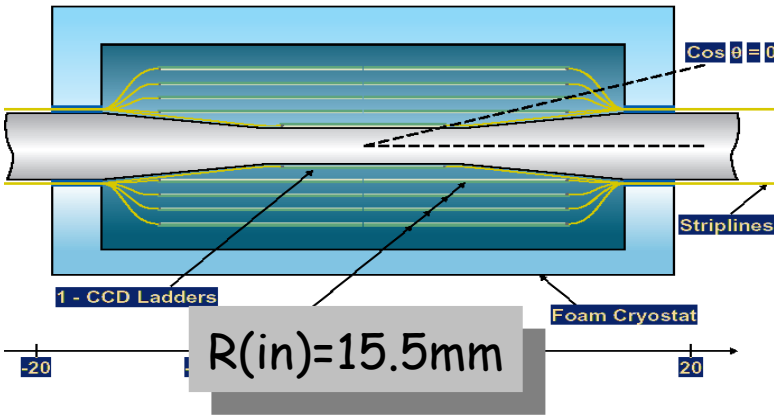
Pixel technology, many different technologies are under consideration

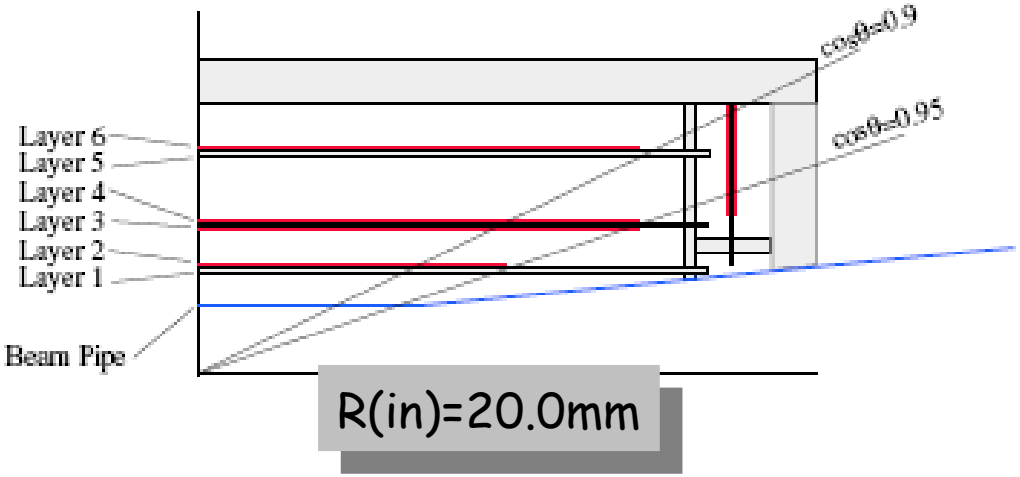
LDC

- 5 layers
- equally spaced
- no endcap for VTX
- no technology baseline

GLD:

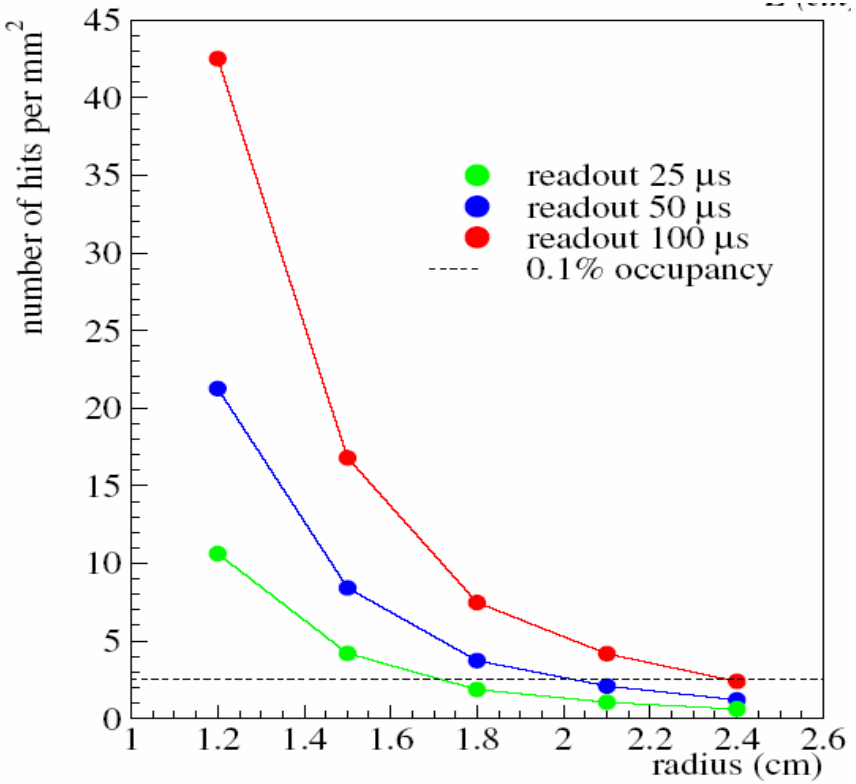
- 6 layers
- paired, on common support structure
- one endcap disk
- baseline fine pixel





