Using Pandora PFA on $e^+e^- \rightarrow Z + H$ with LDC01Sc

Getting ready to compare with MAPS

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Outline

1. Overview
2. Preparation
3. Results
4. Summary

Testing Pandora

Preheat oven to 180 °C:

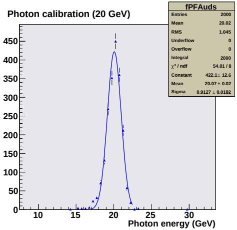
1. Compile Pandora having downloaded it out of CVS.
2. Calibrate it on photons, antineutrons and everything else
3. Recalibrate on the $Z \to uds$ pole
4. Run on events of interest

- Will consider the channel $e^+e^- \to Z + H$ where H is invisible (set $m_H = 140\,\mathrm{GeV}/c^2$) and Z decays to two jets.

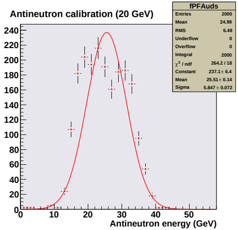
- Also using LDC01Sc.

Calibration is crucial

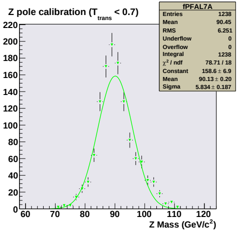
Interested in jets ⇒ use Z pole



(a) Calibration with photons



(b) Calibration with antineutrons



(c) Calibration at the Z pole, for $Z \rightarrow uds$ jets.

Calorimeter for ILC

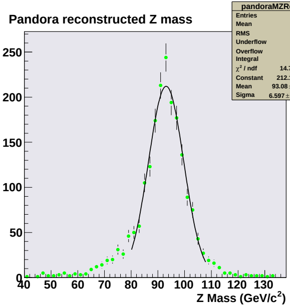
Calibration for LDC01Sc

Use the following in the Pandora steering file

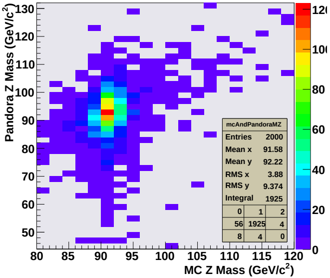
Obtained by hand, optimising for Z jets...

```
<parameter name="HCALMIPcalibration" type="float">42.5 </parameter>
<parameter name="ECALThreshold" type="float">0.5 </parameter>
<parameter name="HCALThreshold" type="float">0.3 </parameter>
<parameter name="ECALEMMIPToGeV" type="float">0.0058 </parameter>
<parameter name="ECALHadMIPToGeV" type="float">0.005 </parameter>
<parameter name="HCALEMMIPToGeV" type="float">0.013 </parameter>
<parameter name="HCALHadMIPToGeV" type="float">0.034 </parameter>
```

Reconstructed Z mass



(d) The reconstructed Z mass found using Pandora.

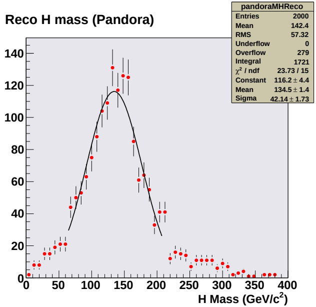


(e) A 2D Histogram of the Z mass from Pandora compared with the Monte Carlo Z mass for that event.

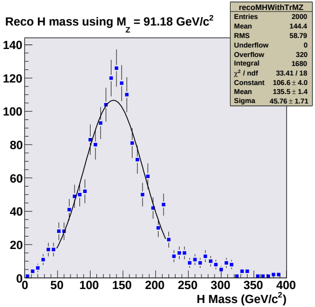
Figure: Pandora's reconstructed Z mass, with a comparison with the Monte Carlo Z mass.

Vanilla H mass reconstruction

$m_H = \sqrt{(E^2_{\mathrm{CM}} - E_{\mathrm{event}})^2 - p^2_{\mathrm{event}}}$



(a) The reconstructed H mass using Pandora's reconstructed Z mass.



