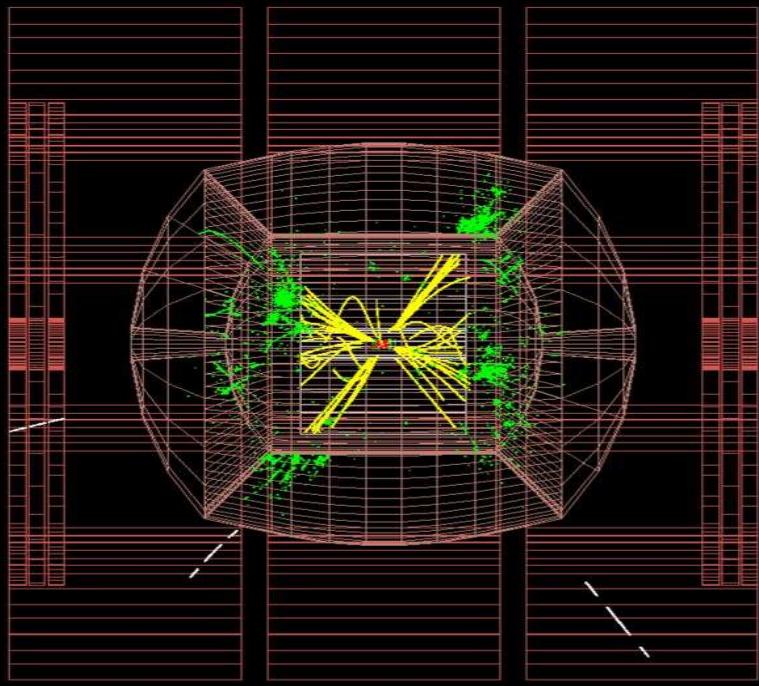


# Higgs Studies in the *4<sup>th</sup> Concept*



TILC09 - Corrado Gatto

Corrado Gatto  
INFN Napoli/Lecce  
On behalf of the  
4<sup>th</sup> Concept Collaboration

# 4<sup>th</sup> Concept Software Framework: ILCroot

- CERN architecture (based on Alice's Aliroot)
- Full support provided by Brun, Carminati, Ferrari, et al.
- Uses ROOT as infrastructure
  - All ROOT tools are available (I/O, graphics, PROOF, data structure, etc)
  - Extremely large community of users/developers
- TGenerator for events generation
- Virtual Geometry Modeler (VGM) for geometry
- Virtual Montecarlo for particle transport
- Growing number of experiments have adopted it: Alice (LHC), Opera (LNGS), (Meg), CMB (GSI), Panda(GSI), 4th Concept, LHeC and the forthcoming International Dual Readout Collaboration
- Six MDC have proven robustness, reliability and portability

# From Bangalore to Now: Detectors in ILCroot

- **4th Concept Baseline**
  - VTX: from SiD scaled to 3.5 Tesla (original version)
  - Drift Chamber: 2<sup>nd</sup> version
  - Fiber Triple Readout Calorimeter: 3° version
  - Muon Spectrometer: Original version
- **New additions:**
  - Crystal Triple Readout Calorimeter      ← Included into the Lol
  - FTD (from SiLC)                          ← Did not make it into the Lol
- **Also available**
  - VTX Detectors: Original SiD
  - Central Trackers: TPC, Si-Strips (SID01), SPT (Pixel Tracker)
- **Total: 10 subdetectors (16 versions), most of them with full simulation**

# The Virtual Montecarlo Concept

- Virtual MC provides a virtual interface to Monte Carlo
- It allows to run the same user application with all supported Monte Carlo programs
- The concrete Monte Carlo (Geant3, Geant4, Fluka) is selected and loaded at run time
  - Compare Montecarlo performance and possible flows
  - Choose the optimal Montecarlo for the study



April 18th, 2009

Perfect Tool for Designing/Optimizing new Detectors

# Physics Studies in the 4th Concept

- Detector simulation frozen in July 2008 (except Ecal). Simu & Reco started August 2008
- Several event samples used:
  - 4th Concept (Pandora-Pythia, Whizard, Evtgen, etc,..)
  - ILD sample for LOI (many thanks to Frank and Akiya)
  - KEK sample
- Fluka and Geant4 (through VMC)
- Not only ILCroot: MarlinKinFit & Rave
- 99% computing resources are from Fermilab
- ILCroot is freely available at Fermilab

<http://ilc.fnal.gov/detector/rd/physics/technical/resources/ilcroot.shtml>

# Processing Flow

Simu sig

hits files sig

Simu bkg 1

hits files bkg 1

Simu bkg 2

hits files bkg 2

SDigitizer

SDigits files sig

SDigitizer

SDigits files bkg

SDigitizer

SDigits files bkg

Digitizer

Merged Digits files

Reconstruct

ESD

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All detectors are fully simulated (except gaussian smearing of hits in the Muon Spectrometer):

VMC

# Reconstruction

Clusterizer

RecPoints files

Track Finder

RecParticles files

Track Fitter

ESD

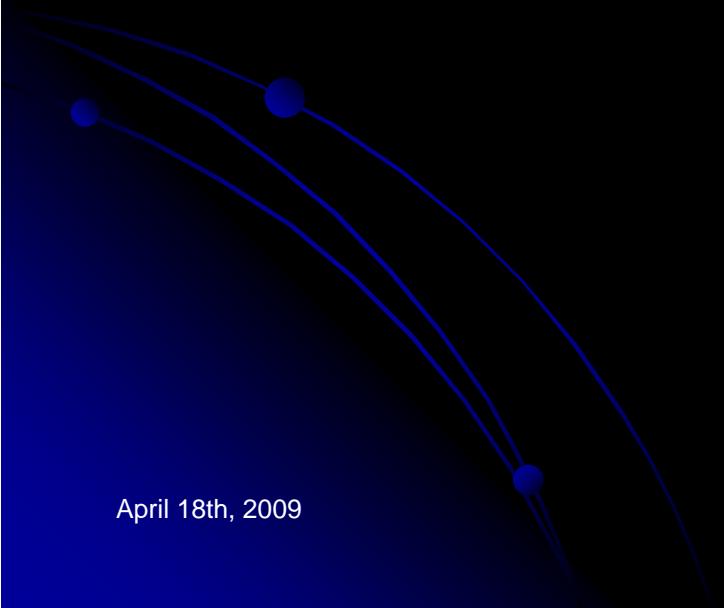
Local tasks

Global tasks

Local tasks

Steer

# Recoil mass analyses



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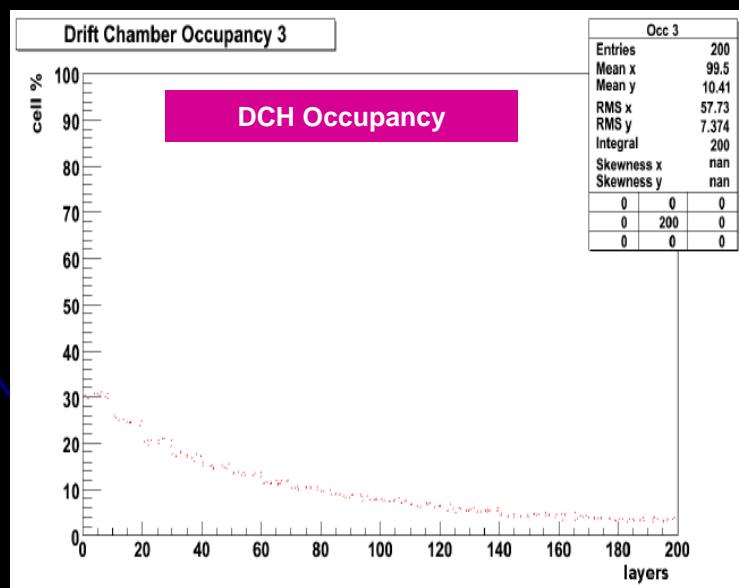
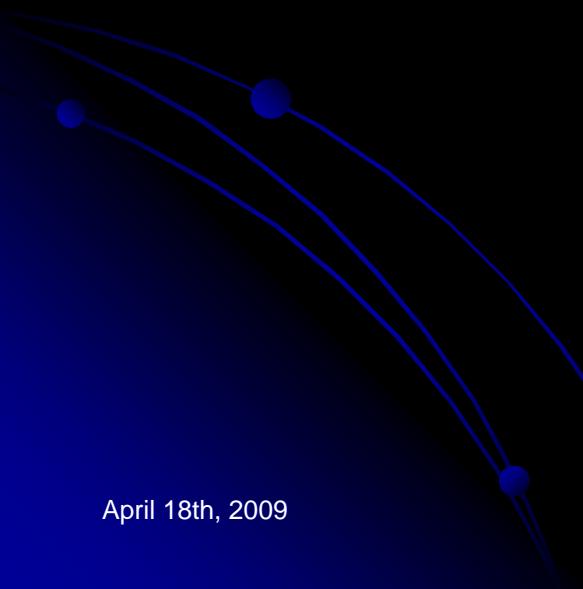
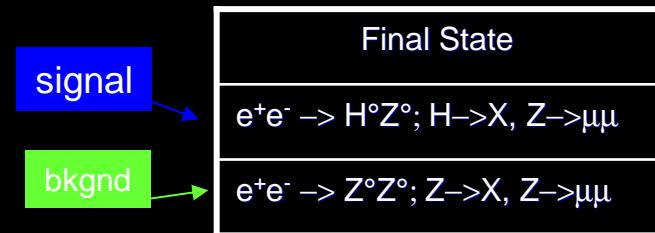
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# $e^+e^- \rightarrow Z^0H^0 \rightarrow \mu^+\mu^- X$ $\sqrt{s}=250$ GeV

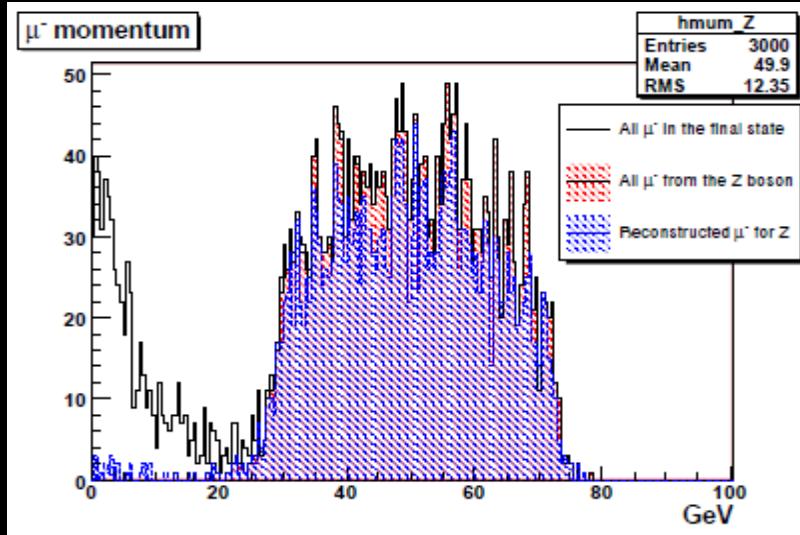
## Older Analysis

- KEK event sample for signal and SM background
- ISR and beam spread (0.25%) included
- 80%  $e^-$  polarization, +30%  $e^+$  polarization
- Add GuineaPig events at digitization step (1BX for DCH and 10BX for VTX)
- Geant4 for particle transport of signal events
- Geant4 for particle transport of beam background events
- No calorimetry used



# $e^+e^- \rightarrow Z^0 H^0 \rightarrow \mu^+ \mu^- X$ $\sqrt{s}=250$ GeV

## Older Analysis



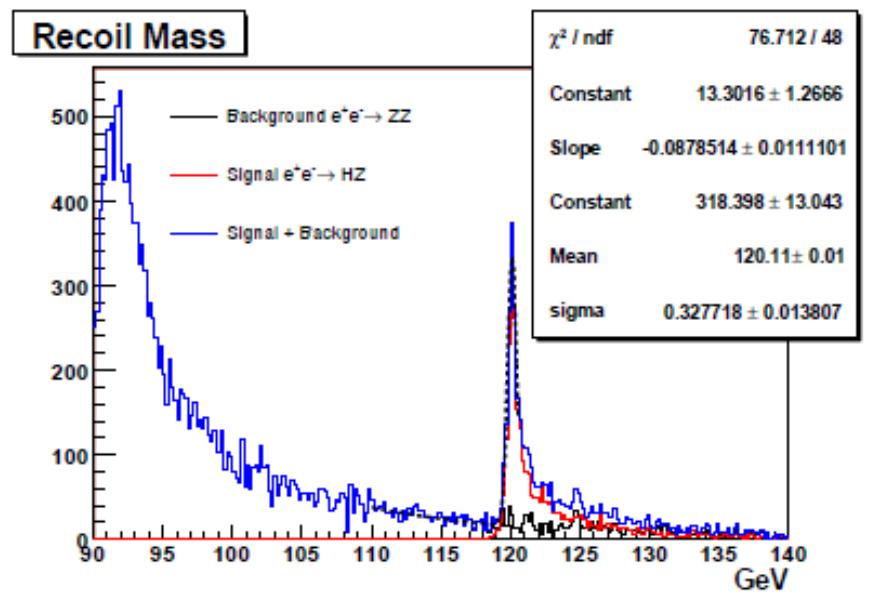
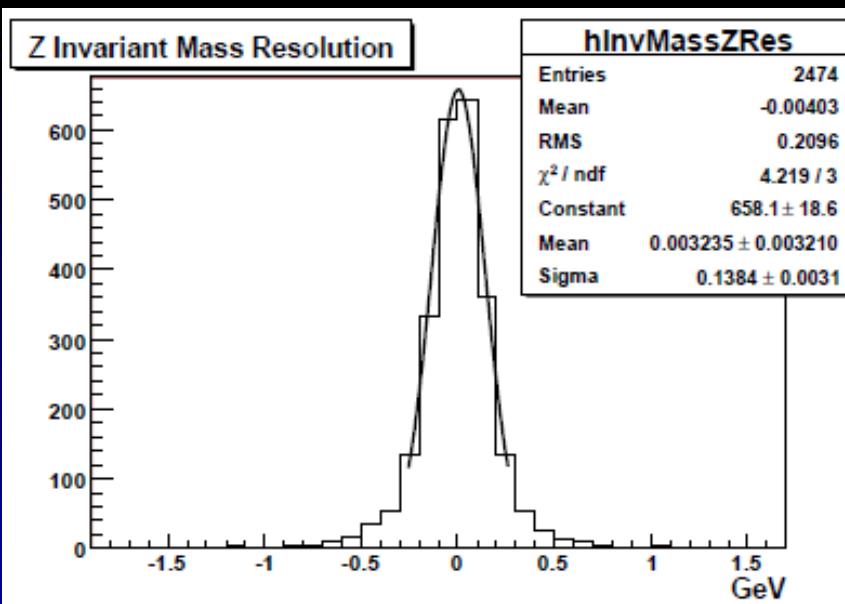
## Results

$$M_{Higgs} = 120.11 \pm 0.01 MeV/c^2$$

$$\sigma_{Higgs} = 328 \pm 0.01 MeV/c^2$$

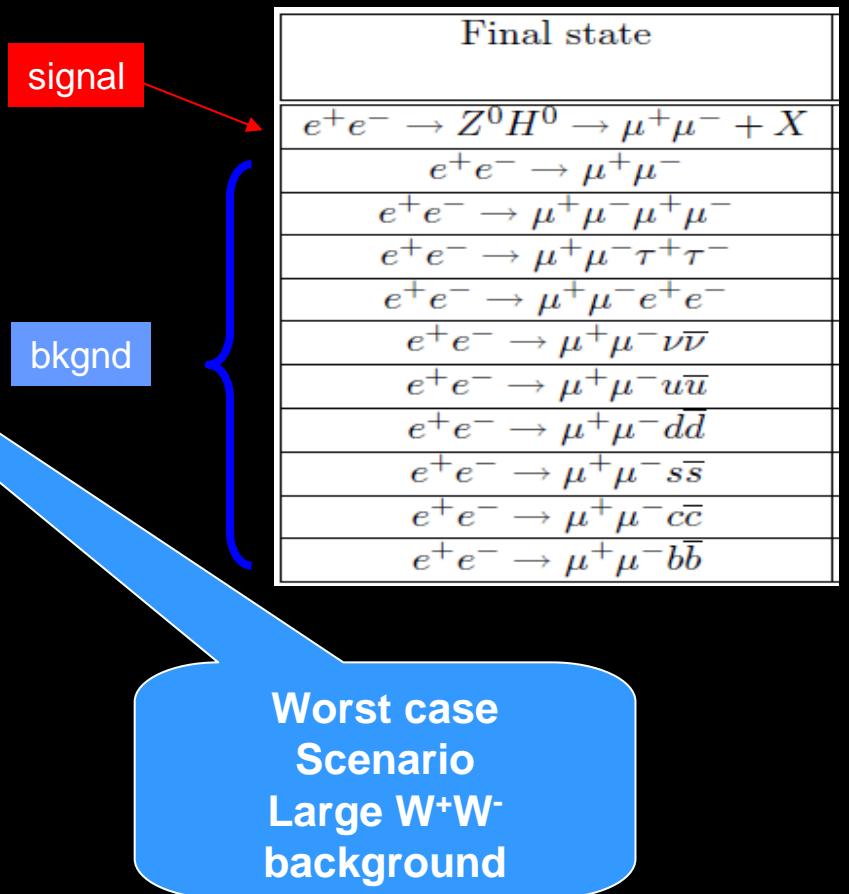
$$\Delta M_{Z^0}^{stat} = 138 MeV/c^2 \quad \Delta M_{Z^0}^{syst} = 3 MeV/c^2$$

$$\epsilon_{reconstruction} = 72.8\%$$



# $e^+e^- \rightarrow Z^0H^0 \rightarrow \mu^+\mu^- X$ $\sqrt{s}=250$ GeV from LOI

- ILD event sample for signal and SM background
- ISR and beam spread (0.3%) included
- +100%  $e^-$  polarization, -100%  $e^+$  polarization
- Add GuineaPig events at digitization step (1BX for DCH and 10DX for VTX)
- Fluka for particle transport of signal events
- Geant4 for particle transport of beam background events
- ECAL+HCAL with implementation of Triple Readout