VTX parameters

Most critical parameter: inner radius

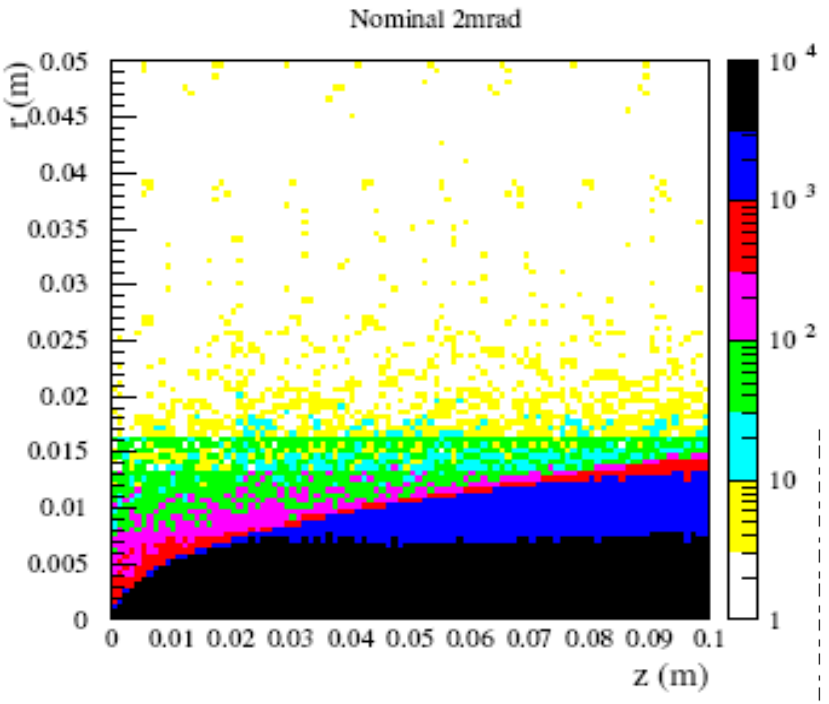


Background hit occupancy
as a function of radius

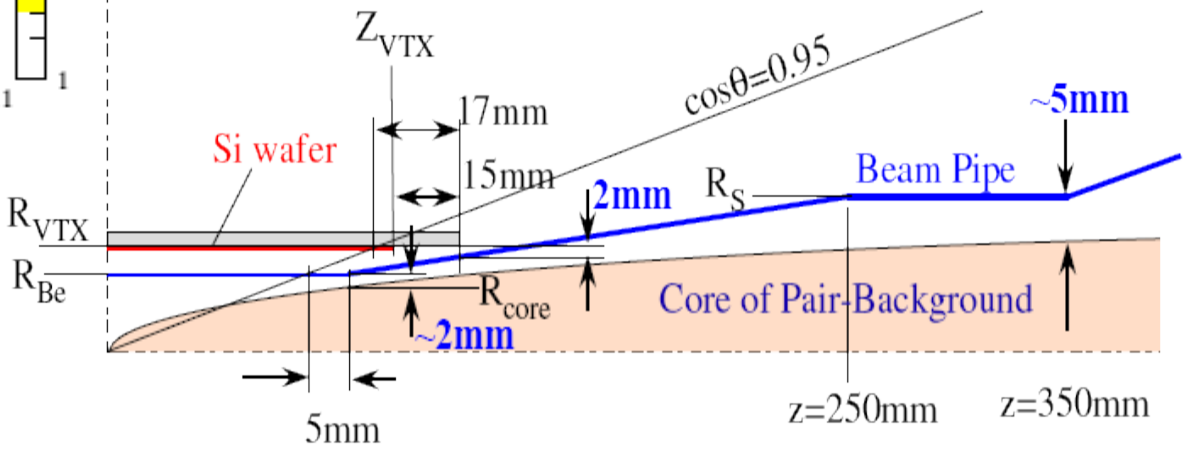
Possible inner radius is
mostly driven by magnetic field

Detailed layout will depend
on final choice of field
(or determine final field value)
and machine parameters

VTX optimization



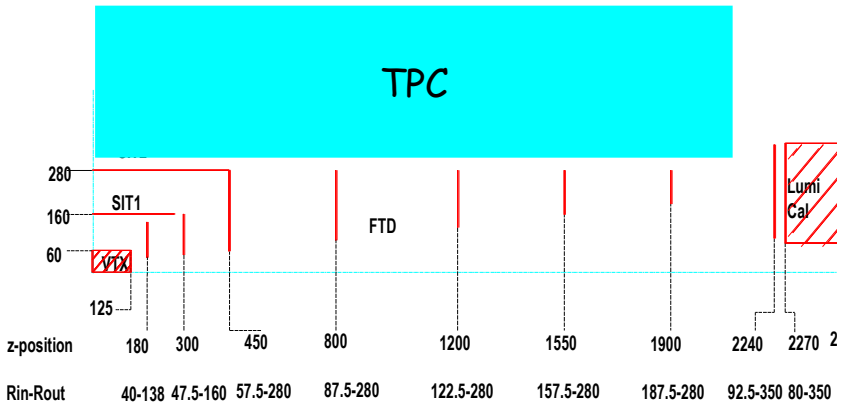
Background plays central role
in determining the inner radius



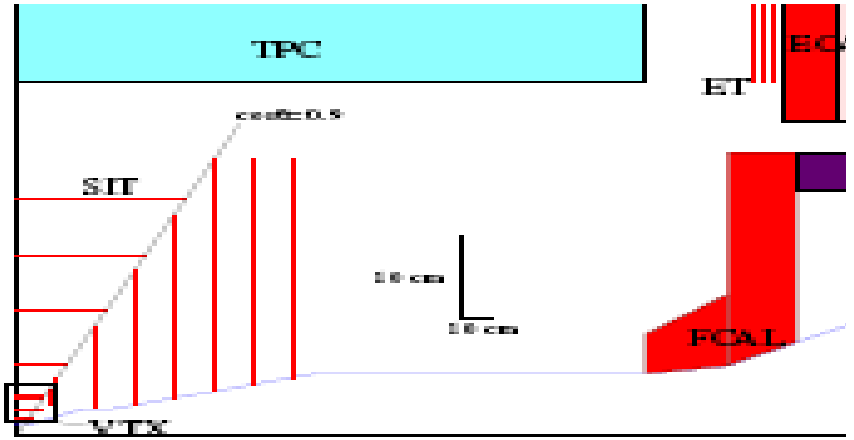
The inner detector

Basic layout:

high precision VTX detector
auxiliary SI tracking to bridge the gap between VTX and TPC
high precision many point TPC



2 SIT layers

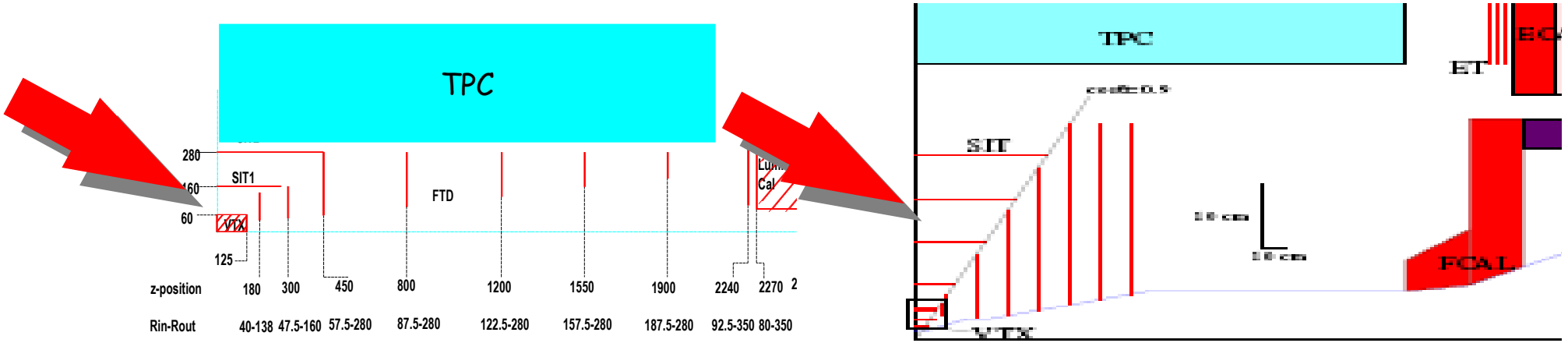


4 SIT layers

The inner detector

Basic layout:

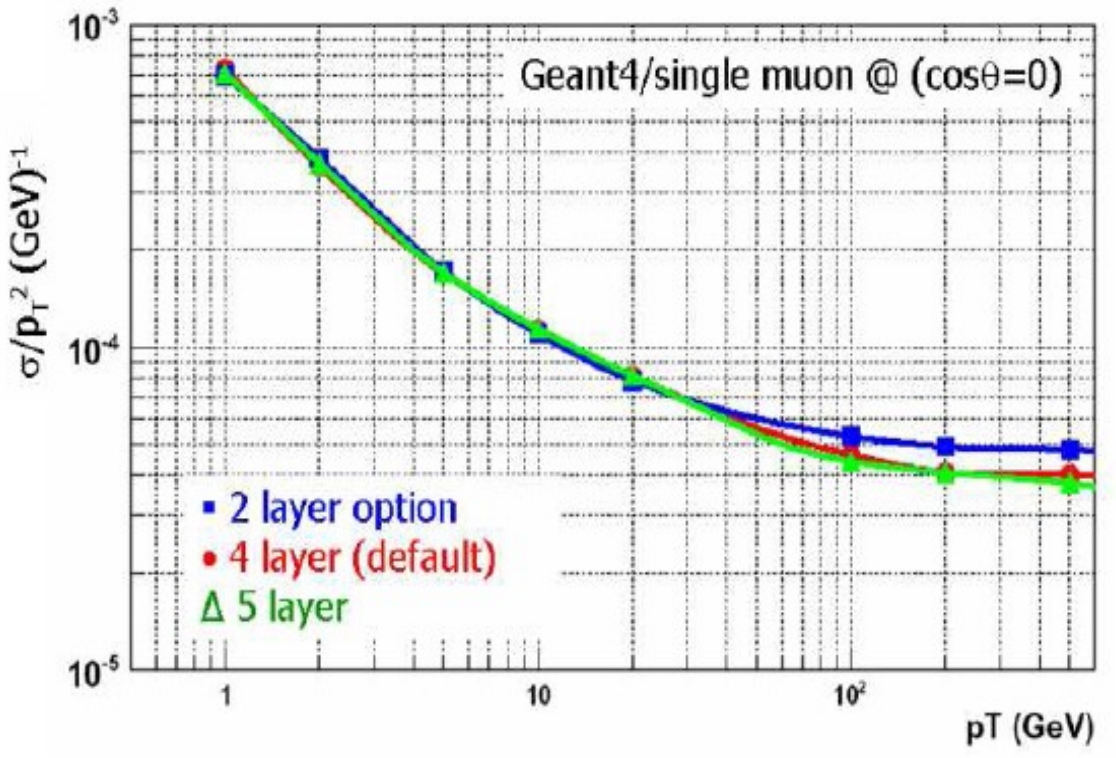
number of SIT layers?



2 SIT layers

4 SIT layers

Number of SIT layers



4 layers:
better momentum resolution

Material?

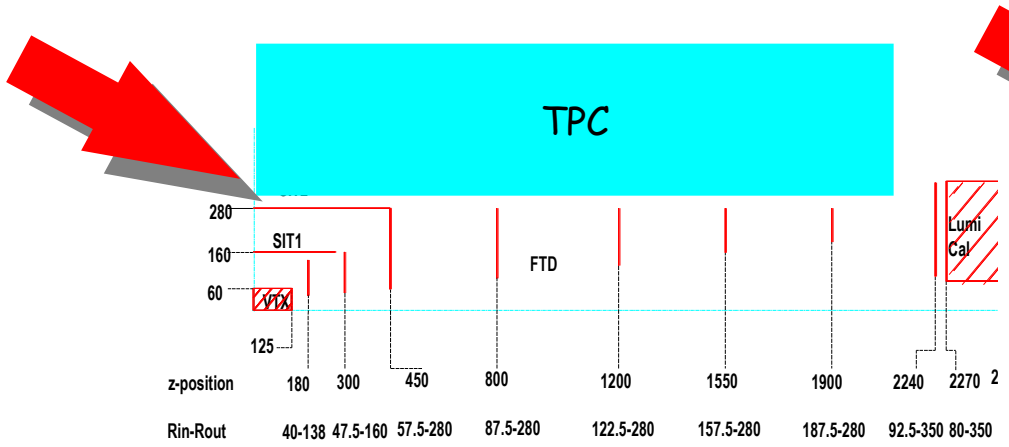
Tracking efficiency?

The inner detector

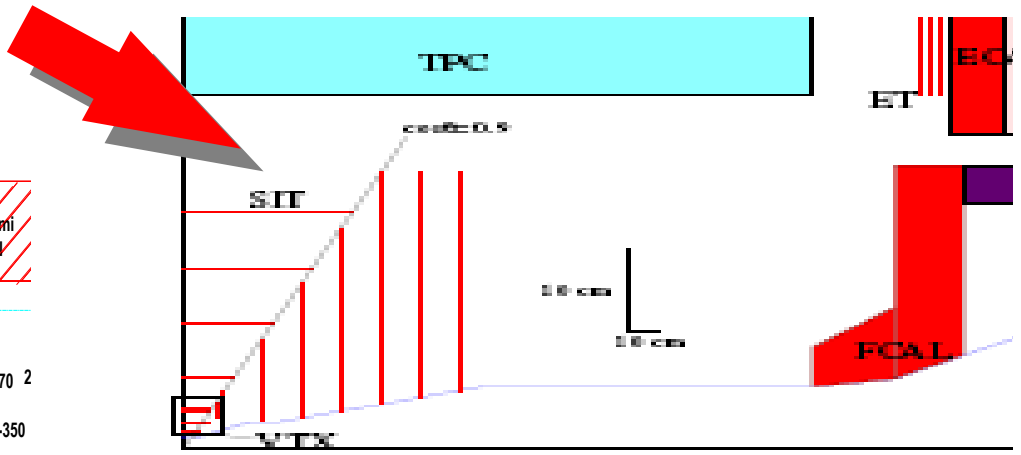
Basic layout:

number of SIT layers?

Position of last SIT layer?



2 SIT layers



4 SIT layers

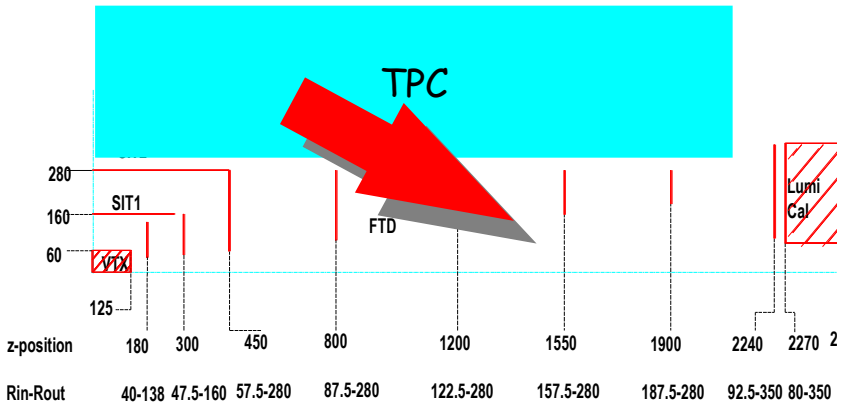
The inner detector

Basic layout:

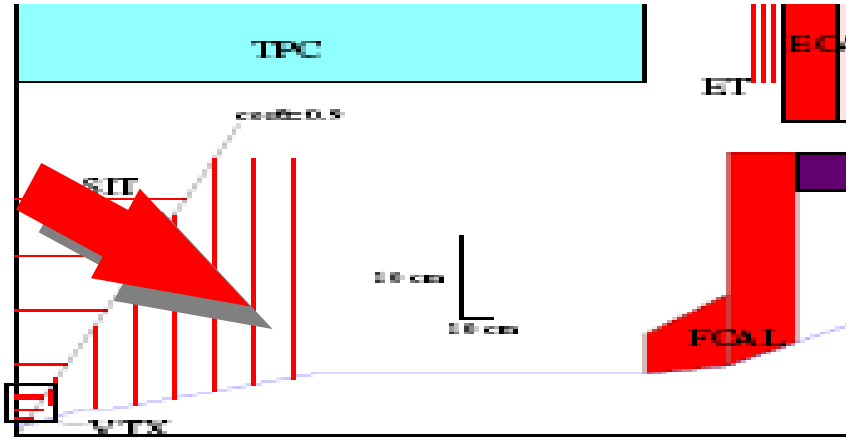
number of SIT layers?

