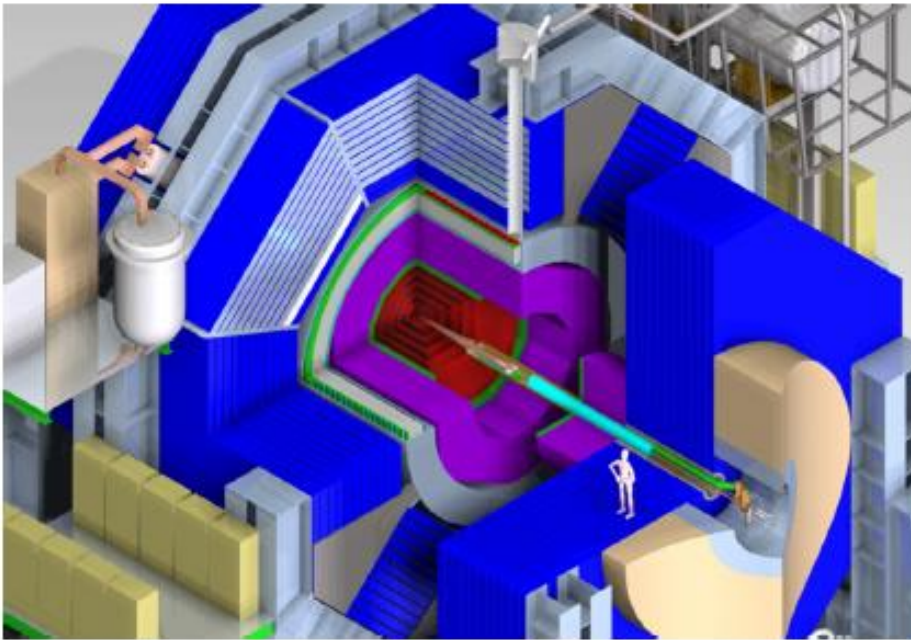# SiD Detector Baseline
(A brief review)

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SiD Detector Baseline

- Basic design evolved up to the Detector Baseline Design (DBD)
- Essentially unchanged since then

- Short review of baseline technologies and options

- Discussion of the baseline, recent developments
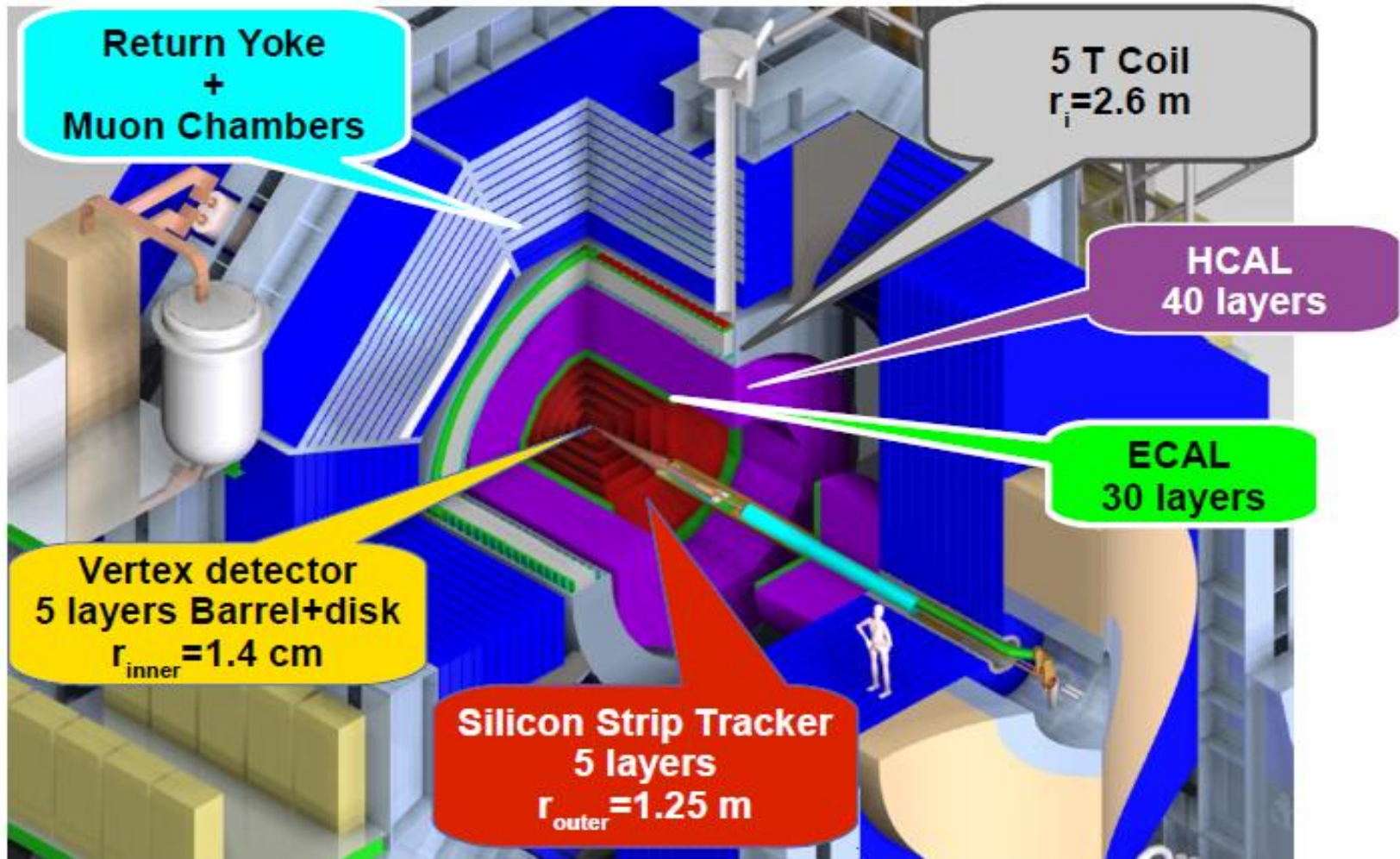- Physics and other arguments for changes

