Ivo's first 5+5 months as CERN fellow

in 5x5 slides

Note: superficial talk … just meant to show what I did

DELPHI

Higgs search

Preshower

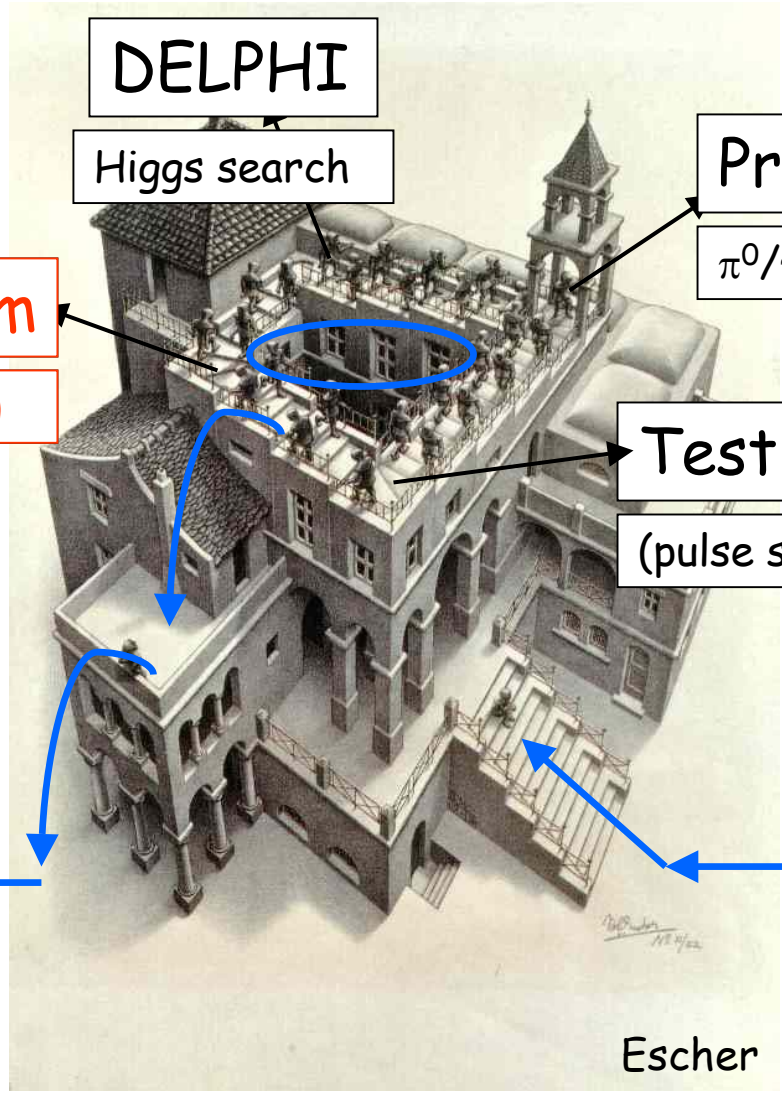
π^0/γ separation

Testbeam

(Calibration)

Testbeam

(pulse shape)



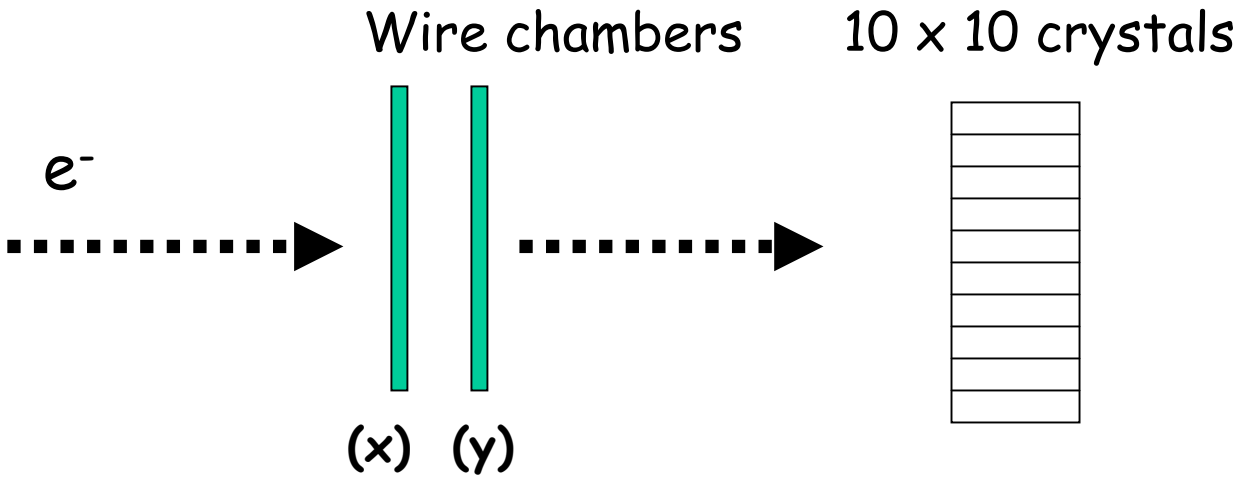
Escher

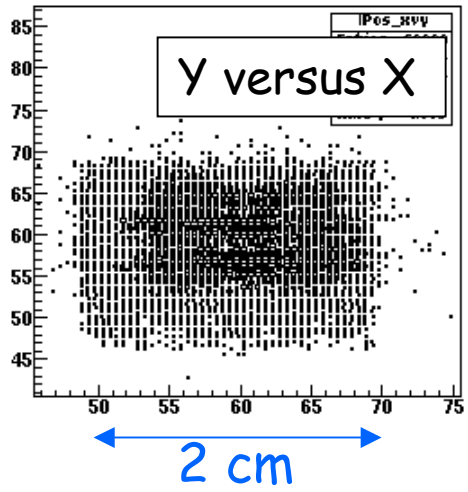
Rest of 2003

Testbeam

wire chambers: efficiency & new tracking calibration

H4 testbeam (efficiency study)





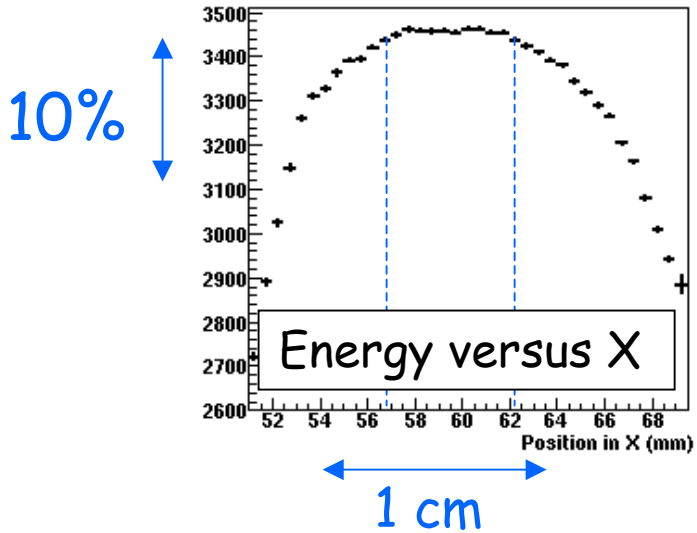
Track reconstruction efficiency:

2001 > 90%

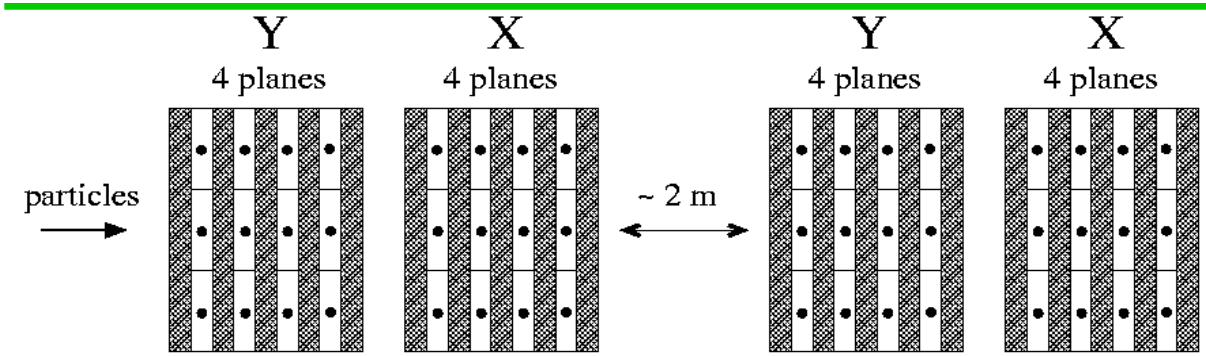
2002 < 60%

"Ivo, why don't you have a look:

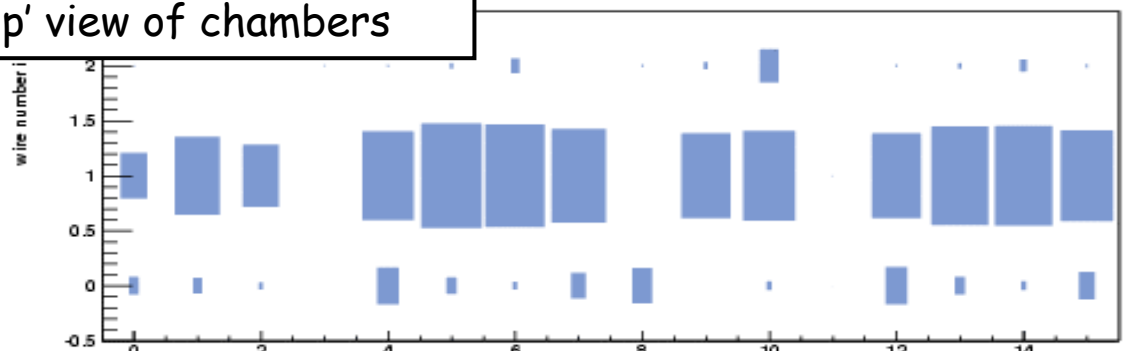
1 month work, learn C, people, useful"

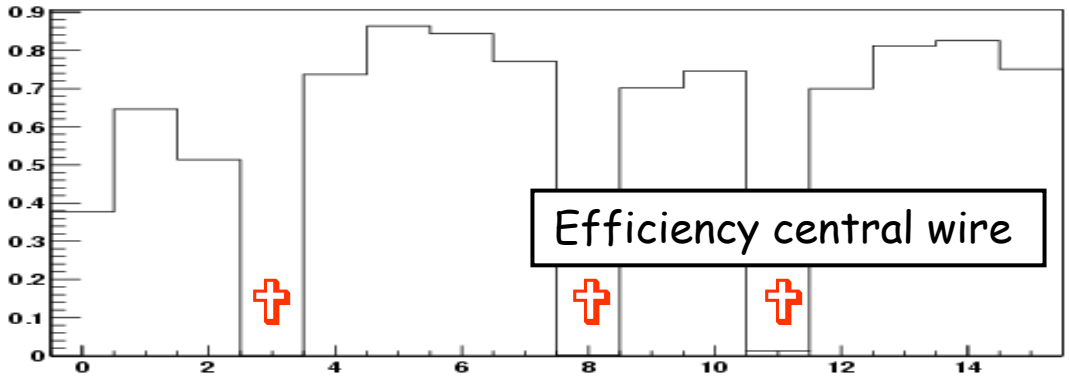


H4 testbeam (efficiency study)



