



Simulation of the CALICE Test Beams with MOKKA



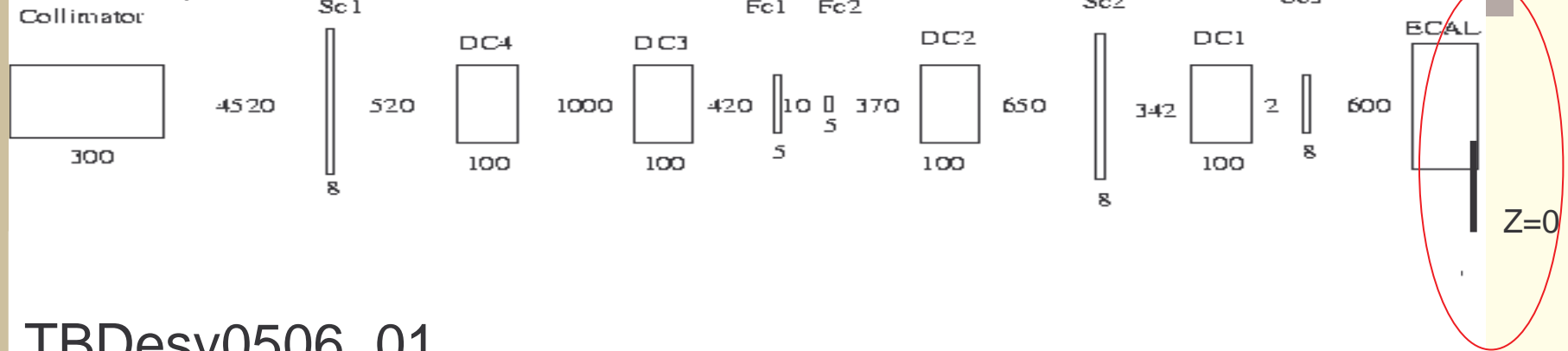
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Simulation of 2006 test beams

- n Latest version of Mokka (Sept 07): v06-04p03
 - n Compatible with V9 of Geant4 (patch01)
 - n Bug/memory leak fixes; improvement in DC simulation for Desy06
- n Setup of **2006 test beams** at **Desy** and **CERN** has been simulated in detail in Mokka
- n **Different test beam models** have been implemented
 - n **'Old' coordinate system:** origin of coordinate system on the **back plane of the ECAL**
 - n Desy tb: model TBDesy0506
 - n CERN Aug tb: model TBCern0806
 - n CERN Oct tb: model TBCern1006
 - n **'New' coordinate system:** origin of coordinate system on the **back plane of DC closer to ECAL (DC1)**
 - n Desy tb: model TBDesy0506_01
 - n CERN Aug tb: model TBCern0806_01
 - n CERN Oct tb: model TBCern1006_01