- Plan going forward

SiD Detector Rationale

A compact, cost-constrained detector designed to make precision measurements and be sensitive to a wide range of new phenomena
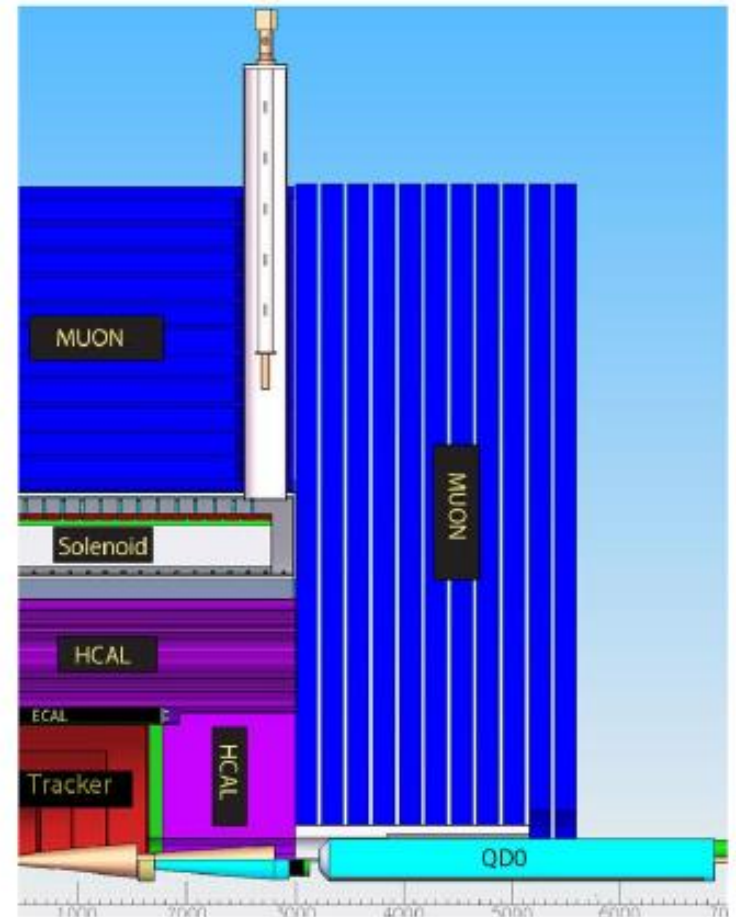
SiD Detector Baseline

Overall dimensions (DBD)

Table 1.1.1: Key parameters of the baseline SiD design. (All dimension are given in cm.)

| SiD BARREL	Technology	Inner radius	Outer radius	z max
Vertex detector	Silicon pixels	1.4	6.0	± 6.25
Tracker	Silicon strips	21.7	122.1	± 152.2
ECAL	Silicon pixels-W	126.5	140.9	± 176.5
HCAL	RPC-steel	141.7	249.3	± 301.8
Solenoid	5 Tesla	259.1	339.2	± 298.3
Flux return	Scintillator/steel	340.2	604.2	± 303.3

SiD ENDCAP	Technology	Inner z	Outer z	Outer radius
Vertex detector	Silicon pixels	7.3	83.4	16.6
Tracker	Silicon strips	77.0	164.3	125.5
ECAL	Silicon pixel-W	165.7	180.0	125.0
HCAL	RPC-steel	180.5	302.8	140.2
Flux return	Scintillator/steel	303.3	567.3	604.2
LumiCal	Silicon-W	155.7	170.0	20.0
BeamCal	Semiconductor-W	277.5	300.7	13.5