'top' view of chambers





Observations:

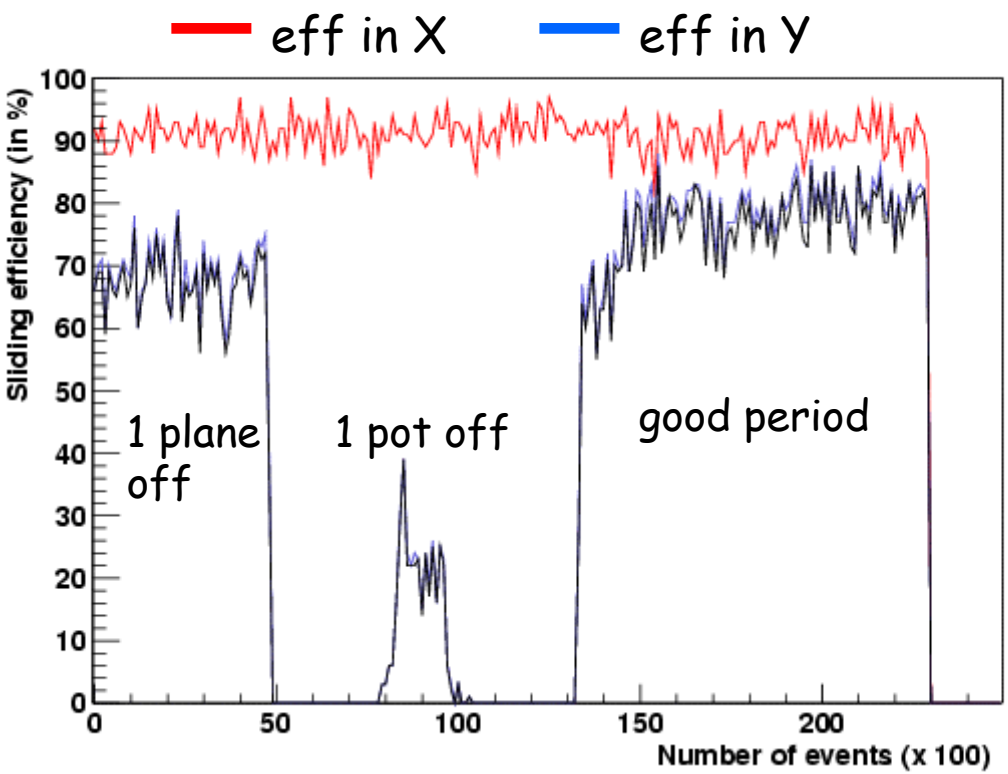
- in x all is fine
- 3 central wires in y are off
- in y less efficient

Tracking procedure:

- Simple χ^2 fit (y=ax+b)

  Rewritten so I understood what was happening
- 2002: minimal ('2+1') track definition

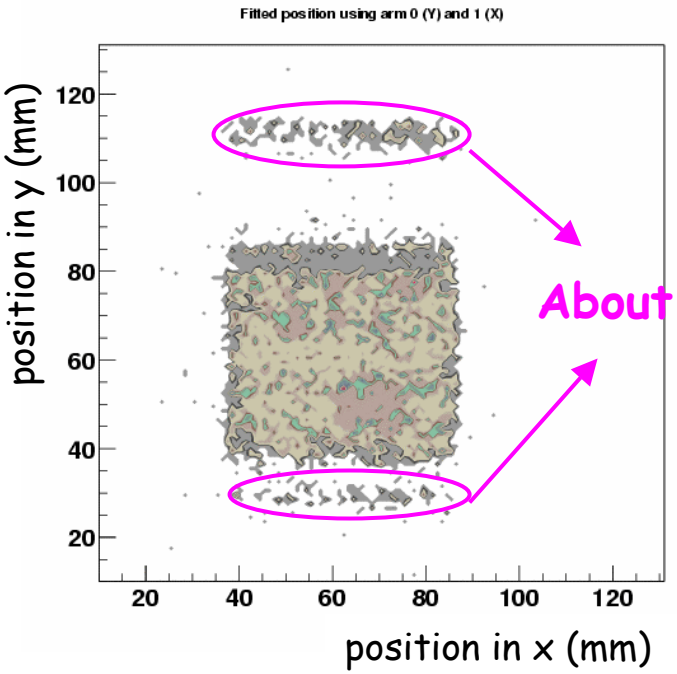
H4 testbeam (efficiency study)



(y) efficiency:

- maximally = 75-80%
- very sensitive to operating conditions

Bad tracks in Y



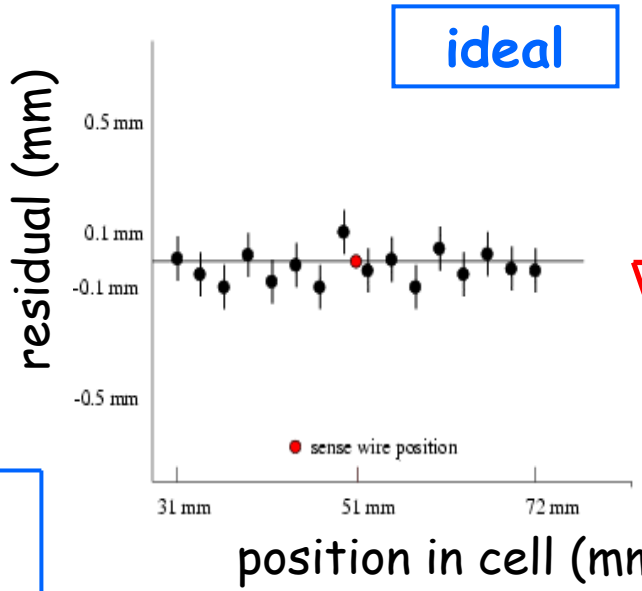
- Recover almost all of them using new tracking procedure:

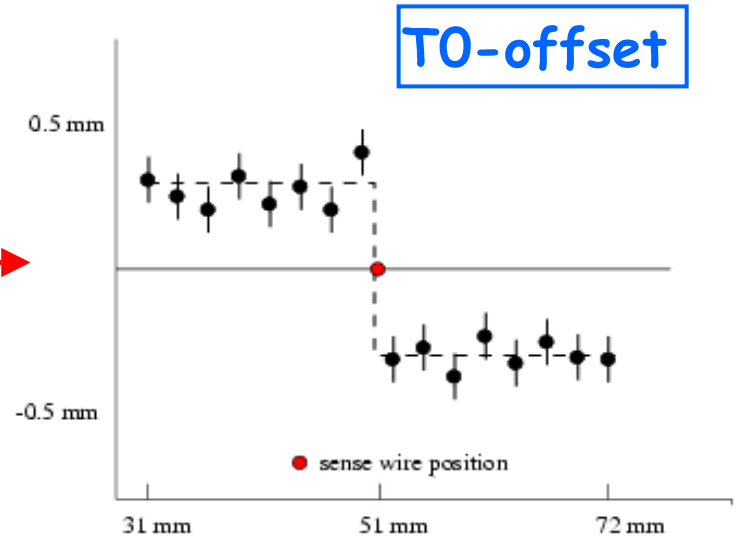
20% … more than 2 weeks data taking

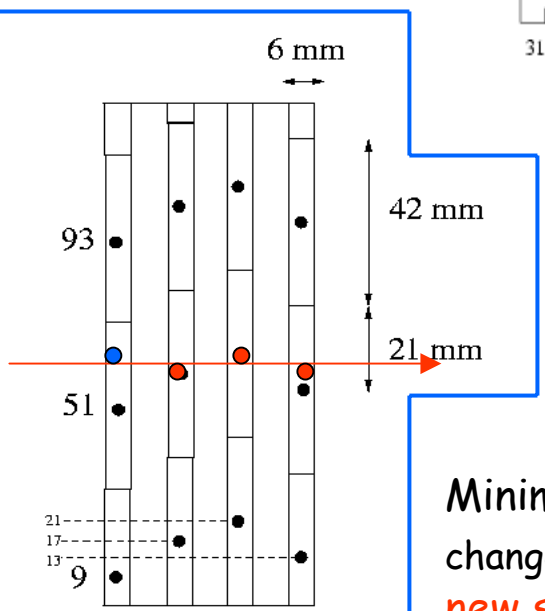
↓

15 night shifts where not useless !!

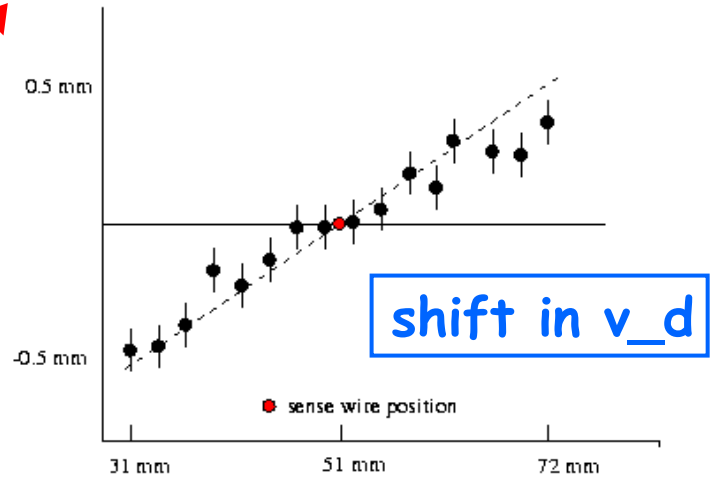
H4 testbeam (calibration)