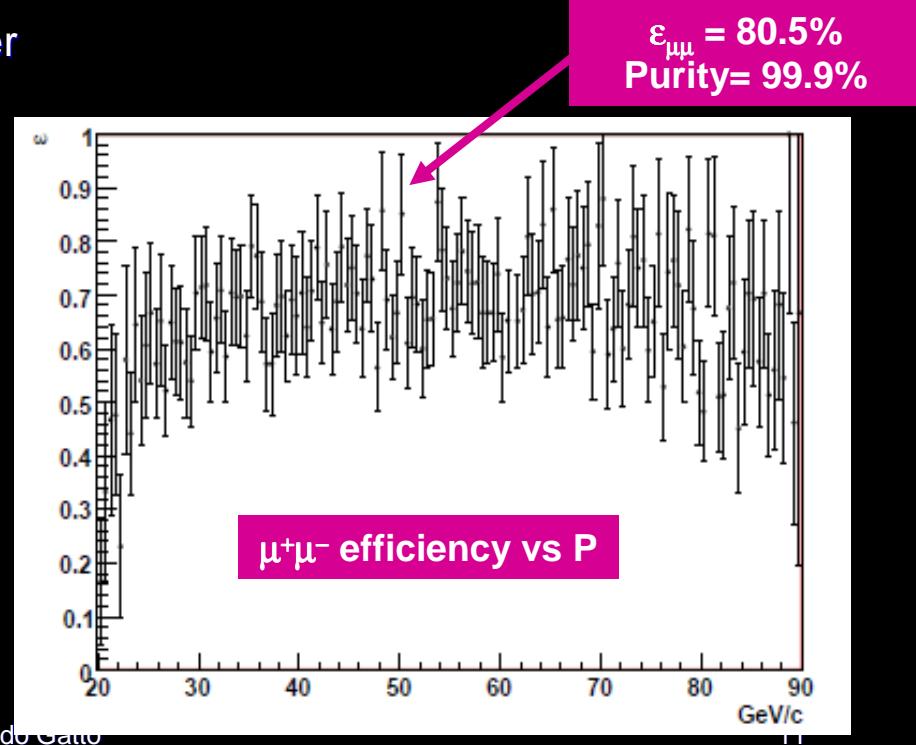
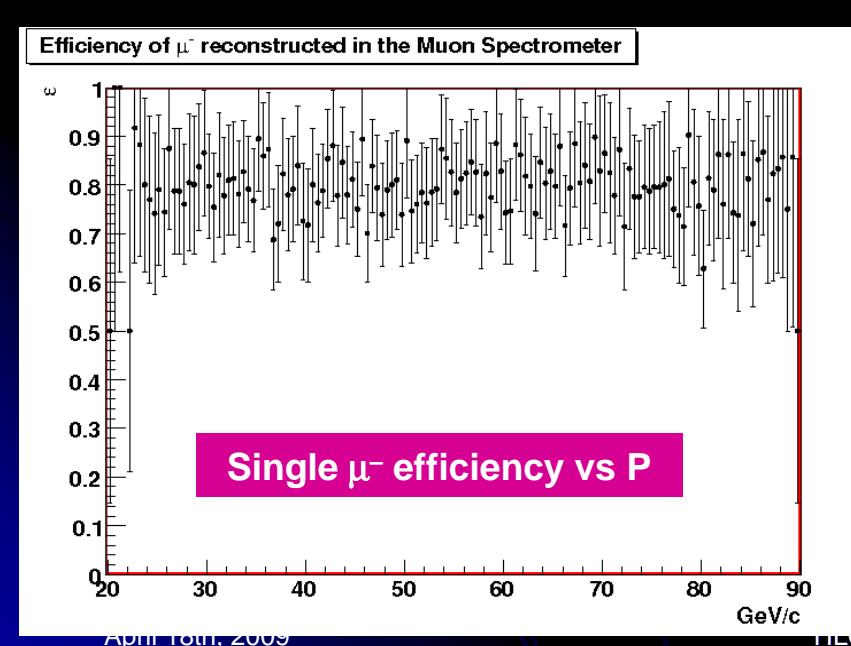
$$e^+ e^- \rightarrow Z^0 H^0 \rightarrow \mu^+ \mu^- \times \sqrt{s}=250 \text{ GeV}$$

### *Analysis strategy*

#### 1. Initial cuts to reduce background

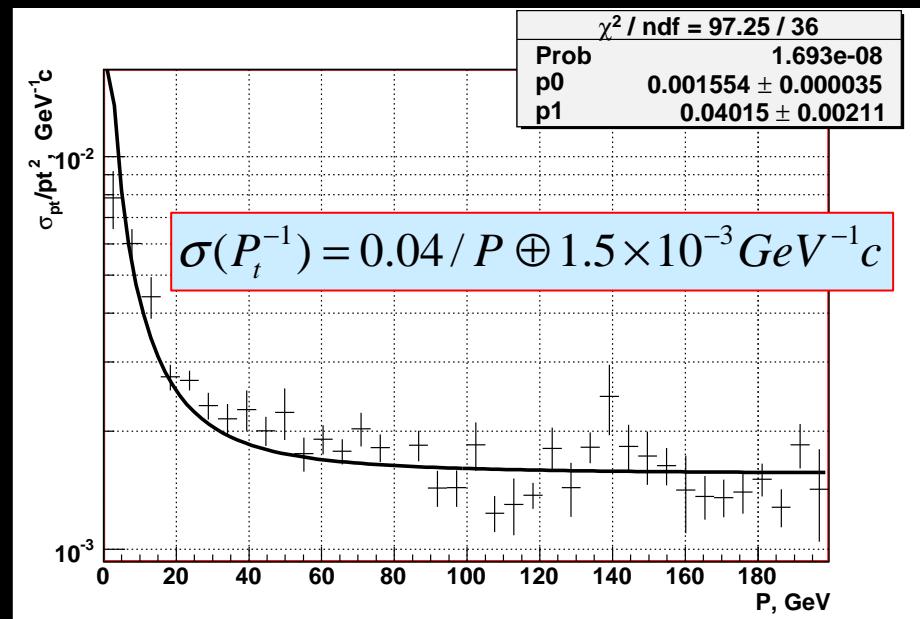
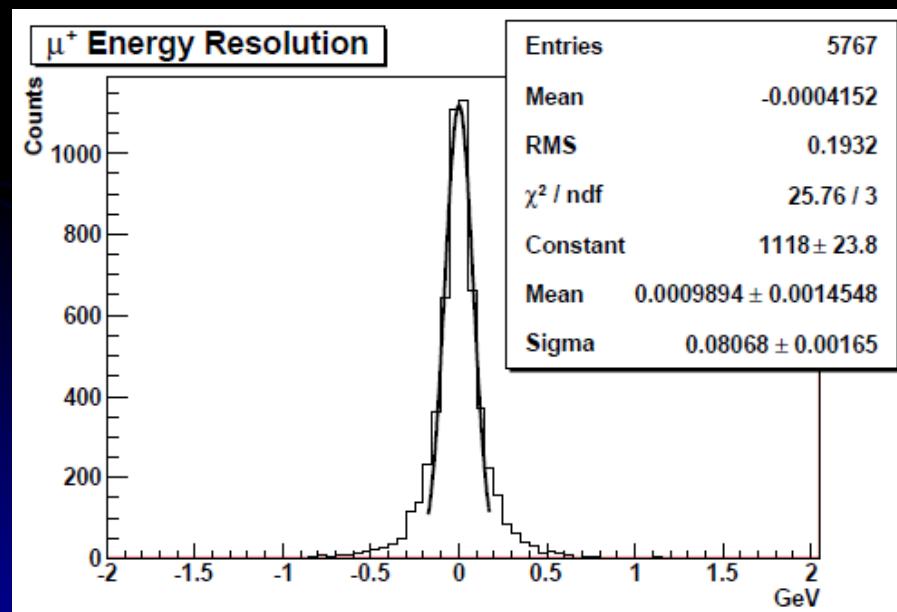
- 1.  $|\cos\theta_\mu| < 0.98$
- 2.  $P_t(\mu^\pm) > 9 \text{ GeV}$
- 3.  $72 < M(\mu^+\mu^-) < 110 \text{ GeV}$
- 4.  $102 < M_{recoil}(\mu^+\mu^-) < 168 \text{ GeV}$
- 5. At least 4 charged tracks for the

#### 2. Require two tracks in the Muon Spectrometer



$e^+e^- \rightarrow Z^0H^0 \rightarrow \mu^+\mu^- X$   $\sqrt{s}=250$  GeV

### Resolution of Muon Spectrometer



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$$e^+ e^- \rightarrow Z^0 H^0 \rightarrow \mu^+ \mu^- \times \sqrt{s}=250 \text{ GeV}$$

### Final cuts for S/N enhancement

1. largest  $P_\mu > 20 \text{ GeV}$
2. At least 5 charged tracks successfully reconstructed (including the muons)
3. Distance of closest approach to the origin for the candidate muon tracks  $< 6 \text{ mm}$ .

## Results

$$\Delta M_{Higgs}^{stat} = 296 \text{ MeV}/c^2 \quad \Delta M_{Higgs}^{syst} = 31 \text{ MeV}/c^2$$

$$\Delta M_{Z^0}^{stat} = 171 \text{ MeV}/c^2 \quad \Delta M_{Z^0}^{syst} = 40 \text{ MeV}/c^2$$

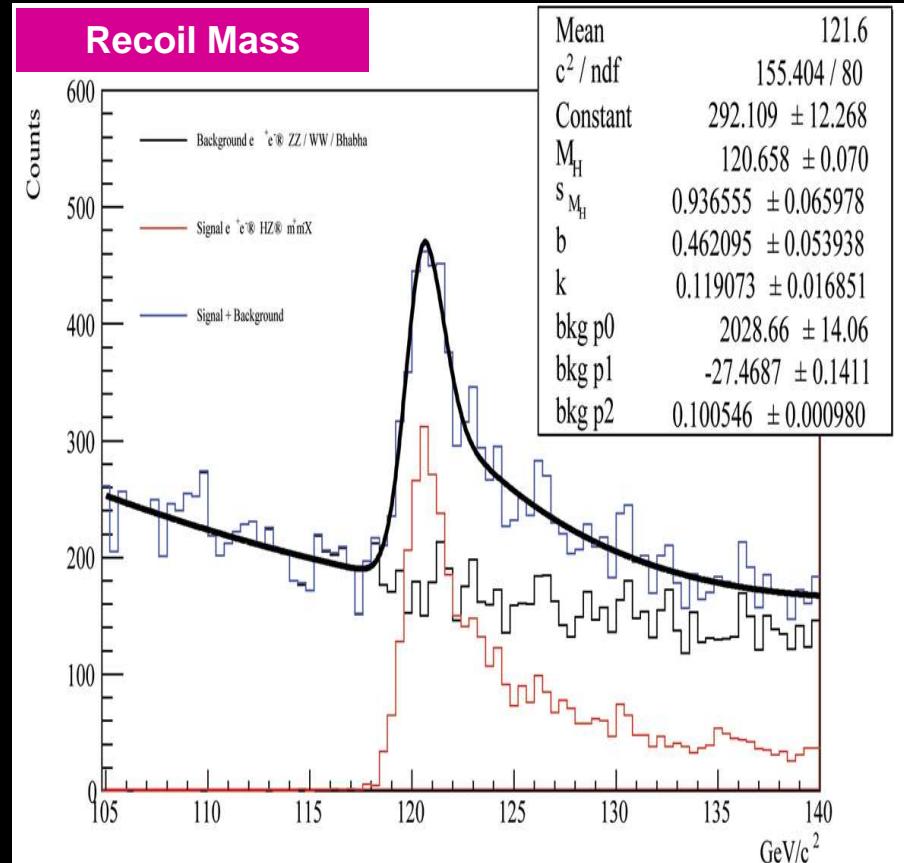
$$\sigma_{e^+ e^- \rightarrow Z^0 H^0} = 13.62 \pm 0.77 \text{ fb}$$

$$\epsilon_{\text{reconstruction}} = 64.1\%$$

$$(\Delta\sigma)^2 = \left( \sigma_{ZH} + \frac{\sigma_{back}}{\epsilon_{sel}} \right)^2 \times \left( \frac{1}{N_S} + \frac{(\Delta L)^2}{L^2} \right)$$

where:

- $N_S$  is the number of events in the final sample
- $L$  is the luminosity
- $\epsilon_{sel}$  is the selection efficiency
- $\sigma_{back}$  is the cross section of the background



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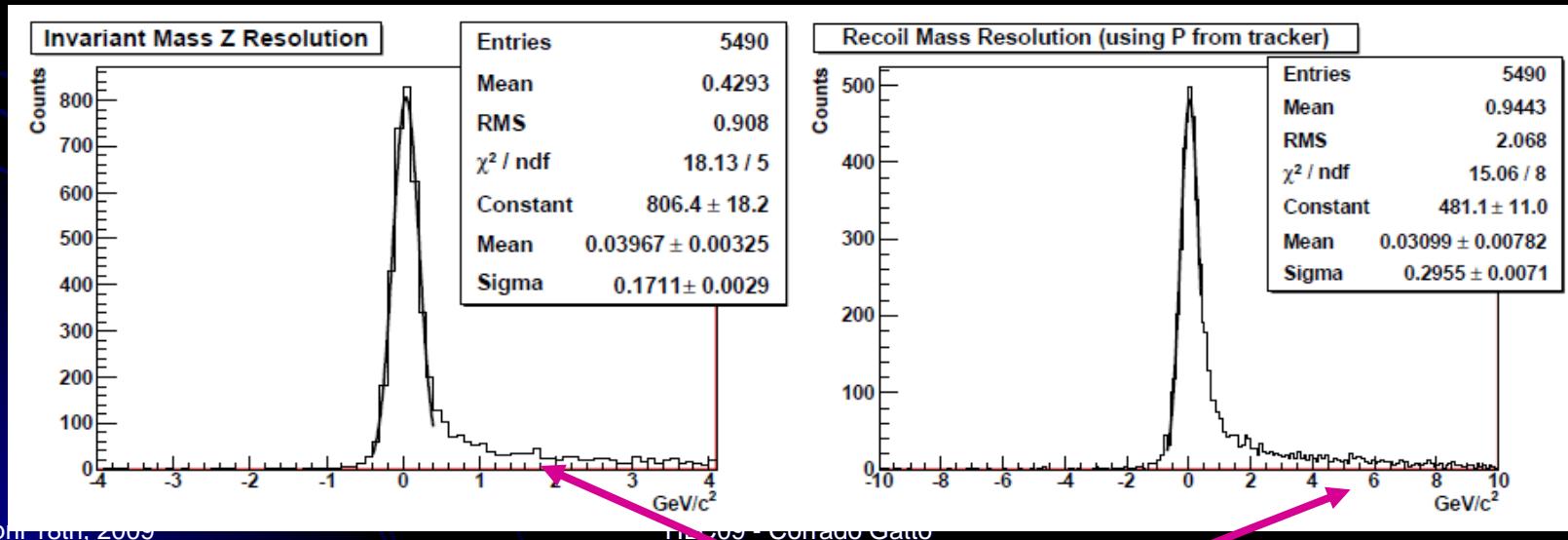
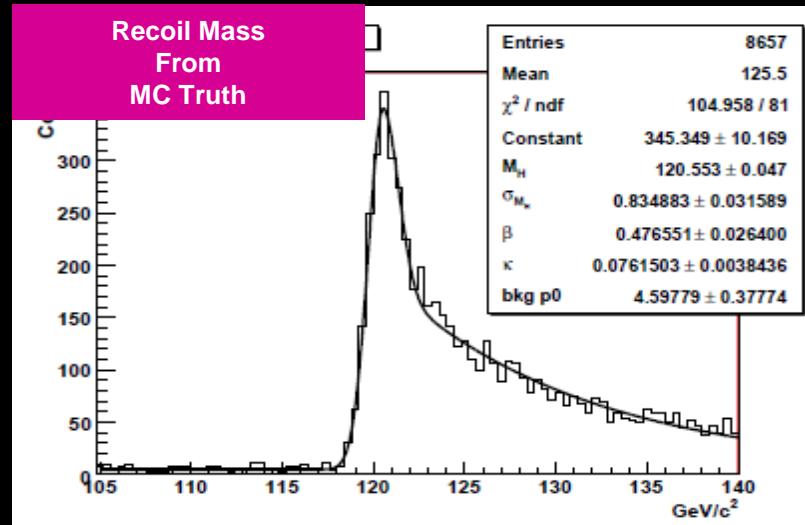
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$e^+e^- \rightarrow Z^0 H^0 \rightarrow \mu^+ \mu^- \times \sqrt{s}=250 \text{ GeV}$

## Resolutions

Results affected by  
 $M_\mu=0$   
 (and consequent  
 $\mu$  brehemstralung)



April 10th, 2009

HL-209 - Corrado Gallo

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# $e^+e^- \rightarrow Z^0H^0 \rightarrow e^+e^-X$ $\sqrt{s}=250\text{ GeV}$ from LOI

- ILD event sample for signal and SM background
- ISR and beam spread (0.3%) included
- +100%  $e^-$  polarization, -100%  $e^+$  polarization
- Add GuineaPig events at digitization step (1BX for DCH and 10DX for VTX)
- Fluka for particle transport of signal events
- Geant4 for particle transport of beam background events
- ECAL+HCAL with implementation of Triple Readout

Final state	
signal	$e^+e^- \rightarrow Z^0H^0 \rightarrow e^+e^- + X$
bkgnd	$e^+e^- \rightarrow e^+e^-$
	$e^+e^- \rightarrow e^+e^-e^+e^-$
	$e^+e^- \rightarrow e^+e^-\tau^+\tau^-$
	$e^+e^- \rightarrow e^+e^-\mu^+\mu^-$
	$e^+e^- \rightarrow e^+e^-\nu\nu$
	$e^+e^- \rightarrow e^+e^-u\bar{u}$
	$e^+e^- \rightarrow e^+e^-d\bar{d}$
	$e^+e^- \rightarrow e^+e^-s\bar{s}$
	$e^+e^- \rightarrow e^+e^-c\bar{c}$
	$e^+e^- \rightarrow e^+e^-b\bar{b}$

