

Simulation of the CALICE Test Beams with MOKKA



Fabrizio Salvatore

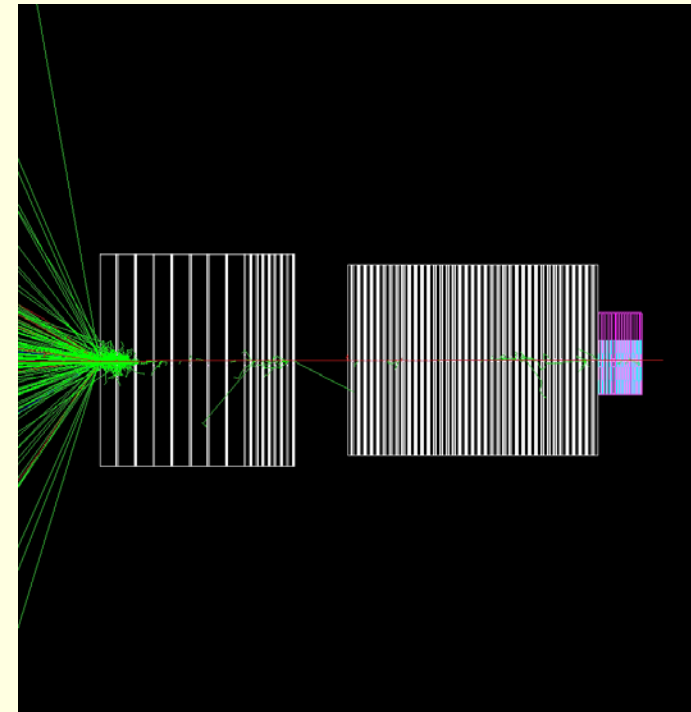
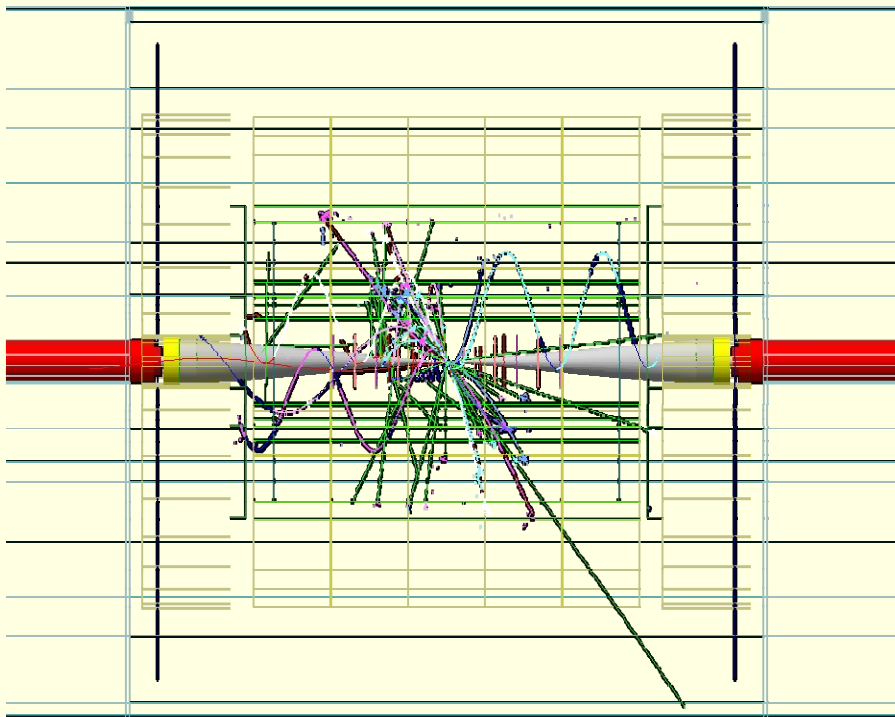
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What is Mokka ?