Tracking

Vertex
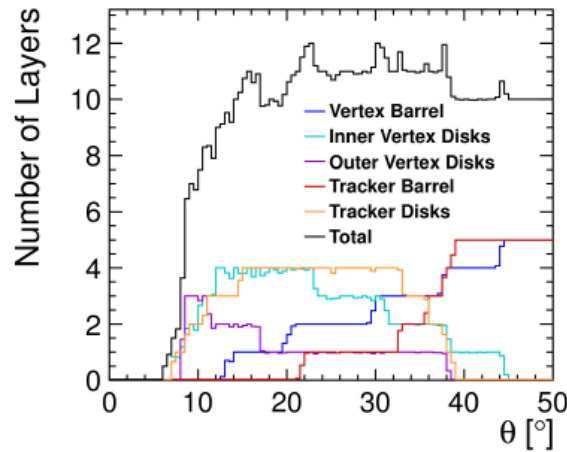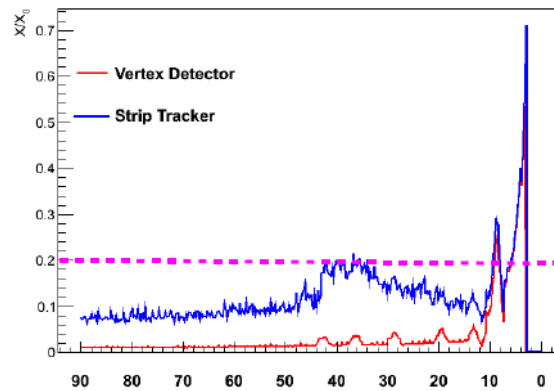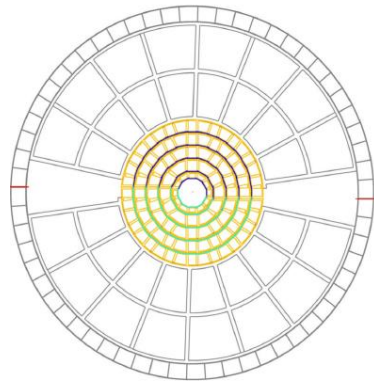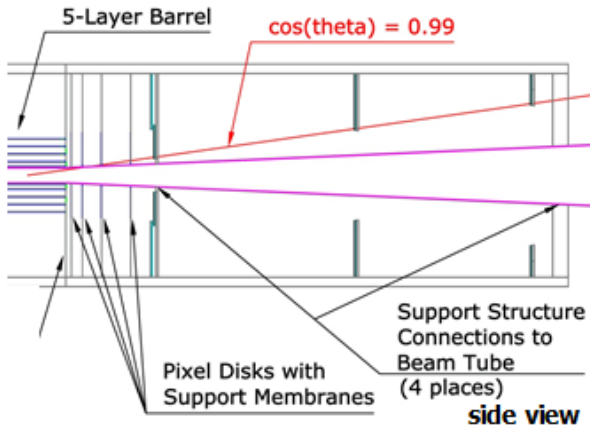
Tracker
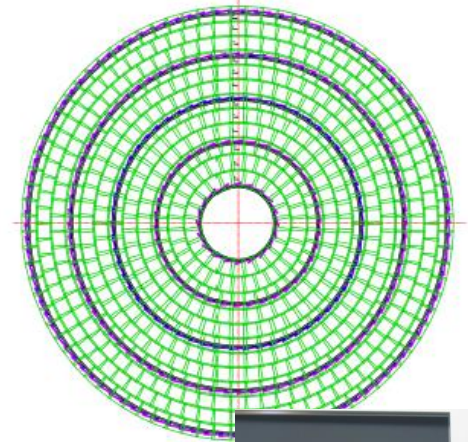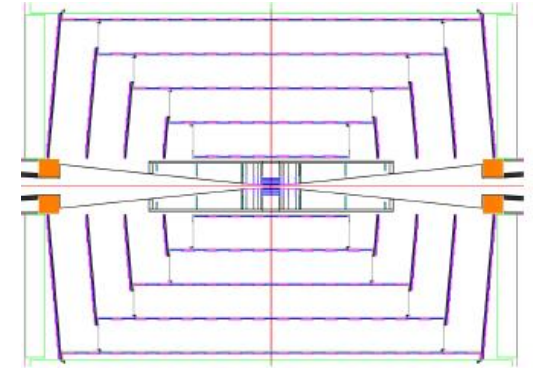
NO baseline selected – too early
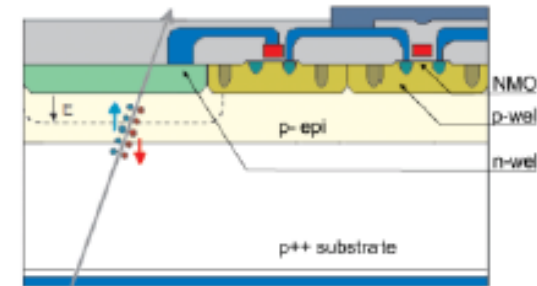R&D: Chronopix, 3-D,…

Si Strips + KPiX
MAPS ??

A number of sensor technologies being explored…
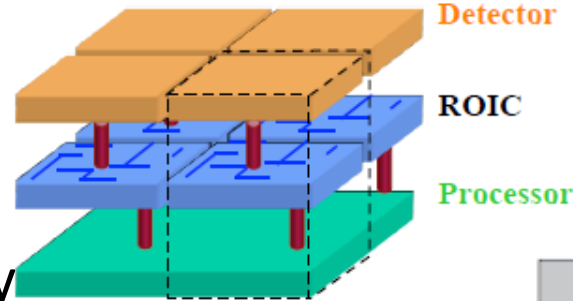
- Si diode pixels ("standard" technology)
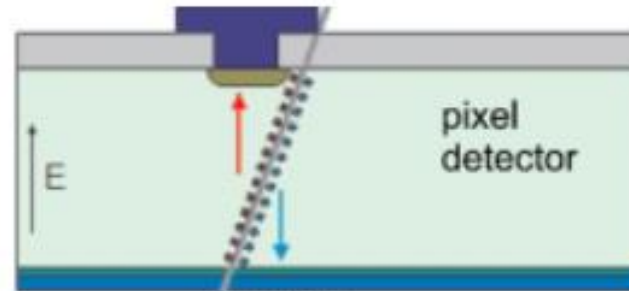
- Monolithic designs (MAPS, Chronopix)

