Progress on ECAL design: towards a new baseline solution

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good progress with the arrival of the Mainz group

still an activity quite understaffed!
Why we wanted to change compared to TP?

1) reduce possibly cost

2) add the measurement of shower angle for neutral final states (need few mrad resolution for $\text{ALP} \rightarrow \gamma\gamma$) and possibly suppress background

3) improve e/pi separation

of course it is a $5 \times 10 \text{ m}^2$ guy…
We have tested with simulation a few options

The only viable seems to be ...
Implemented in FairShip and “tested” (with some cheating...) in blue a sampling Pb ECAL with X-Y plastic scintillator bars readout via WLS fibres from the sides (see our ICL June2016 talk)

in red the high precision layers that can be staged in case of lack of money
How is made?

The ECAL:
- Pb(Fe)-Scint: 50 Pb layers, $25X_0$ in total

Full detection planes (segmented only in the readout), 0.5cm thick WLS fibres readout, low granularity, details in Rainer’s talk including cost estimate

The angular measurement part:
- Gas detector; x,y resolution on hit 150um
- still, technology ($\mu$mega or $\mu$WELLS) and cost of this part undefined
In Berlin: we presented some simulation results of

1) energy resolution

2) e/πi separation (already studied since 19 Jan meeting)

3) angular resolution

Since Berlin:

- starting technical design and costing of the main body ECAL (see Rainer talk)

- new improved simulations and new ideas for angular resolution

- evaluation of criticality of material in front of ECAL (29 March meeting)

- code from INFN Cagliari shared with the Mainz group to start to implement more realistic simulations and test reconstruction codes
Given the new “light” end plug a configuration with $<1X0$ in front of ECAL is possible

in yellow the Timing Detector (if the TD light enough)
Add 1X0 of Lead in front

20 GeV generated in the yz plane with 100mrad angle and z=20m from ECAL surface in vacuum

energy deposited in Scintillator *0.5% (fraction of light eventually detected by Muon-like detectors)

14.5 0.51 —> 3.6%
shower direction reconstructed from linear fit to the reconstructed median distribution in each of the three high precision layers

cumulative shower profiles in the three high precision layers

fiducial cut at + -5cm from MCTruth point' (the real procedure would be an iterative one starting from the median without cut)
3.0mrad (about 2.5mm position resolution at shower maximum)
ATLAS ECAL performance TDR: in blue our result at 20GeV; large improvement but cost??

CMS recently estimated for 140m$^2$ (similar to our requirements) of $\mu$WELLS about 1M€ (detector only)

Readout to be optimised
Future needed simulation work:

the main issue to be demonstrated before claiming that the scintillator part could be a baseline solution is to see if X vs Y strip readout can work in a calorimetric environment

for the high precision detector we also need to test X vs Y strip readout and try some new ideas that may lead to optimisation of strip size and cost reduction:

- try to fit an analytical shape instead of doing the median (in the past used to get good spatial resolution e.g. CDF SMD calorimeter used Lorentzian shape and 6 mm strips)
Planning

2-3 months for the simulations (Rainer has a PhD student and a post-doc who are starting working on this + Cagliari work)

For the end of the year 2017 we could have some pre-technical design

Some experimental tests (e.g. readout) could be planned for 2018 once the concept is shown to work in simulation

Still the combination of HCAL+MUON needs to be optimised; nobody is working on these simulations; help needed!
will be committed soon

Particle Identification tools and performance in the SHiP Experiment

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Abstract. This note describes in detail the HNL Particle Identification in SHiP experiment.
backup
assuming crossed XvsY strips (that we have not tested yet in the MC, only pads used so far) 500\(\mu\)m strip pitch with 20cm length (as CMS) it is 10,000x50+20,000x25=1M channels x 3planes — >3M channels

for the sake of comparison of large numbers: CMS outer tracker upgrade has 200m\(^2\), 50M strips and 218M macro-pixels; EM calo 6M channels