Pandora PFA vs. Wolf PFA @ WW scattering

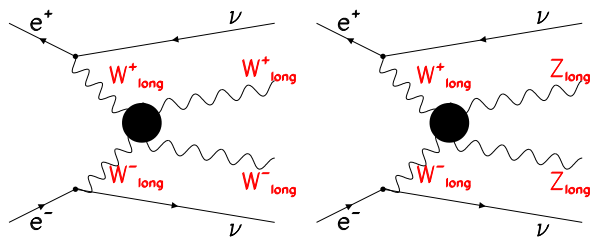
Mark Thomson, David Ward and Wenbiao Yan

UNIVERSITY OF CAMBRIDGE

- **WW scattering**
- **Pandora PFA vs. Wolf PFA**
- **Summary and outlook**

WW scattering

- **WW scattering: 1000 fb^{-1} @ $\sqrt{s} = 800$ GeV with ISR by Whizard v 1.50**



- **Physics parameters: anomalous couplings α_4 & α_5**

- **Motivation @ this work**
  - **WW/ZZ separation**
  - **Extract α_4 & α_5:**
    - **How to do ? Follow hep-ph/0604048**
    - **Detector model: LDC00, LDC00Sc, LDC01, LDC01Sc**
    - **PFA: PandoraPFO PFA vs. Wolf PFA**

- **This talk: Compare PandoraPFO PFA and Wolf PFA @ WW scattering**

Event reconstruction

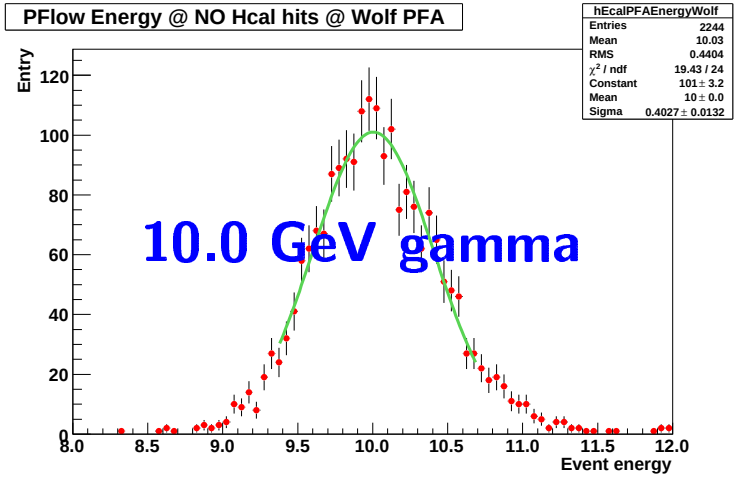
- **Mokka v6.2; Marlin v00-09-06; MarlinReco v00-02; MarlinUtil v00-02**
- **Pandora PFA v01-00; Wolf PFA @ MarlinReco v00-02**
- **Processors for Digitization**
  - **VTXDigi FTDDigi TPCDigi**
  - **SimpleCaloDigi**
    - **two calibration constants for two Ecal parts**
    - **one calibration constants for Hcal**
- **Processors for Wolf PFA**
  - **tracking finding: TrackCheater**
  - **cluster finding: TrackwiseClustering**
  - **track-cluster match: Wolf**

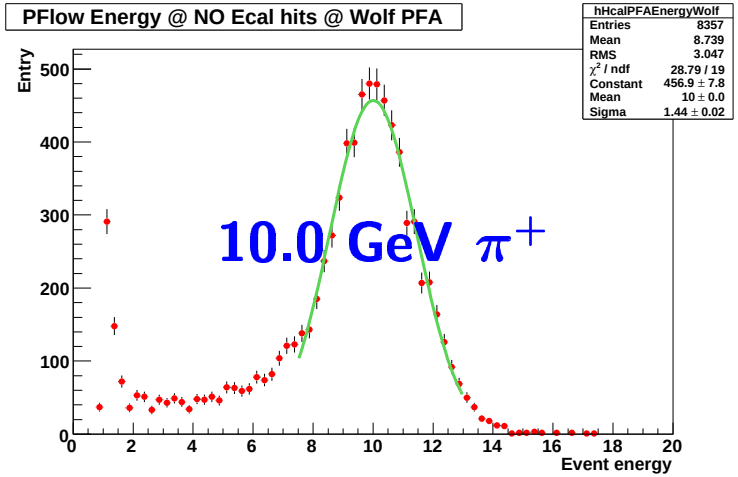
Event reconstruction

- **Processors for Pandora PFA**
  - **tracking finding: TrackCheater**
  - **cluster finding & track-cluster match: PandoraPFAProcessor**
- **Processors for Perfect PFA**
  - **true MC tracks: TrackCheater**
  - **true MC clusters: ClusterCheater5_3**
  - **track-cluster match: Wolf**
- **Wolf PFA vs. Pandora PFA**
  - **tracking finding: same**
  - **cluster finding: TrackwiseClustering vs. PandoraPFAProcessor**
  - **track-cluster match: Wolf vs. PandoraPFAProcessor**

Calibration constants @ PFAs

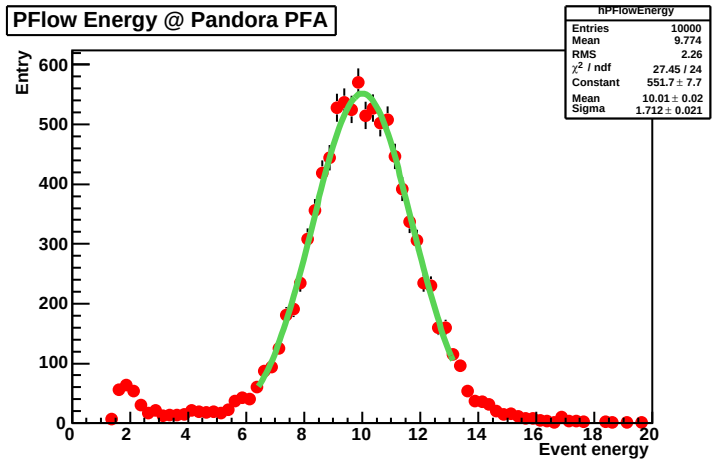
- **common calibration constants SimpleCaloDigi**
  - **Ecal: two calibration constants for two Ecal parts**
    - **fix ratio 1:3 (LDC00Sc); 1:2 (LDC01Sc) by radiation length**
    - **10.0 GeV gamma events without Hcal hits**
  - **Hcal: one calibration constant**
    - **10.0 GeV pion in front of Hcal without Ecal hits**