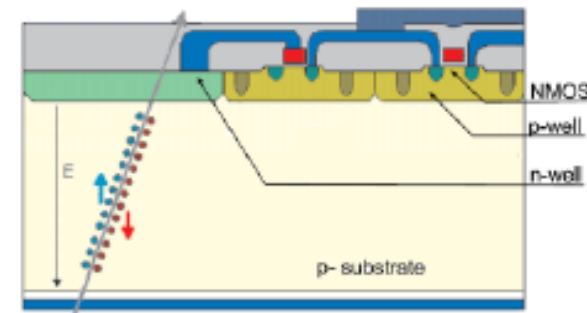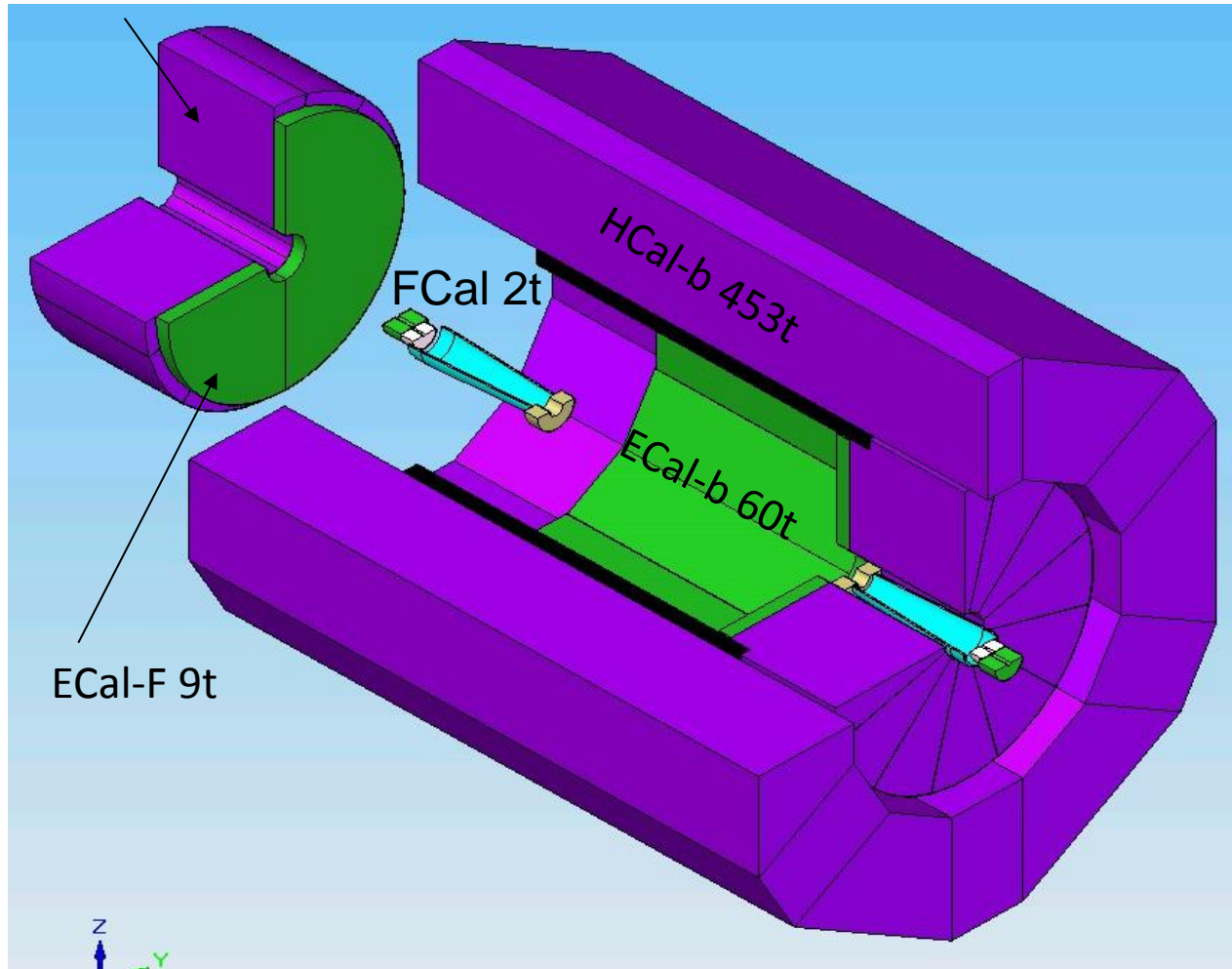- Vertically Integrated ("3D") Approaches (VIP Chip)

- High Voltage CMOS (snappy timing)