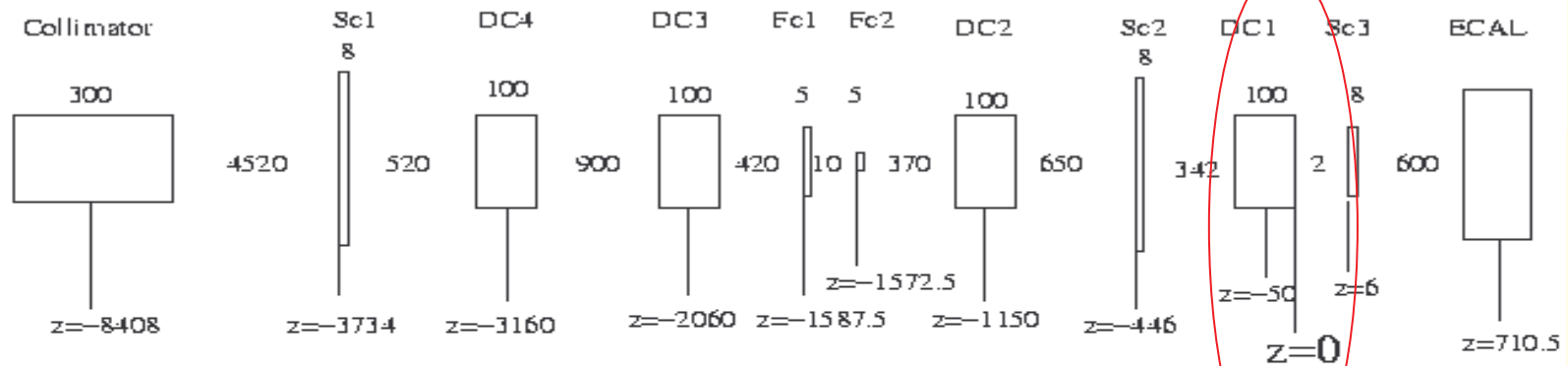
Sketch of Desy models

TBDesy0506

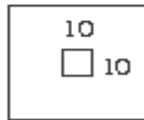


TBDesy0506_01

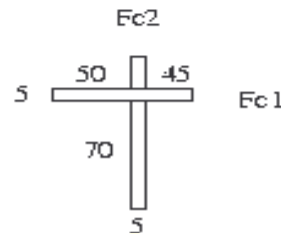
TOP – Desy May 2006



FRONT



Sc1 and Sc2 are 200x200
Sc3 is 120x120

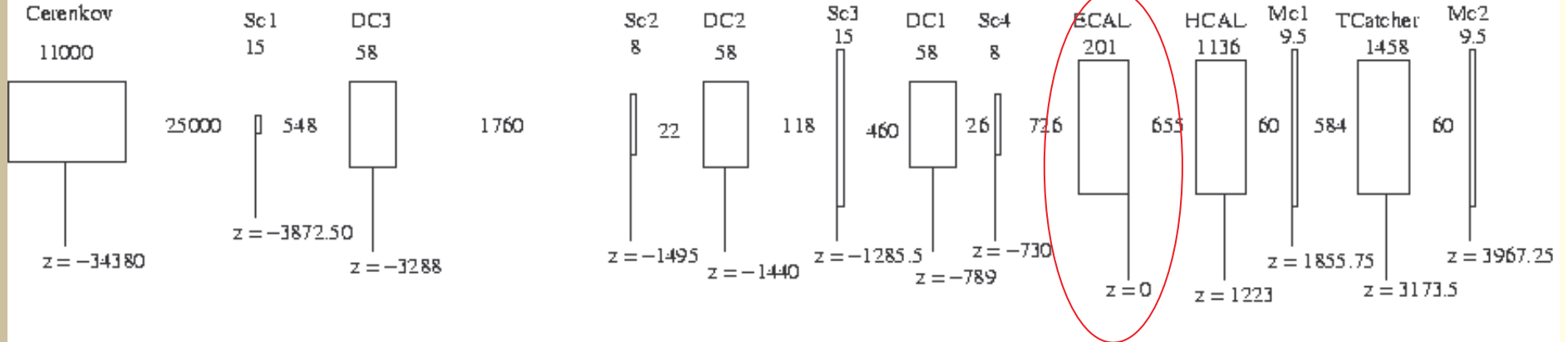


All distances are in mm

Sketch of CERN Aug models

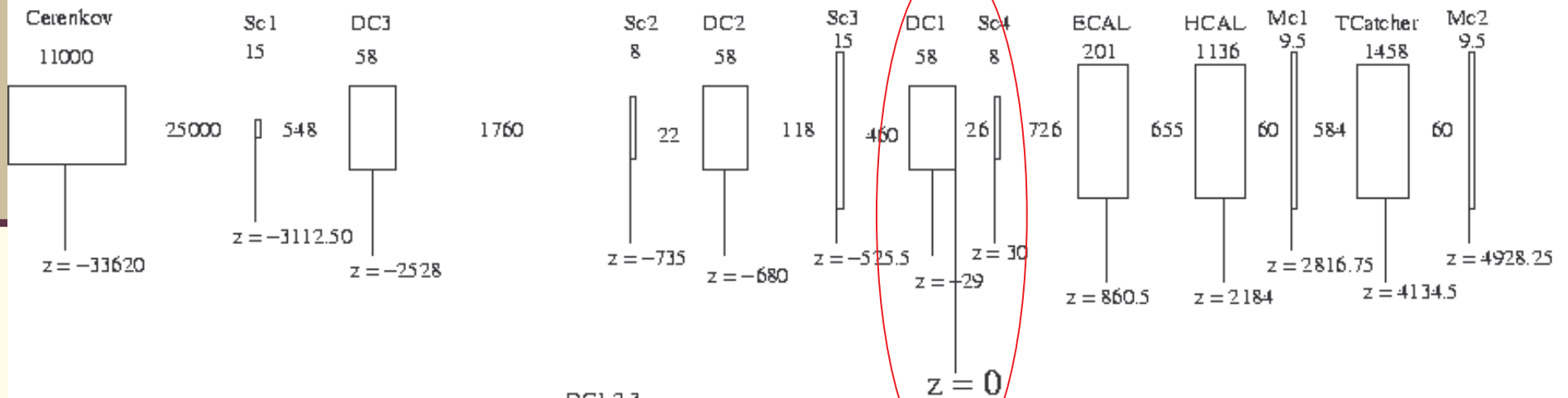