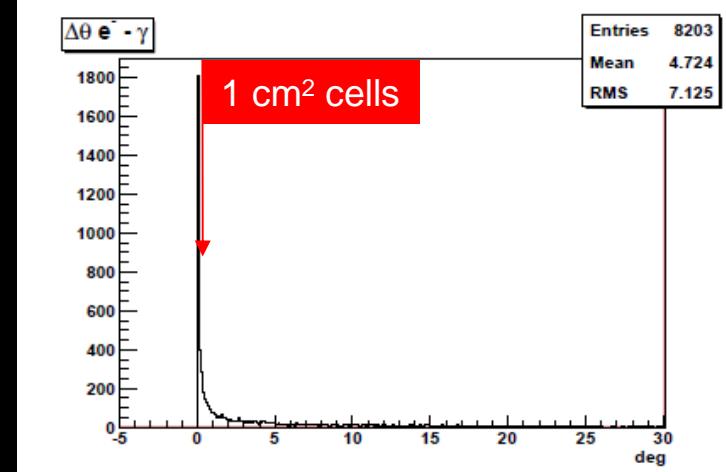
$e^+e^- \rightarrow Z^0H^0 \rightarrow e^+ e^- X$   $\sqrt{s}=250$  GeV

## *ECAL is crucial in this analysis*

1. We first extrapolate the candidate electron track to the electromagnetic calorimeter and look for an associate shower
2. The energy of this shower must be consistent with the momentum of the track measured by the tracking system
3. If the match is poor, we extrapolate the shower axis into the hadronic calorimeter. If an energy deposit is found, it must be smaller than 20% of the corresponding energy measured in the electromagnetic calorimeter.
4. Finally, the Čerenkov and scintillation components of the shower must be consistent with an electron/photon hypothesis. More specifically, we require:

$$\frac{E_{Sc} - E_{Cer}}{E_{Sc} + E_{Cer}} < 6 \times \sigma_{calib}$$

where  $\sigma_{calib}$  corresponds to the width of this distribution.



e<sup>-</sup> energy resolution from VTX+DCH

Entries	6139
Mean	0.06859
RMS	0.3115
$\chi^2 / \text{ndf}$	21.9 / 3
Constant	$1039 \pm 22.9$
Mean	$0.00665 \pm 0.00154$
Sigma	$0.08161 \pm 0.00175$

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09 - Corrado C

e<sup>-</sup> energy resolution from VTX+DCH+ECAL

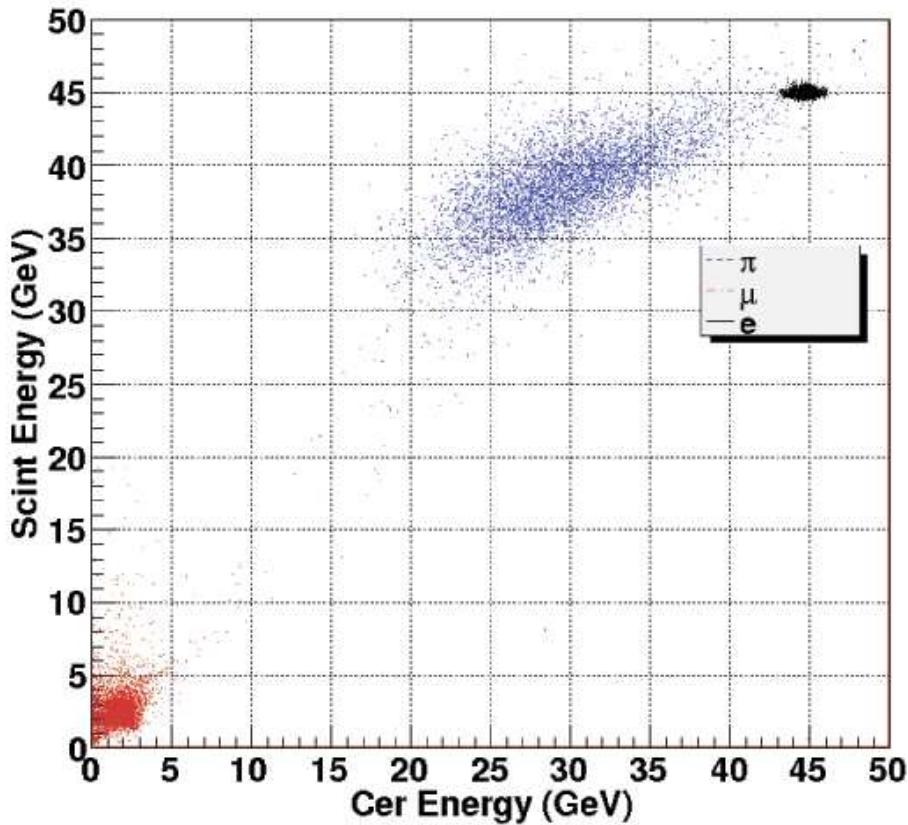
Entries	6419
Mean	-0.1532
RMS	0.4574
$\chi^2 / \text{ndf}$	56.28 / 11
Constant	$564.3 \pm 10.6$
Mean	$-0.1671 \pm 0.0033$
Sigma	$0.1889 \pm 0.0033$

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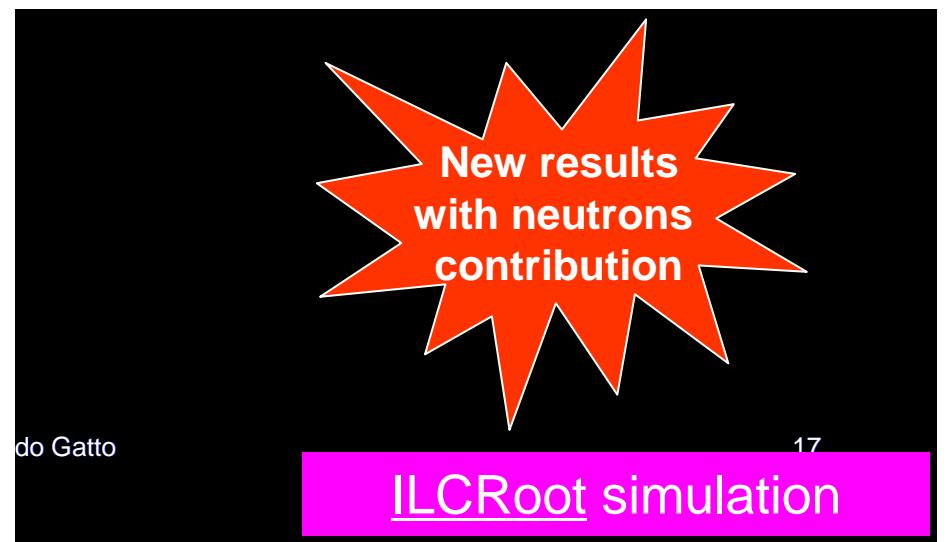
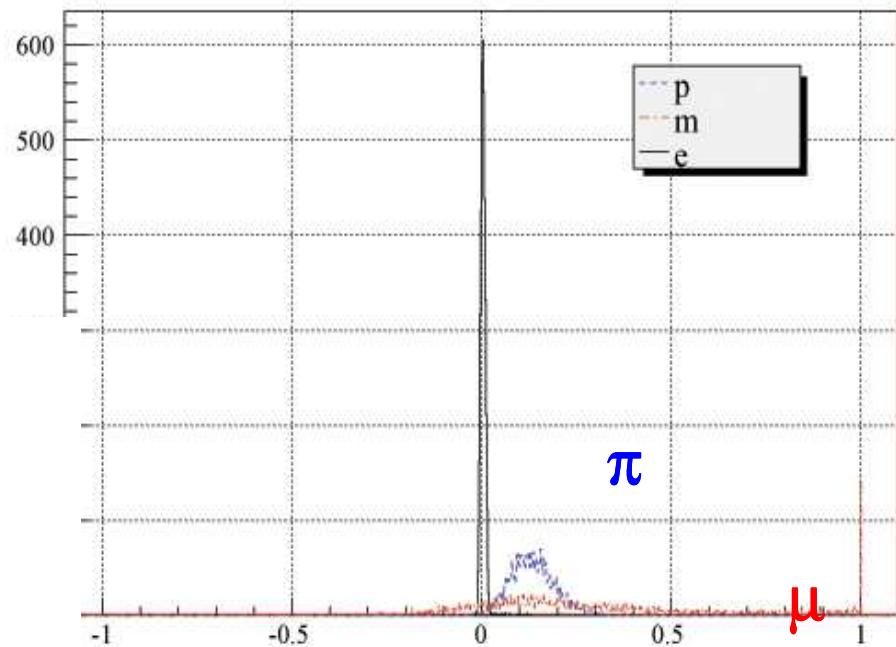
# Particle Identification with Triple Readout

- 45 GeV particles

Cer Energy vs Scint Energy



(S-C)/(S+C)



ILCRoot simulation

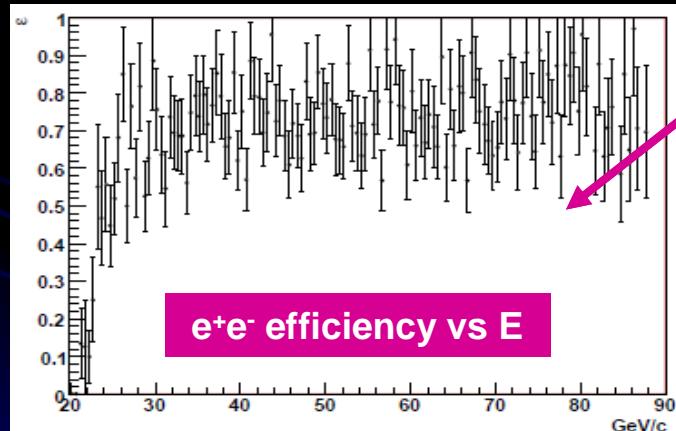
$$e^+ e^- \rightarrow Z^0 H^0 \rightarrow e^+ e^- X \sqrt{s}=250 \text{ GeV}$$

### *Analysis strategy*

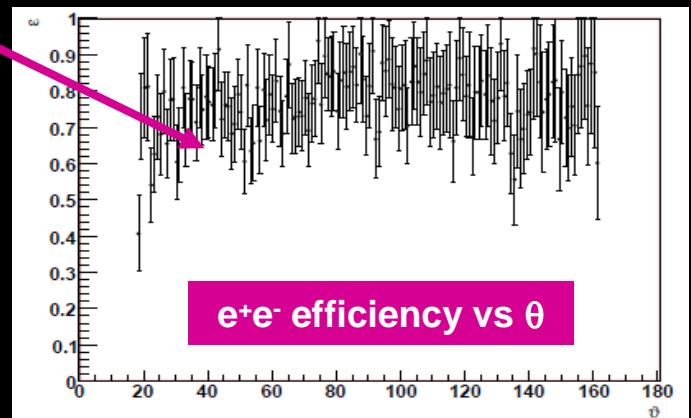
#### 1. Initial cuts to reduce background

- 1.  $|cos\theta_e| < 0.95$
- 2.  $P_t(e^\pm) > 9 \text{ GeV}$
- 3.  $72 < M(e^+e^-) < 110 \text{ GeV}/c^2$
- 4.  $102 < M_{recoil}(e^+e^-) < 168 \text{ GeV}/c^2$
- 5. At least 4 charged tracks for the  $e^+e^- \rightarrow e^+e^-$  montecarlo sample
- 6. At least 6 charged tracks for the  $e^+e^- \rightarrow e^+e^-\mu^+\mu^-$  montecarlo sample

#### 2. Require two electrons in the ECAL/DCH



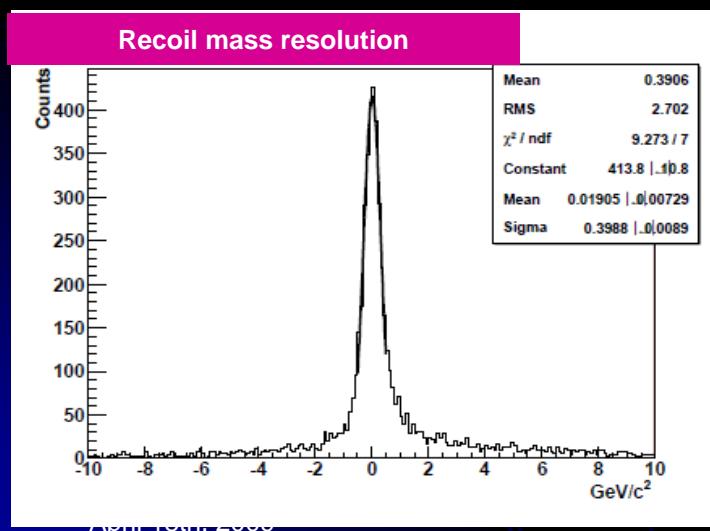
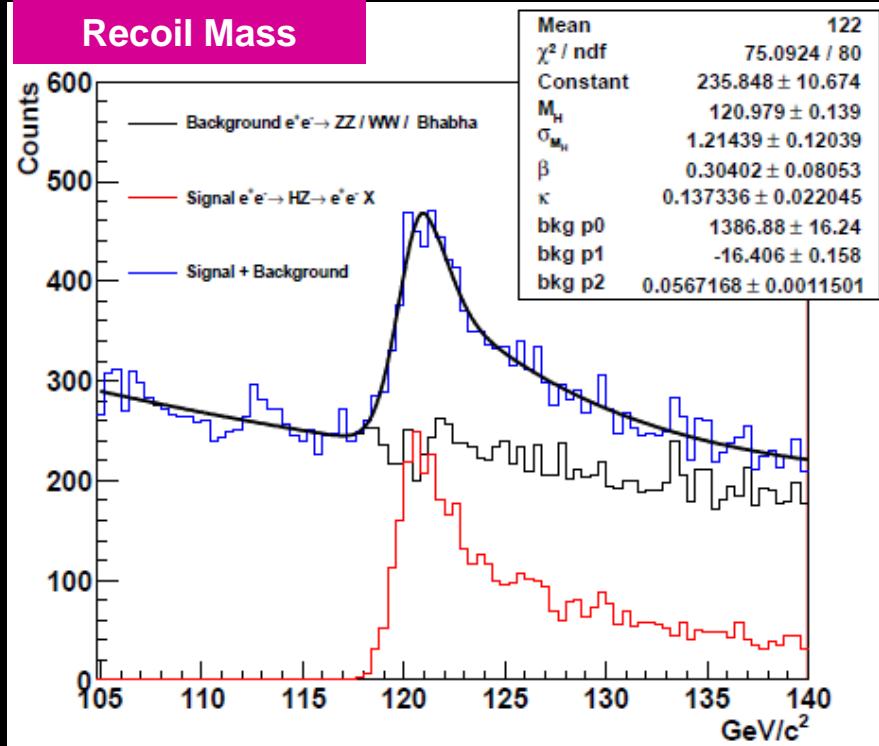
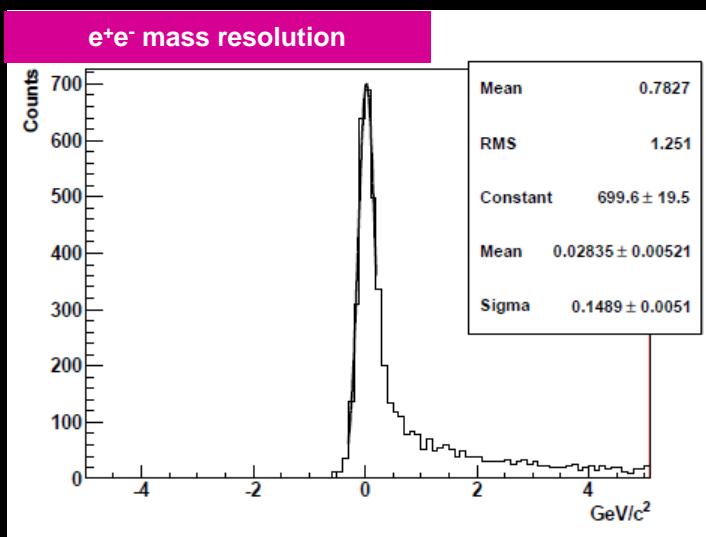
$\epsilon_{ee} = 93.4\%$   
Purity = 98.2%



#### 3. Final cuts for S/N enhancement

- 1. largest  $P_e > 20 \text{ GeV}$
- 2. At least 5 charged tracks successfully reconstructed
- 3. Distance of closest approach to the origin for the candidate electron tracks  $< 6 \text{ mm}$

# $e^+e^- \rightarrow Z^0H^0 \rightarrow e^+e^-X$ $\sqrt{s}=250$ GeV using VTX + DCH



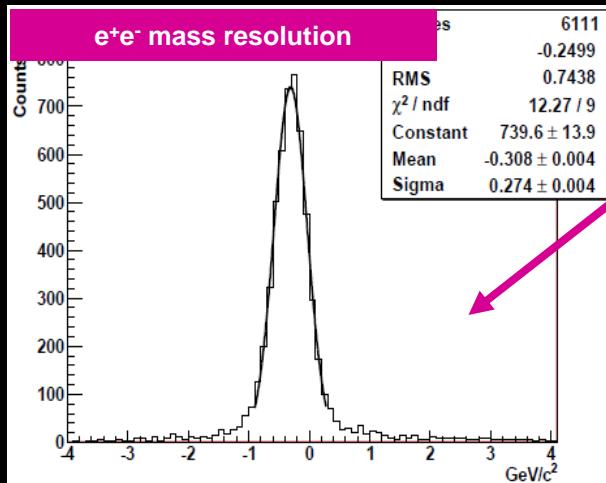
## Results

$$\begin{aligned} \Delta M_{\text{Higgs}}^{\text{stat}} &= 400 \text{ MeV}/c^2 & \Delta M_{\text{Higgs}}^{\text{syst}} &= 19 \text{ MeV}/c^2 \\ \Delta M_{Z^0}^{\text{stat}} &= 149 \text{ MeV}/c^2 & \Delta M_{Z^0}^{\text{syst}} &= 28 \text{ MeV}/c^2 \\ \sigma_{e^+e^- \rightarrow Z^0H^0} &= 15.08 \pm 0.76 \text{ fb} \\ \mathcal{E}_{\text{reconstruction}} &= 68.3\% \end{aligned}$$