Calorimetry

HCal-F 38t

FCal 2t
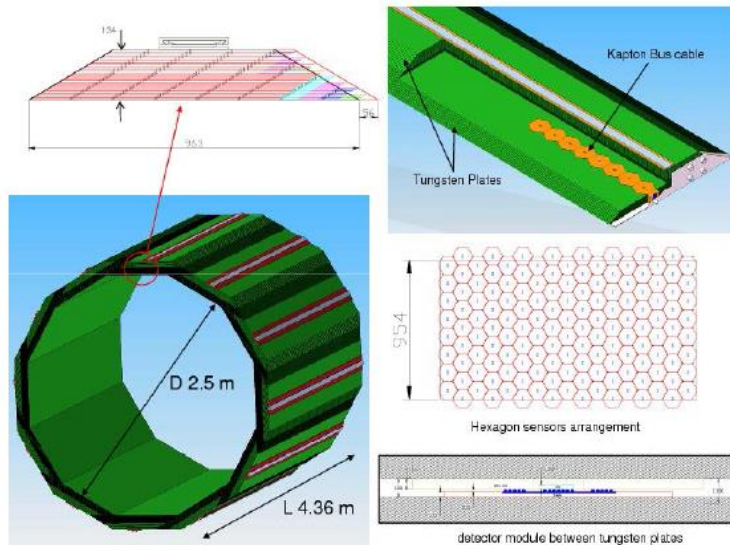
HCal-b 453t

ECal-b 60t

ECal-F 9t

Calorimetry

- SiD ECAL
  - Tungsten absorber
  - 20+10 layers
  - $20 \times 0.64 + 10 \times 1.30\ X_0$
- Baseline Readout using
  - 5×5 mm^2 silicon pads

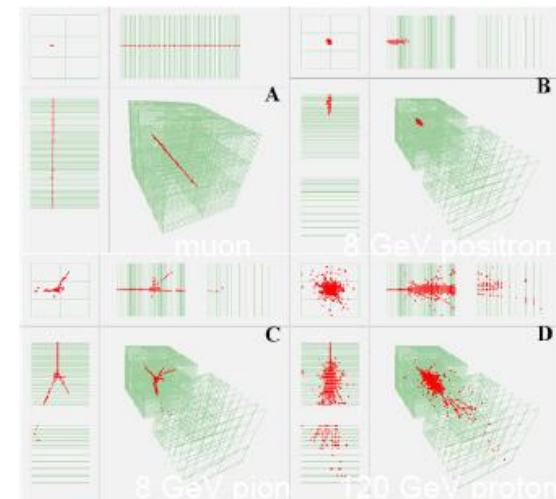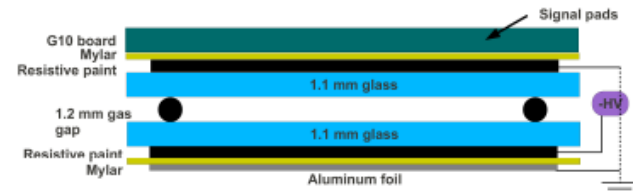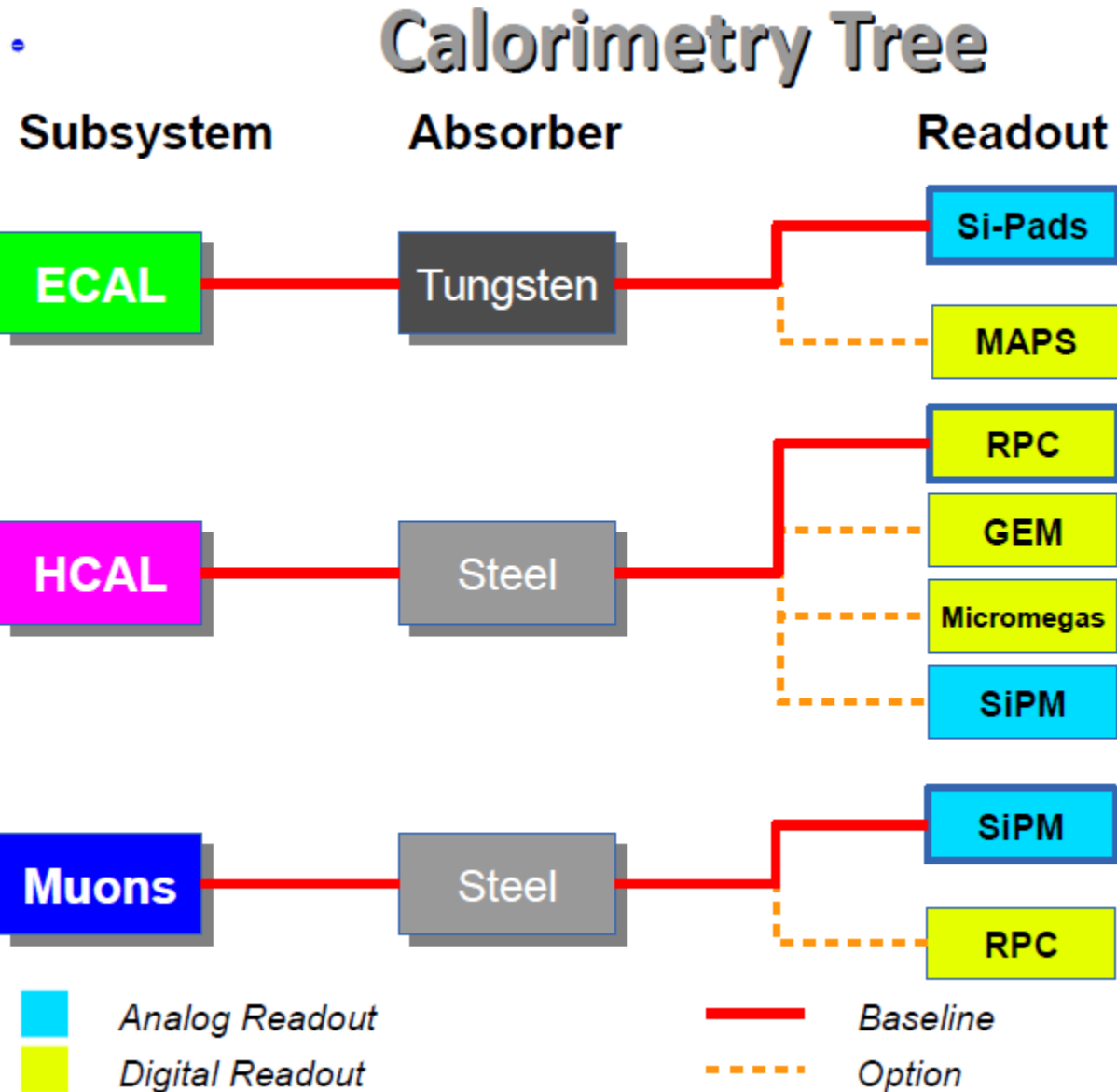An imaging calorimeter: 30 layers tungsten interleaved with 30 layers pixellated silicon