- Full Geant4 based simulation
- Jobs are controlled by a 'steering file' containing native G4 commands and Mokka specific commands
 - \$MOKKA_BIN mokka.steer
- All physics lists available in G4 can be used
 - LC specific list (LCPhys) also available
- Latest version is Mokka 06-03p02, released in April 2007

Same tool for final detector and prototypes

- **One Geometry db** that stores information about geometries supported in the simulation (e.g. **LDC**, **TB**, etc)

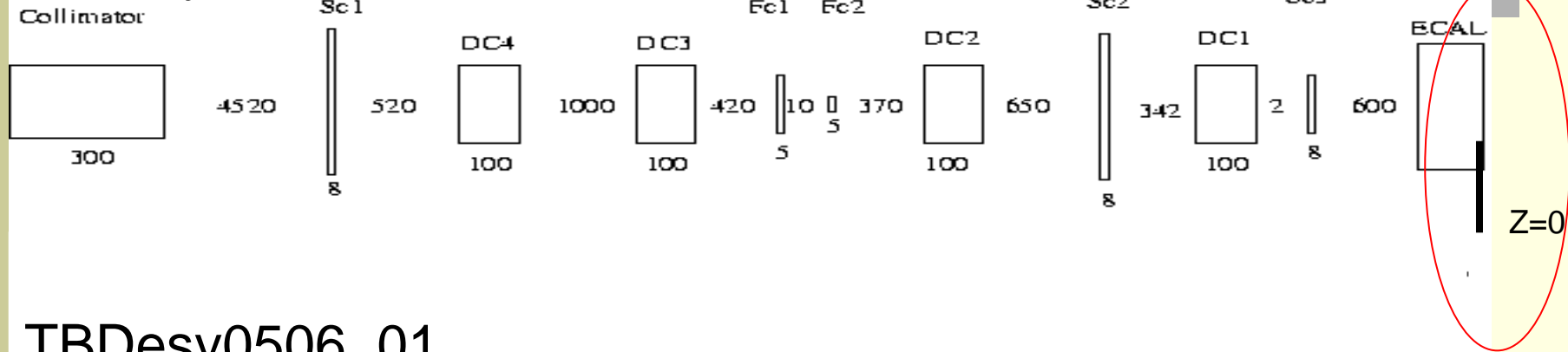


Simulation of 2006 test beams

- Latest version of Mokka (Apr 07): v06-03p02
- Setup of 2006 test beams at Desy and CERN has been simulated in detail in Mokka
- Different test beam models have been implemented
 - 'Old' coordinate system: origin of coordinate system on the back plane of the ECAL
 - Desy tb: model TBDesy0506
 - CERN Aug tb: model TBCern0806
 - CERN Oct tb: model TBCern1006
 - 'New' coordinate system: origin of coordinate system on the back plane of DC closer to ECAL (DC1)
 - Desy tb: model TBDesy0506_01
 - CERN Aug tb: model TBCern0806_01
 - CERN Oct tb: model TBCern1006_01