Position of last SIT layer?

Position of FTD layers in forward direction



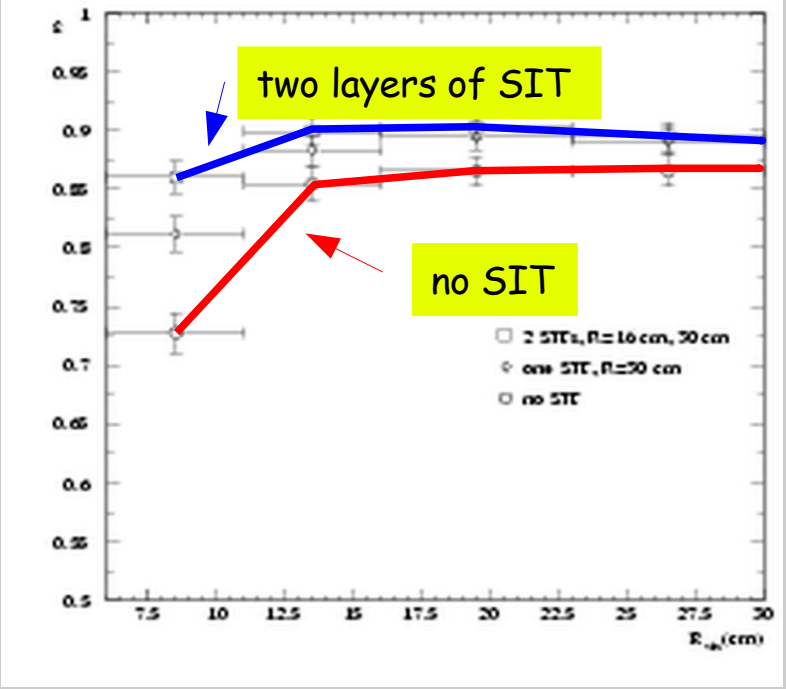
2 SIT layers



4 SIT layers

Silicon tracking

- SIT between GLD and LDC is different
- We need to understand the role of the SIT better
- Dedicated set of studies needed to determine the final layout



Example:
K0 finding efficiency with and without the SIT (LDC case)

TPC

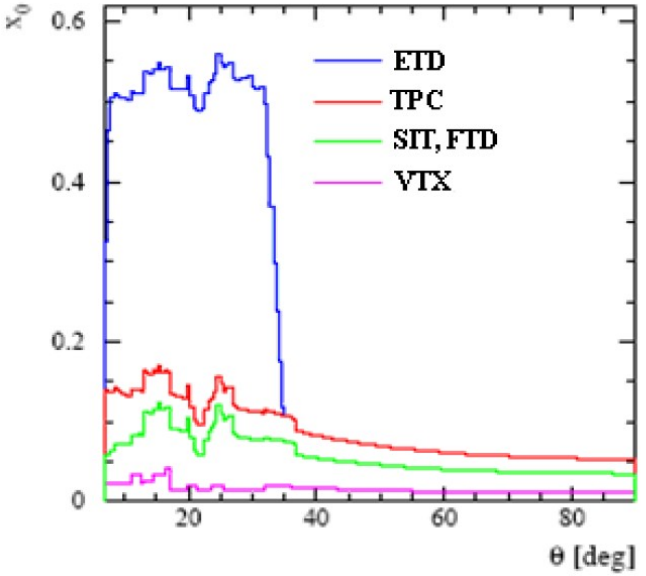
Both GLD and LDC rely on TPC for large volume tracking

differences are small

hardware developments are already done together

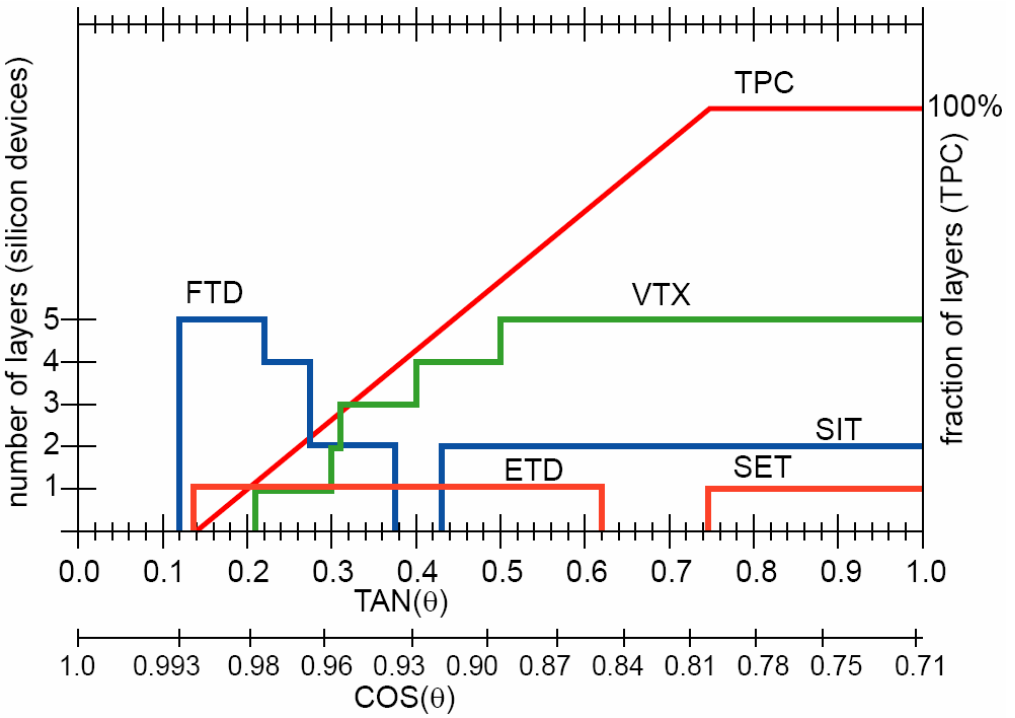
Performance goals seem within reach

biggest question remaining is material:



Tracking Configuration

Coverage of subdetectors:



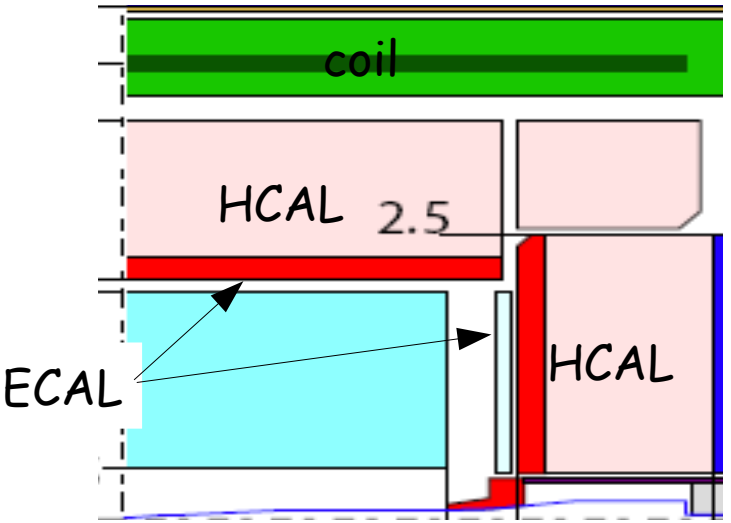
LDC coverage

- Role of additional detectors?
- External Si tracker?
- SI detector behind the TPC endplate?