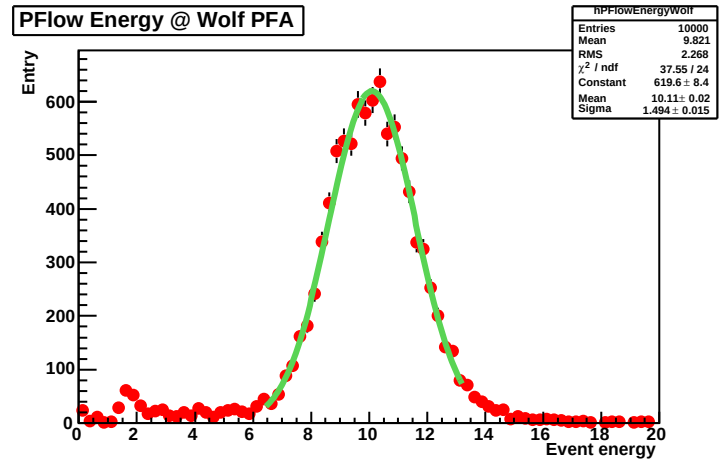


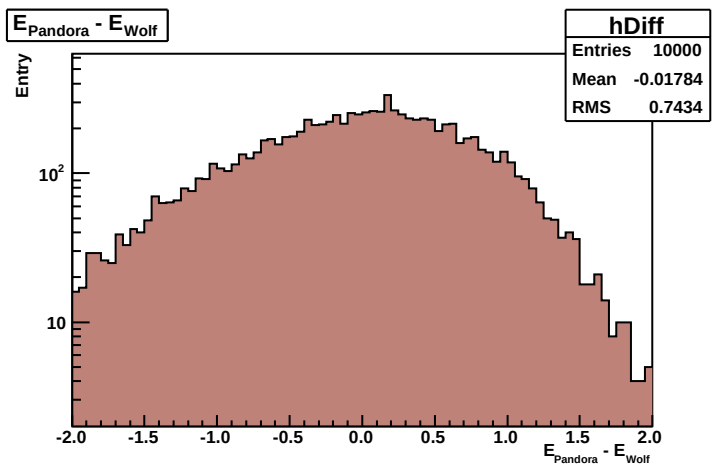


- **calibration constants @ PFAs**
  - **Wolf PFA: no more parameters**
  - **Pandora PFA:** ECALEMMIPToGeV, ECALHadMIPToGeV, HCALEMMIPToGeV, HCALHadMIPToGeV