TBCern0806

TOP



TBCern0806_01

TOP – CERN August 2006



FRONT

Sc1 is 30x30
 Sc2 and Sc4 are 100x100
 Sc3 is 200x200

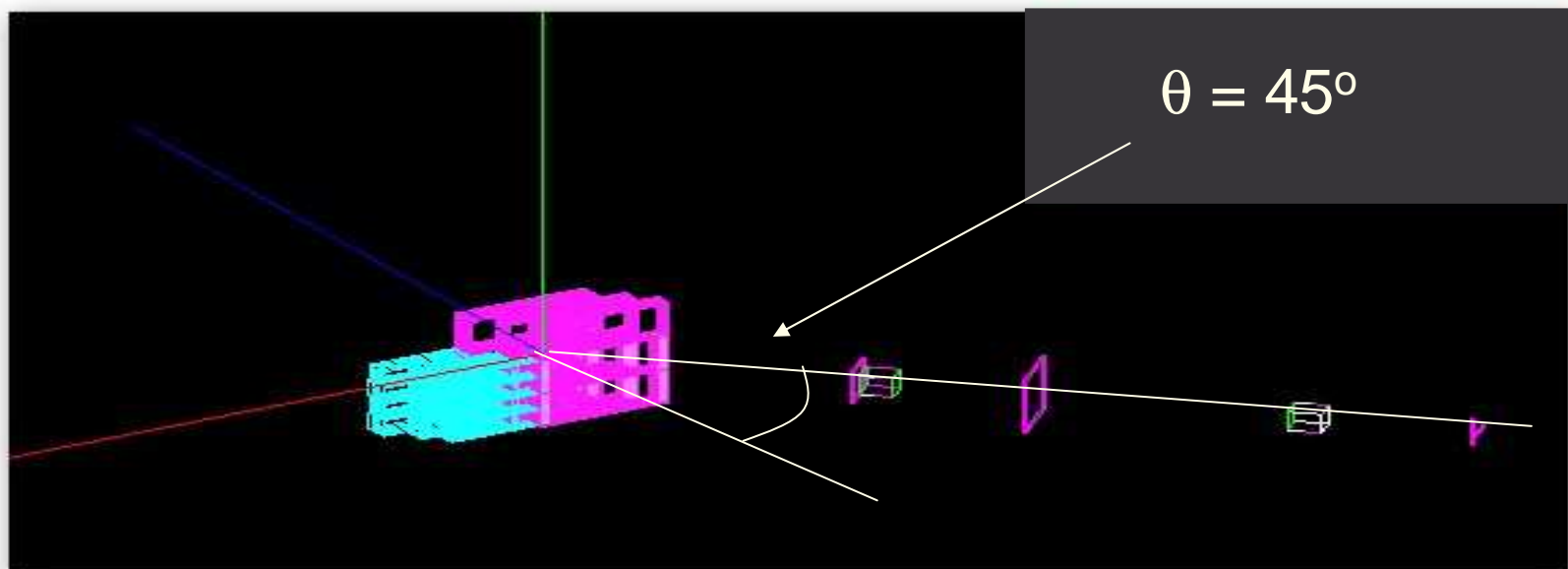


Mc1 and Mc2 are 1000x1000

All distances are in mm

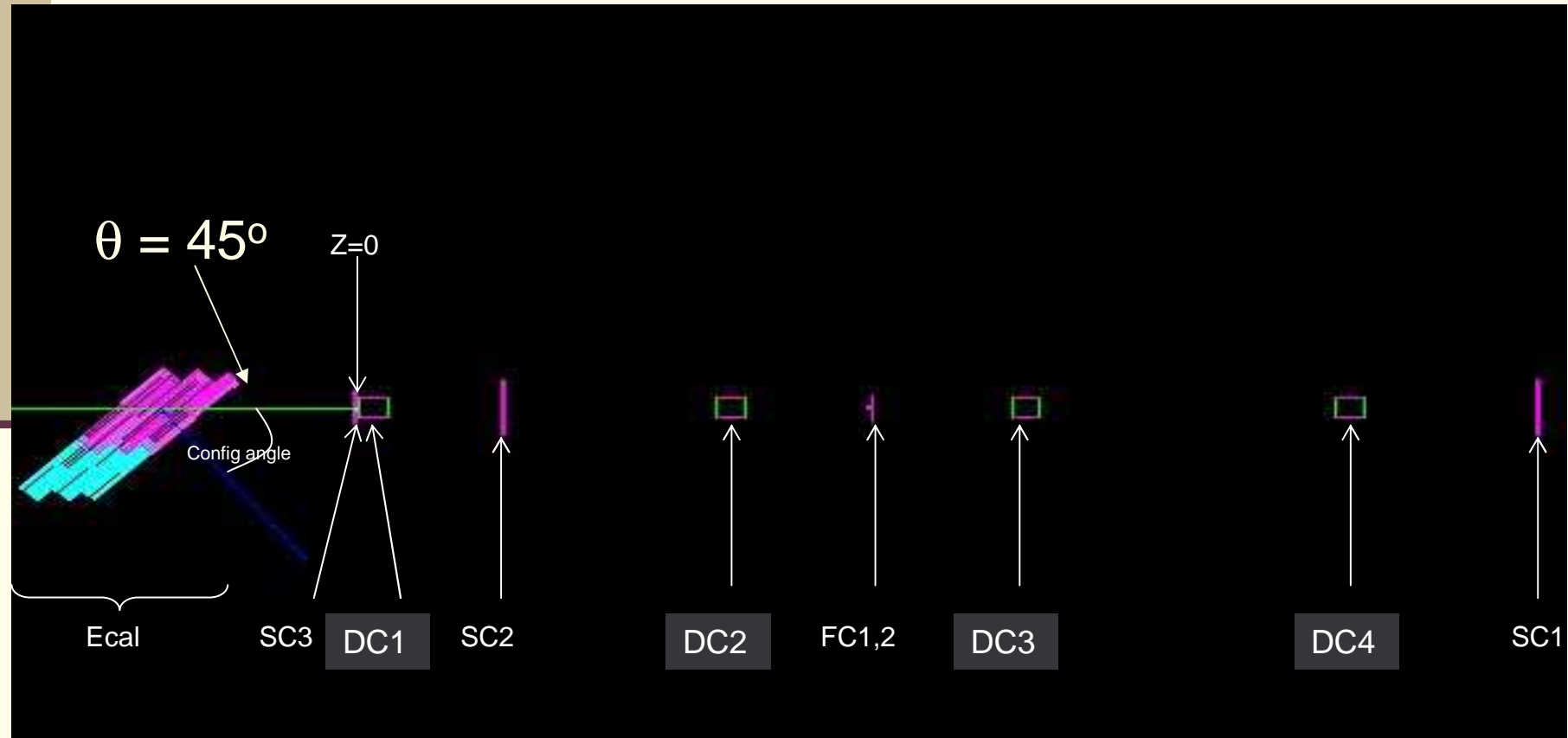
'Old' coord. syst. vs 'New' coord. syst. - I

- n In 'old' coordinate system the axes are tied to the ECAL, therefore when the ECAL is simulated at an angle θ wrt beam normal incidence, the ECAL is kept fixed and all beam detectors are rotated by $-\theta$ wrt the ECAL front face
- n **Not intuitive !**



'Old' coord. syst. vs 'New' coord. syst. - II

- In new coordinate system the axes are not tied to the ECAL, so rotation is done keeping fixed the beam detectors and rotating the ECAL only