- SiD HCAL
  - Steel Absorber
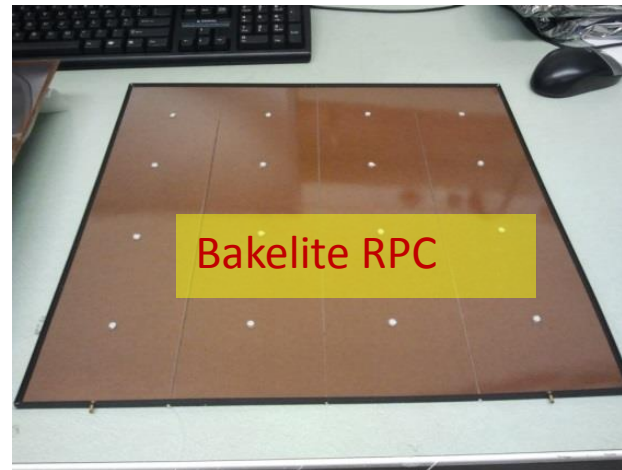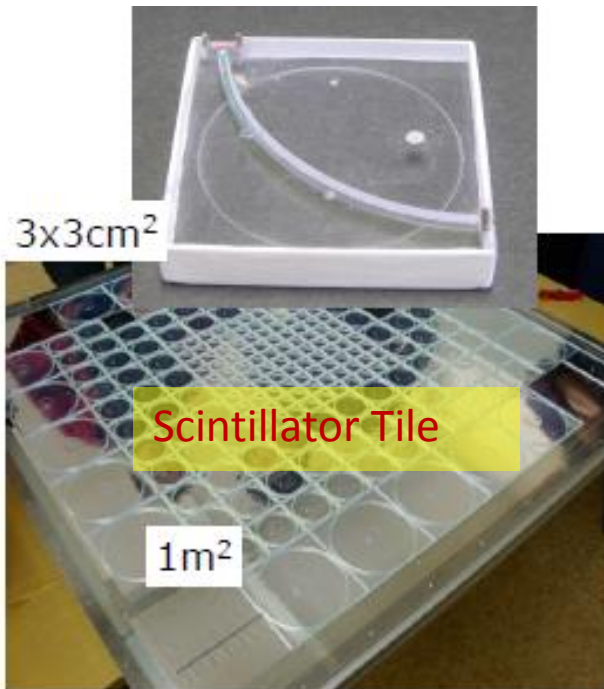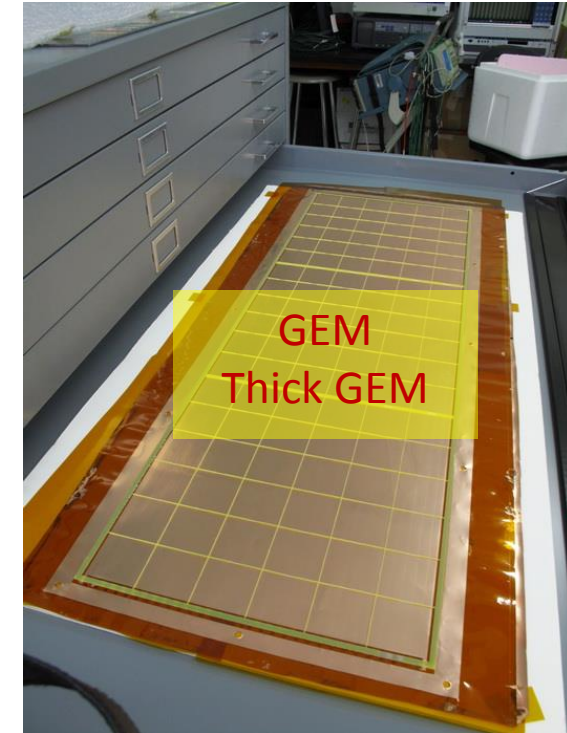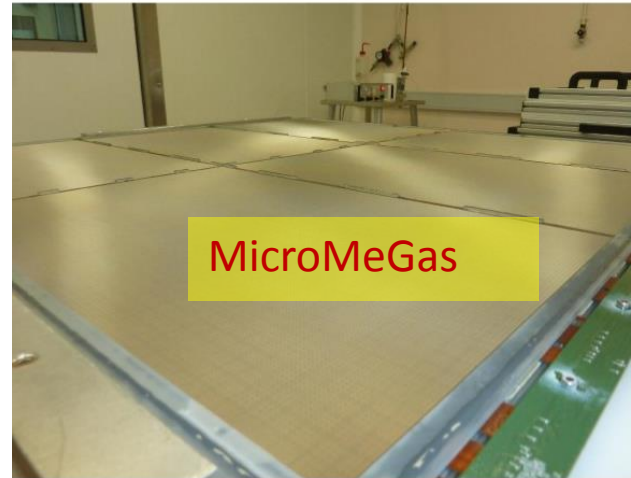 - 40 layers
  - $4.5\ \Lambda_i$
- Baseline readout
  - 1×1 cm^2 RPCs