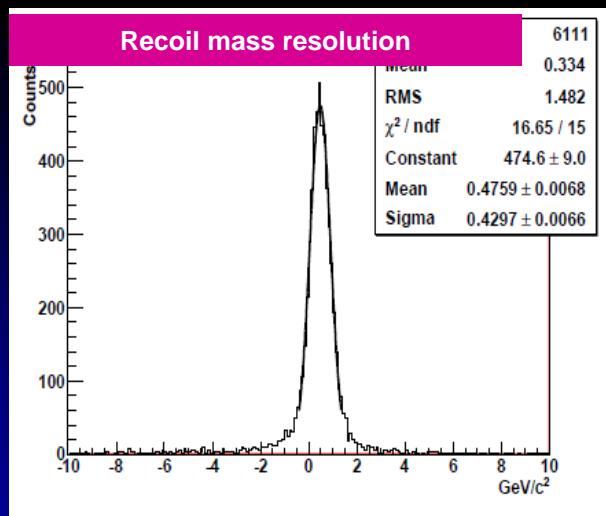
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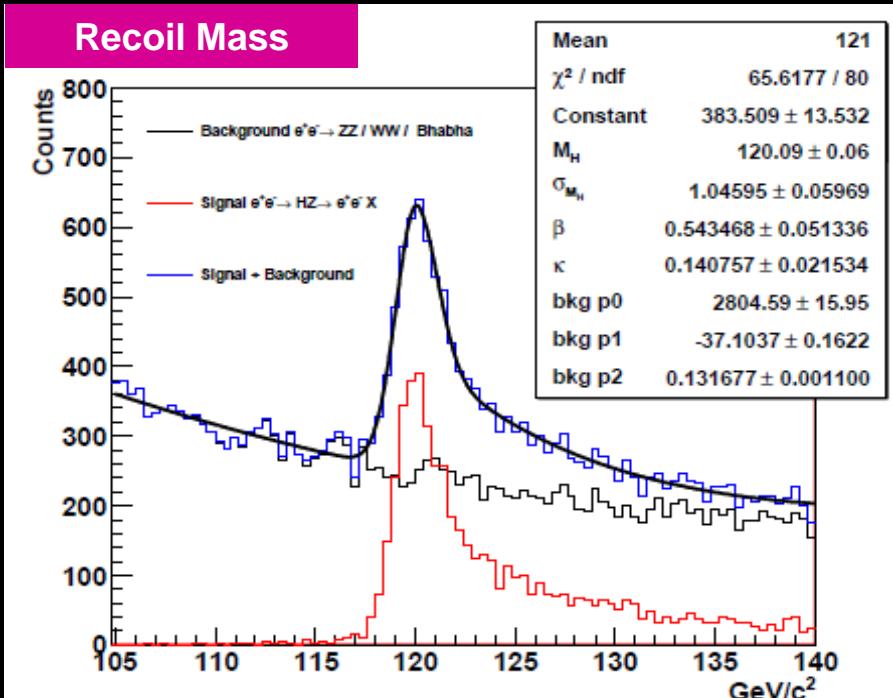
# $e^+e^- \rightarrow Z^0H^0 \rightarrow e^+e^- X$ $\sqrt{s}=250$ GeV using VTX + DCH + ECAL



Long tails  
disappear  
  
Mass shift  
appears



Need a better  
integration of  
the informations  
from tracking  
and  
calorimetry



## Results

$$\Delta M_{\text{Higgs}}^{\text{stat}} = 430 \text{ MeV} / c^2 \quad \Delta M_{\text{Higgs}}^{\text{syst}} = 476 \text{ MeV} / c^2$$

$$\Delta M_{Z^0}^{\text{stat}} = 274 \text{ MeV} / c^2 \quad \Delta M_{Z^0}^{\text{syst}} = 308 \text{ MeV} / c^2$$

$$\sigma_{e^+e^- \rightarrow Z^0H^0} = 16.30 \pm 0.85 \text{ fb}$$

$$\epsilon_{\text{reconstruction}} = 68.3\%$$

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# Jet analyses

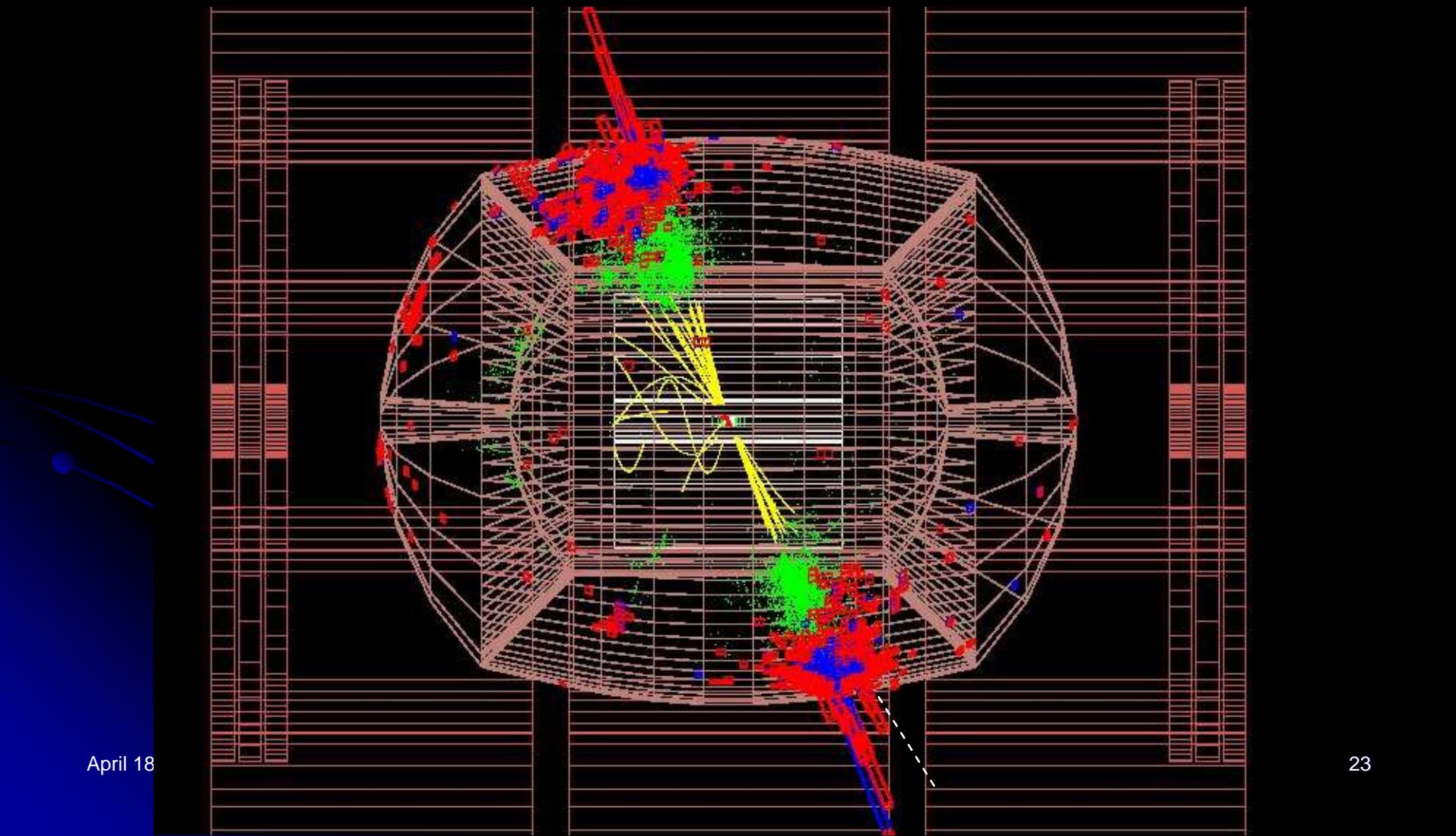
- ILD event sample for signal and SM background
- KEK for  $WWvv$  and  $ZZvv$  analysis
- ISR and beam spread (0.3%) included
- +100%  $e^-$  polarization, -100%  $e^+$  polarization
- No beam background
- Fluka for particle transport of signal events
- No ECAL

# Jet reconstruction: combine calorimetric and tracking informations

(work in progress)



# Jet Reconstruction Strategy



April 18

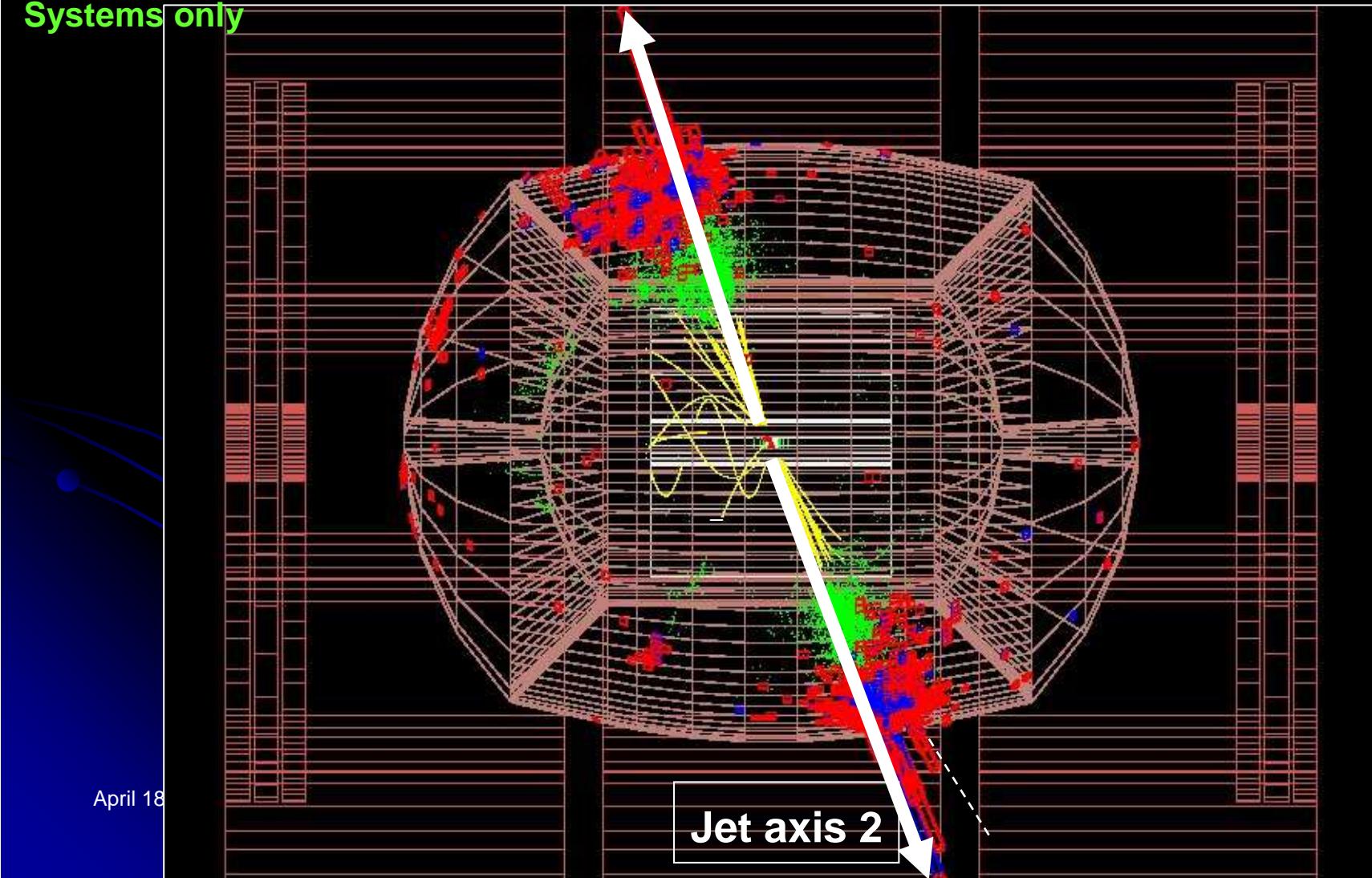
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# Jet Reconstruction Strategy