Residual = distance between track and hit

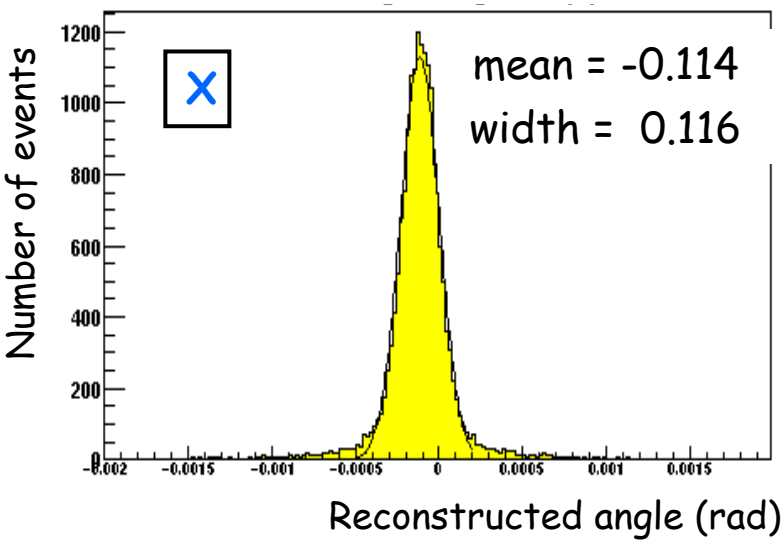


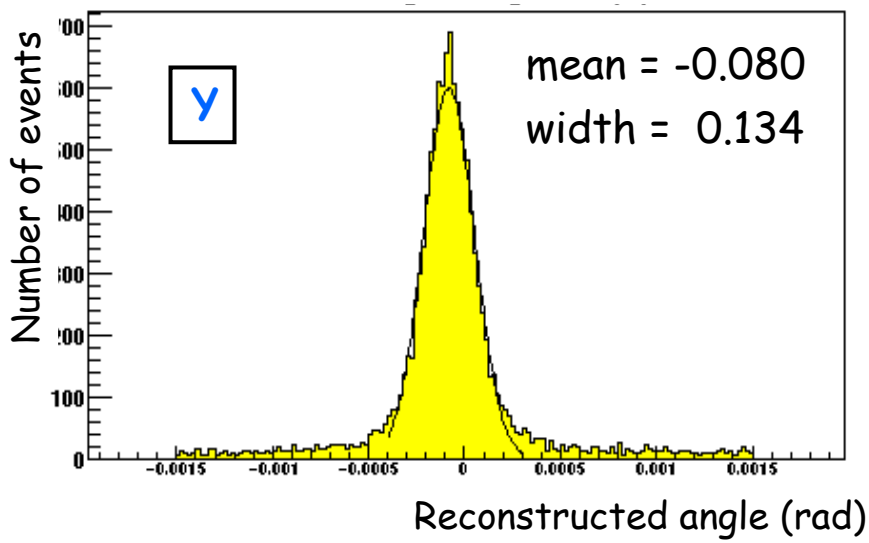
Minimise residuals:

change T0's (per wire) & v_d (per plane)

new set of calibration constants

Angular resolution





Conclusions:

- Efficiency study & new tracking procedure (recover 20% of tracks)
- Started with a note … no push to finsh … should I have ??
- Calibrated wire chambers (angular resolution: 115-135 mrad)

Personal Conclusions:

- ~1 month work, learn C, people (Jean Bourotte & Patrick Jarry), useful

DELPHI

Higgs search

Preshower

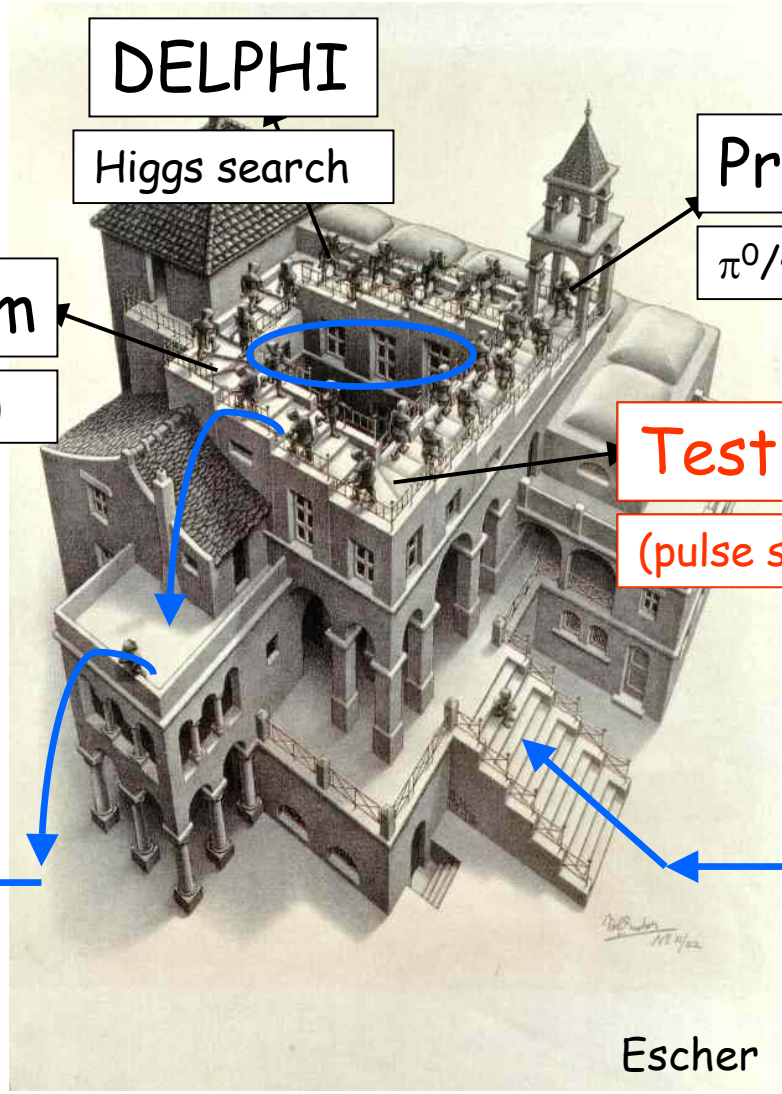
π^0/γ separation

Testbeam

(Calibration)

Testbeam

(pulse shape)



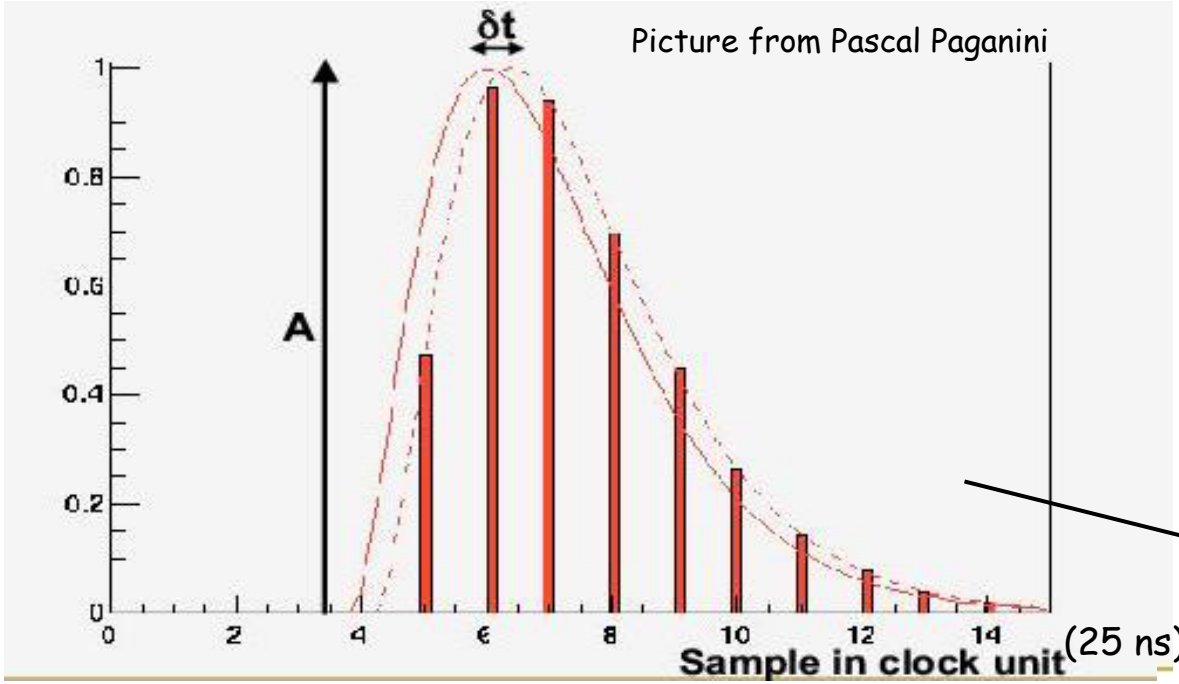
Escher

Rest of 2003

Testbeam

pulse shapes

H4 testbeam (pulse shape)



As in CMS:

Sampling every 25 ns

Pedestal subtraction

Laser monitoring

Different from CMS:

Asynchronous Trigger

(Can correct for this)

Get amplitude

(Measure for energy deposition)

Pulse shape (Amplitude) reconstruction:

Pol (3): fast, but does not use real shape / bias / always ok

Analytic Fit: time consuming / bias (fit) region / laser-beam different shape

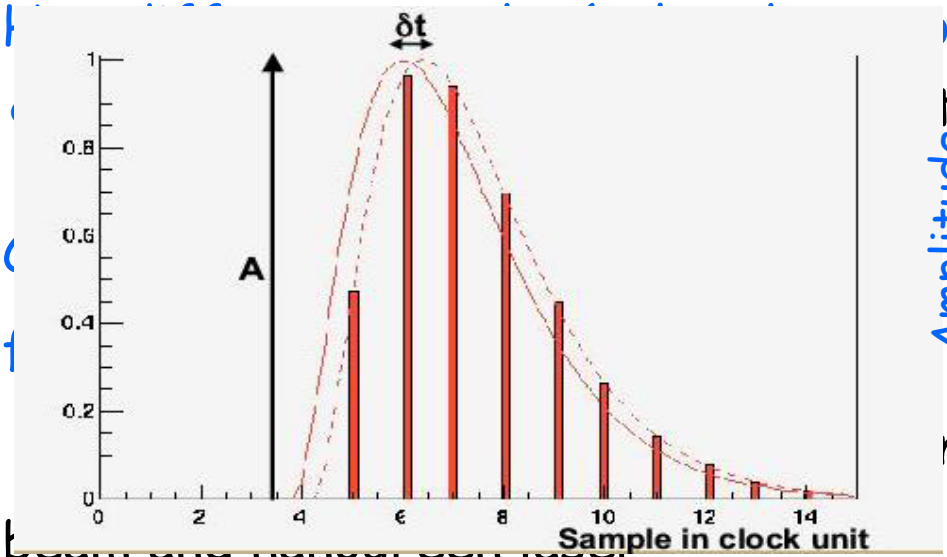
Fit electr. shape: ok for testbeam, not ok for CMS (save shape for each crystal)