Calorimetry Tree

Single-Glass
RPC

MicroMeGas

GEM
Thick GEM

3x3cm²

Scintillator Tile

1m²

Bakelite RPC

Many alternatives under exploration (largely under CALICE umbrella)

Forward Calorimetry

Mask
Beamcal
5.35°
3.64°
216
Lumical
143
1557
130 — 232
2645
2775
3247
L* = 3500
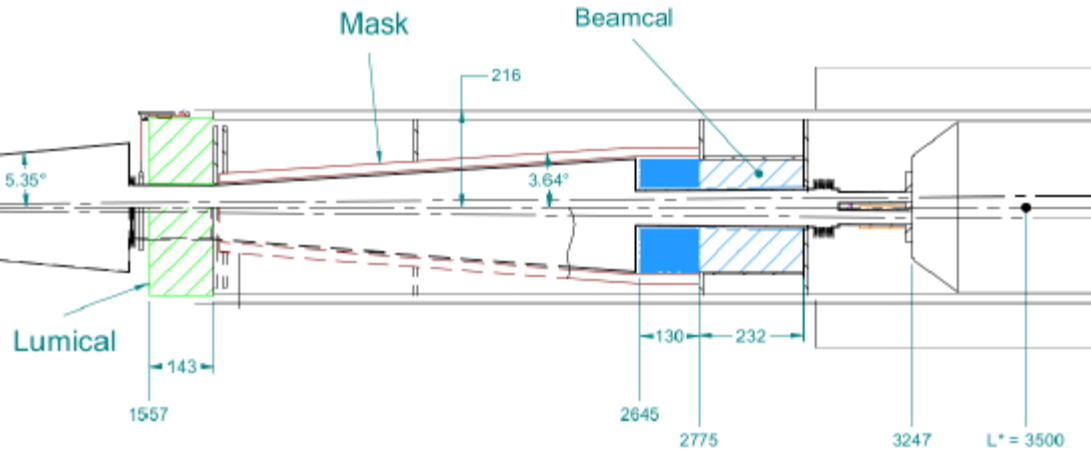
Ongoing electromagnetic radiation damage studies (Si diode, GaAs...) within FCAL Collaboration umbrella

LumiCal
QD0
L*=3.5m
FB Kicker
QF1
L*=9.
Beampipe
W Mask
FB BPM
BeamCal
PolyCarbonate
QD0 Service Pipe
QD0 Cryostat
QF1 Cryosta
HCAL
Door Yoke
PACMAN

Annealing studies
90 Mrad exposure of N-type float-zone Si diode detector

NF7 Annealing Results

90 Mrad Exposure

MedQ
Bias

Pre_Irradiated
Pre_Anneal
26C
50C
60C
70C
80C
90-110C

SiD Muon System

a.

b.
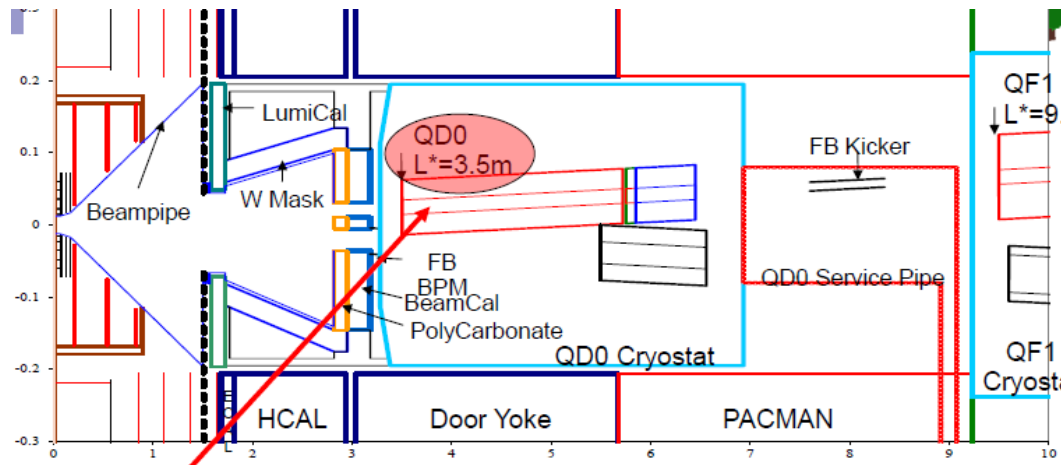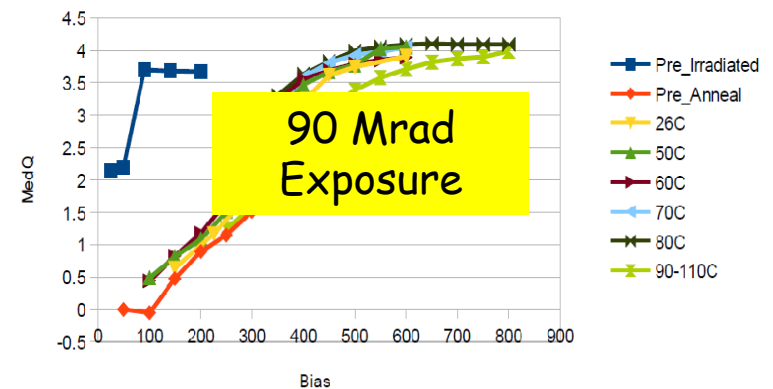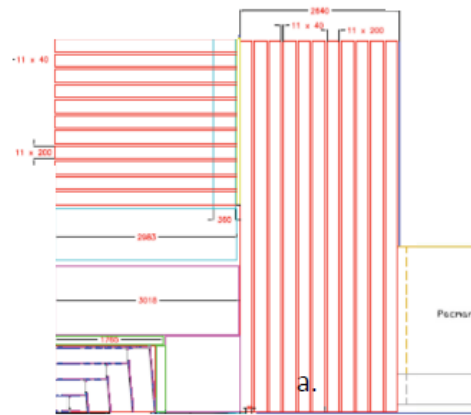
SiD Baseline – long scintillator strips with WLS and SiPM readout