10.0 GeV pion: Pandora PFA vs. Wolf PFA







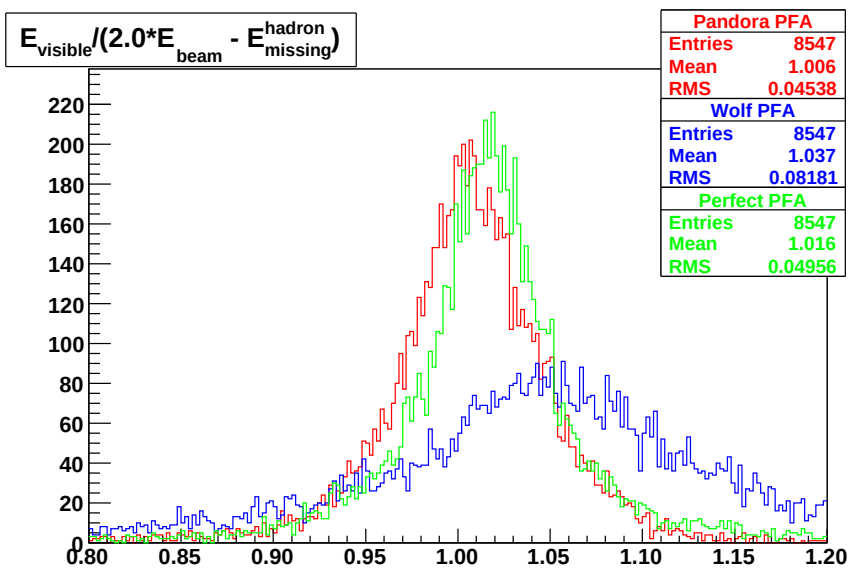
Particles: Pandora PFA vs. Wolf PFA

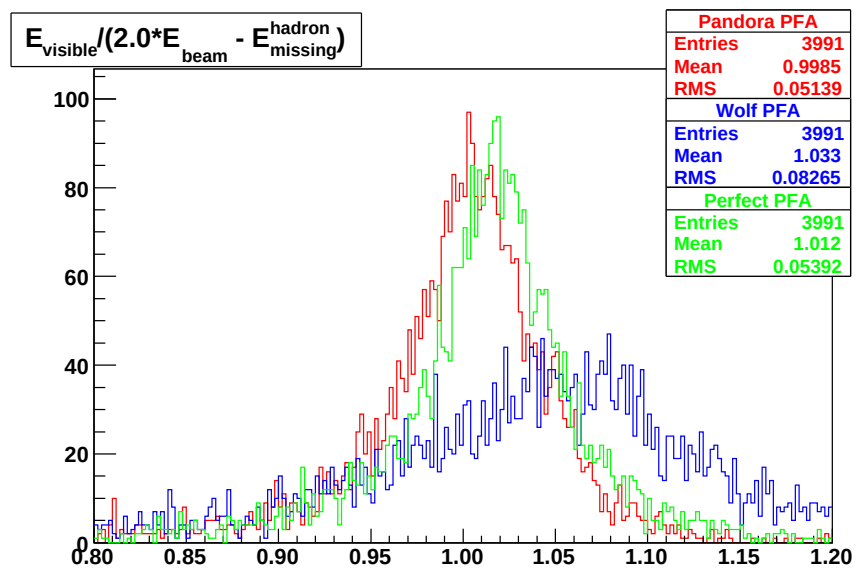
Particle	energy	effective energy	Pandora (in GeV)	Wolf	$\sum E_{hits}$
gamma	5.0	5.0	4.983 ± 0.004	4.99 ± 0.0	4.995 ± 0.004
	10.0	10.0	10.0 ± 0.0	10.01 ± 0.01	10.02 ± 0.01
	20.0	20.0	20.04 ± 0.01	20.05 ± 0.01	20.08 ± 0.01
electron	10.0	10.0	10.0 ± 0.0	10.01 ± 0.01	10.03 ± 0.01
	20.0	20.0	20.07 ± 0.01	20.06 ± 0.01	20.1 ± 0.0
pion	5.0	5.0	4.839 ± 0.015	5.154 ± 0.011	5.098 ± 0.01
	10.0	10.0	10.01 ± 0.02	10.11 ± 0.02	10.04 ± 0.02
	20.0	20.0	20.92 ± 0.03	20.12 ± 0.02	20.06 ± 0.02
klong	5.0	5.0	4.6 ± 0.0	5.05 ± 0.01	5.001 ± 0.011
	10.0	10.0	9.84 ± 0.02	10.24 ± 0.02	10.23 ± 0.02
	20.0	20.0	21.12 ± 0.03	20.21 ± 0.02	20.18 ± 0.02
neutron	10.0	9.06	8.869 ± 0.021	9.455 ± 0.016	9.43 ± 0.02
	20.0	19.06	19.21 ± 0.03	18.86 ± 0.02	18.83 ± 0.02

- **Neutron: effective energy $E_{neutron} - M_{neutron}$**
- **Red words: $|E_{obs} - E_{effective}|/E_{effective} > 3\%$**

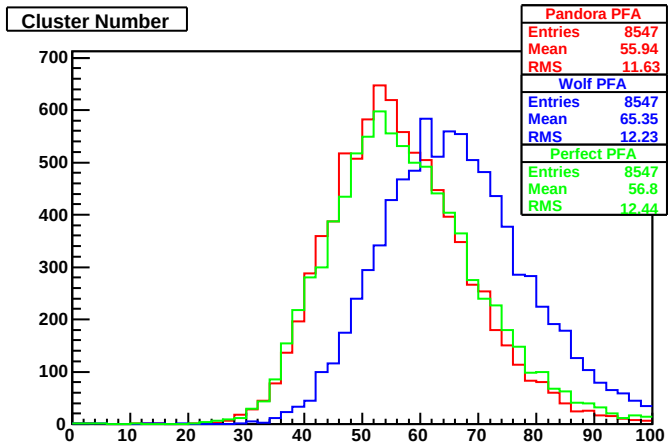
WW event energy: Pandora PFA vs. Wolf PFA

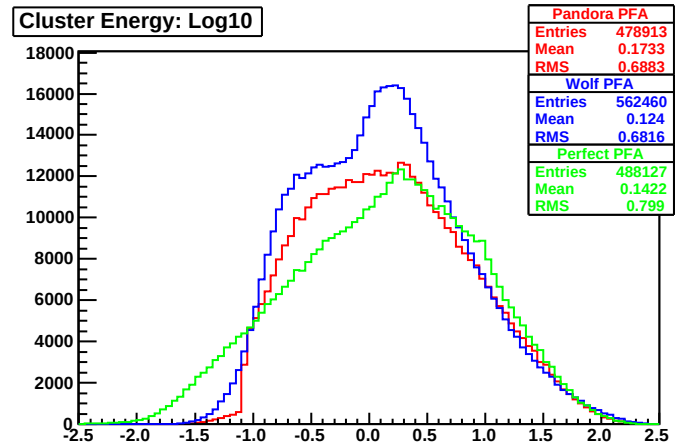
- $E_{missing}^{hadron}$: sum of energy for neutrins and particle in beam pipe at hadron level
- $E_{beam} = 400.0$ GeV; $E_{visible}$: visible energy at detector level
- Left: $\nu_e\bar{\nu}_e WW$; Right: $\nu_e\bar{\nu}_e ZZ$

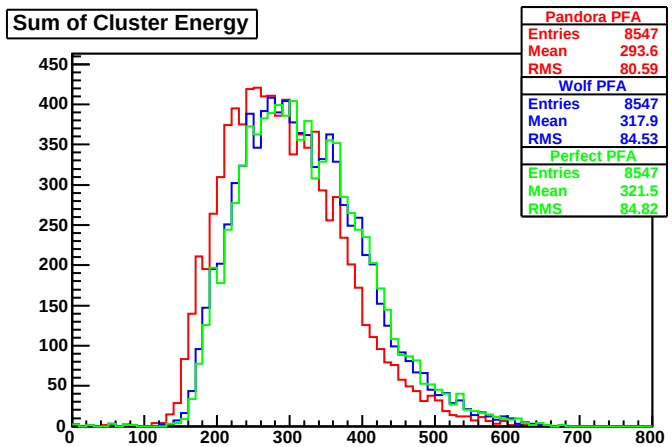




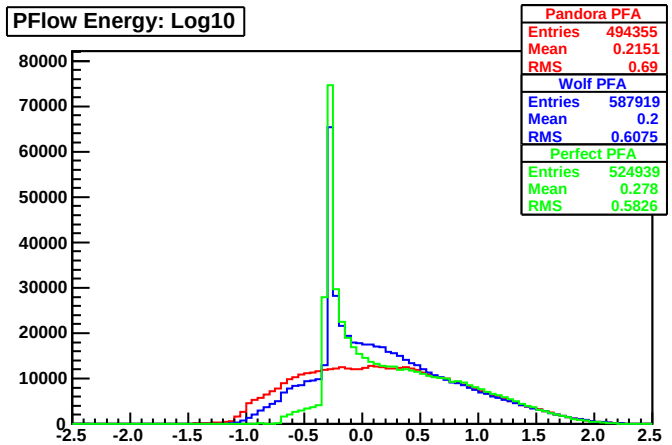
Cluster finding: TrackwiseClustering vs. PandoraPFA

