ILD dimensional constraints

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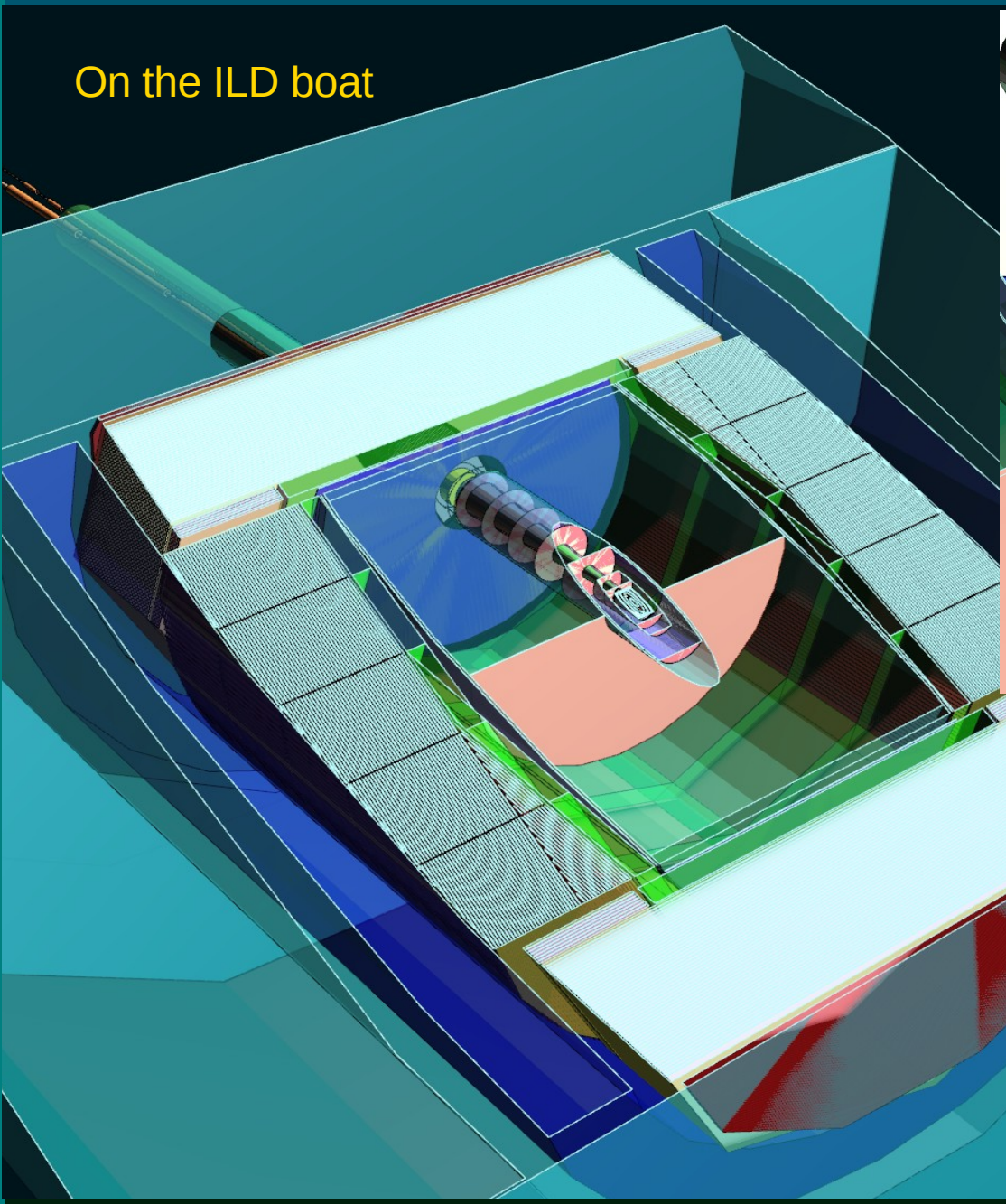
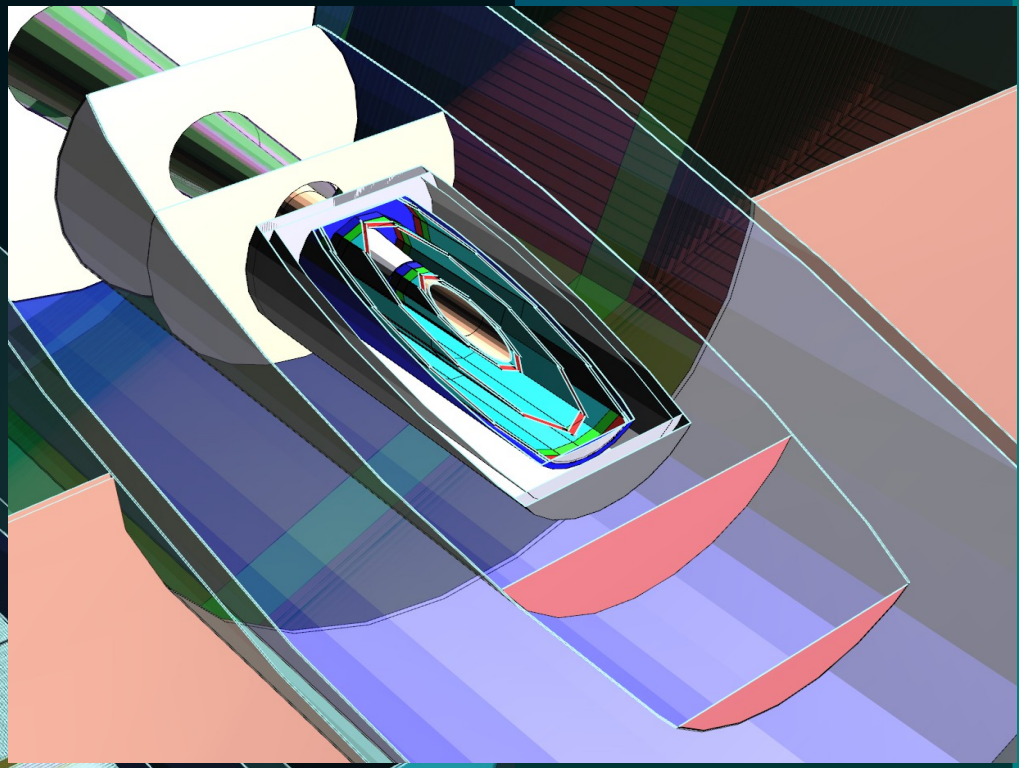
A more or less organised set of questions
as a contribution to the MDI/integration meeting,
an introduction to many other presentations