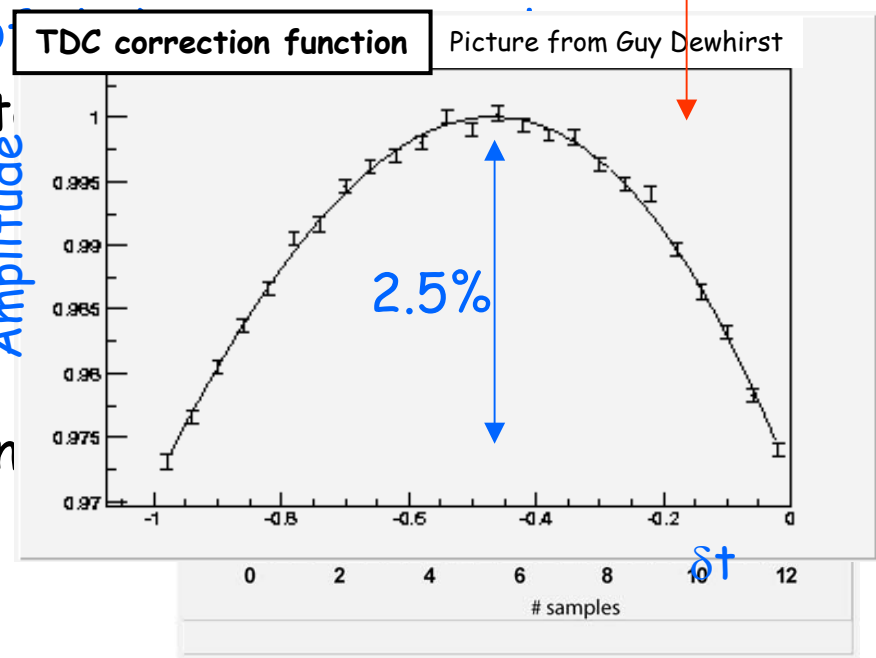
Weights method: $\tilde{A} = \sum w_i \mathbf{S}_i$ / most promising candidate (also in ORCA)

Weights method: $\tilde{A} = \sum w_i S_i$: What is the minimal set of weights ??

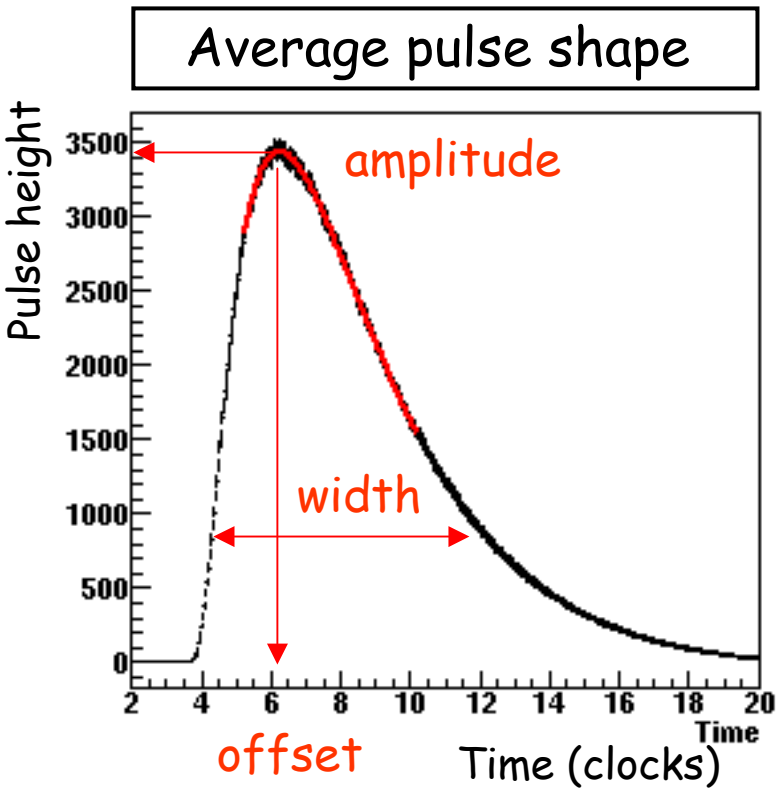
sets: each crystal
each crystal (+ TDC correction function)
(+ weight for each 1ns bin)

each set of crystals
only 1 (from 'the average' crystal)





H4 testbeam (pulse shape)



electrons:

Beamscan: run 42496 - 42987

All crystals

50.000 events per crystal

6.500 events (after cuts)

nanogreen laser run:

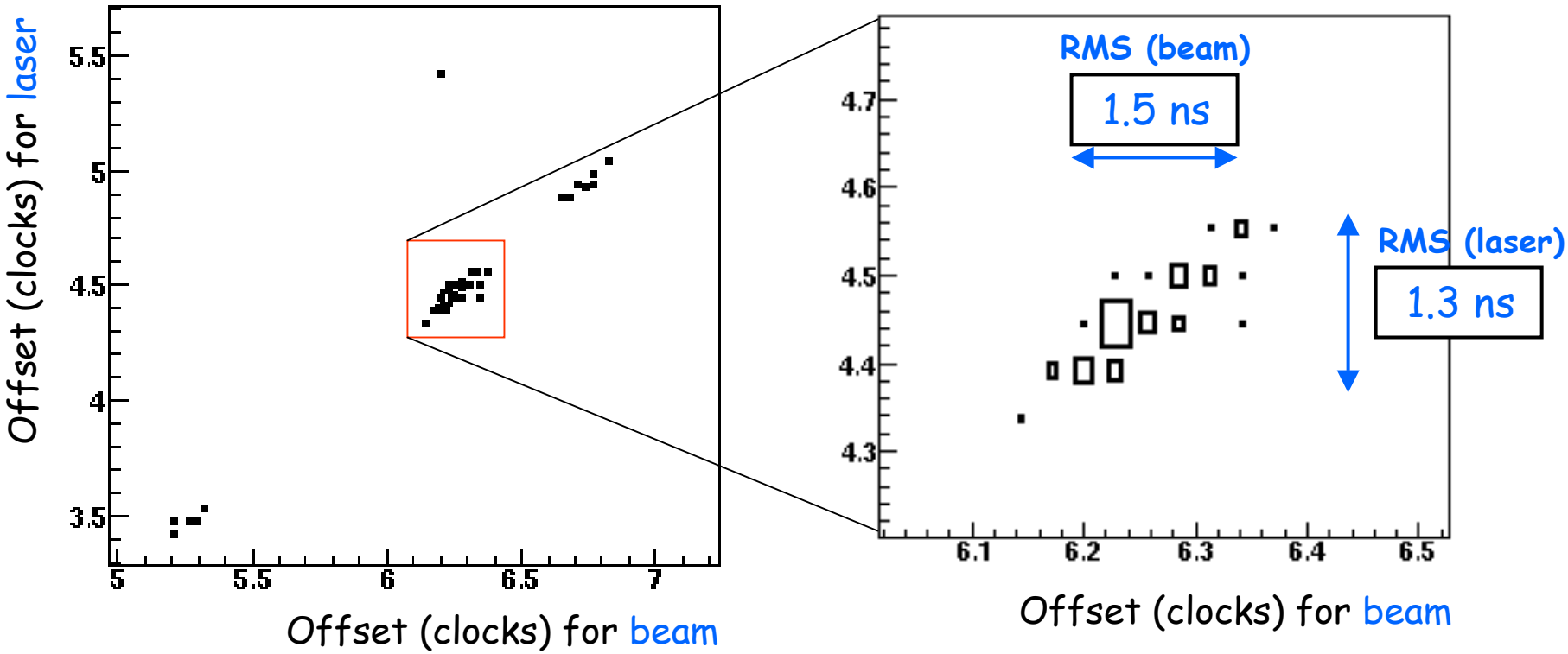
Laser run: run 55066

All crystals

1.500 events per crystal

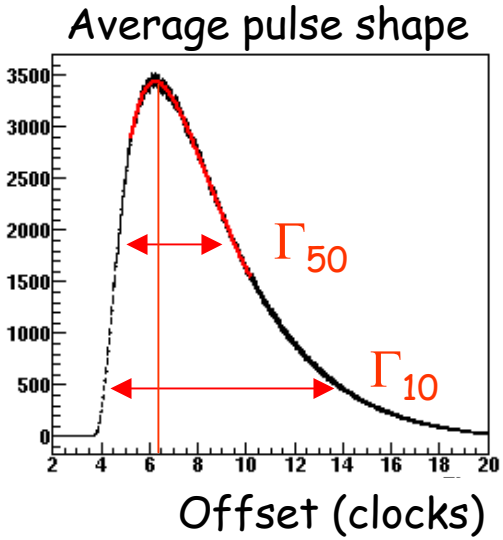
Remember the calibrated wire chambers !

H4 testbeam (pulse shape)



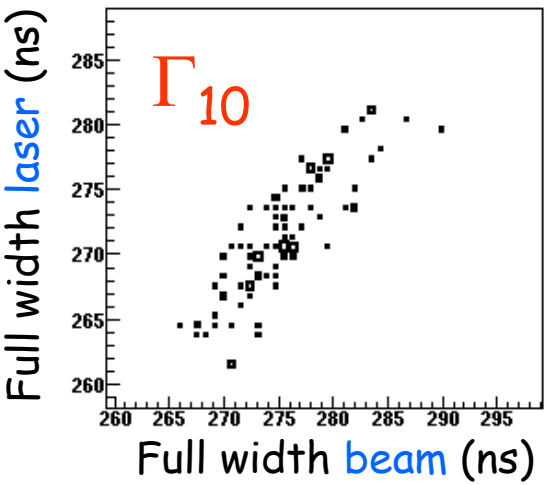
- Small dispersion, but Offset(max-min) = 0.16 clocks = 4.0 ns

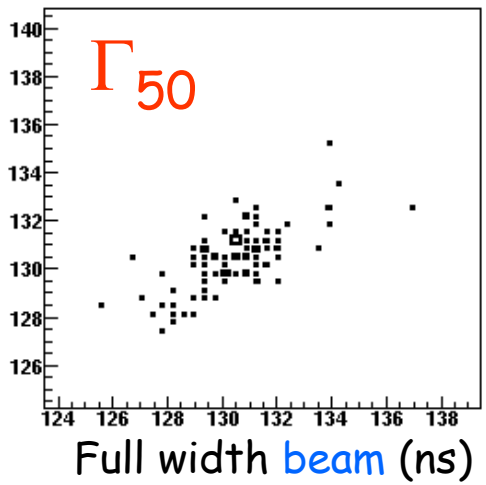
H4 testbeam (pulse shape)



	Beam	Laser
Γ_{10} (ns)	272.2 ± 4.5	270.7 ± 4.8
Γ_{50} (ns)	128.8 ± 1.8	130.1 ± 1.3

- Not shown, but Rise Time is also correlated
  nanogreen is as fast as the electrons





Conclusions:

- Correlation between beam runs and nanogreen laser runs

  Yes, they have a similar shape, … and yes, you can use laser runs to prepare

- Dispersion between crystals is rather small

  Yes, you can probably live with a small number of weights & correction functions

Personal Conlusions and Outlook:

- Nice set-up, lot's to do, but no clear coherence in analyses (different in 2003)
- Study Impact of using 1 set of weights from an 'average' crystal:
  Some channels 2-4 ns off / Some channels are 0.5 clocks off
- Impact on energy resolution & (small) signal efficiency

  Using data and 'simulation'
- Participate in 2003 data analysis with more clear objective

DELPHI

Higgs search

Preshower

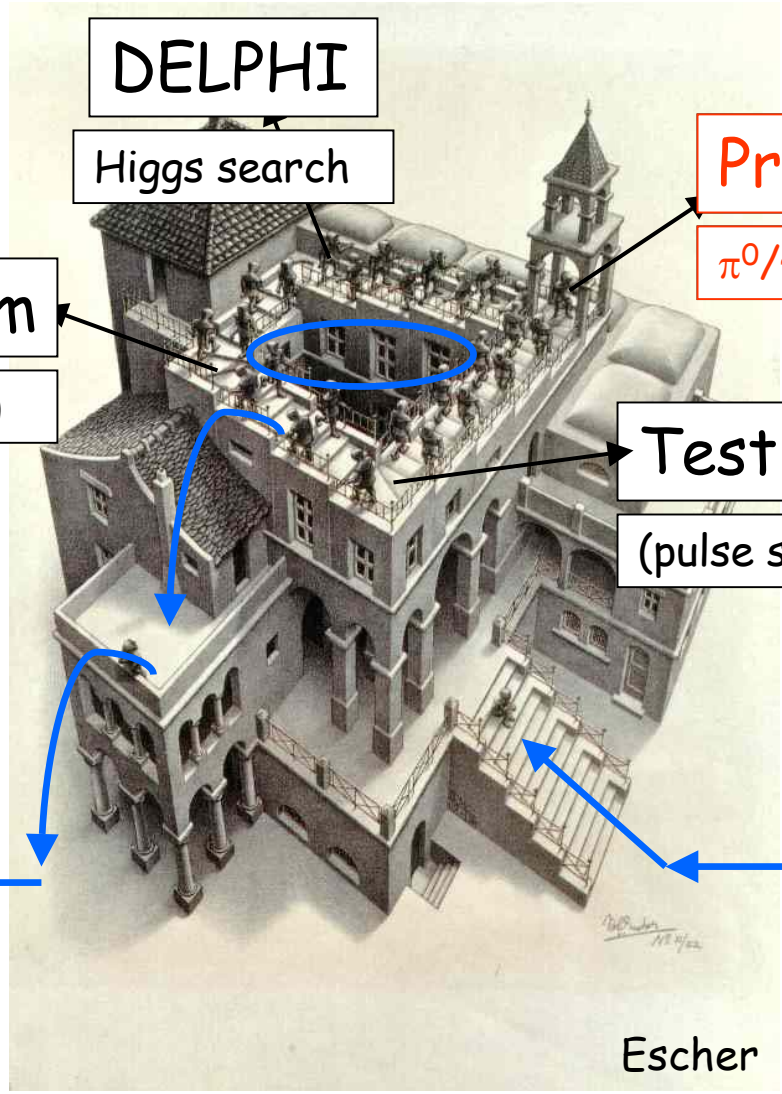
π^0/γ separation

Testbeam

(Calibration)

Testbeam

(pulse shape)



Rest of 2003

NIKHEF

Preshower

(π^0/γ - separation)

Preshower: (π^0/γ - separation)

In ECAL: Look for photons … try to reject jet background

Use both isolation cuts & differences between a γ and a π^0

1999: CMSIM 116 Et=50 / 90% γ eff: π^0 rejection = 65%

2002: CMSIM 126 Et=50 / 90% γ eff: π^0 rejection = 48%

+ ORCA

Is there a simple bug or something more deeply wrong in ORCA ??

Redo full study of separation using large samples

200,000 events = 2 -- single-γ and single-π^0

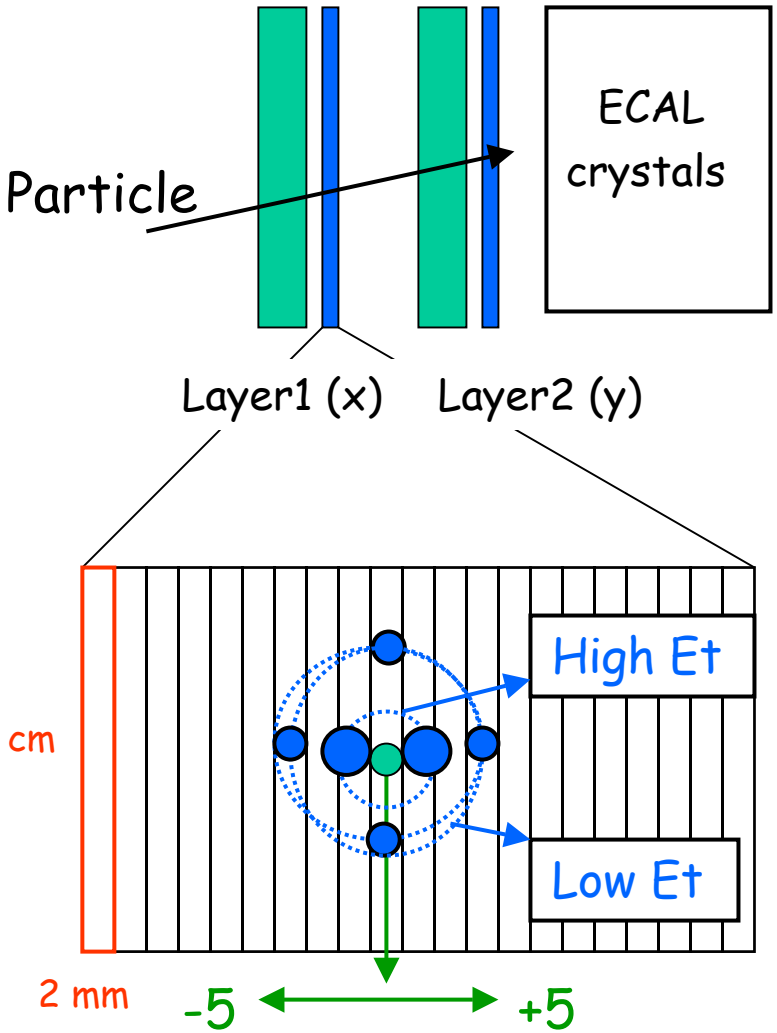
x 2 -- η = 1.7 and η = 2.4

x 5 -- E_T = 20, 30, 40, 50 and 60

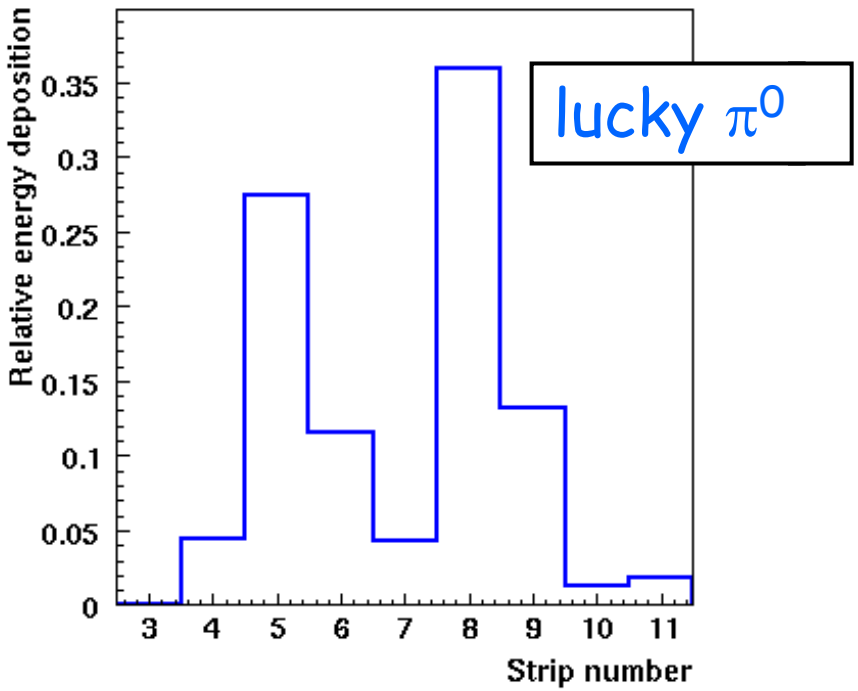
x 10,000 -- events

CMS computing
(30 Gbyte MC data)

Preshower: (π^0/γ - separation)