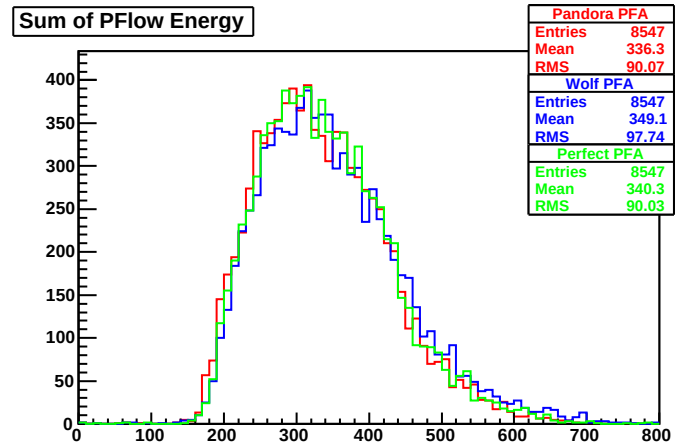


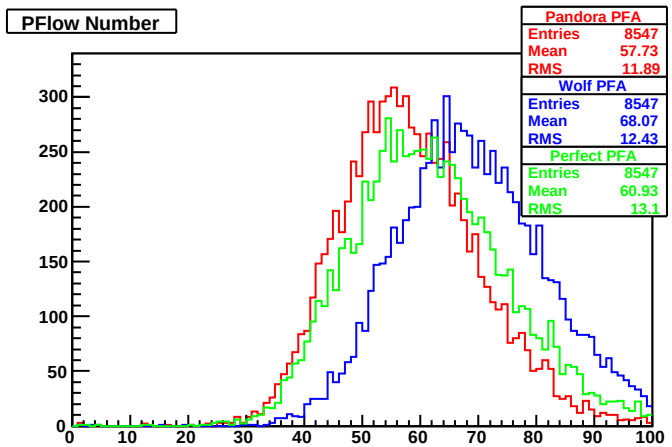


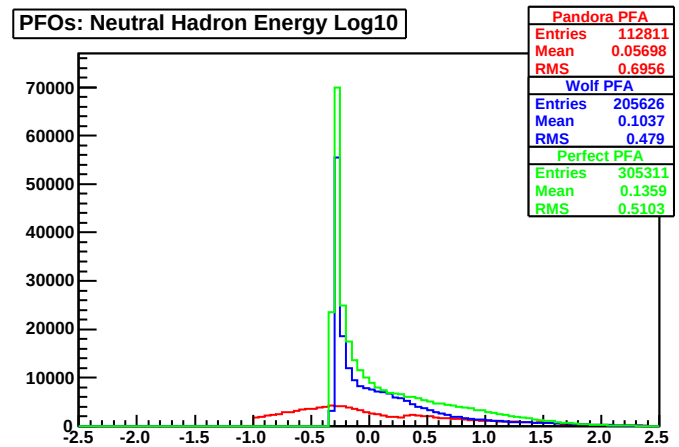


PFlow objects: Pandora PFA vs. Wolf PFA



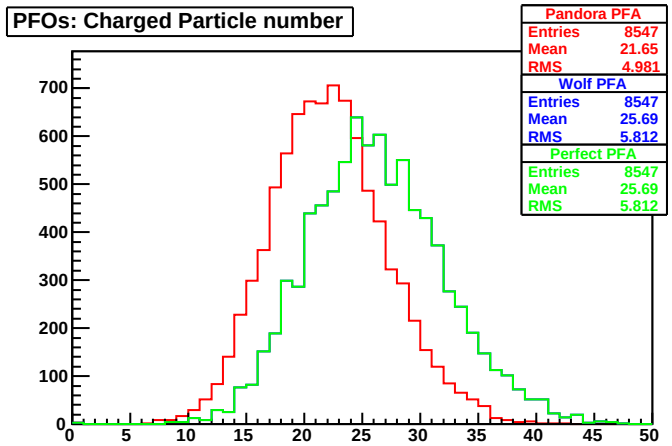


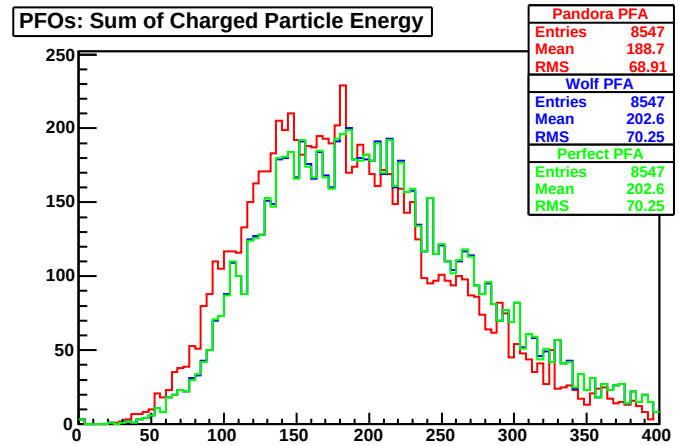


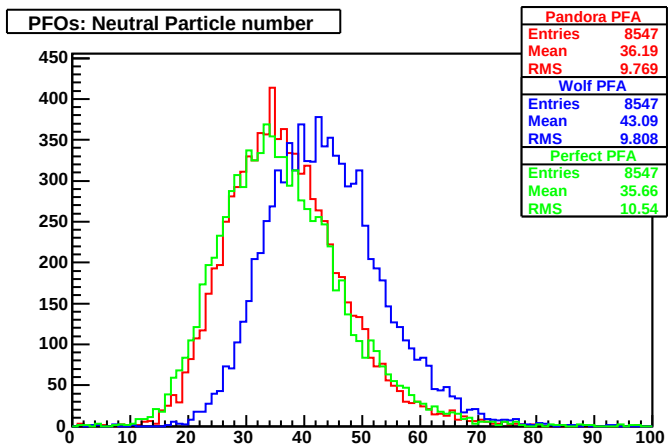


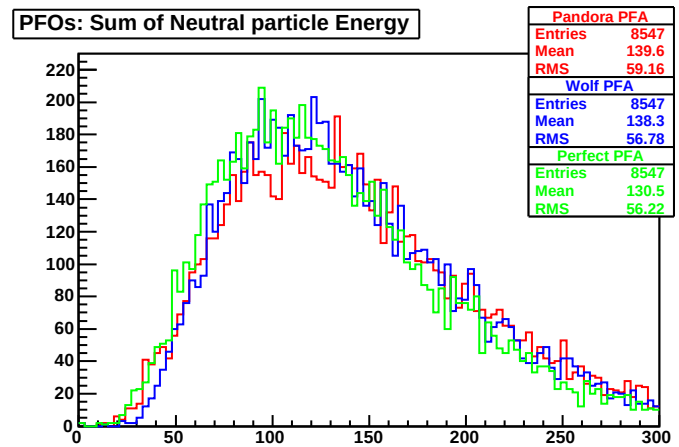
- **Peak @ PFlow energy: cutoff @ Wolf PFA for neutral hadron ???**