Fluctuat nec mergitur *

On the ILD boat





As seen in ILD00

* Paris motto

Outline

Constraints from:

Hall, push-pull and opening,
Shielding
End cap coils
Accelerator, L*
QD0
background
Coil, field quality and (anti-)DID

Playing with dimensions, construction constraints

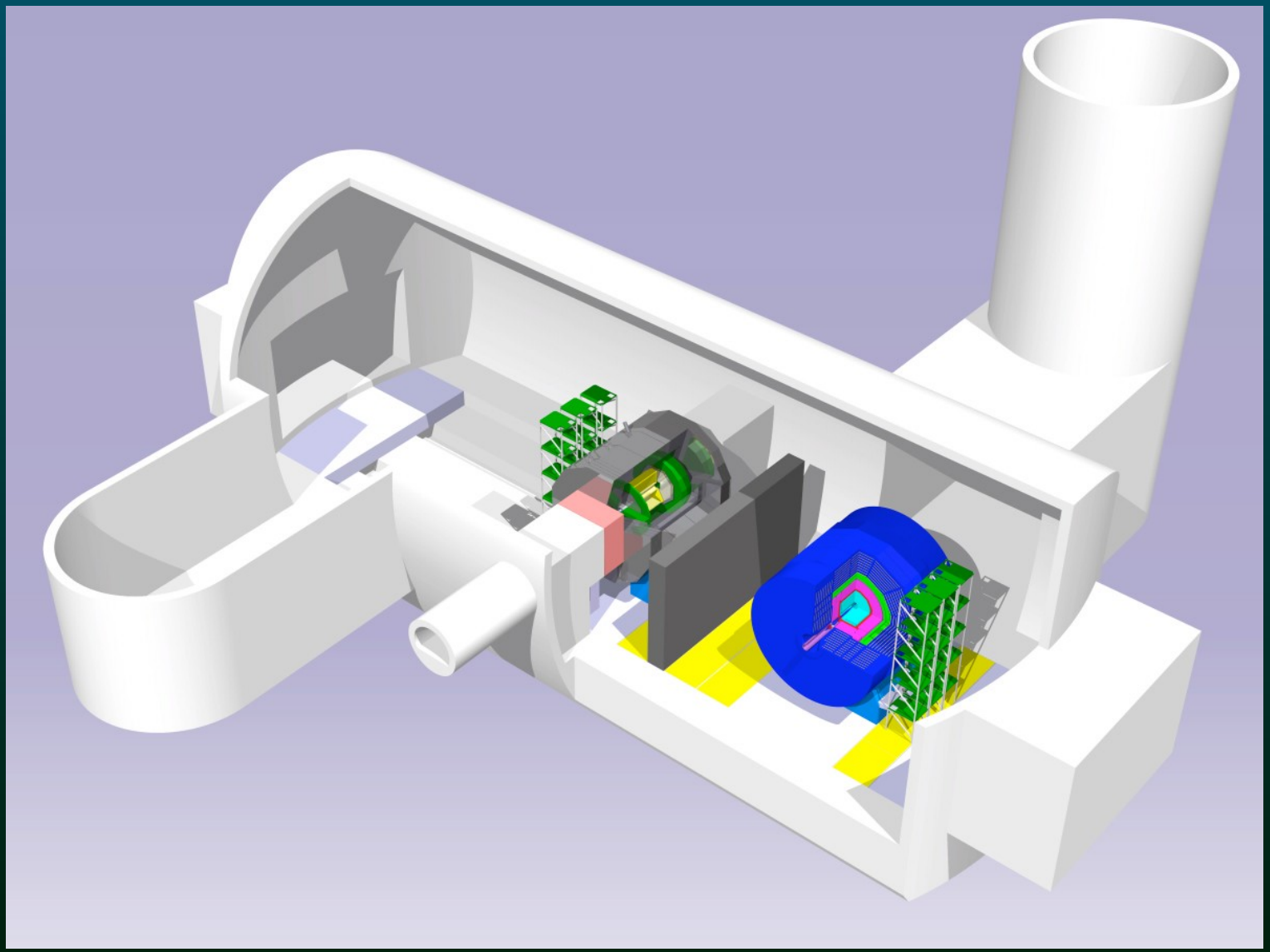
About length

TPC end plate thickness
TPC end plate to ECAL (ETD) distance
End cap to barrel distance (overlap)
Using the tail catcher in the EC?
What does optimisation say about TPC length?