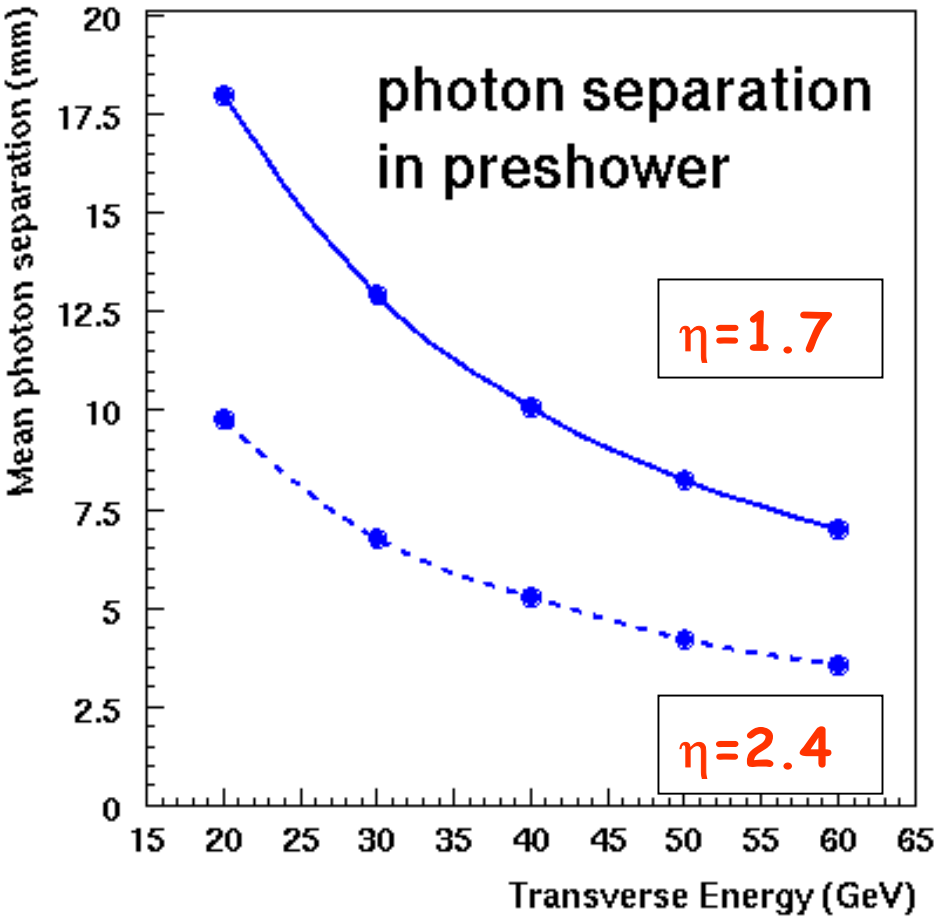


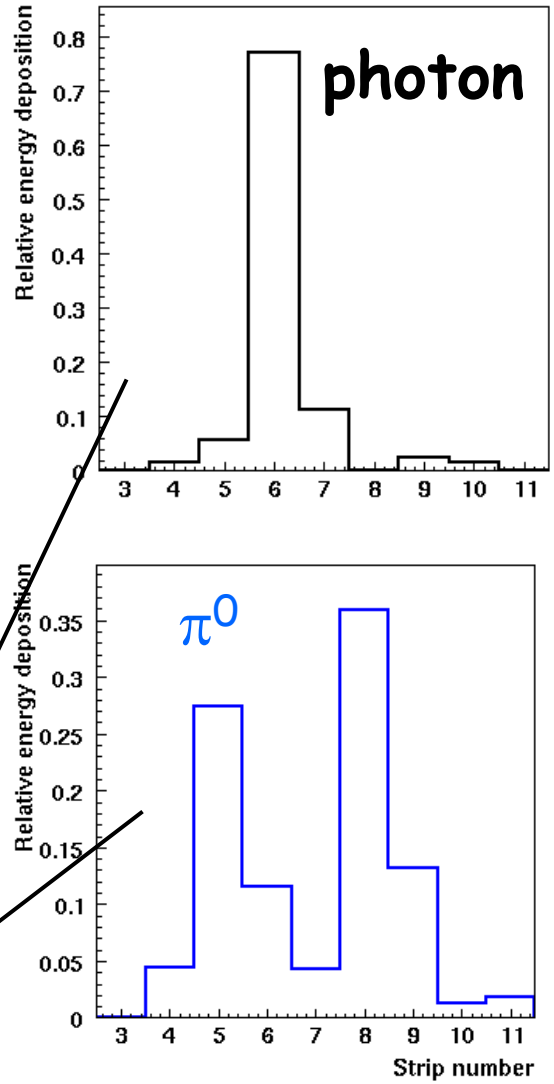
π^0 --> $\gamma\gamma$ (98.8 %)
--> $e^+e^-\gamma$ (1.2 %)



Preshower: (π^0/γ - separation)

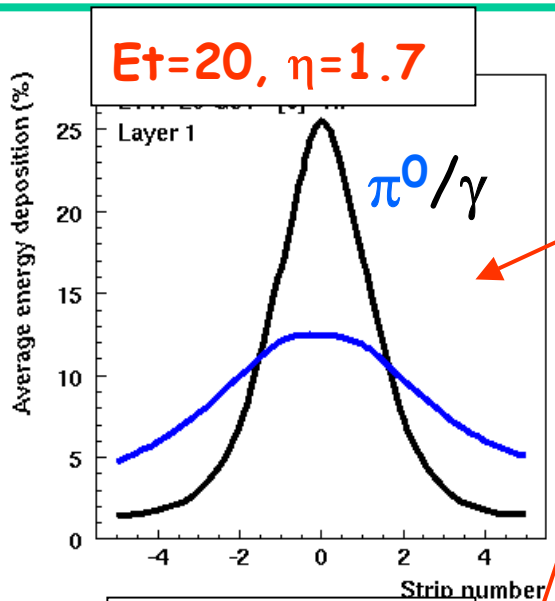
PreShower strip = 6 cm x 2 mm

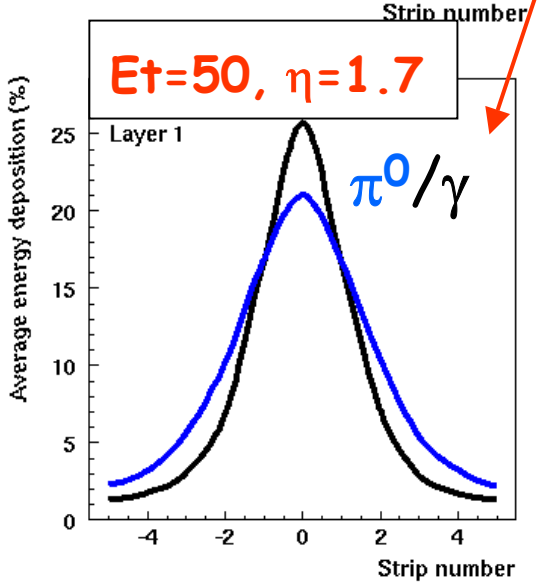




Unfortunately you cannot win the lottery every week

Preshower: (π^0/γ - separation)





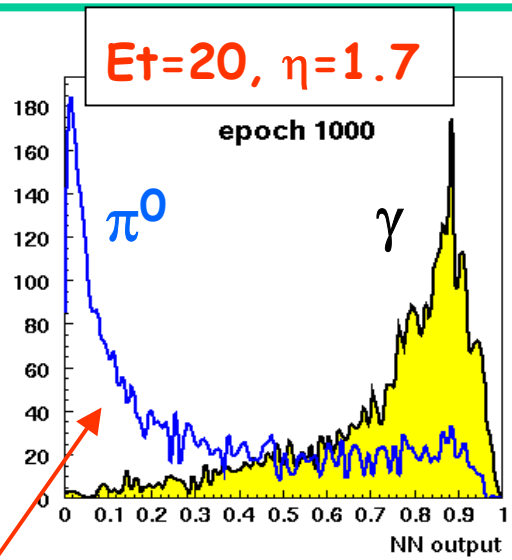
Average event shape

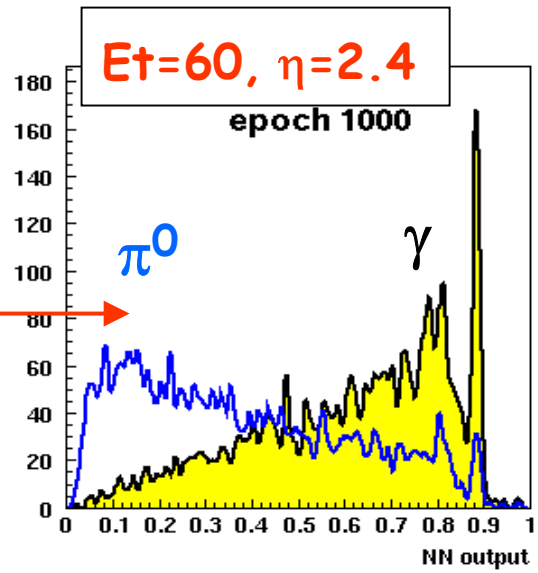
Use Neural Network:

energy deposition in

2x11 strips

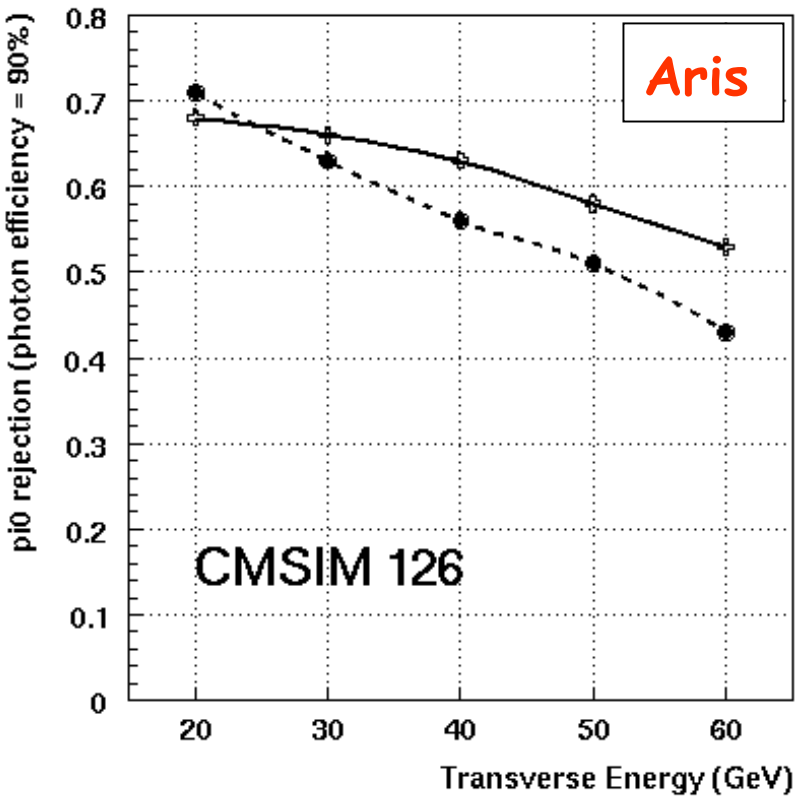
Neural Network output

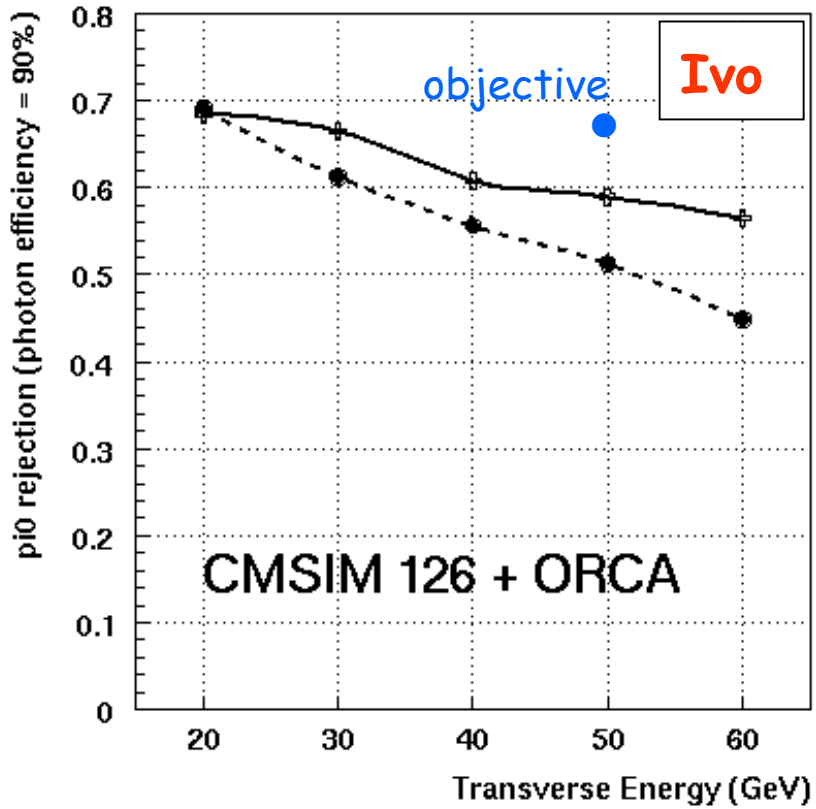




Preshower: (π^0/γ - separation)