Calorimetry: Layout

Basic layout is the same:

ECAL, HCAL both within the coil
Separation into barrel and endcap



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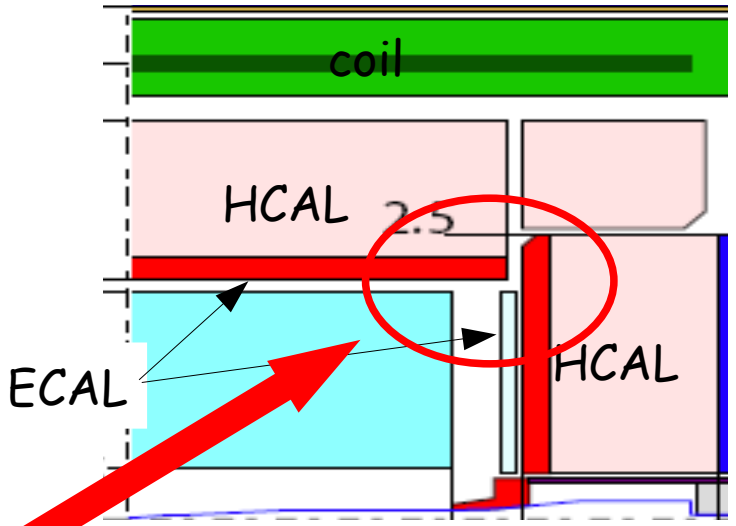

Layout of the corner
is not well enough studied
and different in detail

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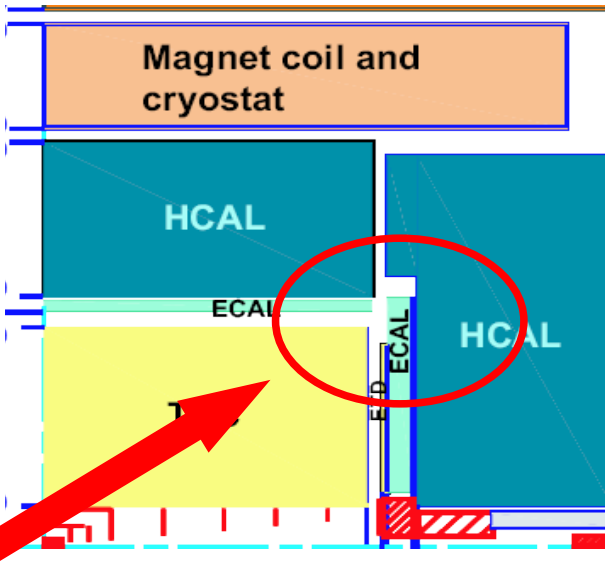

Layout of the corner
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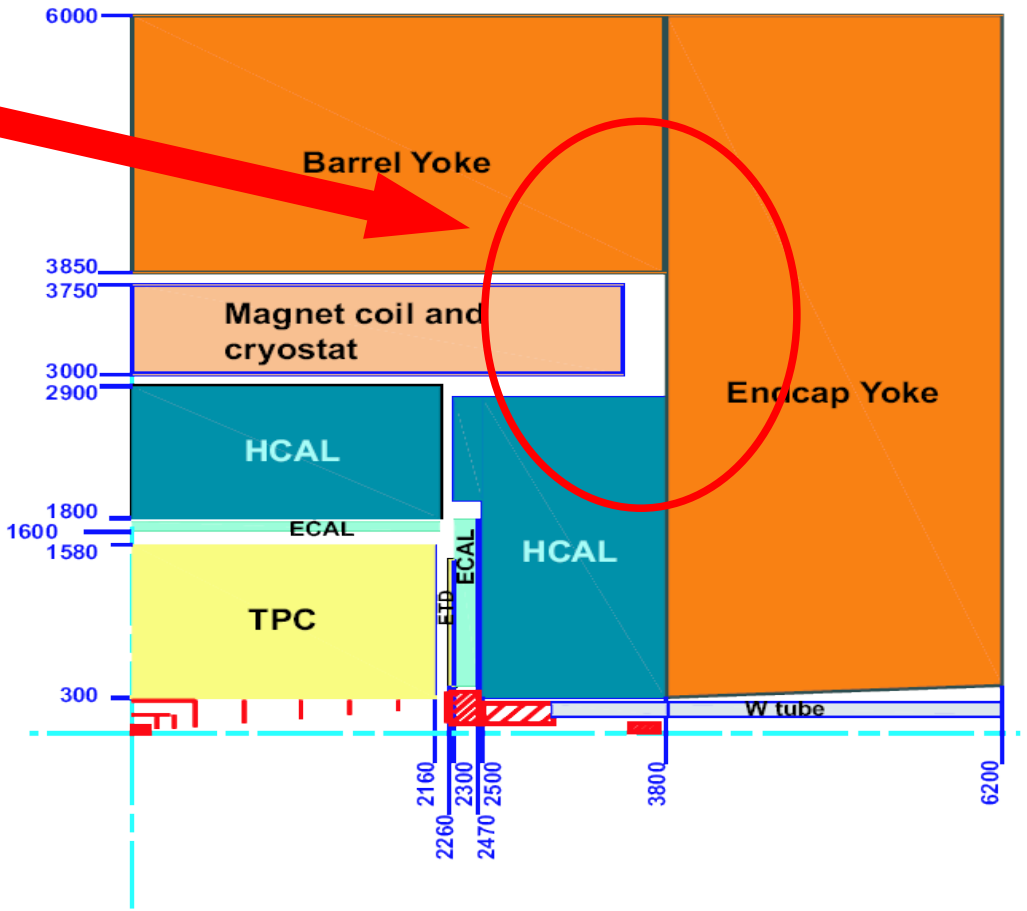
Calorimetery: Layout

Layout of the magnet relative to the HCAL:

corner region?