About radius

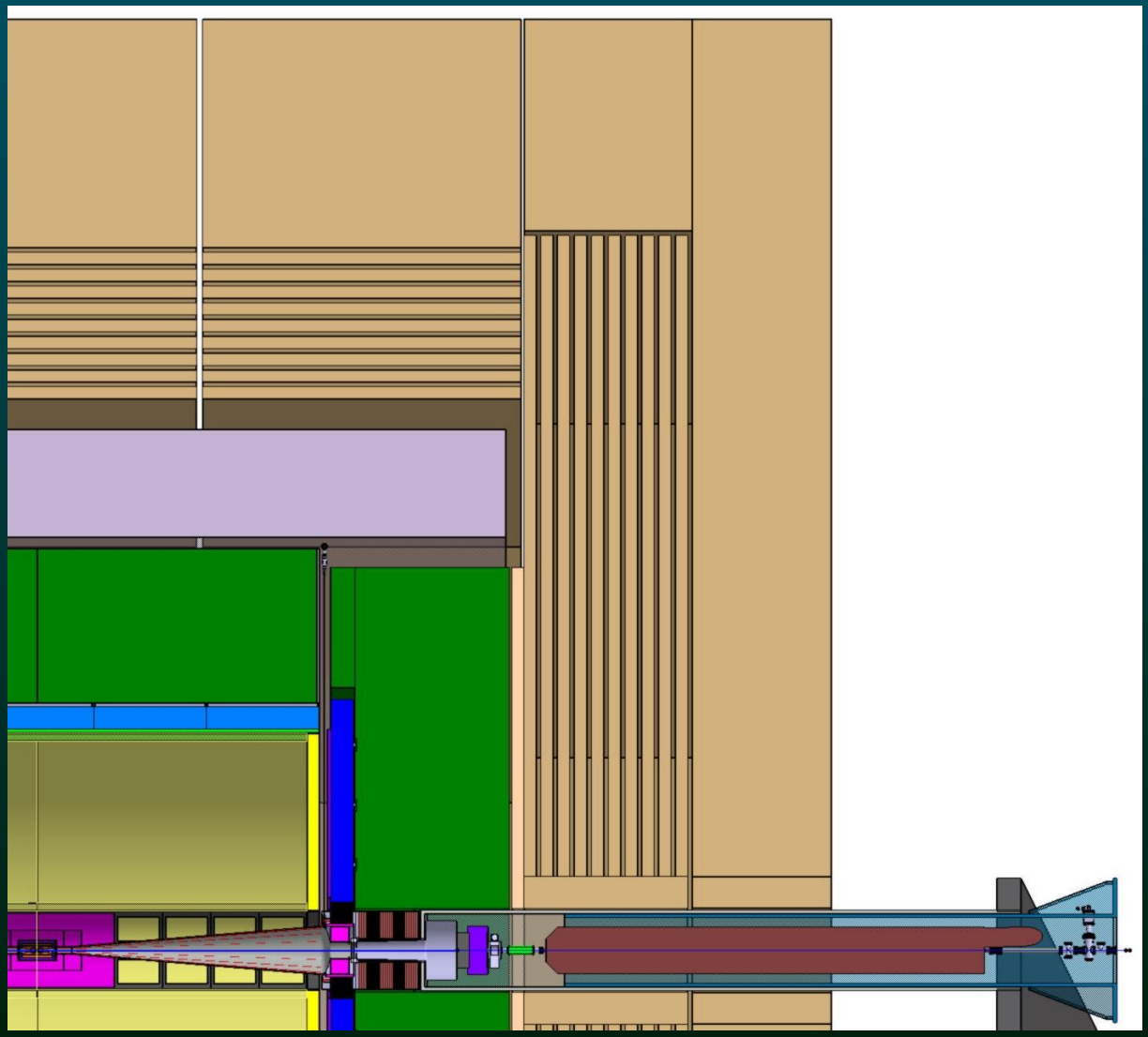
Coil thickness (DID)
HCAL thickness, sampling? W? (in memoriam)
ECAL thickness and shape
TPC field cage thickness and shape
radius/SET
Reduce material inside

A plausible hall with the two detectors in push-pull



Hall, push-pull and opening

ILD, as of today, makes more than 7m x7m and 14000 tons = 2x Eiffel tower (without restaurants)



To install in a hall,
To push and pull
To open (in garage position)
To fit between two quads
which “define” the luminosity

The deep yoke controls well radioactivity
But is designed to control the stray field

Then can we reduce its thickness by using end cap coils (H Gerwig)? Or outside coil?
What are the terms of the bargain?

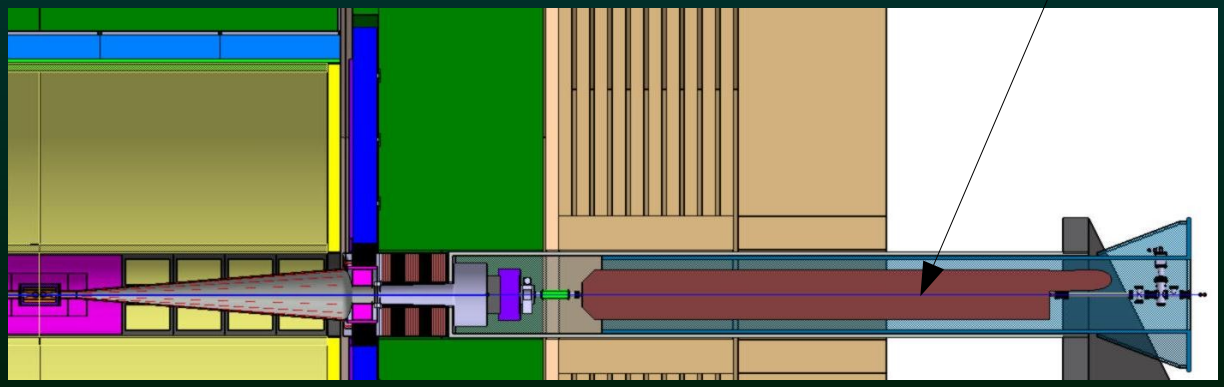
The current L* for ILD is today 4.5m
Do we loose by not being shorter?