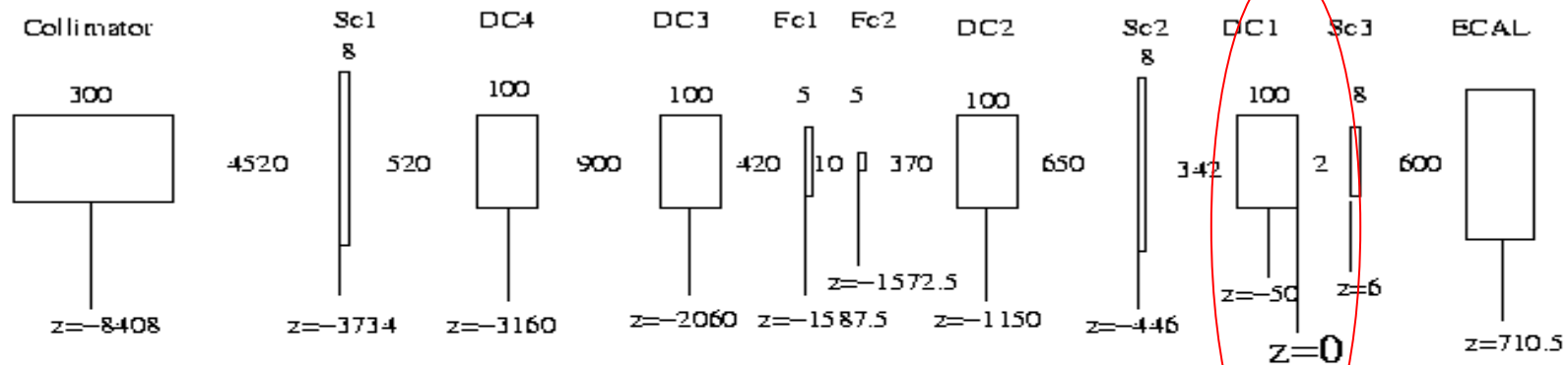
Sketch of Desy models

TBDesy0506

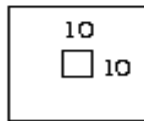


TBDesy0506_01

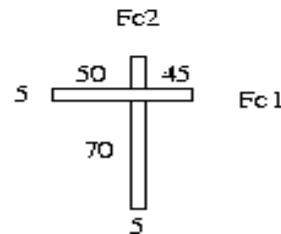
TOP – Desy May 2006



FRONT



Sc1 and Sc2 are 200x200
Sc3 is 120x120

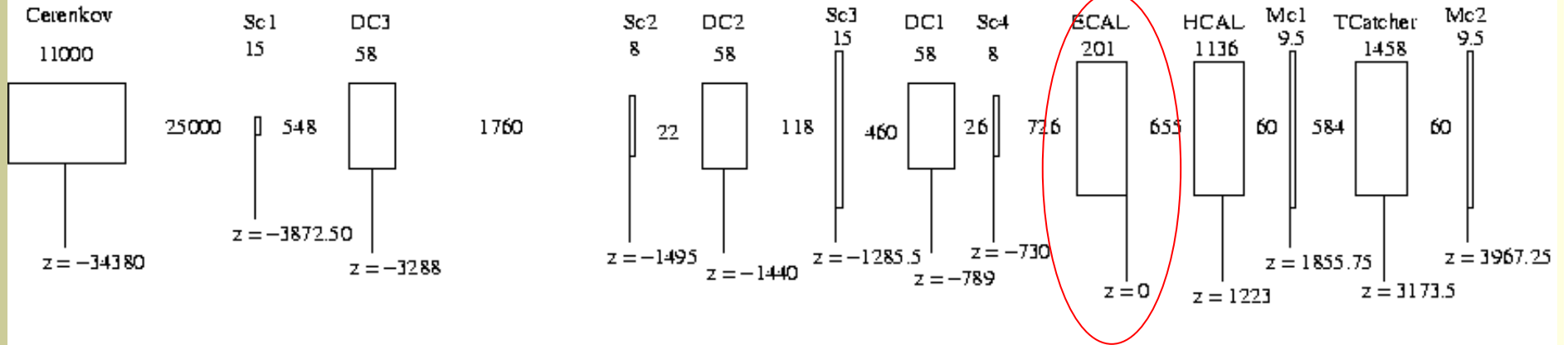


All distances are in mm

Sketch of CERN Aug models

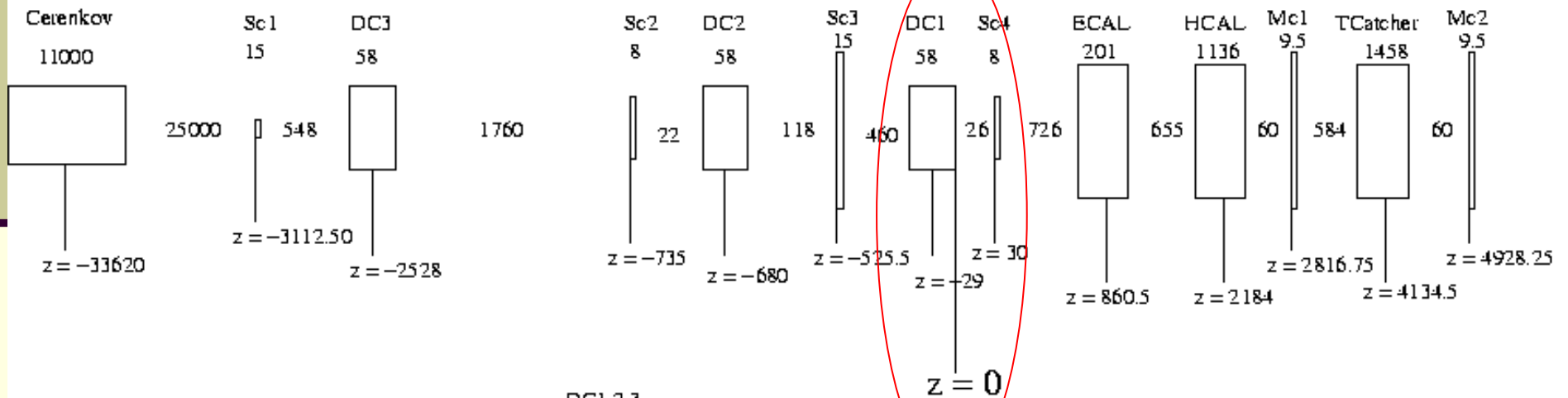
TBCern0806

TOP



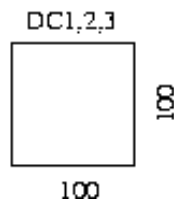
TBCern0806_01