Performance: Look at π^0-rejection @ 90% γ-efficiency





- Still not as expected, but nothing wrong in ORCA

Preshower: (π^0/γ - separation)

Conclusions & outlook

- No disasters / ORCA seems ok, but a bit worse than expected
- Study the extrapolation (ECAL --> Preshower) inside ORCA

  Any error will smear profile and thereby worsen separation power
- Simulate samples with the tracker & look at converted photons

Personal conclusions:

- Experience was not what I expected

  Idea: quick physics study with a bit of C++, but … BlackBox.cxx

  --> I summarised my efforts and it will be continued by

  [Aristoteles Kyriakis & Chia-Ming Kuo]

DELPHI

Higgs search

Preshower

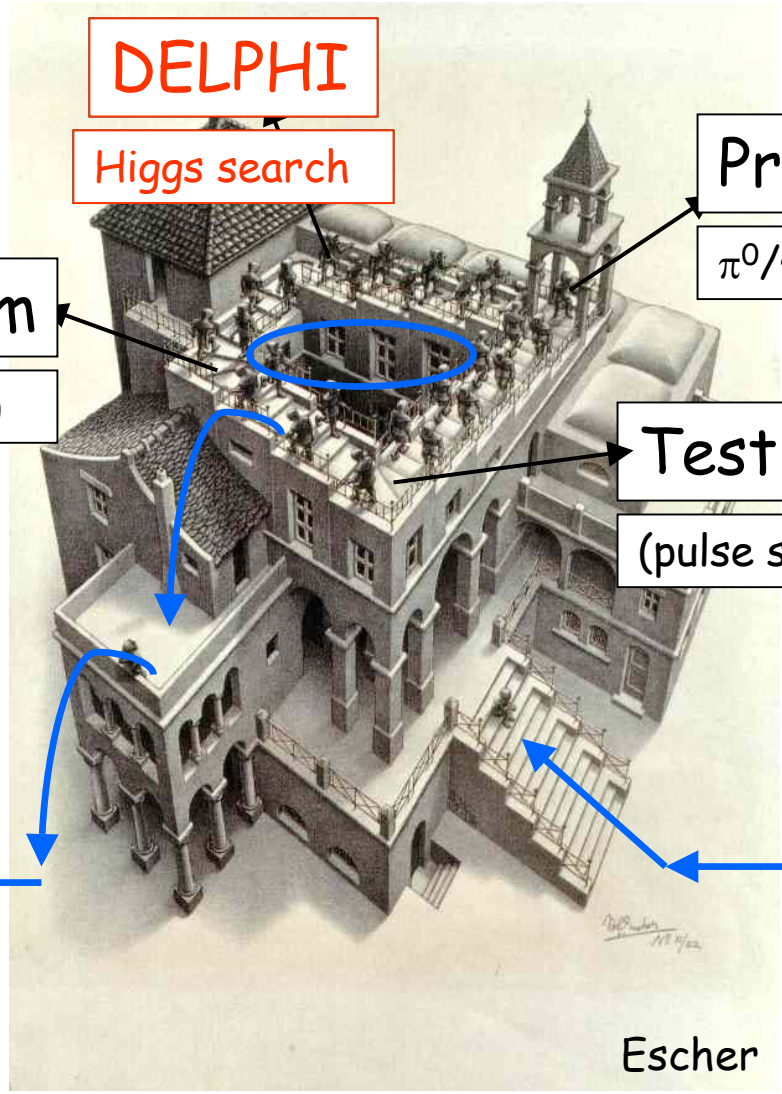
π^0/γ separation

Testbeam

(Calibration)

Testbeam

(pulse shape)



Escher

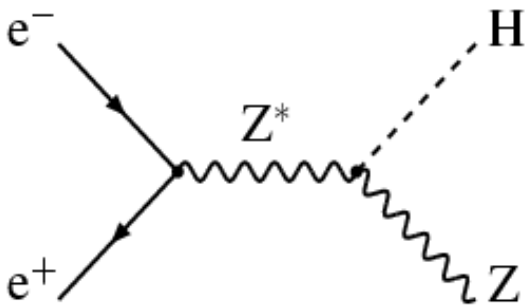
Rest of 2003

Higgs search

flavour independent

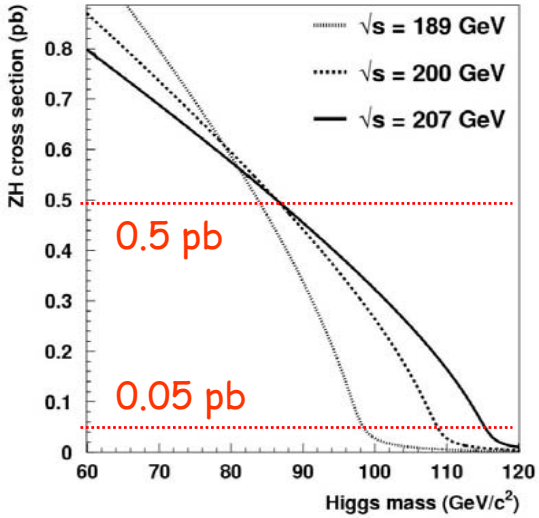
Higgs searches at LEP: in one slide !

HZ production

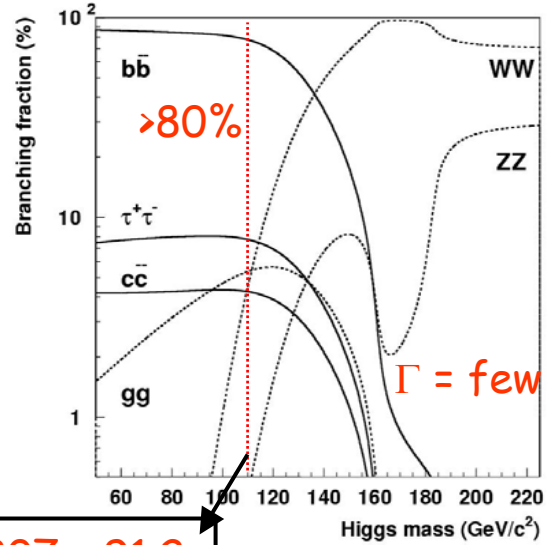


Γ(Z-->)	qq	νν	ll
	70%	20%	10%

HZ cross section



Higgs decay



207 - 91.2

#background & # signal

↓

Exclude HZ cross sections

↓

Exclude Higgs mass

Analysis:

2-b jets

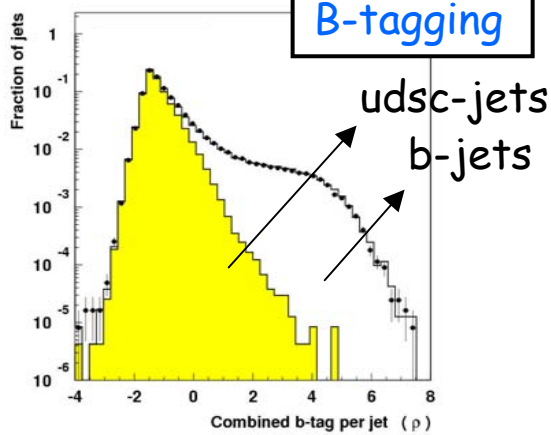
non-QCD topology

⊕

M(Z-obj)=91 GeV/c²

my thesis: 4 quarks

B-tagging



Intermezzo: (my thesis)

My thesis: 4(5) jet final states

- Measure ZZ cross section

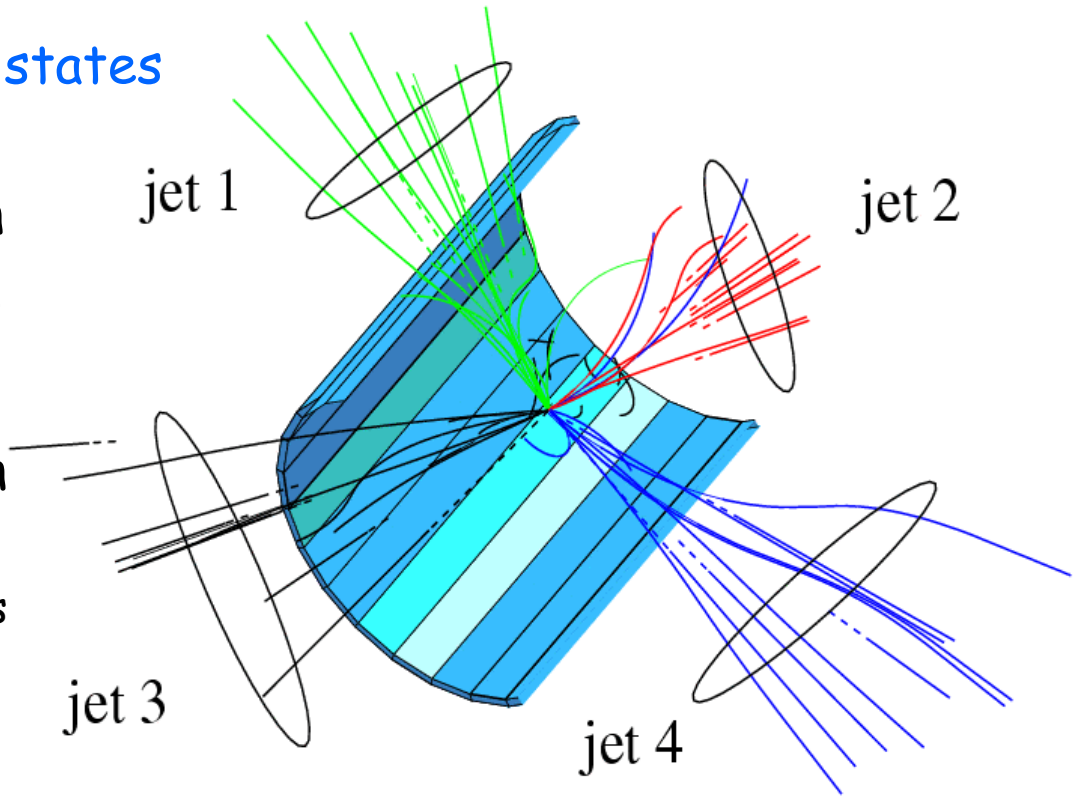
  Same hadronic cross section (0.5 pb) and signature as HZ