PFlow objects: Charged & neutral particles

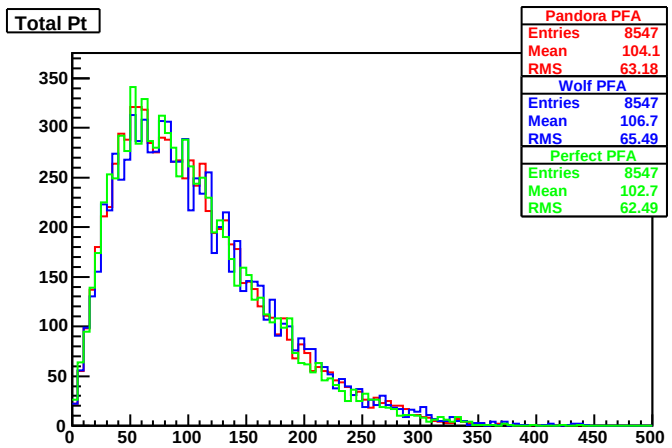


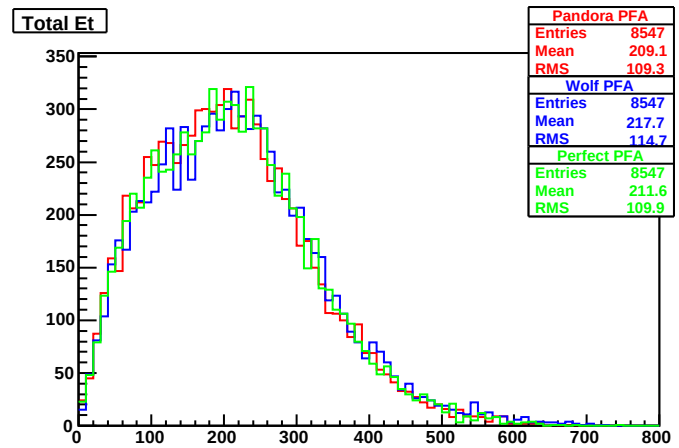


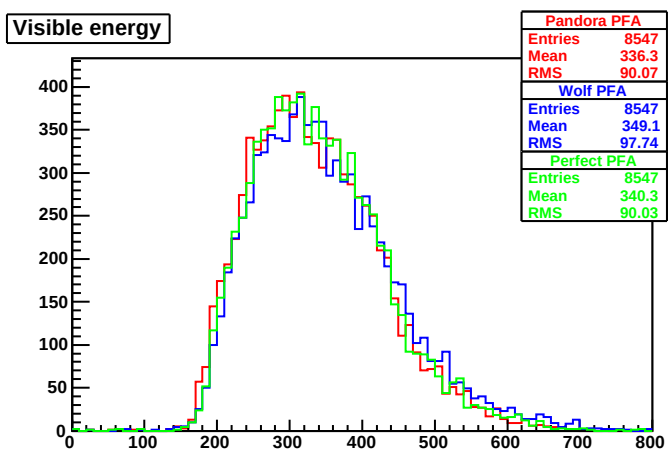


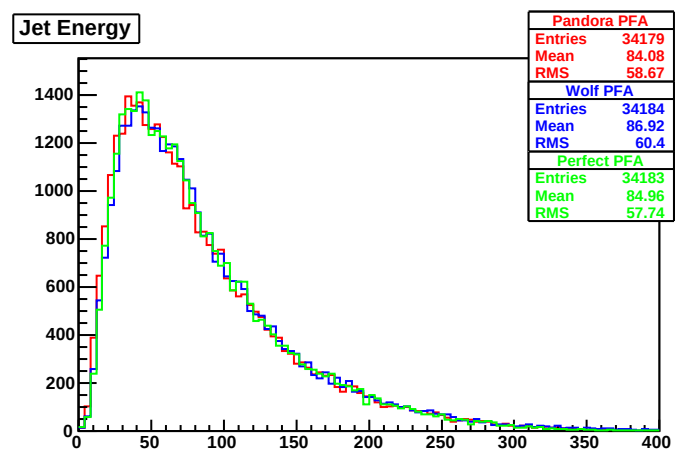


Detector level: Pandora PFA vs. Wolf PFA @ WW

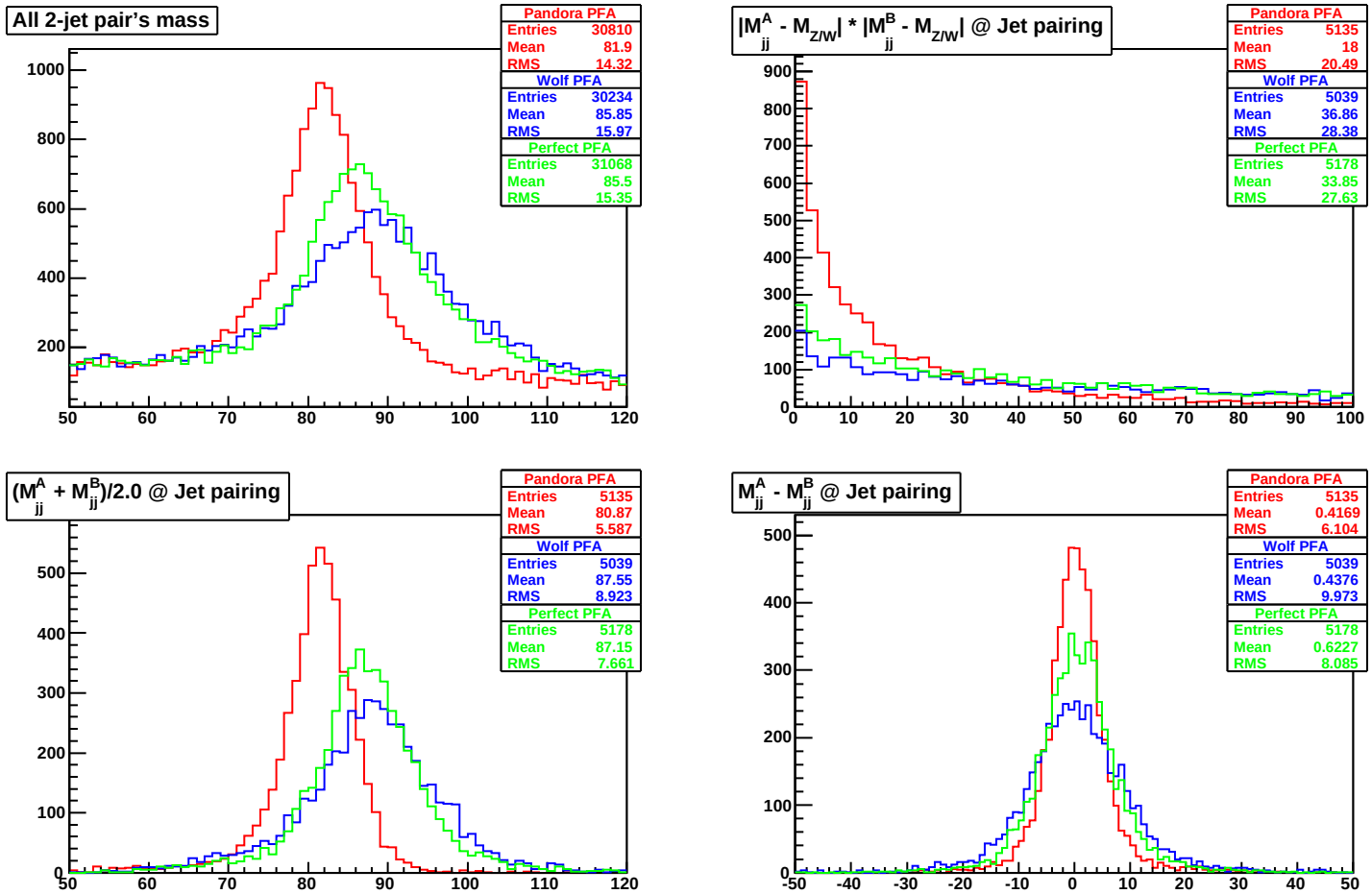






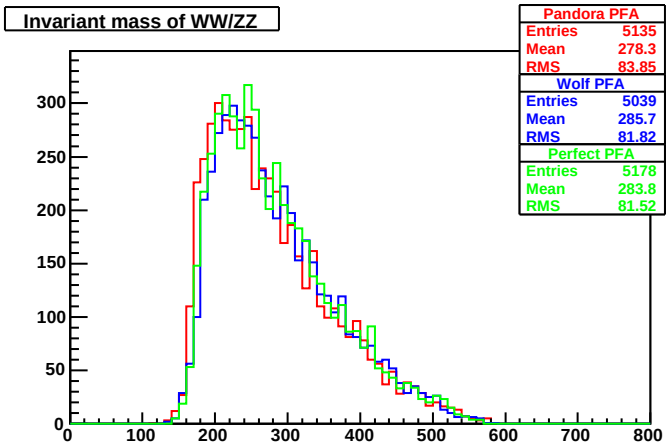


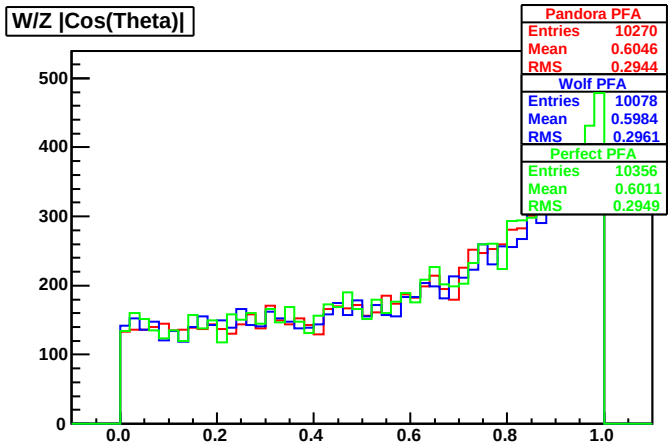
WW: Pandora PFA vs. Wolf PFA