Use informations  
from tracking  
Systems only

Jet axis 1

Jet axis 2

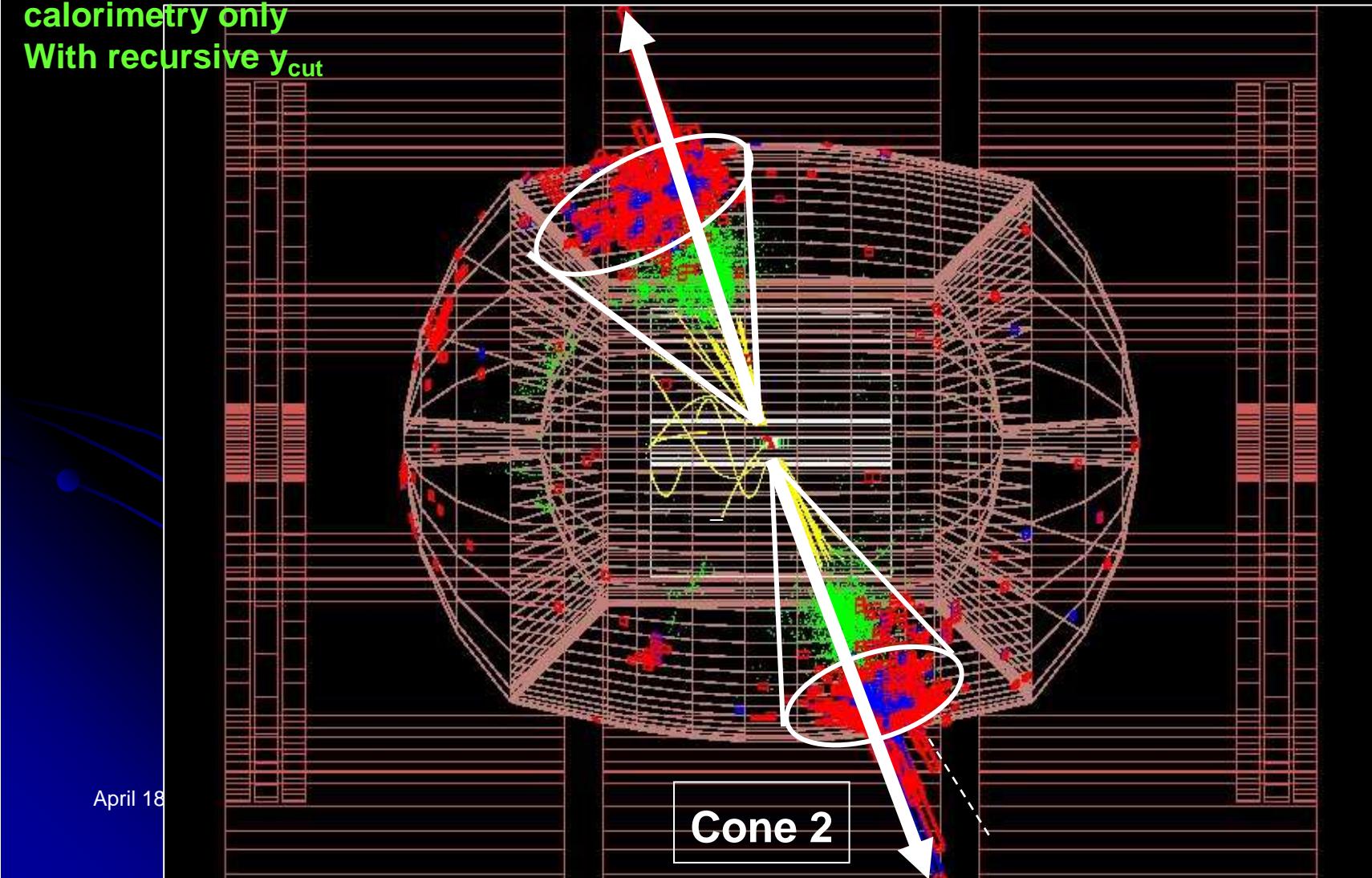


# Jet Reconstruction Strategy

Use informations  
from tracking  
calorimetry only  
With recursive  $y_{cut}$

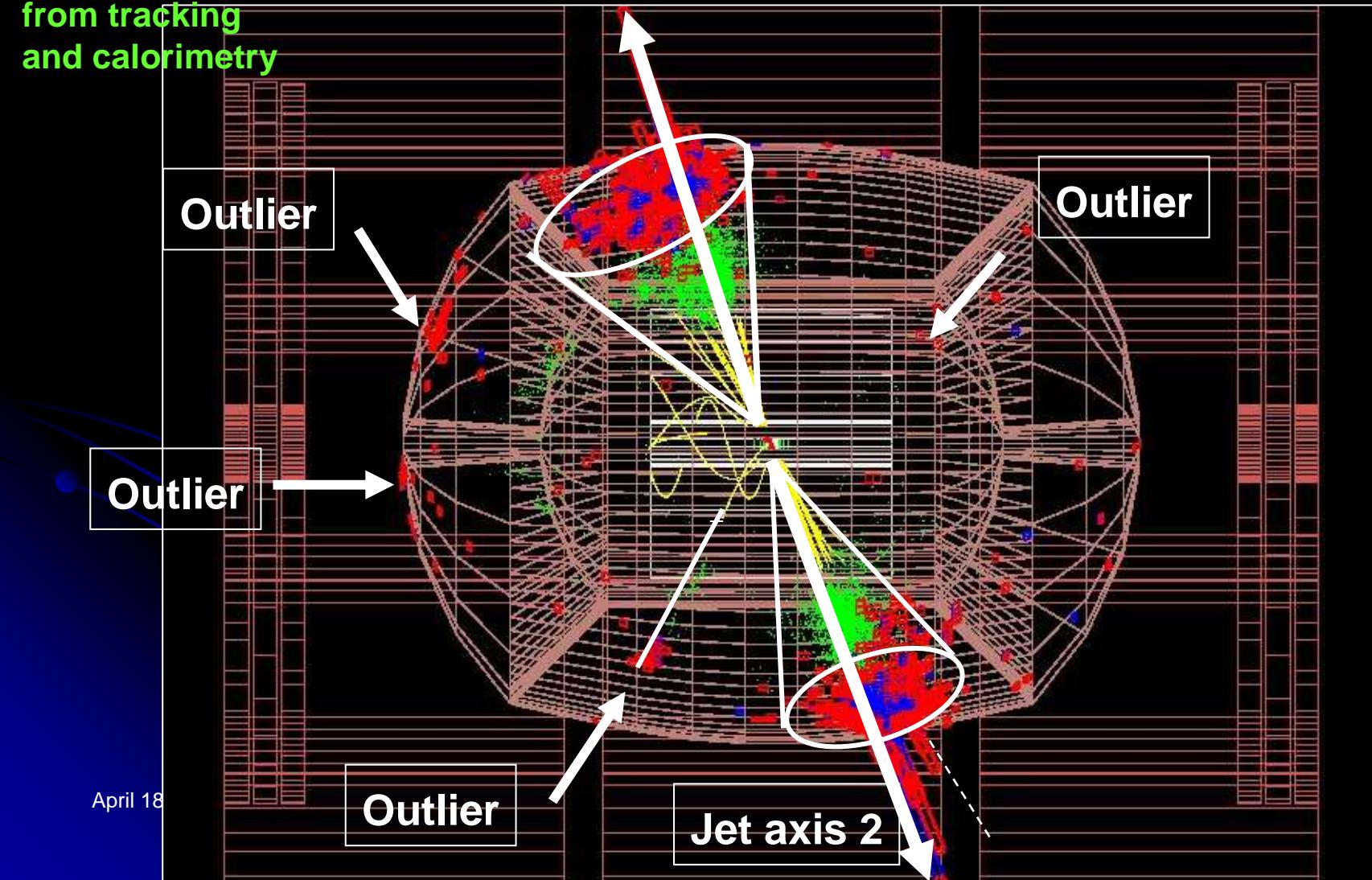
Cone 1

Cone 2



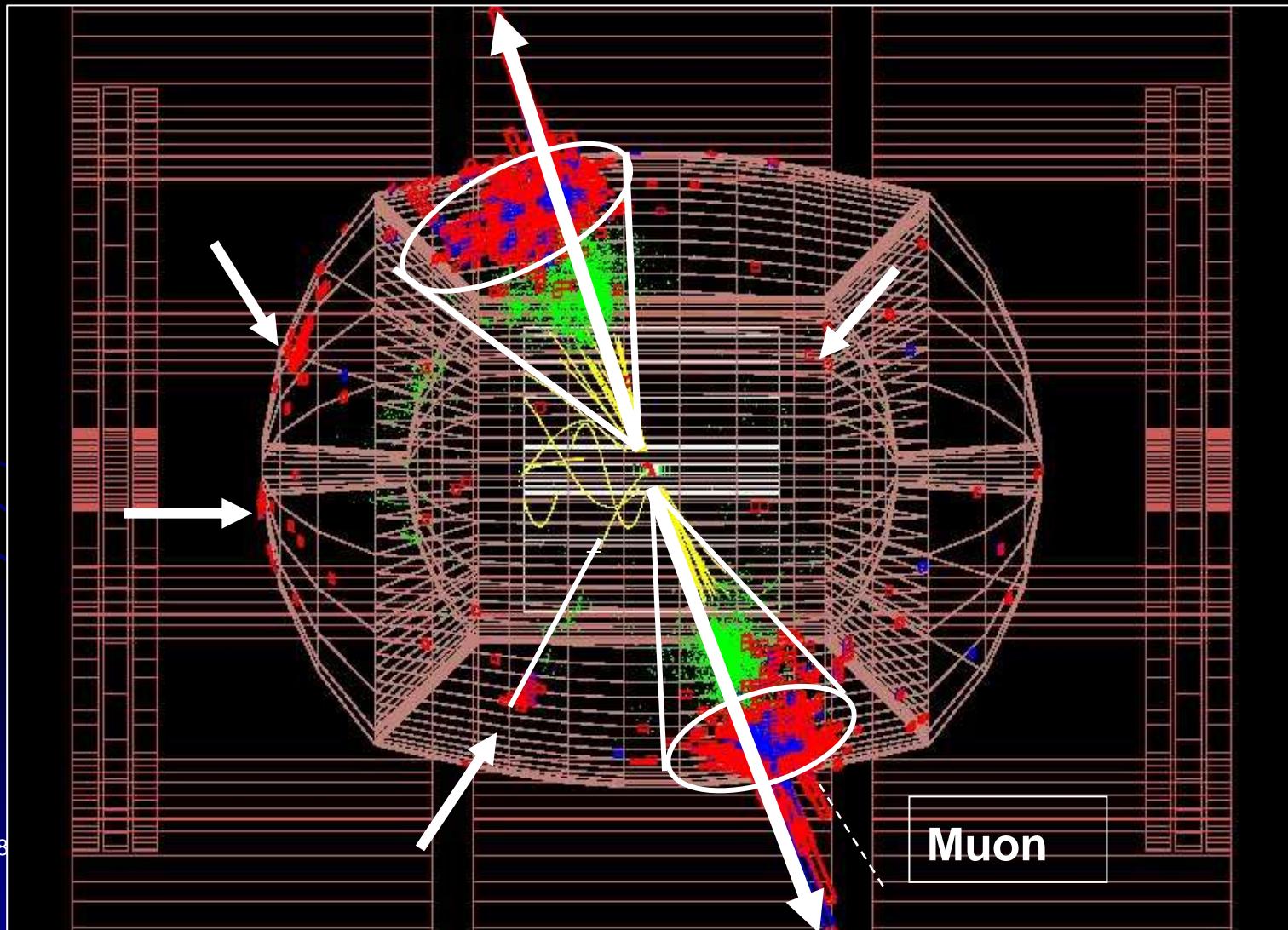
# Jet Reconstruction Strategy

Use combined  
informations  
from tracking  
and calorimetry



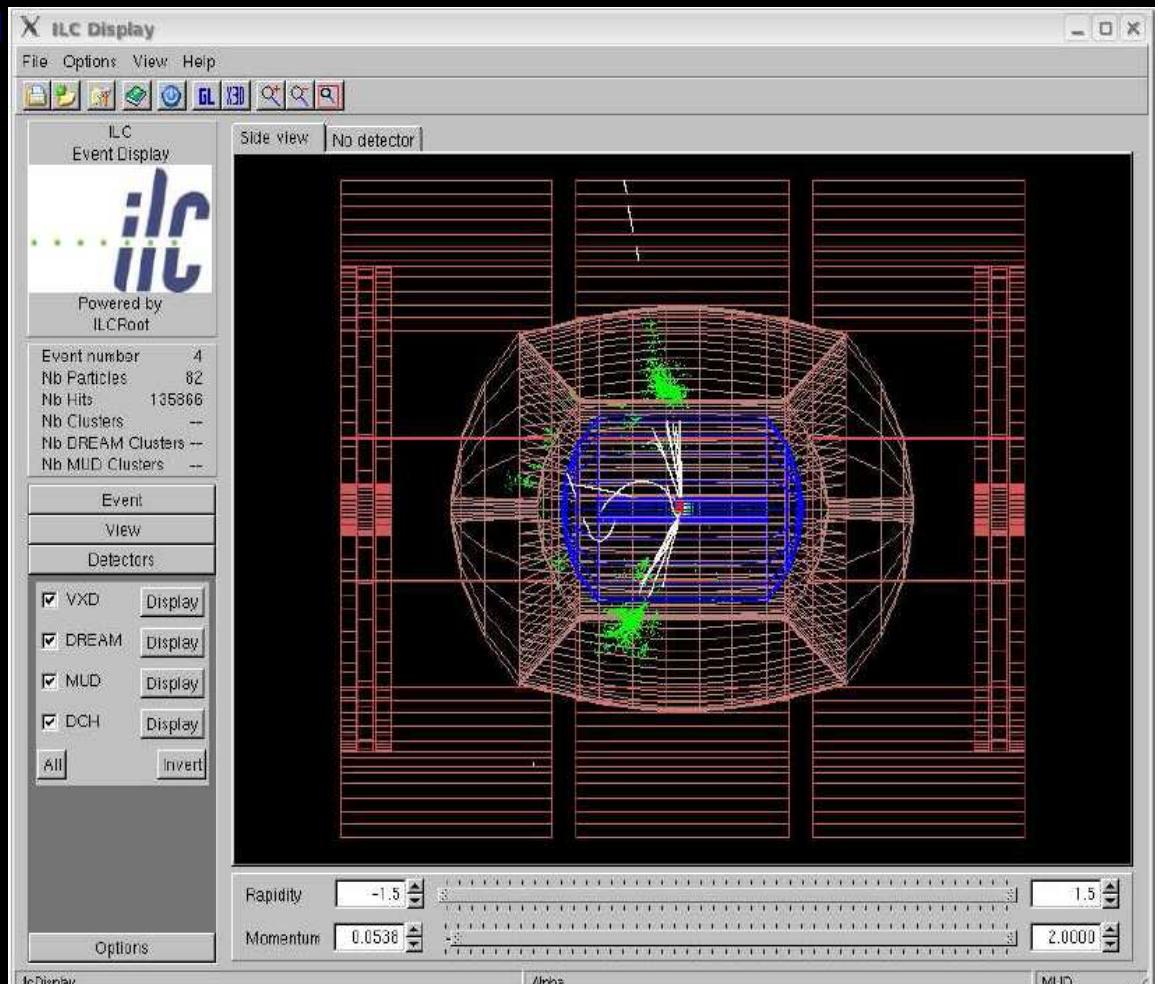
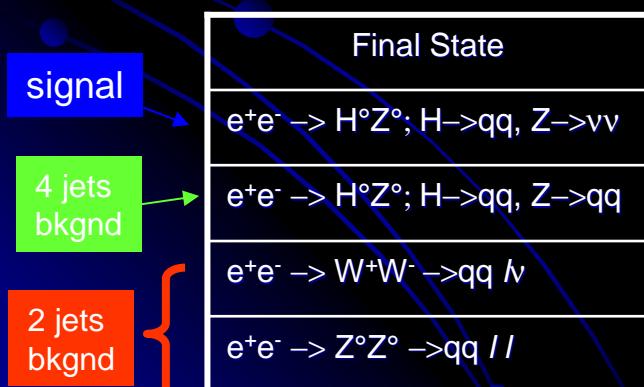
# Jet Reconstruction Strategy

Include muon  
spectrometer



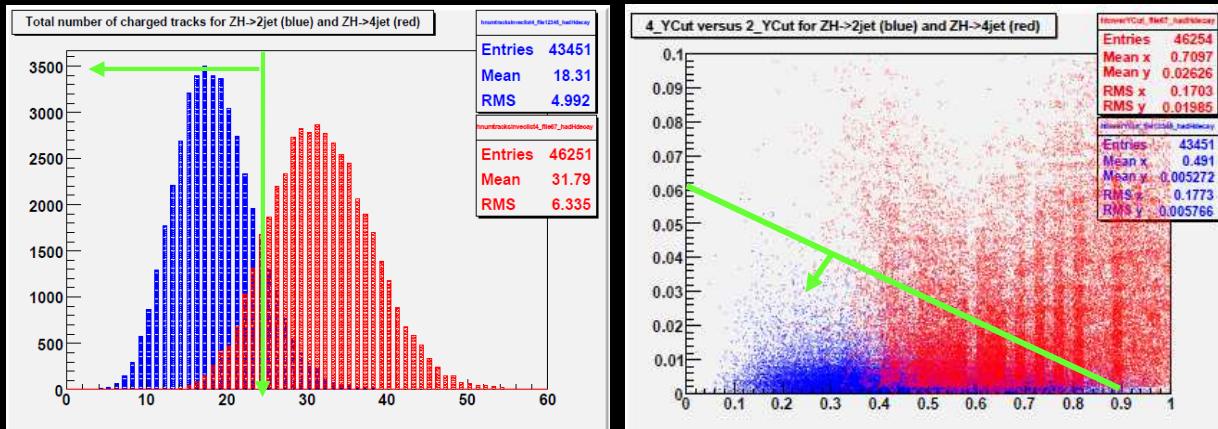
# $e^+e^- \rightarrow Z^0H^0 \rightarrow \nu\bar{\nu} X$ $\sqrt{s}=250$ GeV from LOI

- ILD event sample for signal and SM background
- ISR and beam spread (0.3%) included
- No Beam background
- Fluka for particle transport of signal events
- Only HCAL with implementation of Triple Readout (ECAL implemented later)

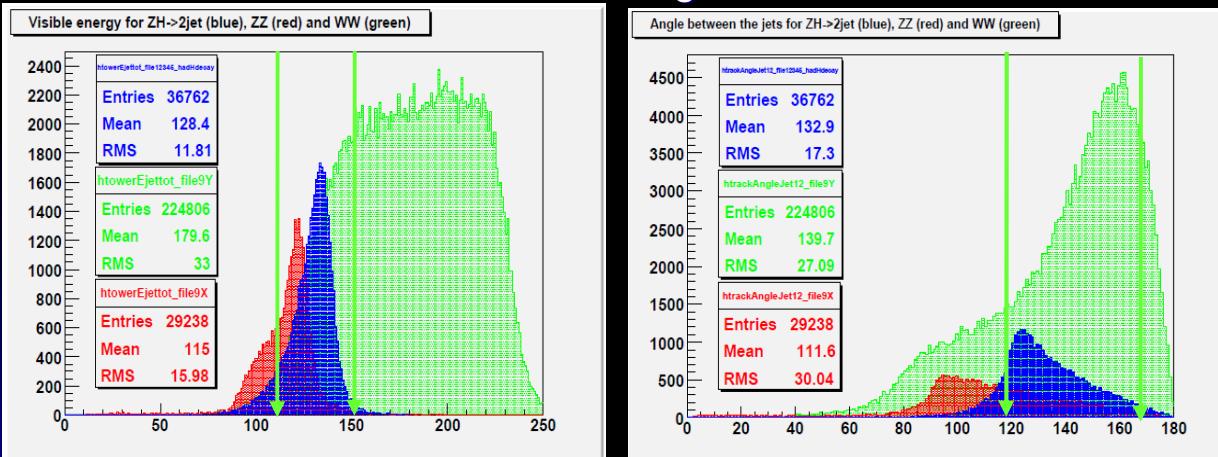


$$e^+e^- \rightarrow Z^0 H^0 \rightarrow \nu\bar{\nu} X \sqrt{s}=250 \text{ GeV}$$

## 1. Disentangle 2-jets from multi-jets events



## 2. Reduce ZZ and WW background



$e^+e^- \rightarrow H^0 Z^0 \rightarrow qq \nu\nu$   
+

$e^+e^- \rightarrow Z^0 Z^0 \rightarrow qq \nu\nu$

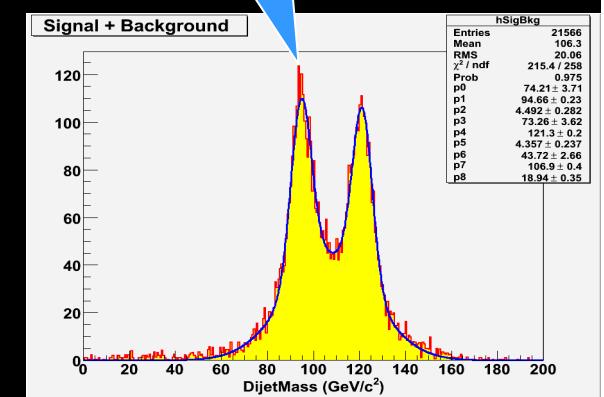
Already studied

## 3. Reject prompt muons (via the Muon Spectrometer) from leptonic WW decay

April 18th, 2009

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A. Mazzacane



$e^+e^- \rightarrow Z^0H^0 \rightarrow v\bar{v} X$   $\sqrt{s}=250$  GeV

## Results

$$M_{Higgs} = 119.60 \pm 0.07 \text{ GeV}/c^2$$

$$\sigma_{Higgs} = 3.83 \pm 0.07 \text{ GeV}/c^2$$

$$\sigma(e^+e^- \rightarrow Z^0H^0; Z \rightarrow v\bar{v}; H \rightarrow q\bar{q}) = 155.3 \pm 2.2 \text{ fb}$$