Improvements in simulation wrt Mokka 06-03p01

- n **Real drift chambers** in the **Desy** setup give **separate measurement of X and Y position on hits**
 - n **Fist half of the chamber gives X position, second half gives Y position**
- n As chambers were simulated in **Mokka v06-03p01**, **each hit has an X and Y position**
 - n **Re-write driver** to match real chambers as much as possible
- n At the **digitization stage**, we would like to use **drivers that are independent of the setup (Desy or CERN)**
 - n Need to write **one single collection of hits** instead of **one collection per chamber**

New DCH driver for Desy0506 model

- n **New DCH driver** has been tested
 - n Each chamber is built assuming **two different gas volumes** (one for X and one for Y)
 - n **Hits** in each gas volume are **simulated as TRKHit** (==SimTrackerHit in LCIO)
 - n (x,y,z) position of hit is generated
 - n Digi code will have to consider the appropriate coordinate (x or y) depending on the layer
 - n Total of **8 layers (2Xchambers)**
 - n New test beam model **implemented in the DB**
 - n **TBDesy0506_dchxy_new**

New chamber layout

- n Two separate volumes

- n One single hit collection

- n TBdchXY02_dchSDxy0

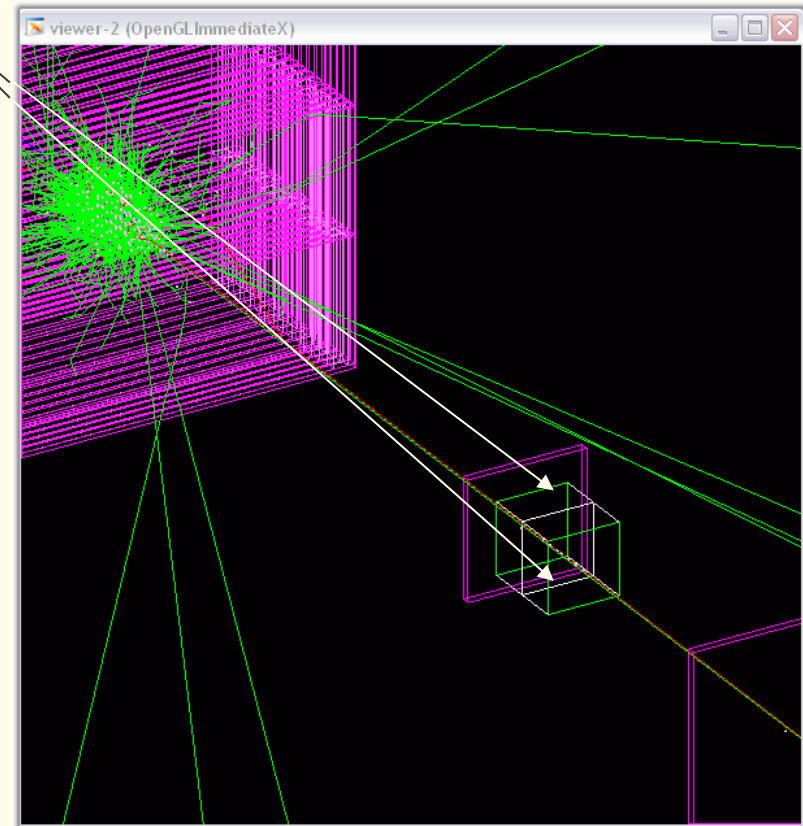
- n Use cellID to distinguish hits from each layer:

- n DC1 -> layer 0 (X), 1 (Y)

- n DC2 -> layer 2 (X), 3 (Y)

- n DC3 -> layer 4 (X), 5 (Y)

- n DC4 -> layer 6 (X), 7 (Y)



The 2007 test beam simulation - I

- n Need to implement a **new model for this year's test beam**
- n **Beam line detectors are the same as last year**
 - n MWPCs and scintillators are the same, need to implement the new positions wrt (0, 0)
 - n Veto counters need to be added
 - n Expect ~1 week to finish implementation (FS)
- n **ECAL driver needs to be updated**
 - n Implement 3 different setups:
 - n Complete ECAL: 30 layers – fully instrumented One model: e.g. TBCern07
 - n Exact test beam prototype: 2 separate models: e.g. TBCern0707
 - § Missing bottom/front 6 layers (prototype until 24th July 2007) TBCern0807
 - § With bottom/front 3 layers + 3 alveolae with Tungsten only (prototype from 25th July to 22nd August 2007)
 - n Add parameter in steering file
 - n Expect ~2 weeks for implementation and testing (Gabriel)