TOP – CERN August 2006



FRONT

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

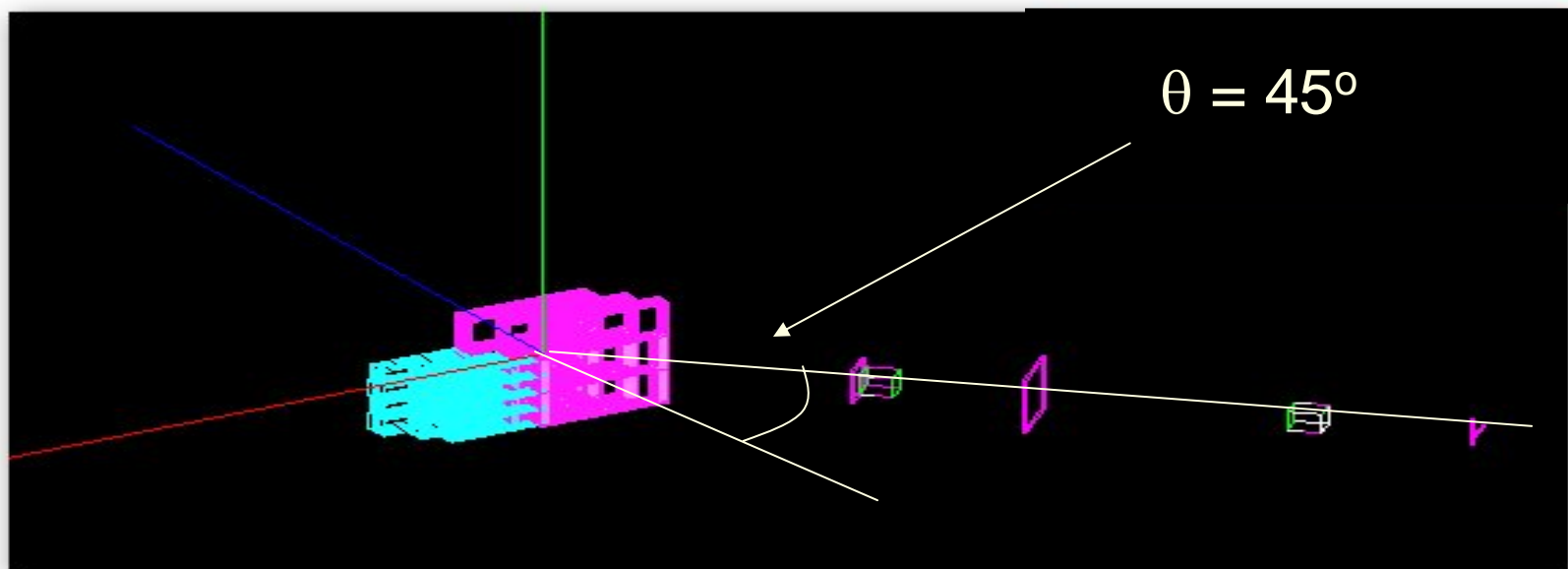


Mc1 and Mc2 are 1000x1000

All distances are in mm

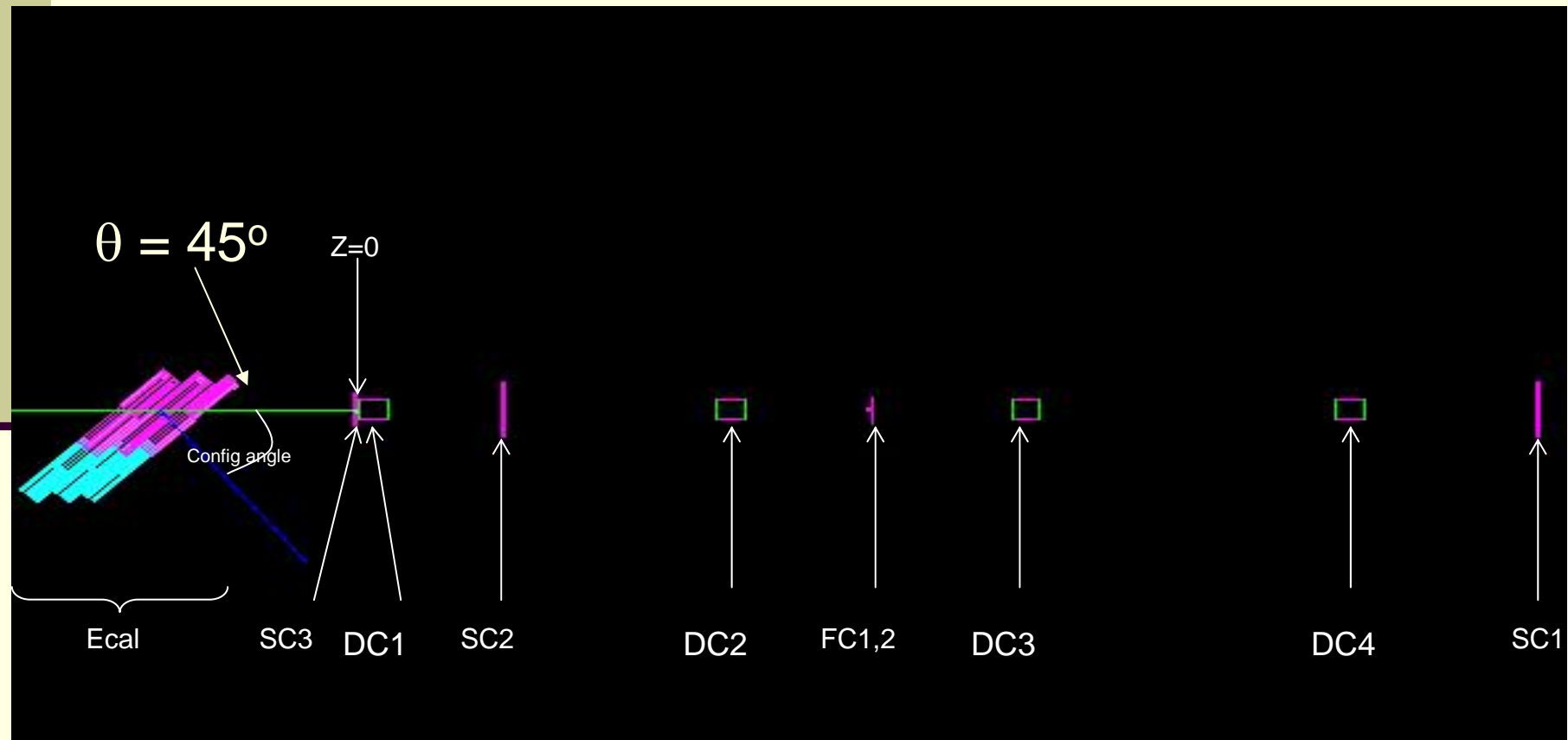
'Old' coord. syst. vs 'New' coord. syst. - I

- 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
 - 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



- **Drift Chambers (FS):**
 - installed by Kobe collaborators for the 05 test beam
 - **gas mixture is non-flammable** (96% Ar, 4% Ethane)
 - **4 drift chambers** (72x72x88 mm³)
 - **hits written out in LCIO format**
 - To reduce number of hits, only hits with $E_{rel} > 0.001$ are written in output
- **Trigger scintillators (FS):**
 - **3 scintillators** (one 120x120x8 mm³, two 200x200x8 mm³) used in the trigger
 - **hits written out in LCIO format**
 - Hits simulated as **Calorimeter hits** (one hit per chamber)