LDC: short coil
but highly inhomogeneous field region

GLD: longer coil, better coverage of the HCAL corner



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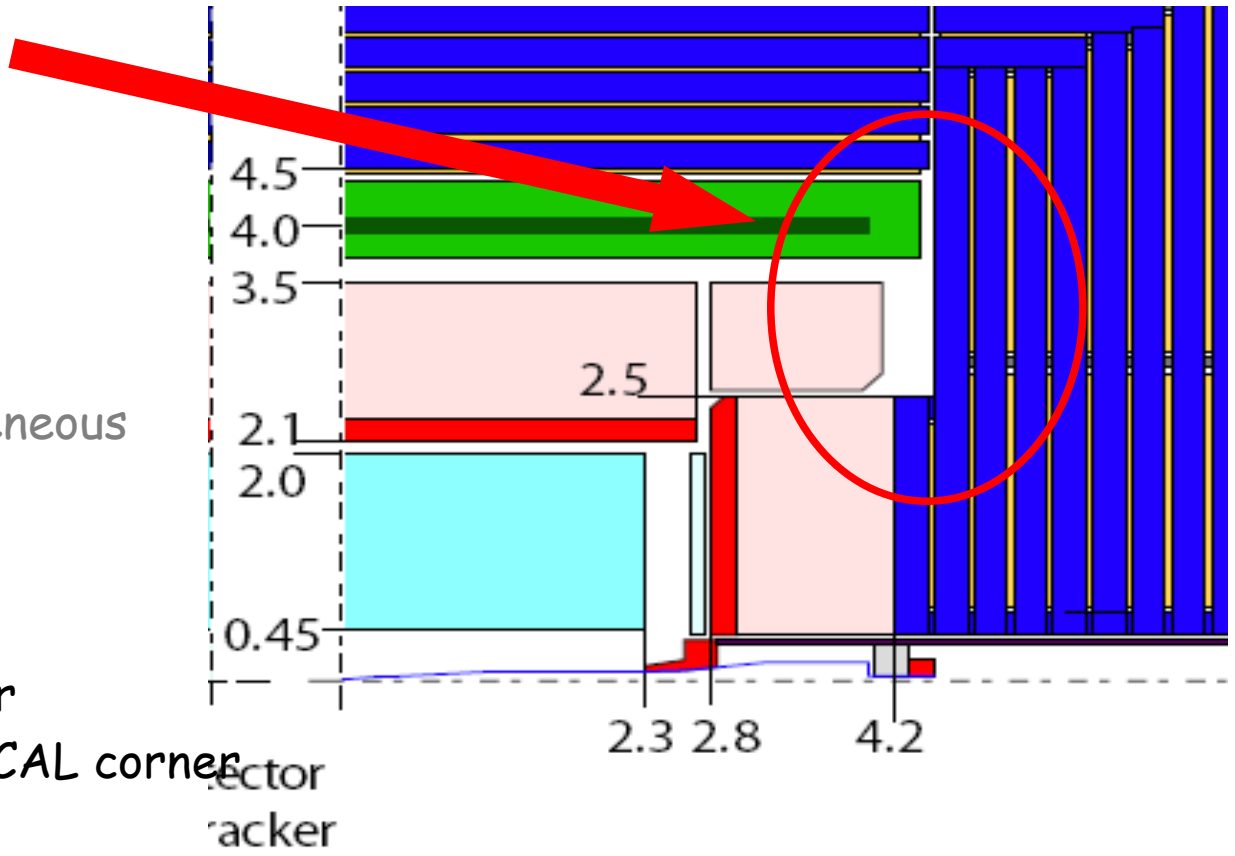
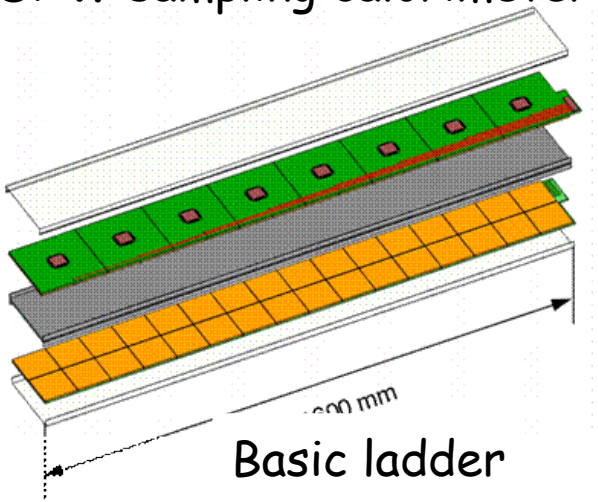