The 2007 test beam simulation - II

- n Existing AHCAL driver can be used to simulate this year's setup (Oliver)
 - n Needs the updated information in the db for the geometry
 - n Update driver to **account for re-staggering** after rotation
- n TCMT driver not capable of simulating the staggering feature introduced in the latest run at CERN
 - n Cassettes have been staggered

n alternate cassettes have been moved up (horizontal) or sideways (vertical)

Layer 1 (vertical) ----> nominal position
Layer 2 (horizontal) ----> nominal
Layer 3 (vert) ---> moved -1.0 inch in x
Layer 4 (hori) ----> moved +1.0 inch in y
Layer 5 and 6 ---> nominal
Layer 7 (vert) ---> -1.0 inch in x
Layer 8 (hori) --> +1.0 in y

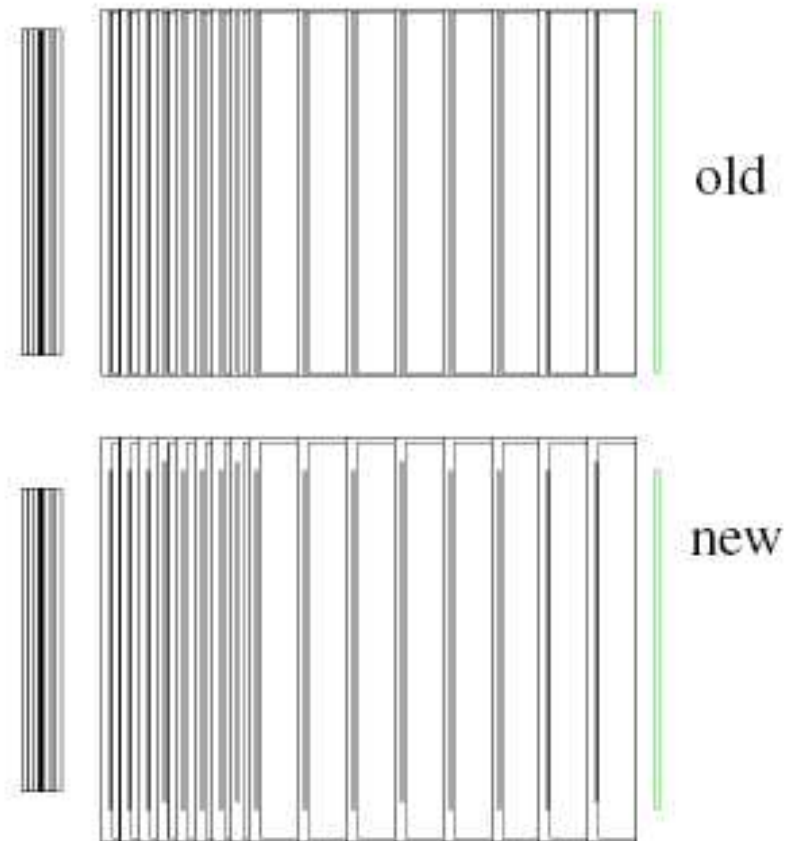
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- n Time estimate: ~2 weeks to solve some technical problems with G4 and implement changes (Guilherme)

TCMT model already in progress...

Mokka: TCMT model for TBCern0707

- New Mokka driver TBcatcher06 is ready for simulations of July'07 running period at CERN
 - Staggering of TCMT modules (hardcoded!):
 - For horizontal strips:
 - layers 2,6,10,14: nominal (y_{nom})
 - layers 4,8,12,16: $y' = y_{nom} + 2.54\text{cm}$
 - for vertical strips:
 - layers 1,5,9,13: nominal (x_{nom})
 - layers 3,7,11,15: $x' = x_{nom} + 2.54\text{cm}$
 - Absorbers have been enlarged