Aspects of luminosity

The L* is the distance between IP and the front of QD0

The luminosity grows by reducing L*
forces QD0 in the detector
QD0 has to be stable to 20µm or so
forces QD0 to be supported by the tunnel
then outside of the detector

The extra coils may help solve the problem



What is really in between
QD0 and Lumical?
Pump size?
Valves?

Do we need more space?
Can we reduce L*?

Background and field quality

The background hurts Vdet but may hamper measuring the luminosity

The DID dilemma

The TPC may require or not a rather homogeneous magnetic field
($\omega\tau \sim 15$)

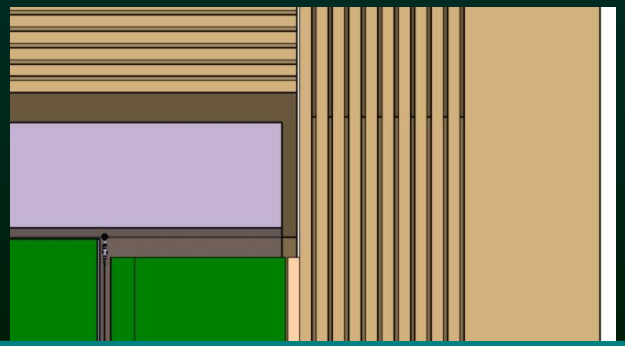
To achieve it requires, in the current yoke design, a peculiar coil
and the DID destroys anyway this homogeneity.
What is the mechanical impact of DID on the coil structure?

Choice:

Drop the DID and make a nice but difficult field homogeneity
Changing the pole design?
Impact on background?

Drop the field homogeneity and relax

When to do this choice?
Yesterday



About the length of the detector

End-cap yoke already discussed

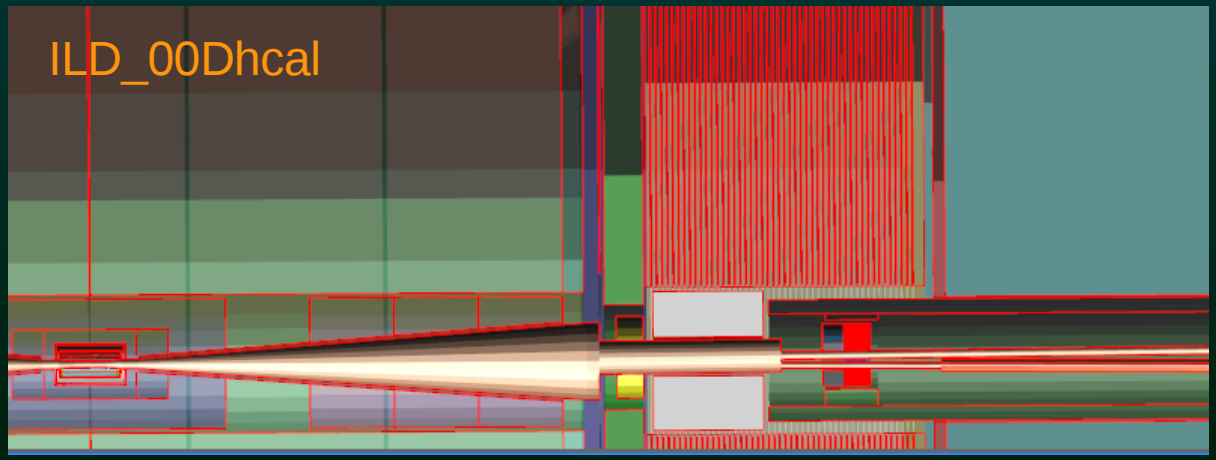
The end-cap HCAL, sampling 2 → 3 cm (1 → 1.5 X_0) gains 10cm, looses what?
reduce the λ_I length using the tail catcher?

The end-cap ECAL, thickness may increase (+2cm in EUDET)
But sampling may be coarser (20 layers -3cm)

TPC to ECAL play: 10cm → 6 ? ETD layers, TPC cables and services?

TPC end-plate thickness 10cm → 6? what does that contain?