$$\epsilon_{reconstruction} = 28.8\%$$

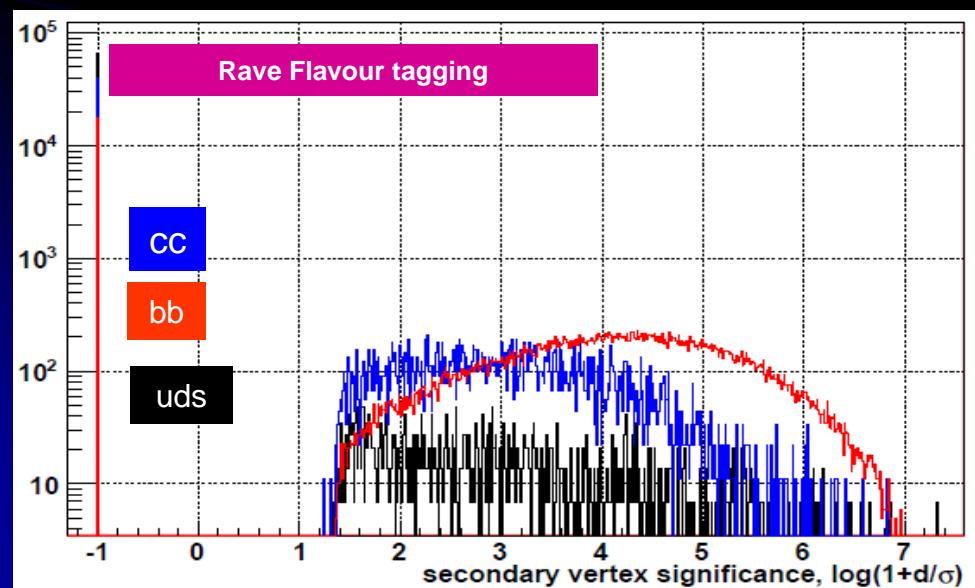
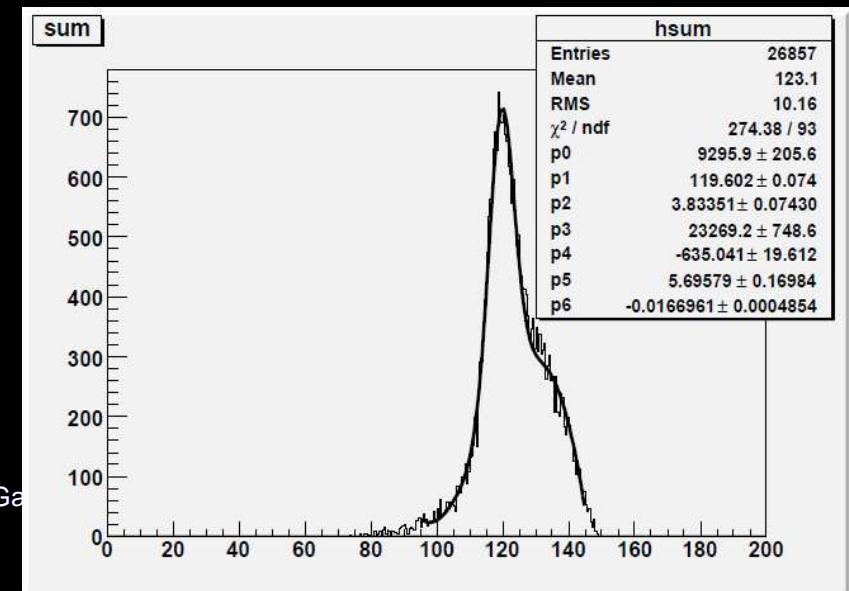
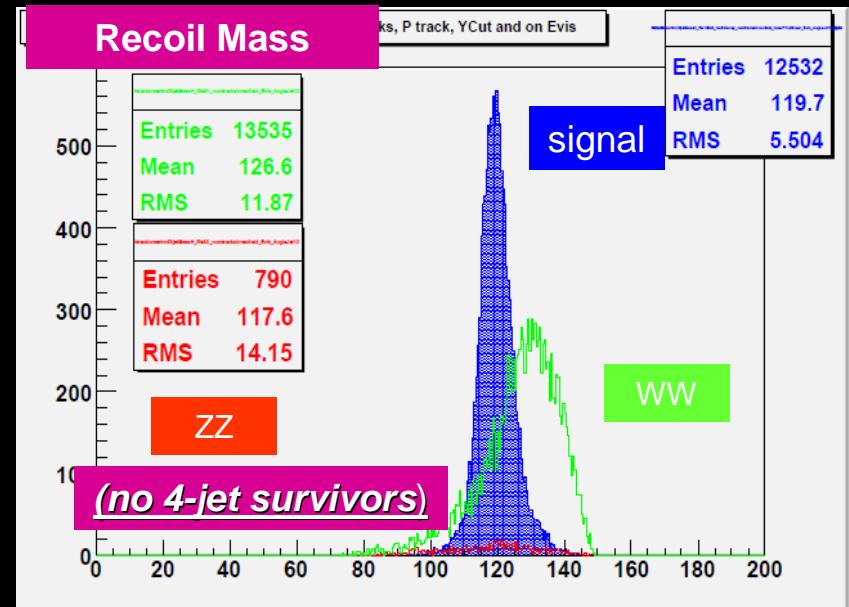
Next step is to consider

$$e^+e^- \rightarrow Z^0Z^0 \rightarrow qq vv$$

and

$$e^+e^- \rightarrow Z^0Z^0 \rightarrow qq qq$$

$$e^+e^- \rightarrow W^+W^- \rightarrow qq qq$$

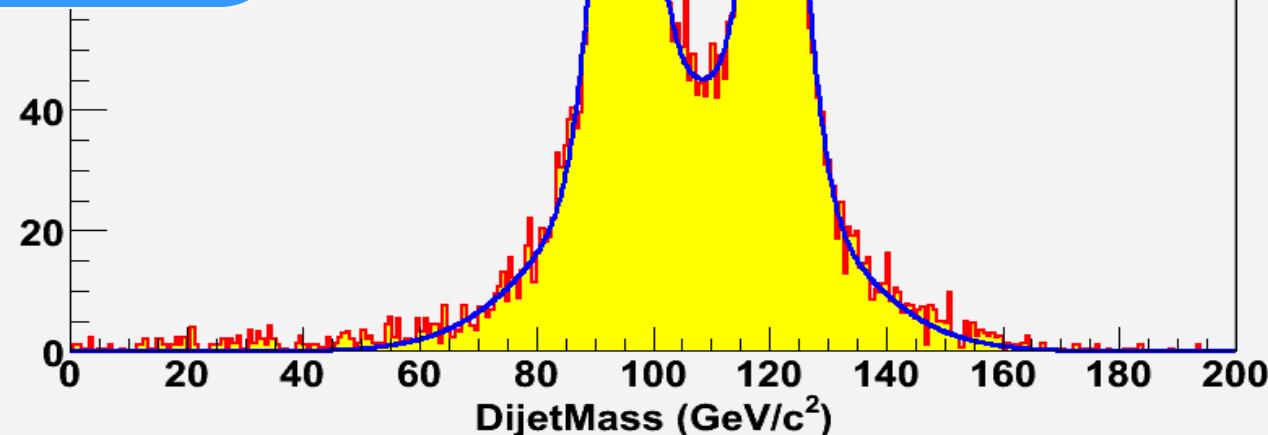


# $e^+e^- \rightarrow Z^0 H^0 \rightarrow \nu\bar{\nu} c\bar{c} + ZZ$ Background

Triple Readout

Compare with  
our previous analysis  
Using  
KEK data  
(thanks to A. Myamoto)

hSigBkg	
Entries	21566
Mean	106.3
RMS	20.06
$\chi^2 / \text{ndf}$	215.4 / 258
Prob	0.975
p0	$74.21 \pm 3.71$
p1	$94.66 \pm 0.23$
p2	$4.492 \pm 0.282$
p3	$73.26 \pm 3.62$
p4	$121.3 \pm 0.2$
p5	$4.357 \pm 0.237$
p6	$43.72 \pm 2.66$
p7	$106.9 \pm 0.4$
p8	$18.94 \pm 3.35$



1% Error on  
the mass

- Signal + ZZ background
- Requires 2 jets from jet-finder
- $E_{\text{vis}} > 130 \text{ GeV}$
- **No flavor tagging**
- Fit with three gaussians
- Selection Efficiency = 80.2%

$e^+e^- \rightarrow Z^0 H^0 \rightarrow 4 \text{ jets analyses}$

(work in progress)

$e^+e^- \rightarrow Z^0H^0$ ; and  $Z^0 \rightarrow c\bar{c} H^0 \rightarrow b\bar{b}$   $\sqrt{s}=250$  GeV

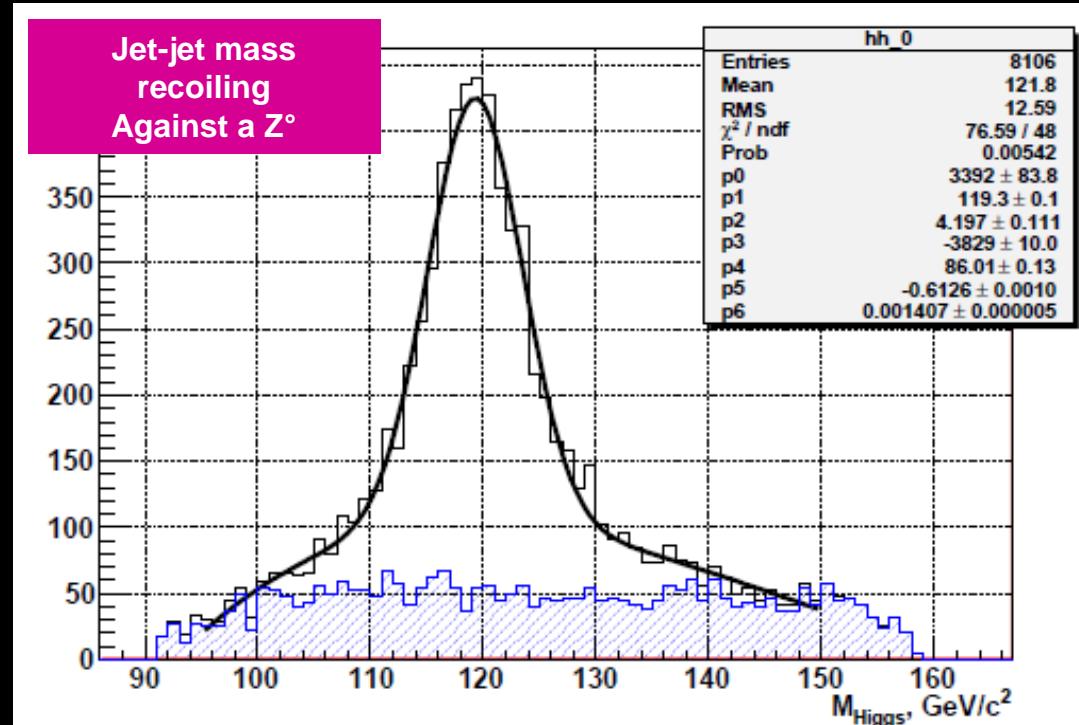
### Analysis strategy

1. Select Event with 4 jets (use jet finder with recursive  $y_{cut}$ )
2.  $E_{calo} + E_{muon}$  cut to reduce background (events with neutrino or ISR)
3. 5-C kinematic fit to all possible jet-jet combinations

Signal only  
No Background

1.  $\sum \vec{P}_i = 0$
2.  $\sum E_i = 250$  GeV
3.  $M_Z = 91$  GeV/c $^2$

4. Pick combination with highest probability
5. Final cut:  $\chi^2/ndf < 16/5$



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F. Ignatov

$e^+e^- \rightarrow Z^0H^0 ; Z^0 \rightarrow u\bar{u} H^0 \rightarrow c\bar{c}$   $\sqrt{s}=250$  GeV

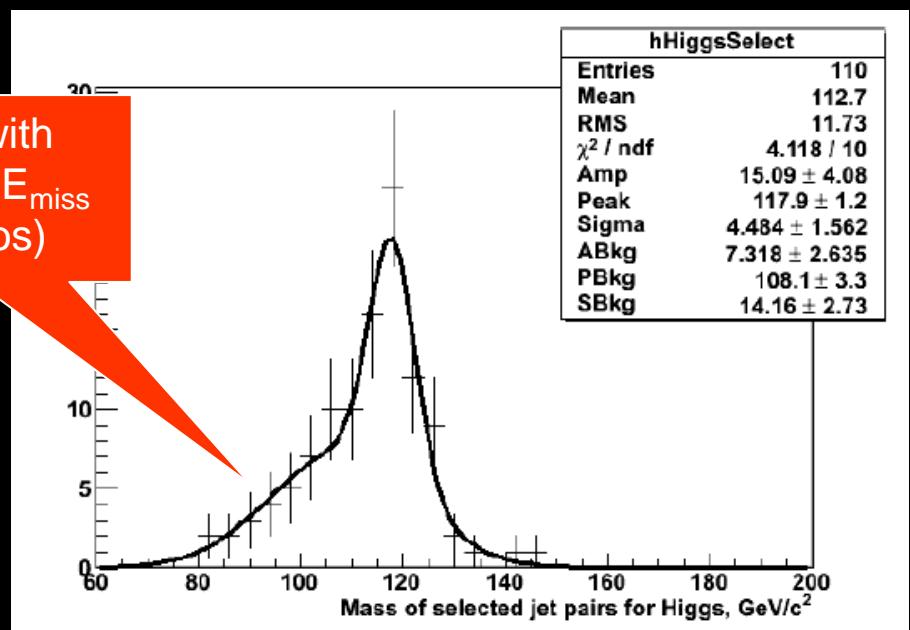
### Analysis strategy

Signal only  
No Background

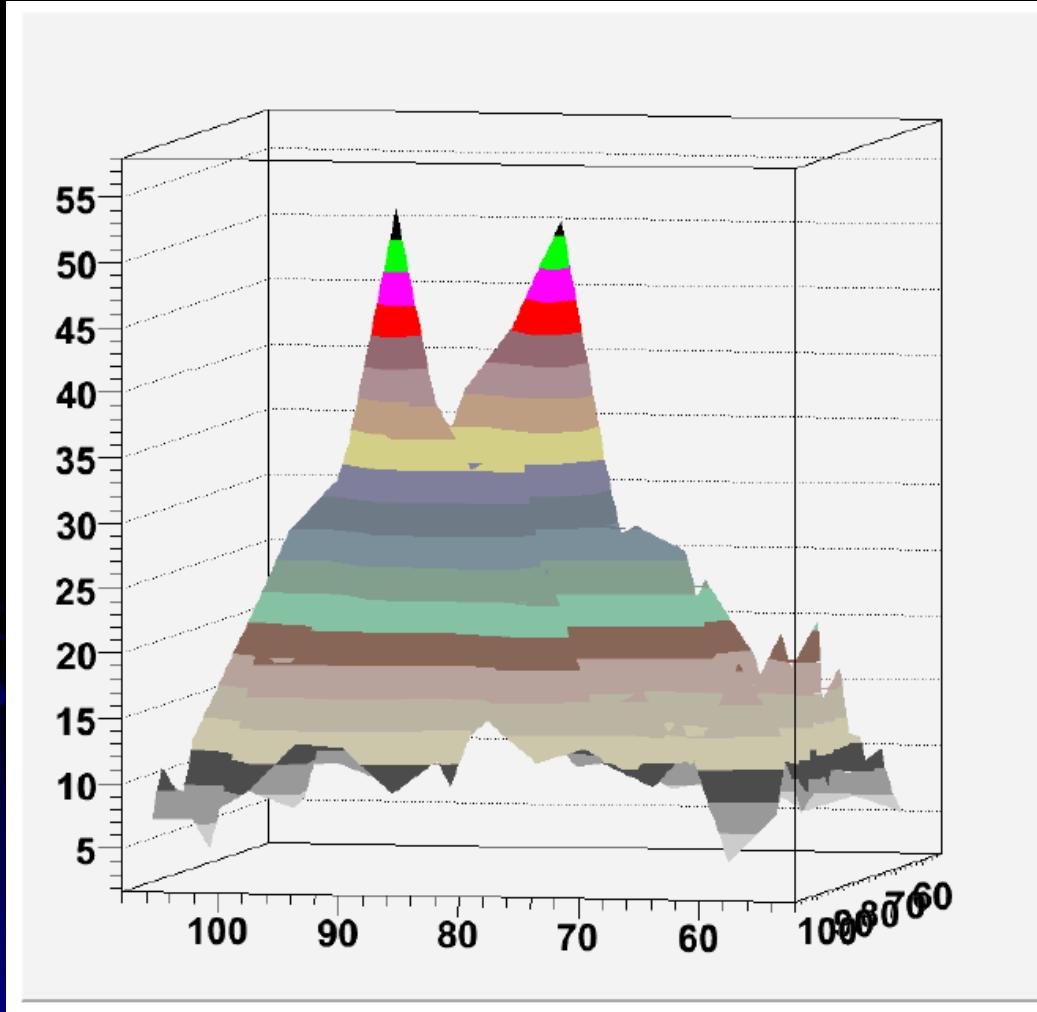
1. Select Event with 4 jets (use jet finder with recursive  $y_{cut}$ )
2. Select  $M_{j1j3}$  and  $M_{j2j4}$
3. Requires 1 combination within 10 GeV from nominal  $Z^0$  mass
4. Plot the other combination

Analysis is still in progress

Events with significant  $E_{miss}$  (neutrinos)



# W/Z Mass Separation



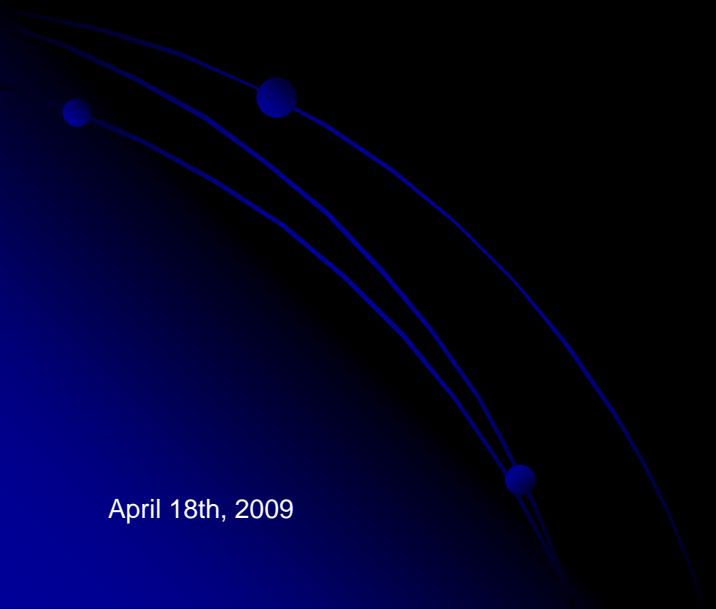
$$e^+ e^- \rightarrow W^+ W^- \nu \bar{\nu}, Z^0 Z^0 \nu \bar{\nu}$$

- KEK event sample
- Simple Durham jet-finder a la L3 (recursive  $y_{cut}$ ) used for this analysis
- No combined information with tracking yet (3 entries/evt)
- No ECAL
- 4-jets finding efficiency: 95%

# Status and Perspectives

- ILCroot framework is stable and very fast
- It runs smoothly on the GRID at FNAL
- Very detailed simulation & reconstruction takes 20'-60'/event
- Most of the effort by the 4th Concept Simulation group has been put into implementing the baseline detectors + several options
- Some work on the detectors is still needed (detector optimization and SILC+CLUCOU)
- Lots of Physics studies will follow
- Add other background sources
- Anybody is welcome on board