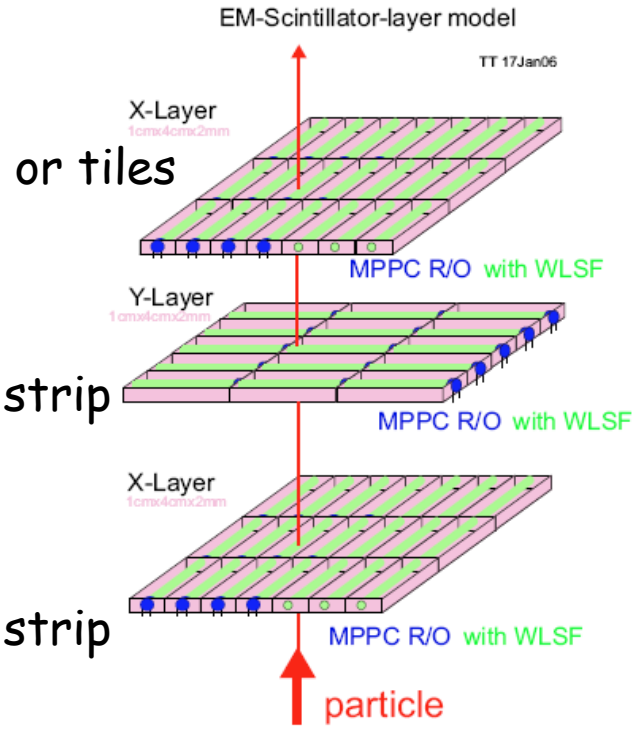
ECAL: technology

Particle flow calorimetry:
small cells, small Moliere radius

LDC: Si-W sampling calorimeter



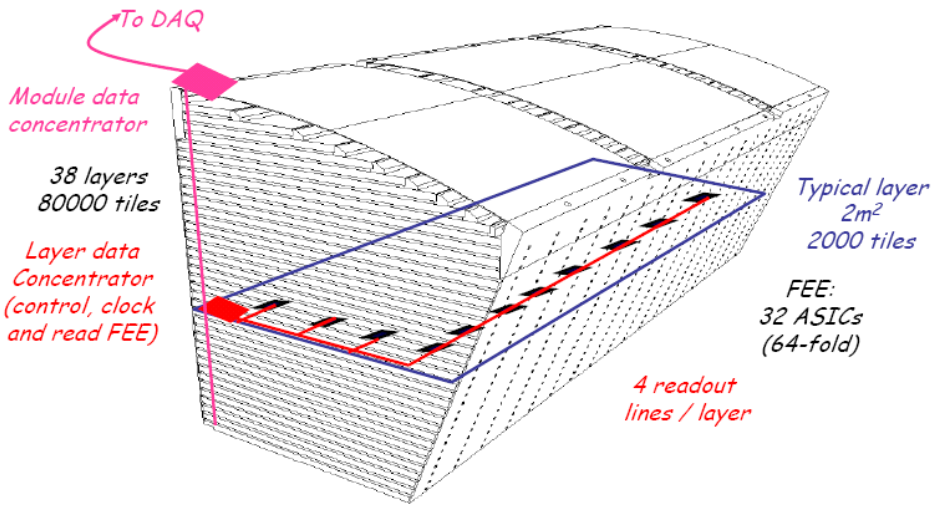
Basic ladder design

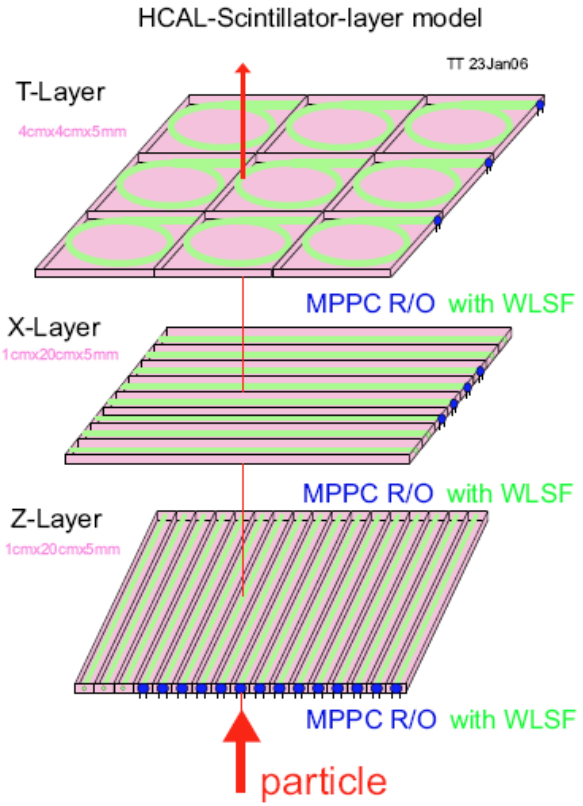


GLD: Scintillator-Pb sampling calorimeter

HCAL

LDC: Analogue Scintillator tile – Fe sampling
digital Fe-sampling

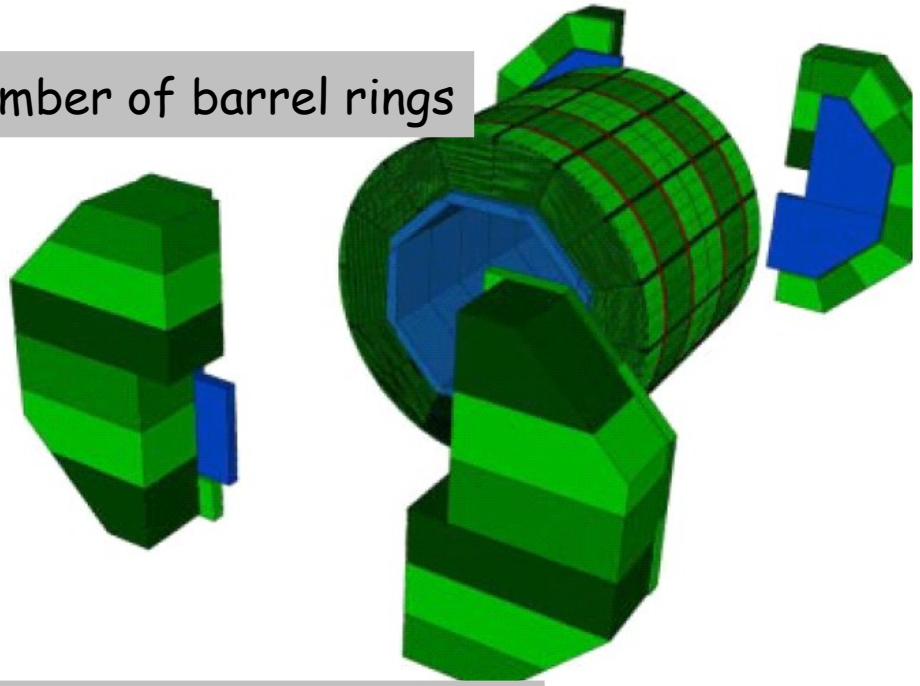




GLD: Analogue Scinitillator tile – Pb sampling (maybe Fe)

Calorimeter: System design

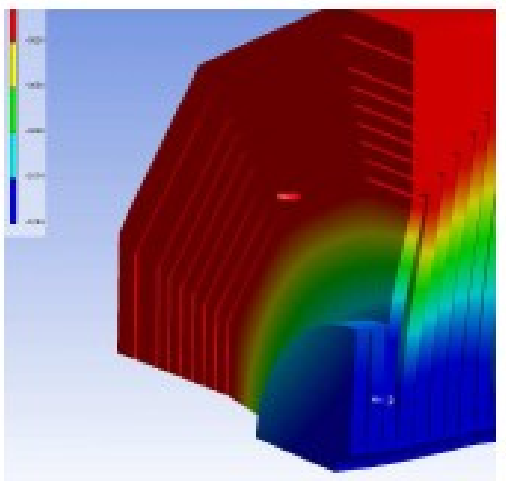
Number of barrel rings



Single or split endcaps?

Overall design depends on many factors:

- stability
- magnetic forces
- integration aspects
- opening and closing
- etc



Calorimeter conclusion

Conceptually there are no (or little) differences between LDC and GLD

Technologically there are differences

The final choice of technology will depend critically on the performance evaluation, and possibly on cost

Open questions (same for all options)

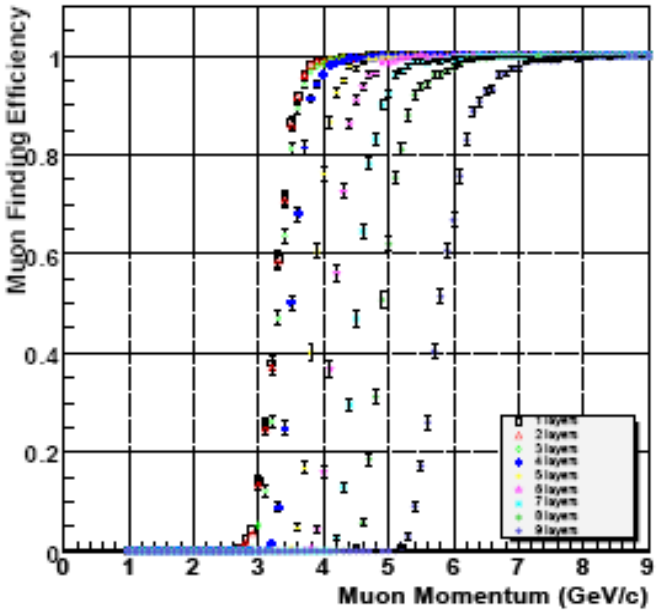
- Optimal sampling
- Optimal granularity
- Thickness (in particular HCAL)
- Barrel-endcap transition
- ....