- Search for HZ production

  Special use of mass information

  Used in official DELPHI analysis

Use ALL pairings



Maybe give a presentation once for interested people

Higgs searches (flavour independent)

"Higgs is produced associated with a Z, but … "

… the Higgs might not couple to fermions (fermiophobic Higgs)

… the Higgs might decay into 'stable' SUSY particles (invisible Higgs)

… the Higgs not couple to b-quarks

… the Higgs decays predominantly into a pair of gluons

… the Higgs decays into 'radions' (no idea what that is)
(but it is very popular)

… each of the above with a cross section 1.2345 times smaller/larger than SM

↳ Many other models that will come up in the (near) future
You want the predictions from these models to be tested against the LEP data

Experimentalists: exclude HZ cross section (Mh) (H --> hadronically)

(for DELPHI I promised to write the paper)

Higgs searches (flavour independent)

- 5 different analyses from people who are working on 4 different experiments now, sometimes difficult and slow to communicate.
- Exclude cross sections for Higgs masses from 4 GeV/c^2 -- 110 GeV/c^2

Analysis: Gluon jets are broader than quark jets (higher multiplicity)

- Selection efficiency higher for gluon-events than for quarks
- Mass resolution in quark events better than for gluons

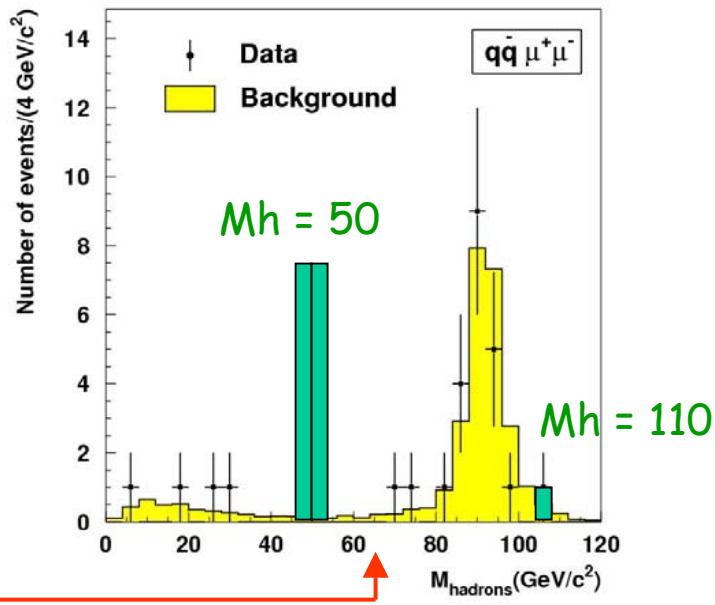
Do analysis for each flavour and take worst result

Example: HZ -> qq$\mu^+\mu^-$ channel

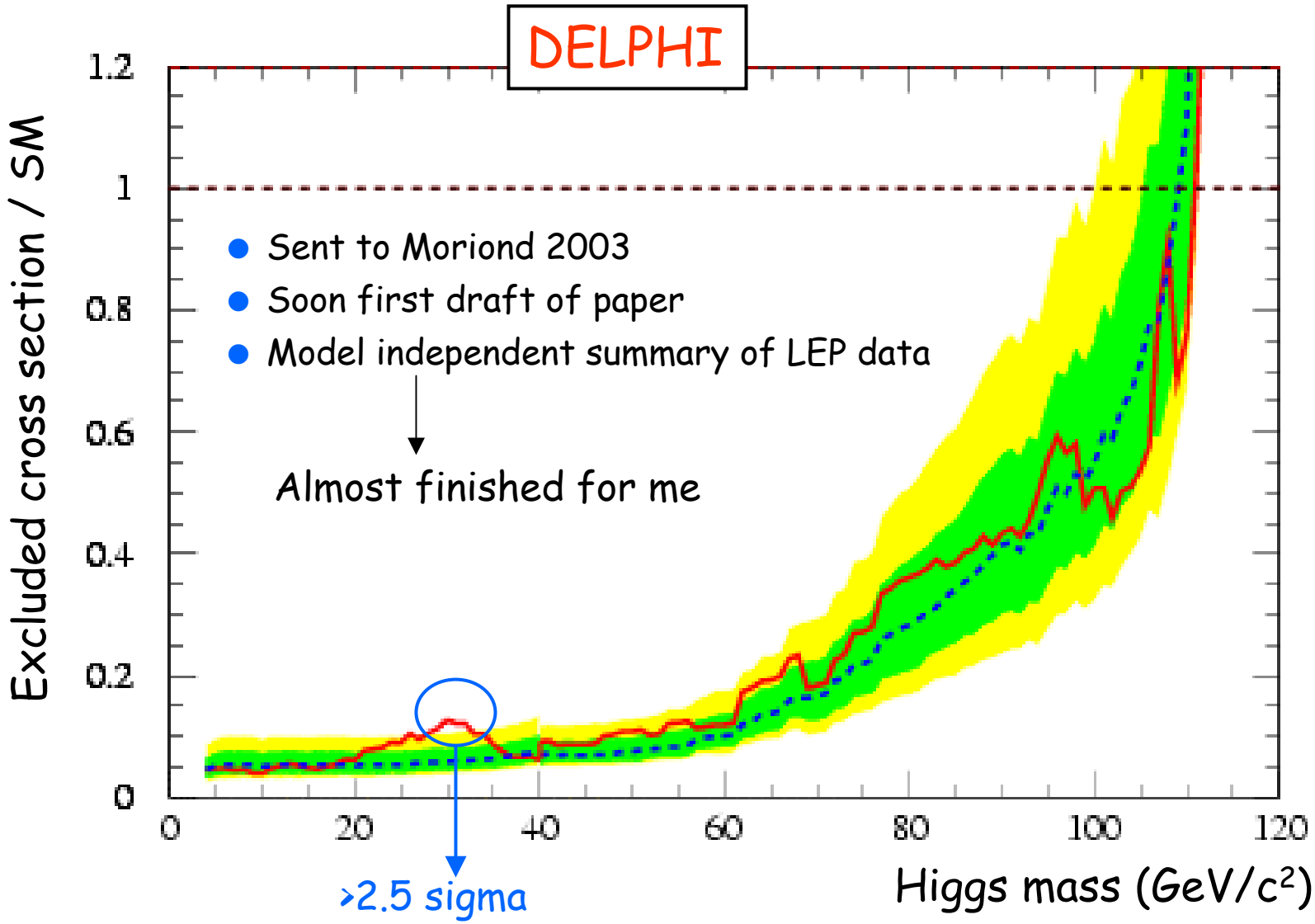
Note: Γ(Z--> $\mu^+\mu^-$) = 3%

$M_{\mu^+\mu^-}$ = close to 91.2 GeV/c^2

Mqq = Mh



Higgs searches (flavour independent)



DELPHI

Higgs search

Preshower

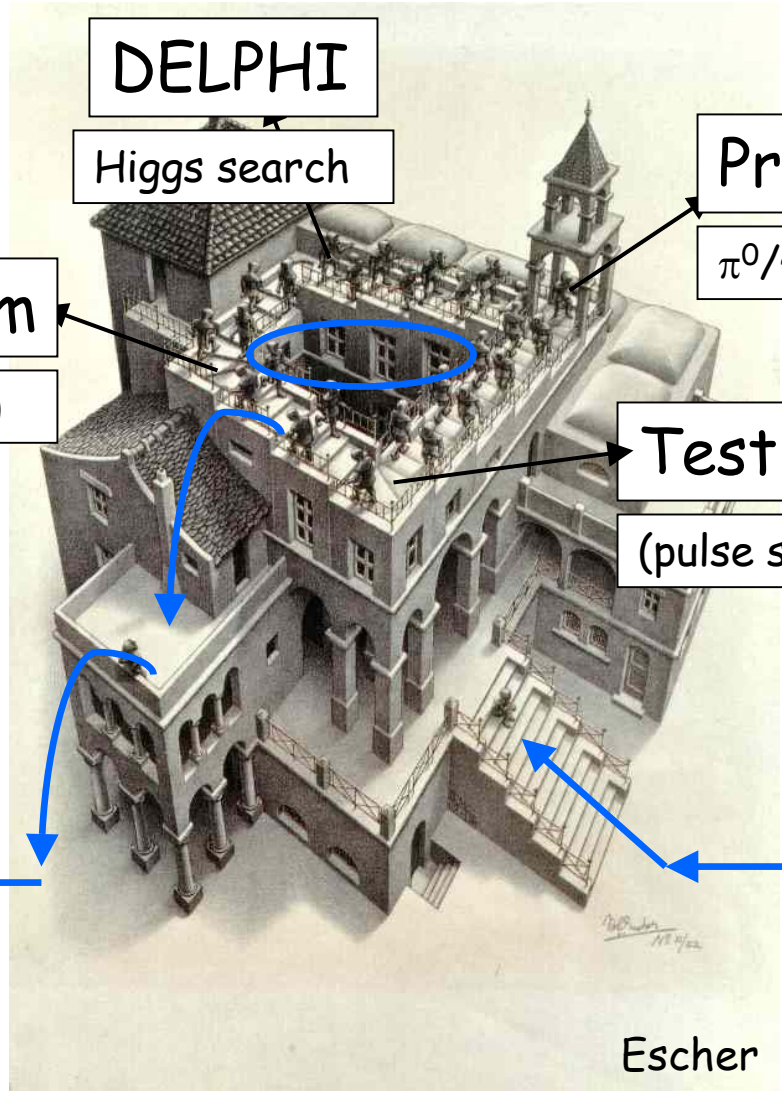
π^0/γ separation

Testbeam

(Calibration)

Testbeam

(pulse shape)



Rest of 2003

NIKHEF

What until 01-05-2004

ECAL Testbeam in H4

CMS Energyflow & physics analysis

Testbeam:

(finally at a stage where I can do some real analyses)

- Study in more detail the weights method

  How to correct for differences between crystals

  Prepare weights method: work with/build on/adapt from Pascal Paganini ('s work)

- Start a more serious and detailed analysis

  Intercalibration / small signal efficiencies

  → Impact on Clustering, Energy resolution, Energy flow

  Also try using simple 'MC' to understand specific issues

- Hopefully more interaction and openness within H4 community

  I'll try to do my part

Plans for 2003

Energy flow & physics analysis :

(finally in a place (I hope) where I can really learn & talk C++ and LHC physics)

- Start working (in a group) with set-up from Patrick & Melissa

  Lots to do, first improve C++ and work with WhiteBox.cxx

- Combine various sub-detectors & do 'full' physics analysis

  Physics groups will start up in near future … help building an analysis framework