# Backup slides



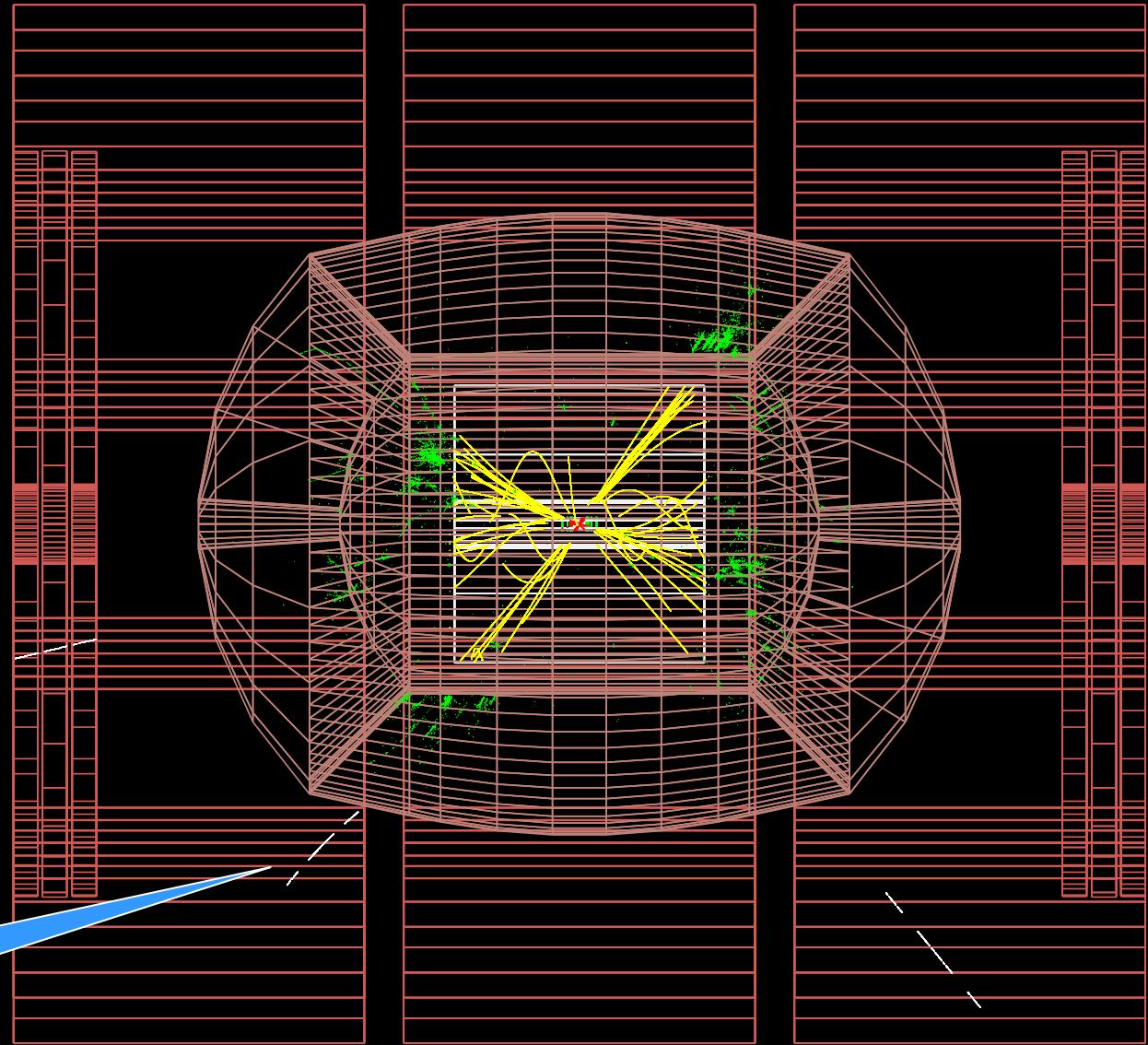
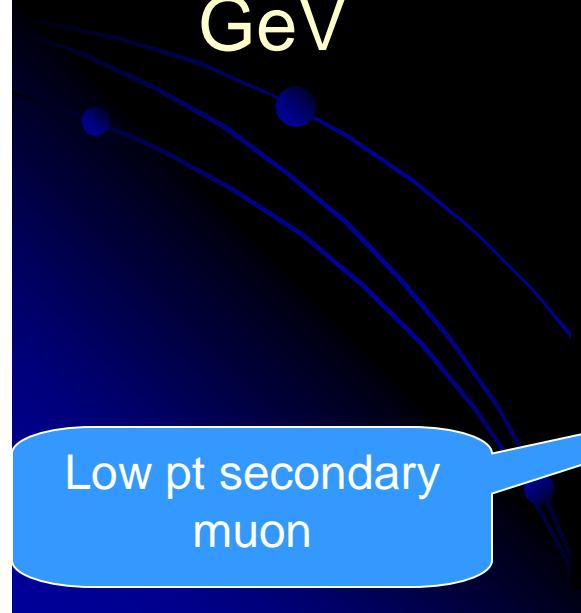
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# Event Display in ILCroot

$e^+e^- \rightarrow H^0H^0Z^0$   
 $\rightarrow 4 \text{ jets } 2 \text{ muons}$   
ECM = 500 GeV



# Outline

- The simulations in the *4th Concept*
  - ILCroot
  - Detector simulations
- Performance & Optimization
- Physics benchmarks for the L0I
- Future prospects

# The Virtual Montecarlo Concept

- Virtual MC provides a virtual interface to Monte Carlo
- It allows to run the same user application with all supported Monte Carlo programs
- The concrete Monte Carlo (Geant3, Geant4, Fluka) is selected and loaded at run time
  - Compare Montecarlo performance and possible flows
  - Choose the optimal Montecarlo for the study



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Perfect Tool for Designing/Optimizing new Detectors

# 4<sup>th</sup> Concept Software Strategy: ILCroot

- CERN architecture (based on Alice's Aliroot)
- Full support provided by Brun, Carminati, Ferrari, et al.
- Uses ROOT as infrastructure
  - All ROOT tools are available (I/O, graphics, PROOF, data structure, etc)
  - Extremely large community of users/developers
- TGenerator for events generation
- Virtual Geometry Modeler (VGM) for geometry
- Based on Virtual Montecarlo
- Could it ever evolve into a general purpose entity for the HEP community (as ROOT)?
- Growing number of experiments have adopted it: Alice, Opera, CMB, (Meg), Panda, 4th Concept
- Six MDC have proven robustness, reliability and portability

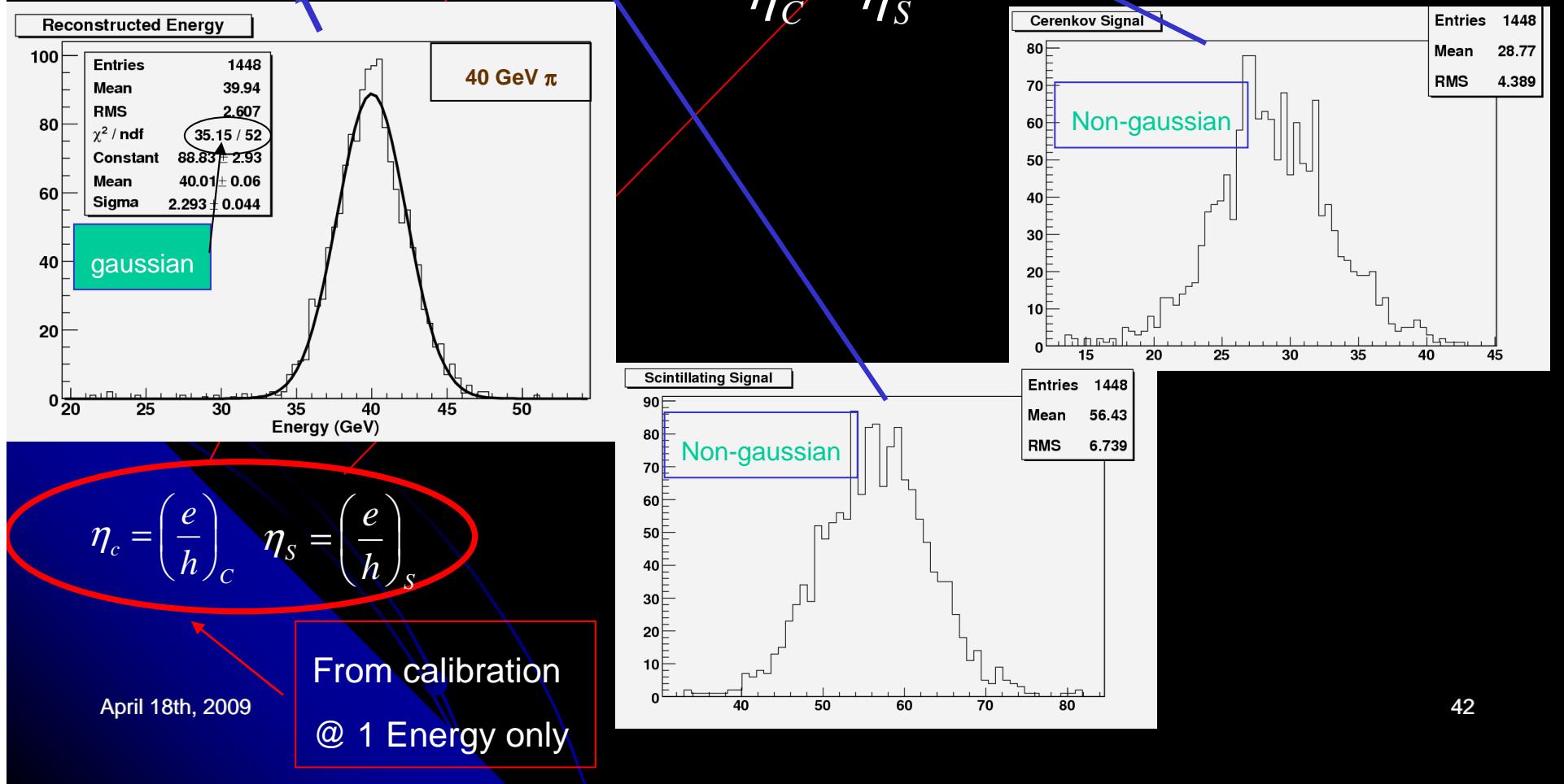
Do not Reinvent the wheel

Concentrate on Detector studies and Physics

# Dual Readout Calorimetry

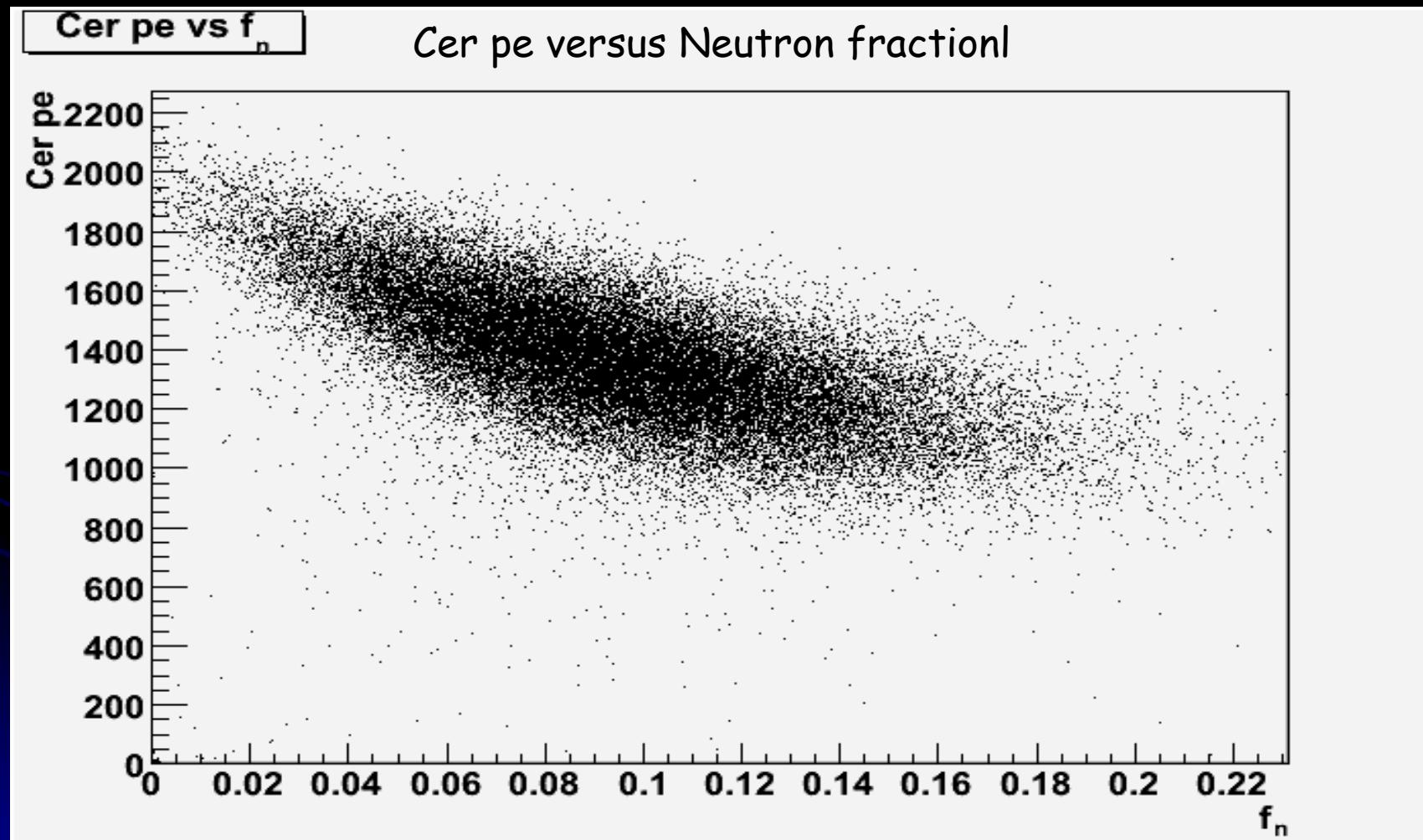
Total calorimeter energy: use two measured signals and two, energy-independent, calibration constants

$$E_{HCAL} = \frac{\eta_S \cdot E_S \cdot (\eta_C - 1) - \eta_C \cdot E_C \cdot (\eta_S - 1)}{\eta_C - \eta_S}$$

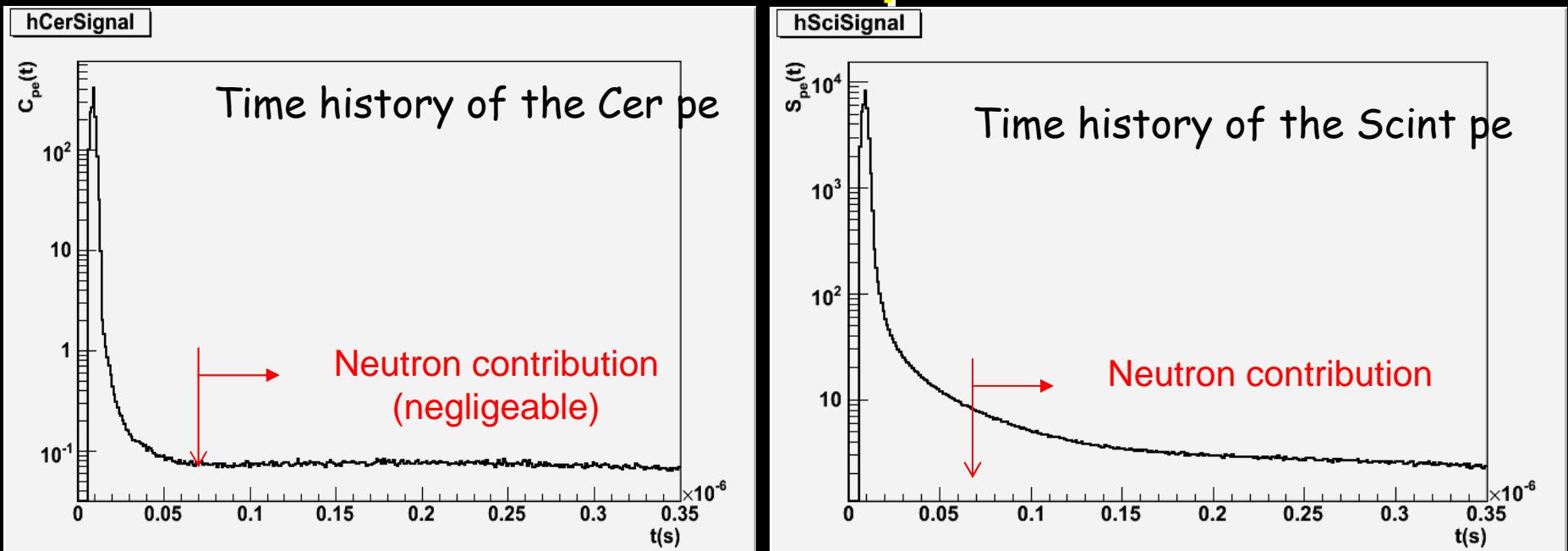


# Improving the Energy Resolution: The Effect of Neutrons

45 GeV  $\pi^-$



# From Dual to Triple Readout



45 GeV  $\pi^-$

$$E_{HCAL} = \frac{\eta_s \cdot E_s \cdot (\eta_c - 1) - \eta_c \cdot E_c \cdot (\eta_s - 1)}{\eta_c - \eta_s} + \eta_n \cdot E_{neutrons}$$