Overlap between End-cap and barrel, services 2.5cm, + play
Reduce it between Ecal parts to 5cm, for shower inefficiencies.
May not be possible for Hcal.



But what says the optimisation about length?
What's important:
TPC length,
Ecal distance,
Lcal distance?

Could'nt we save 20 cm without changing the TPC length?

Digression on the ECAL

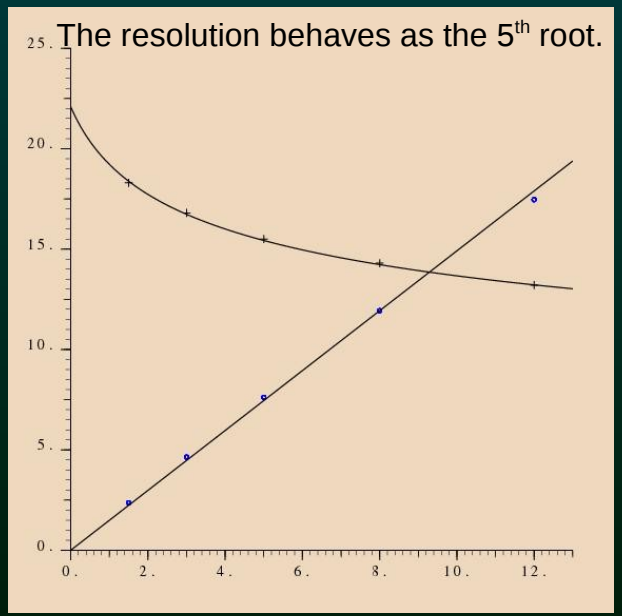
Would it be possible to have an acceptable ECAL reducing its cost by a good deal?

Going from the actual 30 layers to 20, still with two different thicknesses saves 25% of the overall Ecal cost.

Impacts the energy resolution by 22%, may impact the low energy efficiency

Improve the resolution by increasing the Si thickness to 800µm, more suitable for fabrication

Changing the Si thickness from 150µ to 1200.



Improve the low energy efficiency by using all the information, like counting and ...

Ongoing development

About the radius of the detector

What does contribute to the radius of the detector?

Yoke already discussed but for its shape

Impact of the DID on the coil thickness
Is there any impact of the compensation coils?

HCAL In the barrel the muon system does not really act as a tail catcher:
Keep the interaction thickness, but the sampling? Gain 10cm?
We could consider W but the overcost would be more than the ECAL!
In memoriam

The ECAL thickness already discussed
but reduce the 65mm dead zone between ECAL and HCAL to ?

About the radius of the detector

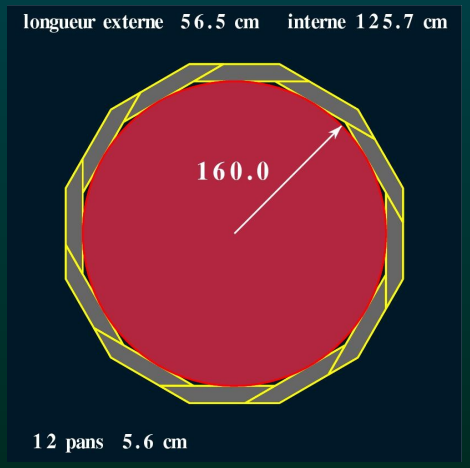
Impact of the ECAL shape

Keeping in mind that the outer limit of HCAL is close to circular

Finding our way between eightfold and dodecagonal

Makes 9cm difference for the outer radius
Impact on the Hcal, on the end-caps...

TPC shape, what is going on in the corner? SET?



TPC outer field cage thickness 65mm → ?
connection between TPC, SET, ECAL

With a precise SET how much can we play with the TPC radius?
What is the stronger constraint, TPC radius or ECAL radius?

TPC inner field cage 65mm?
Interplay with the inner detectors structure
Reduce the material budget

Largely a piecemeal adjustment

Conclusions

Some parameters need optimisation before a”baseline” model is defined.

Some principles need to be stated like “get your heat out”.

This involves some thinking on physics and background
some basic studies, reduced ECAL
before a mechanics re-examination, cables, handling
and the definition of a new simulation model.

We need to identify who is really able and willing to take things in hands
for example the beam tube design.

Just a question of **Who and When**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