TCMT side views

Conclusions

- n **Models for detailed simulations** of the 2006 test beam setup are available
- n **Several models** are implemented in latest version of Mokka (06-04p02)
- n **'Old' coordinate system**
 - n TBDesy0506, TBcern0806, TBCern1006
- n **'New' coordinate system**
 - n TBDesy0506_01, TBcern0806_01, TBCern1006_01
- n **New DCH layout, with one collection of hits**
 - n TBDesy0506_dchxy_new
- n Preparation for TB models for the 07 data already under way
 - n **ECAL and TCMT needs updating**
 - n **Beam detectors and AHCAL ready**
 - n **Time-scale: ~2 weeks (after this meeting)**



A detailed description of the TB06 models

Detector description: TBDesy0506

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n Drift Chambers (FS):

- n installed by Kobe collaborators for the 05 test beam
- n gas mixture is non-flammable (96% Ar, 4% Ethane)
 - n 4 drift chambers (72x72x88 mm³)
 - n hits written out in LCIO format
 - § To reduce number of hits, only hits with $E_{rel} > 0.001$ are written in output

n Trigger scintillators (FS):

- n 3 scintillators (one 120x120x8 mm³, two 200x200x8 mm³) used in the trigger
- n hits written out in LCIO format
 - n Hits simulated as Calorimeter hits (one hit per chamber)

Detector description: TBDesy0506 II

- n **Finger counters (FS):**
 - n **2 scintillators** (5x100x5 mm³) placed in T shape to monitor beam position
 - n hits written out in **LCIO format**
 - n Hits simulated as **Calorimeter hits** (one hit per chamber)
- n **ECAL (G.Musat):**
 - n **3 modules** (5 slabs)
 - n tungsten thicknesses = 1.4, 2.8, and 4.2 mm.
 - n silicon planes divided into wafers
 - § 6x6 cells (10x10 mm²), guard-rings (1 mm width)
 - § **Two separate hits collections**, one for hits in cells and the other for hits in guard-rings

Detector description: TBCern0806

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- n **Cerenkov detector (FS):**
 - n It is **upstream of the first trigger scintillator** (~25 m)
 - n 100x100x11000 mm³, 180μ mylar windows, helium gas
 - n Only the material is simulated
- n **Drift Chambers (FS):**
 - n provided by CERN (50% Ar, 50% CO₂)
 - n **3 drift chambers** (108x108x44 mm³)
 - n **hits written out in LCIO format**
 - § To reduce number of hits, only hits with $E_{rel} > 0.001$ are written in output
- n **Trigger scintillators (FS):**
 - n **3 scintillators** used in the **trigger** (one 30x30x15 mm³, two 100x100x15 mm³)
 - n **One veto** scintillator (200x200x15 mm³)
 - n **hits written out in LCIO format**
 - n Hits simulated as Calorimeter hits

Detector description: TBCern0806

II

n ECAL (G.Musat):

n same as for TBDesy0506

n HCAL (R.Poeschl, O.Wendt):

n 39 layers (900x900x30 mm³). Each layer is composed by an iron absorber and scintillating material and is sub-divided into 90x90 mm² cells of 10x10mm² (virtual cell scheme)

n Cell numbering scheme (from lower left corner of each layer)

§ i = row, j = column, k = layer.

n TailCatcher (J.McCormick, G.Lima):

n 16 layers (absorber+air+readout module)

n 2 different absorber thicknesses (19 mm - layers 1 to 8, 101 mm – layers 9 to 16).

Readout modules: 9.5 mm. X,Y dimensions: 1168x1168 mm²

n All absorbers in place, but only 8 readout modules (1, 4, 7, 10 – vertical strips, 2, 5, 8, 11 – horizontal strips)

n Muon Counters (FS):

n 2 scintillators (1000x1000x50mm³)

n hits written out in LCIO format

n Hits simulated as Calorimeter hits

Detector description: TBCern1006

- n **Cerenkov detector (FS):**
 - n same as TBCern0806
- n **Drift Chambers (FS):**
 - n same as TBCern0806
- n **Trigger scintillators (FS):**
 - n same as TBCern0806
- n **ECAL (G.Musat):**
 - n same as TBCern0806
- n **HCAL (R.Poeschl, O.Wendt):**
 - n Only 30 layers, with same characteristic as TBCern0806
- n **TailCatcher (J.McCormick, G.Lima):**
 - n Same as TBCern0806, but with all layers fully instrumented
- n **Muon Counters (FS):**
 - n same as TBCern0806