Detector description: TBDesy0506 II

- **Finger counters (FS):**
 - **2 scintillators** (5x100x5 mm³) placed in T shape to monitor beam position
 - hits written out in **LCIO format**
 - Hits simulated as **Calorimeter hits** (one hit per chamber)
- **ECAL (G.Musat):**
 - **3 modules** (5 slabs)
 - **tungsten thicknesses** = 1.4, 2.8, and 4.2 mm.
 - 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

I

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

Detector description: TBCern0806 II

- **ECAL (G.Musat):**
 - same as for TBCern0506
- **HCAL (R.Poeschl, O.Wendt):**
 - 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)
 - Cell numbering scheme (from lower left corner of each layer)
 - i = row, j = column, k = layer.
- **TailCatcher (J.McCormick, G.Lima):**
 - 16 layers (absorber+air+readout module)
 - 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
 - All absorbers in place, but only 8 readout modules (1, 4, 7, 10 – vertical strips, 2, 5, 8, 11 – horizontal strips)
- **Muon Counters (FS):**
 - 2 scintillators (1000x1000x50mm³)
 - hits written out in LCIO format
 - Hits simulated as Calorimeter hits

Detector description: TBCern1006

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

Improvements in simulation wrt Mokka 06-03p01

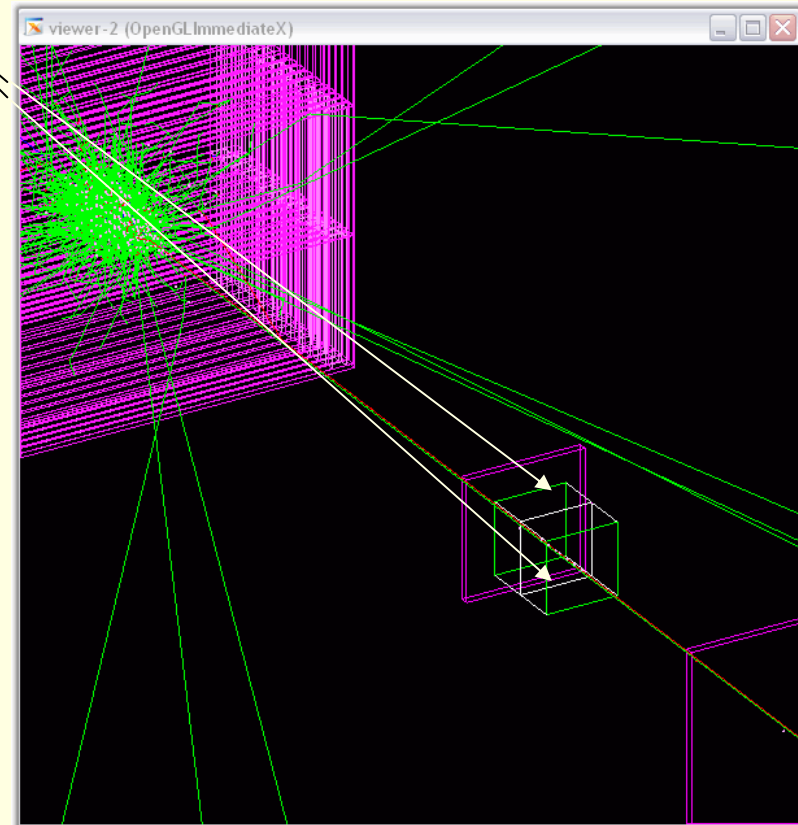
- **Real drift chambers** in the **Desy** setup give **separate measurement of X and Y position on hits**
 - **Fist half of the chamber gives X position, second half gives Y position**
- As chambers are simulated in **Mokka v06-03p01**, **each hit has an X and Y position**
 - **Re-write driver** to match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

New DCH driver for Desy0506 model

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

New chamber layout

- Two separate volumes
- One single hit collection
 - TBdchXY02_dchSDxy0
 - Use cellID to distinguish hits from each layer:
 - DC1 -> layer 0 (X), 1 (Y)
 - DC2 -> layer 2 (X), 3 (Y)
 - DC3 -> layer 4 (X), 5 (Y)
 - DC4 -> layer 6 (X), 7 (Y)