Sandwich of
Al skin (3 layers)
Glue (4 layers)
Scint (2 layers)

X

y

Thickness is 3.38 cm

Flasher LED | Cable connector to front-end board | Counter mother board
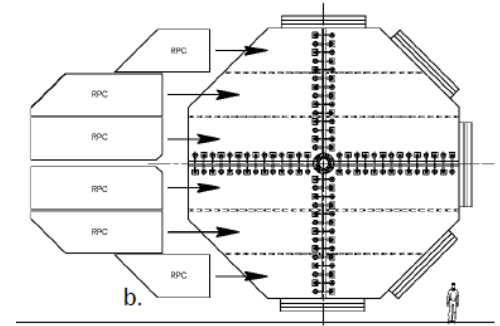
Stand-off | Thermosensor | SiPM mounting block

SiPM

SiPM sleeve

Registration holes

Fiber guide bar

Extrusion | Fiber
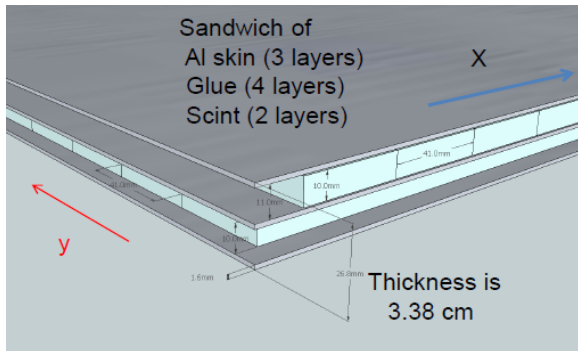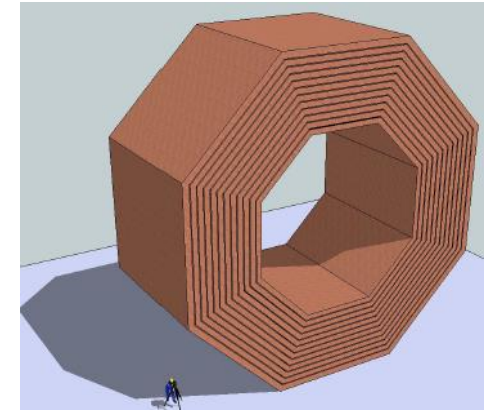
Alternative – RPC muon system – no recent development
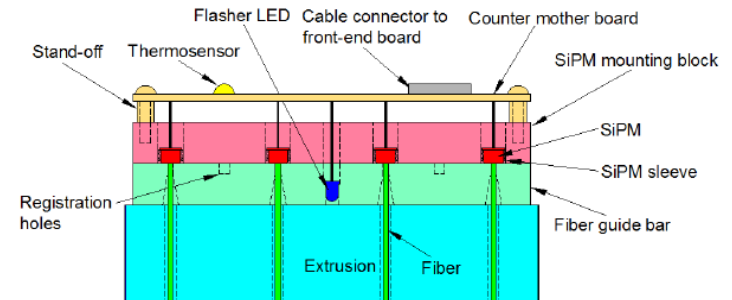
SiD Detector Baseline

The basic SiD detector design is 10 years old.

And we know (see the DBD) that we can deliver good results for the ILC Physics program, but…

- Can we gain (in physics performance) by changing overall dimensions and/or aspect ratio ?
- Are we forever constrained by the size of the coil?
- Can we significantly reduce the material of the tracking system?
- Do we have the optimum arrangement and number of layers for the tracker?
- Can we optimize the barrel/forward transition region?

SiD Detector Baseline

- Is the present ECal + HCal arrangement optimized for PFA?
- If we started with our present knowledge from PFA studies, would we arrive at the same calorimeter system design?
- Is the aspect ratio optimized?
- Are the ECal and HCal depths optimized?
- What are the optimum cell sizes for ECal, HCal?
- Can we gain by introducing on-detector logic/processing?

- In view of L* changes, what is the optimal layout of forward systems?

- What is the required functionality of the muon system as a calorimeter tail-catcher?

- ….?

Discussion