(see Marks talk later today)

Outer Detectors

Muon system: instrumented iron return yoke

Options are Scintillator strip or large area RPC



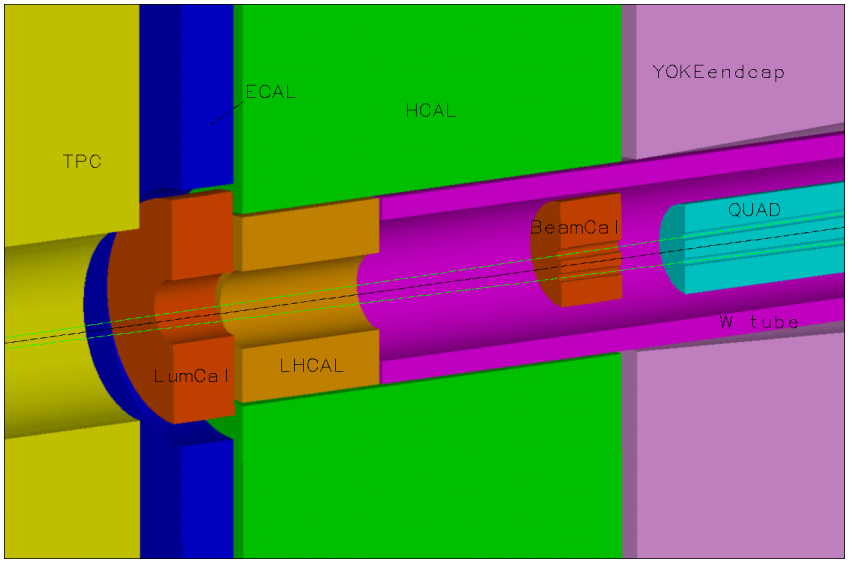
Number and spacing of layers need to be optimized

Role of Muon detector in a PFLOW detector needs to be understood

Very forward detectors

Layout of GLD and LDC are different in detail,

but similar in principle

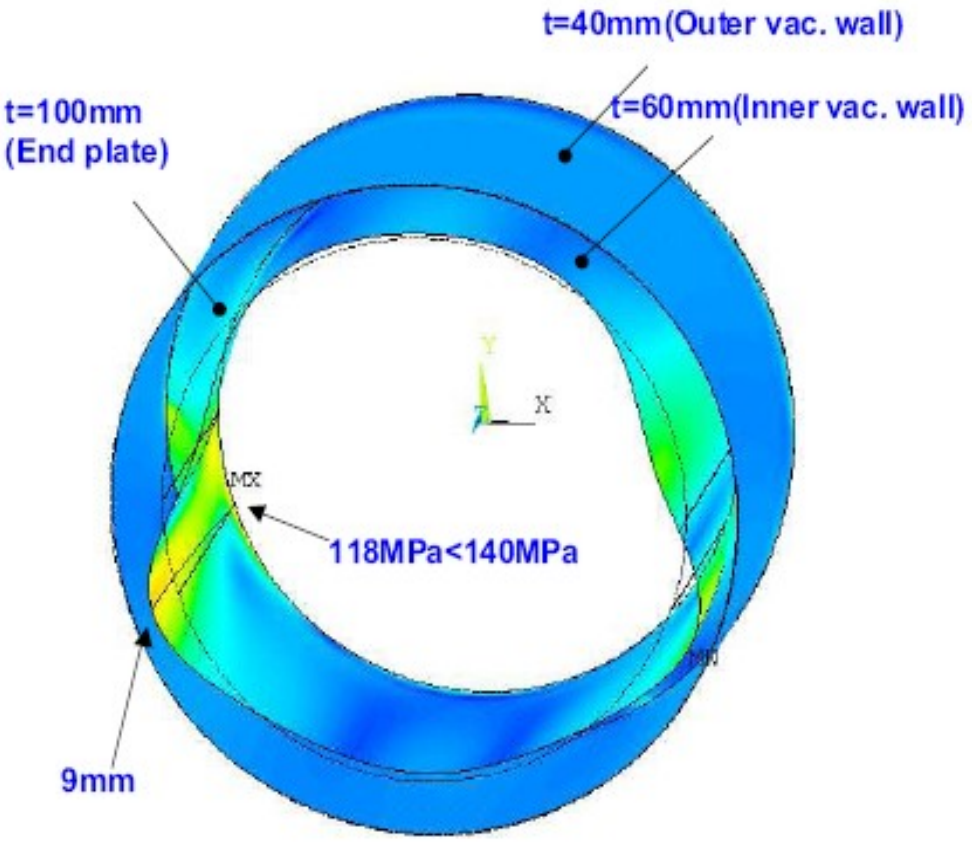


MDI working group is
already studying this in detail

see tomorrows morning session

Coil

Designs for coils exist
for both LDC and GLD



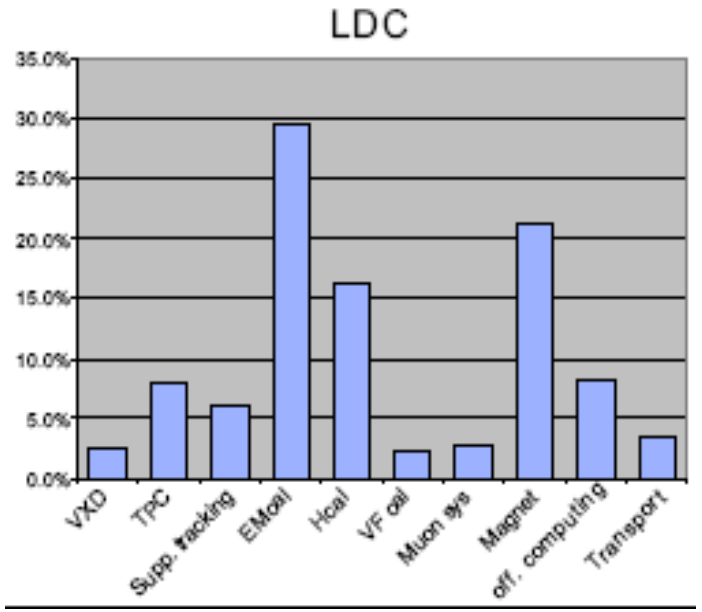
They differ in some details
but not in principle

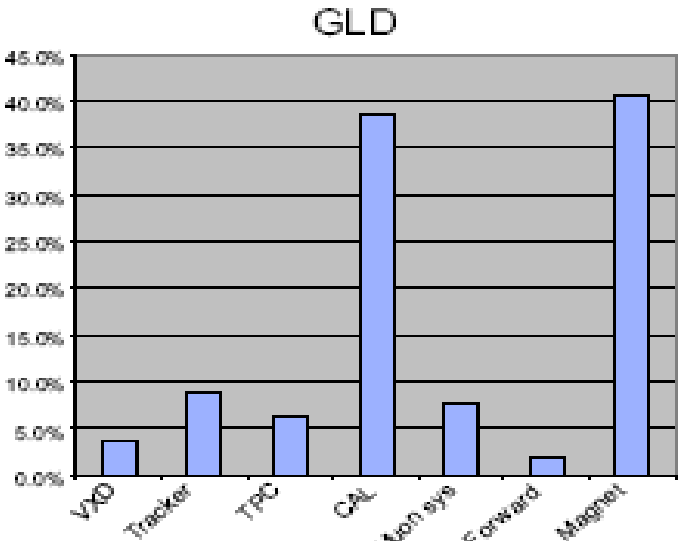
Most relevant question:

what is the optimal field value
(closely related to size optimization discussed at beginning)

Cost

Costs have been evaluated for both LDC and GLD





Cost will play a crucial role in the definition and optimization procedure
We have to understand the costing methodology.

Conclusion

GLD and LDC start from similar assumptions

Solutions found are similar in principle, but different in detail

To define ILD we need

- Understand the arguments for a particular solution
- Explore the available phase space (optimization)
- Understand the cost impact
- Define a baseline configuration with a (hopefully small) number of options

This workshop will show us how to proceed towards ILD