The new Mokka WEB site

<http://polywww.in2p3.fr:8081/MOKKA>

The screenshot shows the Mokka website in a Mozilla Firefox browser window. The browser's address bar displays the URL <http://polywww.in2p3.fr:8081/MOKKA>. The website features a navigation menu with links for home, members, news, events, detector models, software, database, and download. A search bar is located in the top right corner. The main content area is titled "Mokka" and includes a navigation sidebar on the left with links to Home, Members, News, Events, Detector models, and a folder for mokka-06-01. The main text describes the Mokka simulation, mentioning its use of Geant4 and its application in the TESLA project. A list of links is provided, including "History and old stuff", "Detector models simulated by Mokka", "Geometry Database", "Documentation for users and developers", and "Download Mokka". On the right side, there is a "news" section with a link to "mokka-06-01" dated 2006-07-20, and a calendar for September 2006 with the 12th highlighted.

Mokka
by Paulo Mora de Freitas — last modified 2006-09-07 14:19

A detailed Geant4 simulation for the International Linear Collider detectors

« Mokka » is a full simulation using Geant4 and a realistic description of a detector for the future linear collider. The first basic model was the proposed for the TESLA project, described in details in the TESLA Technical Design Report (T.D.R.). Since 1999 several new detector parts, models and prototypes became also available in the Mokka geometry database. In its last releases Mokka provides several models for both LDC and SiD detector concepts, as well for the calorimeters test beams.

- History and old stuff
- Detector models simulated by Mokka
- Geometry Database
- Documentation for users and developers
- Download Mokka

news

mokka-06-01
2006-07-20
More news...

September 2006

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3	4	5	6	7	8	9
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17	18	19	20	21	22	23
24	25	26	27	28	29	30

Paulo Mora de Freitas
Gabriel Musat
Fabrizio Salvatore

The 'Detector models' tab

Test beams — MOKKA - Mozilla Firefox

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Test beams

by Fabrizio Salvatore — last modified 2006-09-12 15:03
Contributors: mora, musat

Description of the test beam models that have been implemented in Mokka in spring/summer 2006

Models are available to generate MC events simulating the detectors and beam conditions at the Desy (05/06) and Cern (08-09/06) test beams. These models are called **TBDesy0506** and **TBCern0806** respectively and are described below.

TBDesy0506. A sketch of the test beam area can be found at the following URL: <http://www.pp.rhul.ac.uk/~calice/fab/TestBeams/DesytbArea.ps>. The coordinate system is left-handed, with the z axis along the beam line. The backside of the ecal defines the z=0 of our setup. The detectors that have been simulated on the beam line (starting from the upstream collimator) are described in the following.

Sc1, Sc2, Sc3: trigger scintillators; dimensions: 200x200x8 mm (120x120x8 mm for **Sc3**). Sc3 is placed between the last drift chamber (**DC2**) and the ECAL module (see sketch of the tb area and below for more description). Sc1 is placed in front of the first drift chamber (**DC4**), 4520 mm after the exit window of the collimator. Hits in the scintillators are simulated as 'tracker hits'. The format of the output from the drivers that build these detector is standard LCIO. In order to output only primary hits, only hits with a deposited energy greater than 0.01 are stored.

DC1, DC2, DC3, DC4: drift chambers; dimensions: 72x72x88 mm. The gas mixture used is 96% Argon and 4% Ethane. The front and back windows (20 micron) are made of mylar. For convention, the drift

news

- mokka-06-01
2006-07-20

More news...

September 2006

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17	18	19	20	21	22	23
24	25	26	27	28	29	30

Done

Conclusions

- **Models for detailed simulations** of the 2006 test beam setup are available
- **Several models** are implemented in **latest version of Mokka (06-03p02)**
- **'Old' coordinate system**
 - TBDesy0506, TBcern0806, TBCern1006
- **'New' coordinate system**
 - TBDesy0506_01, TBcern0806_01, TBCern1006_01
- **New DCH layout, with one collection of hits**
 - TBDesy0506_dchxy_new
- Looking into **more possible improvements**
 - Simulation of **steel frame around scintillators** (Desy/CERN)
 - Improvement in **simulation of CERN DCHs**
- **New Mokka page** with all details of TB models now available (<http://polywww.in2p3.fr:8081/MOKKA>)