(b) Using $m_Z = 91.18\,\mathrm{GeV}/c^2$.

Figure: Reconstructed H masses using two different methods.

Transverse event thrust and alpha

Some definitions

Define transverse thrust:

$$T_{\mathrm{trans}} = \frac{\sum_i p_{z,i}}{\sum_i |\mathbf{p}_i|} \tag{1}$$

Define α:

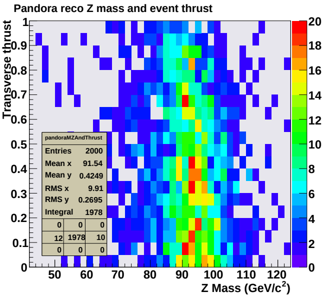
$$\alpha = \frac{m_Z}{m_{\mathrm{event}}}. \tag{2}$$

Corrected H mass:

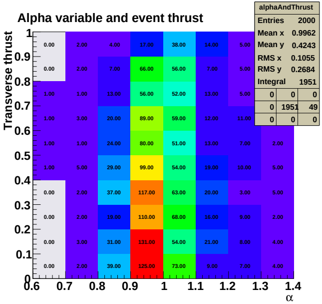
$$m'_H = \sqrt{(E_{\mathrm{CM}} - \alpha E_{\mathrm{event}})^2 - (\alpha p_{\mathrm{event}})^2}. \tag{3}$$

Transverse event thrust and alpha

Relationships



(a) Z mass and transvere thrust relationship.

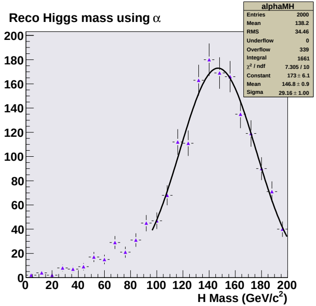


(b) α and event thrust are $\sim$ related.

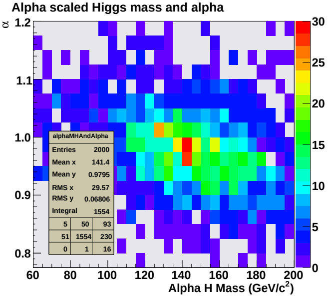
Figure: Exploring the relationship between transverse event thrust, α and the reconstructed Z mass.

Transverse event thrust and alpha

Improvement on the H mass calculation



(a) The H mass when the α scaling variable is applied.



(b) A 2D Histogram of the H mass with α scaling, and the α value.

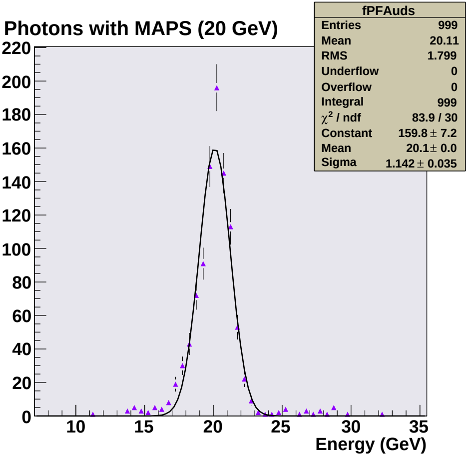
Calorimeter for ILC

Results

☛ Despite poor fits, α correction improves width of Gaussian fit on H mass from 42 GeV to 30 GeV.

First look at photons with MAPS

Hot off the press!



Summary

- Calibration is a pain.
- We can reconstruct Z mass well $\Rightarrow$ do a good job of getting the H mass.
- Dominated by detector resolution; using α scaling works well.
- Need more investigations regarding Pandora's performance i.t.o. event thrust.
- We've started work on MAPS!

CALICE Calorimeter for ILC

Where next. . .

- Improve the handwaved Gaussian fits with Lorentzians where appropriate.
- Automate the calibration.
- Turn on MAPS and check we do as well, if not better(!)
- Optimise Pandora for MAPS.