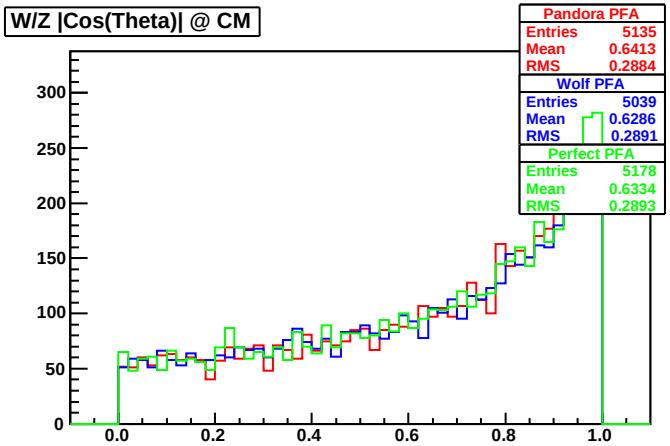


- **W peak @ Wolf PFA ???**

WW: Pandora PFA vs. Wolf PFA

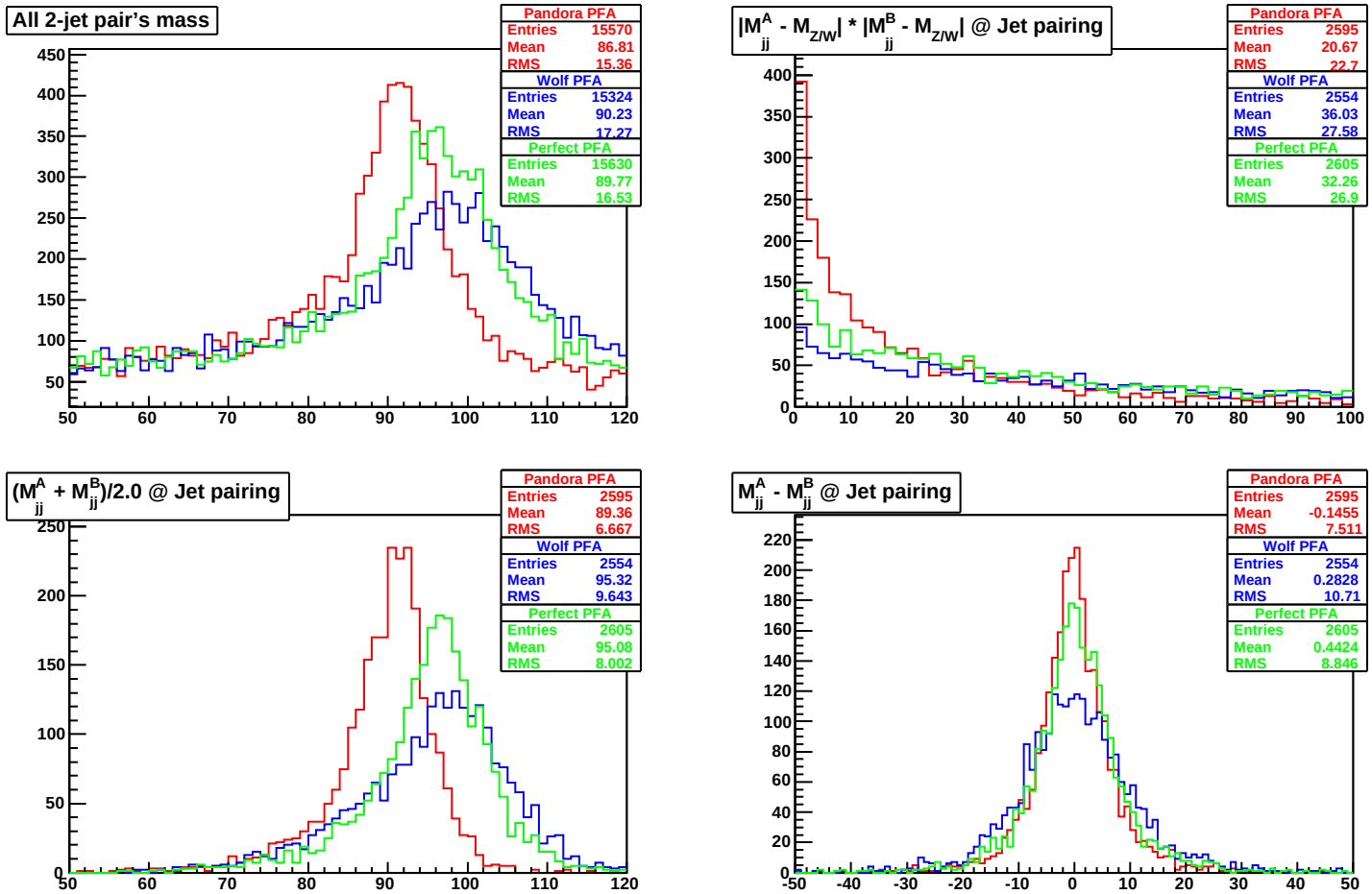






- **Useful plots for α_4 & α_5 fitting**

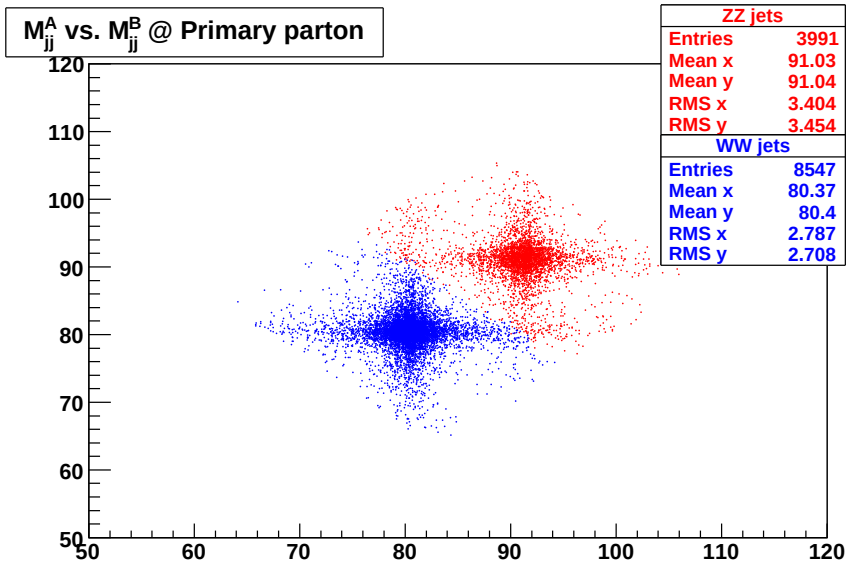
ZZ: Pandora PFA vs. Wolf PFA

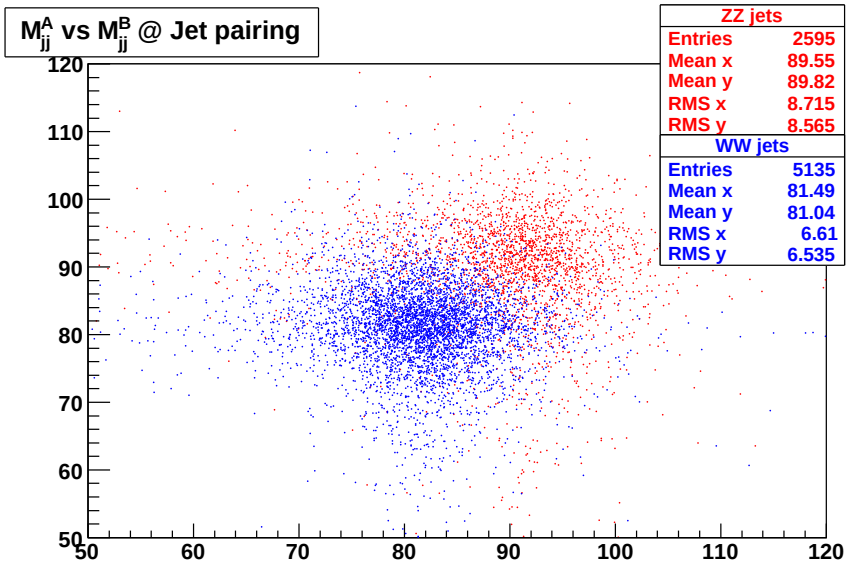


- **Z peak @ Wolf PFA ???**

WW/ZZ separation @ LDC00Sc

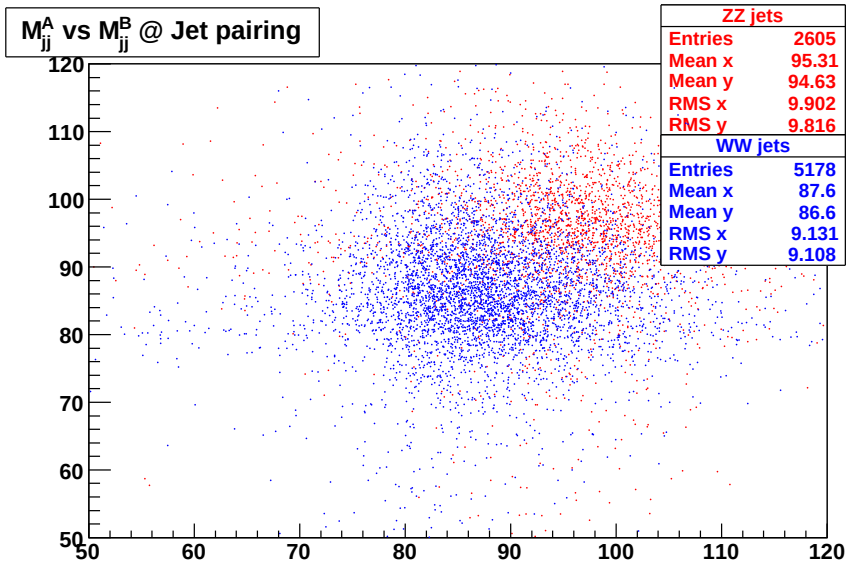