Triple readout aka Dual Readout with time history readout

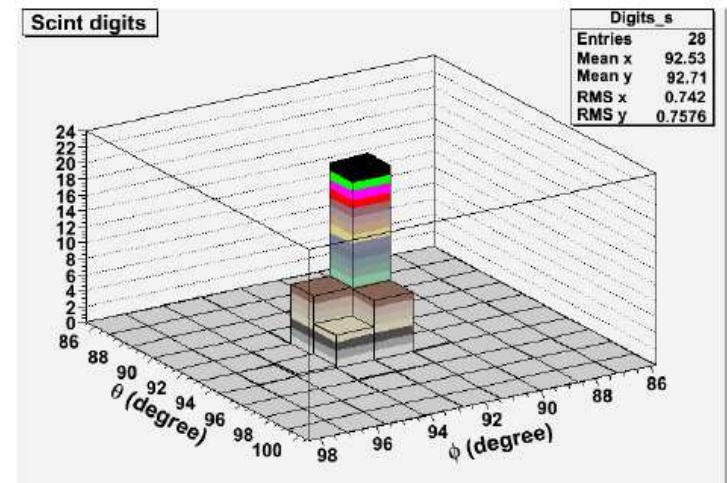
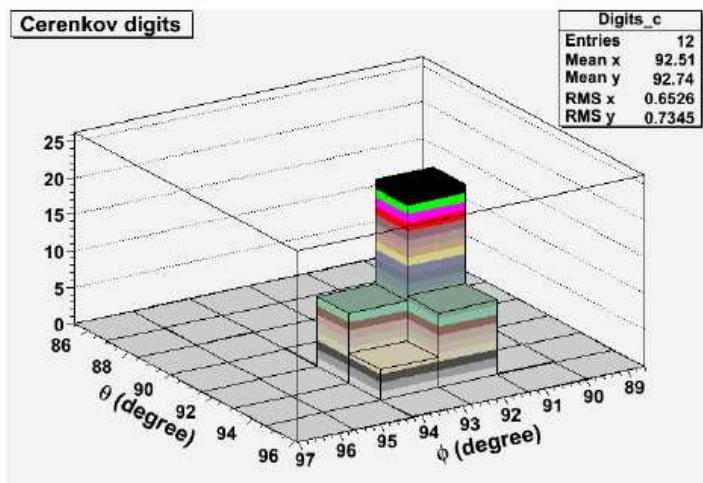
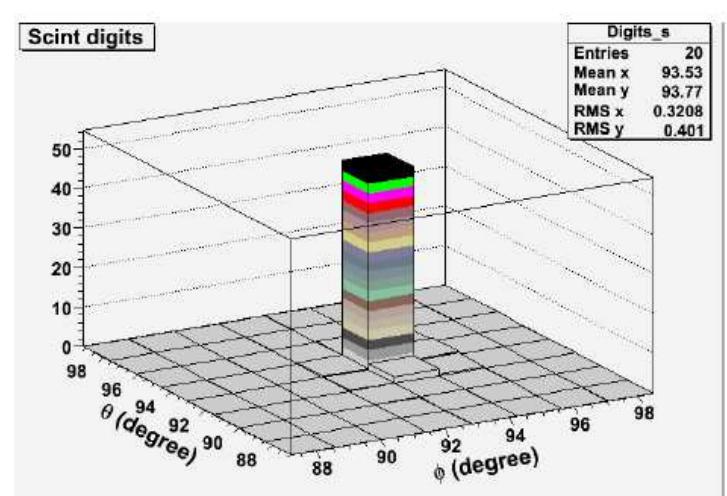
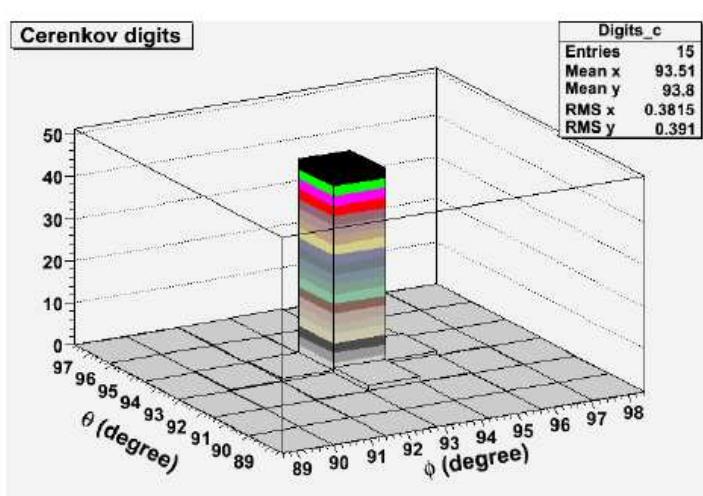
# Compensation with ECAL and HCAL

- Get  $E_{Scint}$  and  $E_{Cer}$  from ECAL (disregard neutrons as  $Z_{BGO} \gg 1$ )
- Get  $E_{Scint}$ ,  $E_{Cer}$  and  $E_{neutr}$  from HCAL
- Then:

$$E_{Total} = \frac{\eta_S \cdot (E_{Scint}^{ECAL} + E_{Scint}^{HCAL}) \cdot (\eta_C - 1) - \eta_C \cdot (E_{Cer}^{ECAL} + E_{Cer}^{HCAL}) \cdot (\eta_S - 1)}{\eta_C - \eta_S} + \eta_n \cdot E_{neutrons}^{HCAL}$$

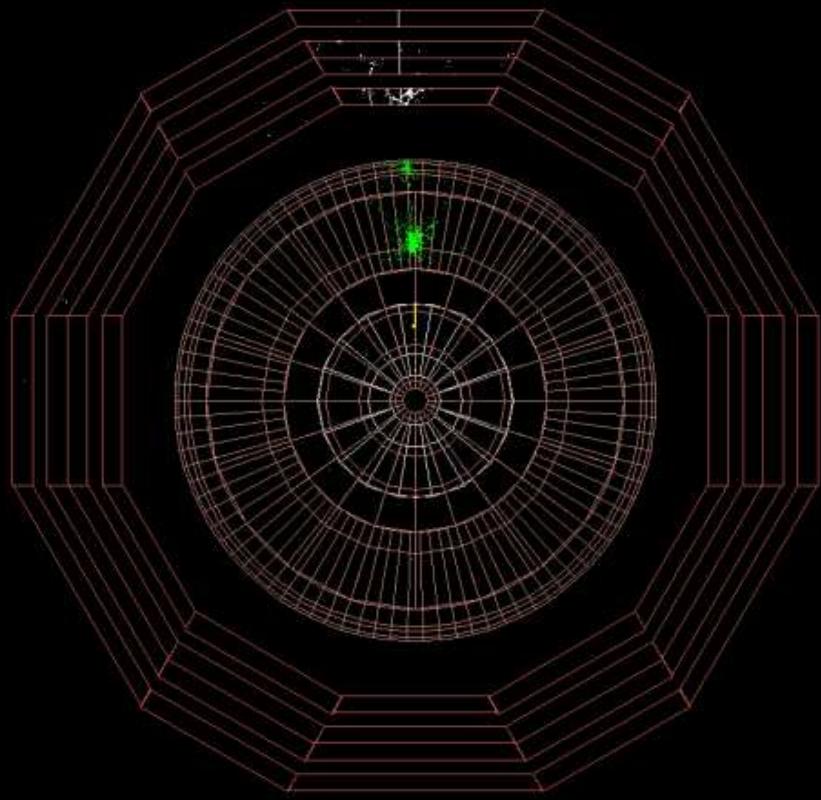
- Estimate  $\eta_C$ ,  $\eta_S$  and  $\eta_{neu}$  from a 45 GeV run ( $\pi^-$  and  $e^-$ ) by minimizing the spread of  $E_{tot}$

# Calorimeter Response for 45 GeV e<sup>-</sup>



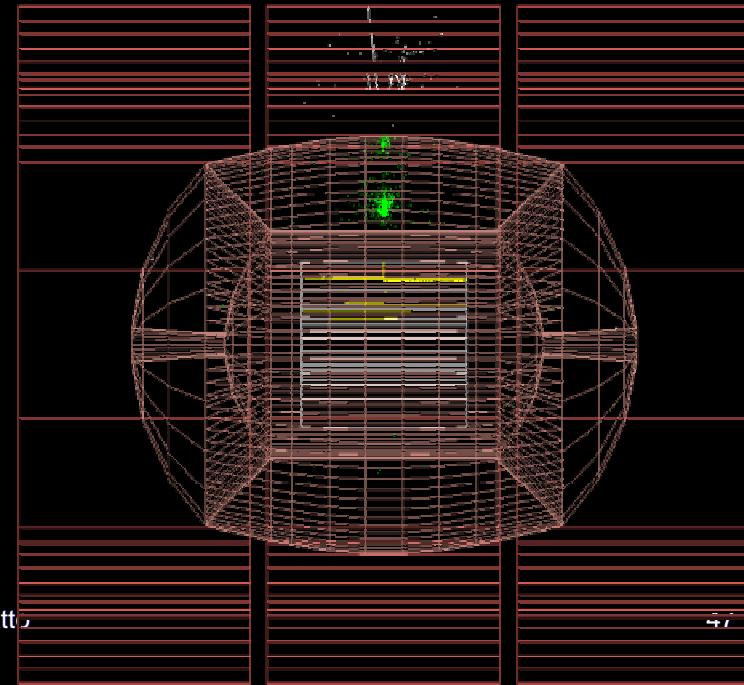
# 80 GeV jet with escaping particles

ILCRoot simulation



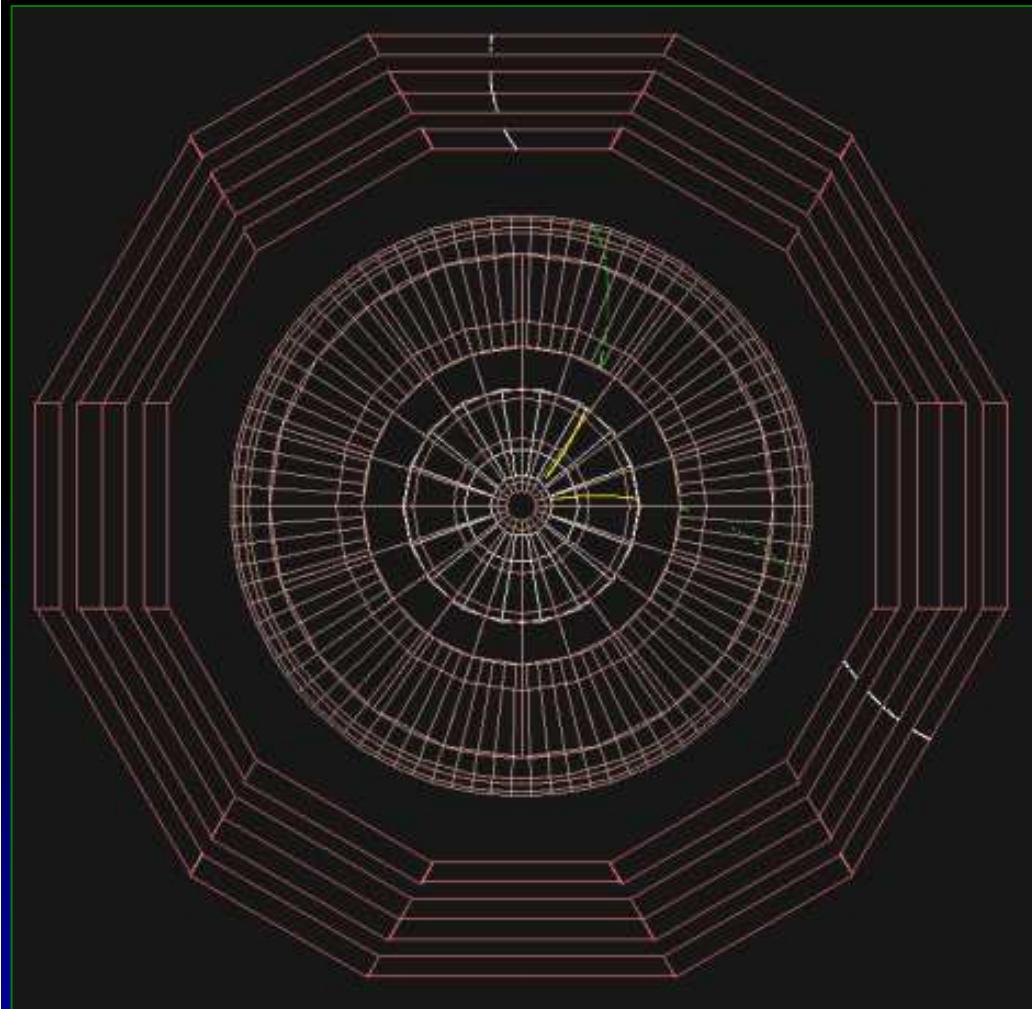
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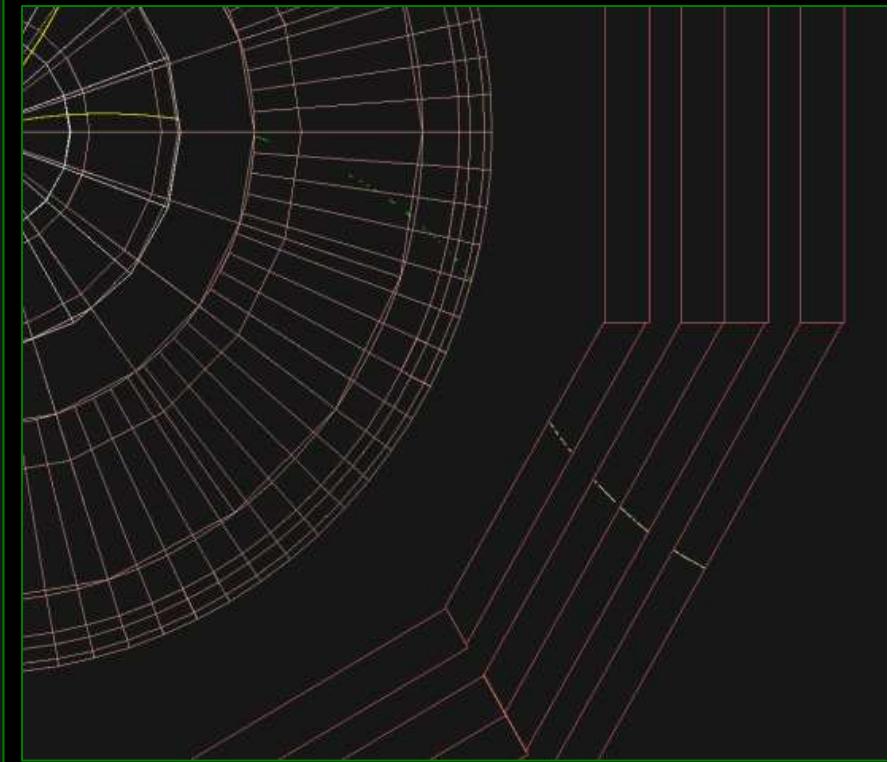
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# $\mu^+ \mu^-$ at 3.5 GeV/c



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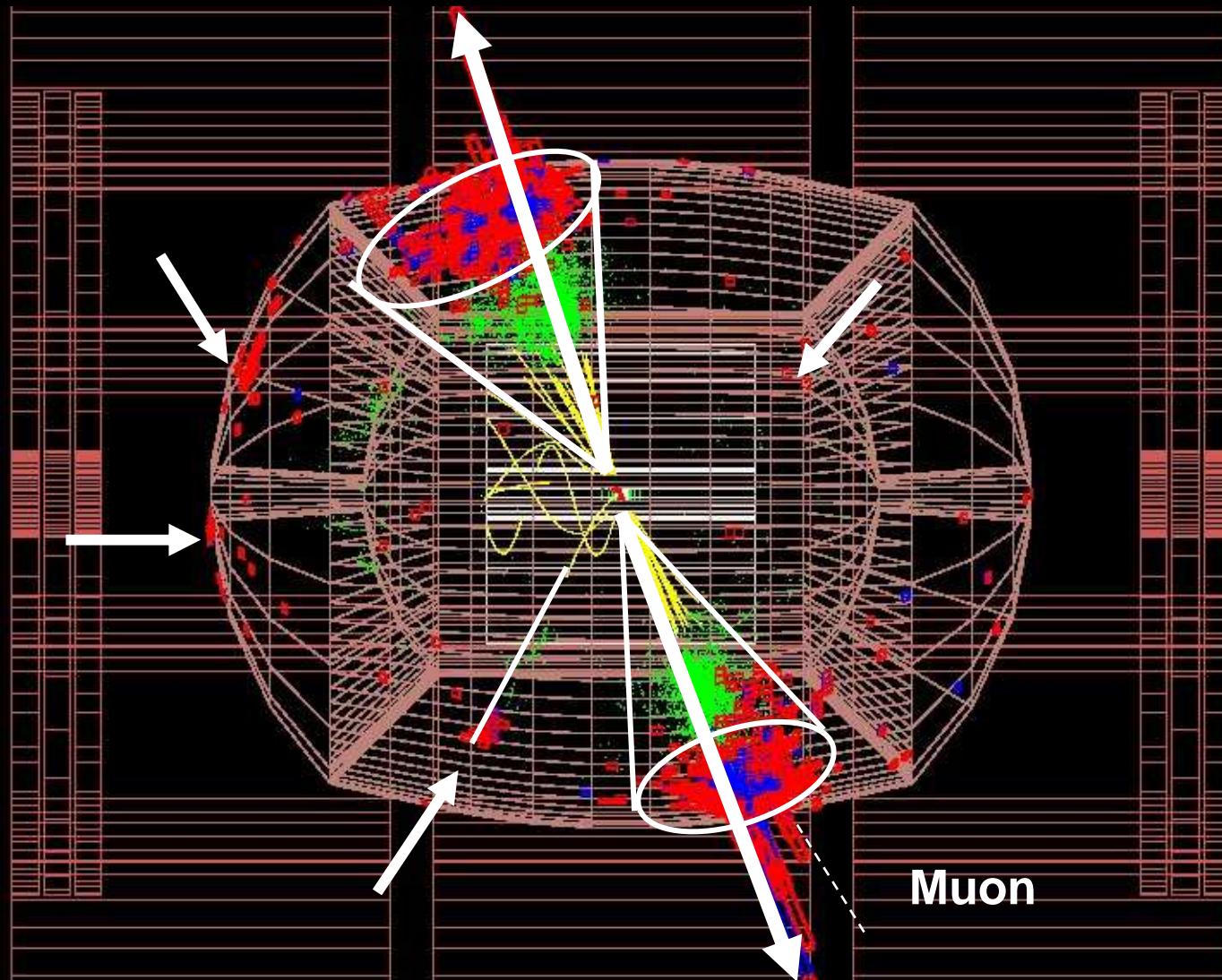
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ILCRoot simulation

# **Jet reconstruction: combine calorimetric and tracking informations**

**(work in progress)**

# Jet Reconstruction Strategy



# Summary

Process	e <sup>-</sup> polar.	e <sup>+</sup> polar.	Ecal	Beam bkgnd	Note
Z <sup>0</sup> H <sup>0</sup> → μ <sup>+</sup> μ <sup>-</sup> X	+100%	-100%	yes	yes	
Z <sup>0</sup> H <sup>0</sup> → e <sup>+</sup> e <sup>-</sup> X	+100%	-100%	yes	yes	
Z <sup>0</sup> H → 4 jets	+100%	-100%	no	no	
Z <sup>0</sup> H <sup>0</sup> → νν X	+100%	-100%	no	no	
e <sup>+</sup> e <sup>-</sup> → t t	+100%	-100%	no	yes	
e <sup>+</sup> e <sup>-</sup> → τ <sup>+</sup> τ <sup>-</sup>	+100%	-100%	yes	yes	

Worst case polarization scenario considered: largest WW background