- **WW/ZZ: SAME selection @ detector level**
- **Left: Parton level; Right: Pandora PFA**

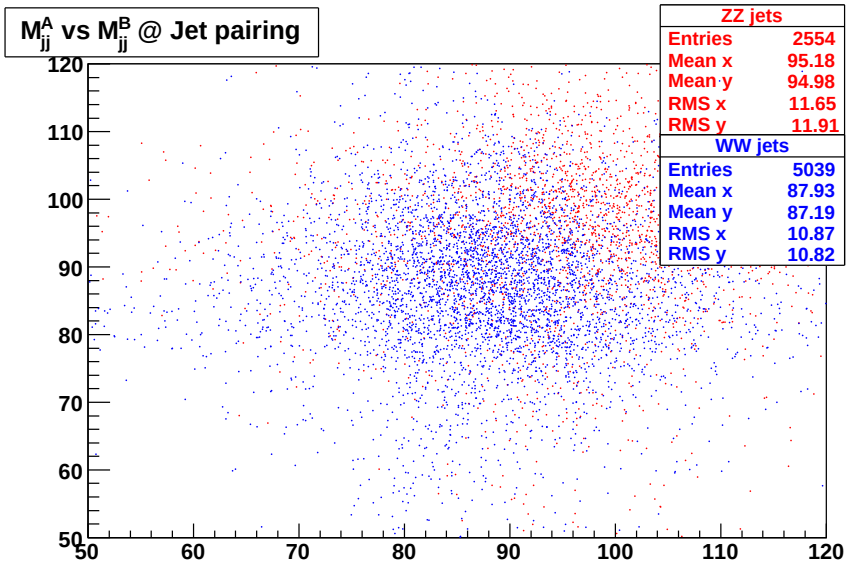




WW/ZZ separation @ LDC00Sc

- **WW/ZZ: SAME selection @ detector level**
- **Left: Perfect PFA; Right: Wolf PFA**





Summary and outlook

- **summary**
  - **calibration constants @ PFAs for LDC00Sc**
  - **compare Pandora PFA, Perfect PFA and Wolf PFA**
  - **ww/zz separation @ LDC00Sc**

- **outlook @ near furture**
  - **understand results by Wolf PFA**
  - **track finding: TrackCheater $\rightarrow$ Track finding**
  - **α_4 & α_5 fitting @ WW scattering**

MC samples @ WW scattering

- **LDC00Sc model & Mokka v6.2**
- $\nu_e\bar{\nu}_e WW$ **&** $\nu_e\bar{\nu}_e ZZ$**: 1000 fb^{-1} @ Whizard**
- $eeWW$**: 500 fb^{-1} @ Whizard**
- $e\nu_e WZ$**: 500 fb^{-1} @ Whizard**
- $t\bar{t} \to X$**: 500 fb^{-1} @ PYTHIA**