Status of WW Scattering

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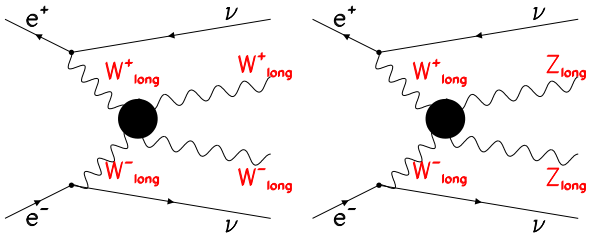
- **WW scattering**
- **Mokka jobs @ grid**
- **Calibration constants @ Pandora PFA**
- **ww/zz separation @ LDC00Sc**
- **Summary and outlook**

WW scattering

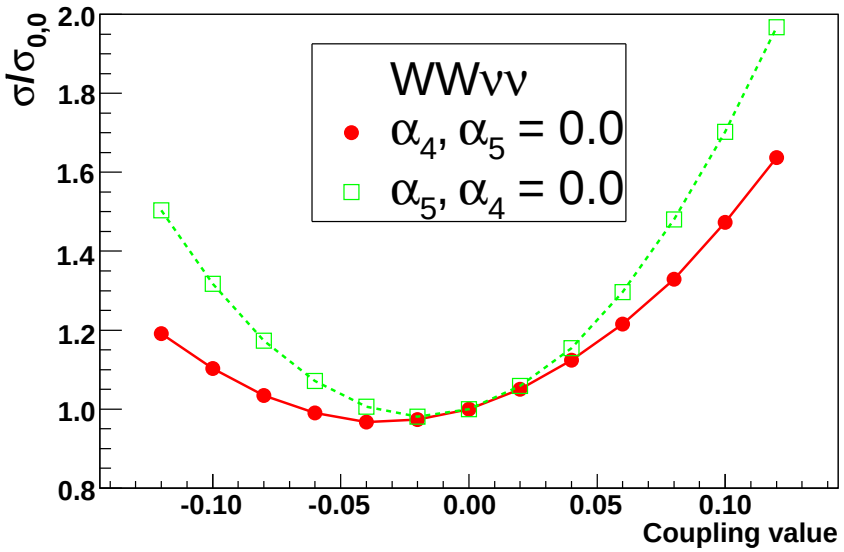
- **WW scattering**

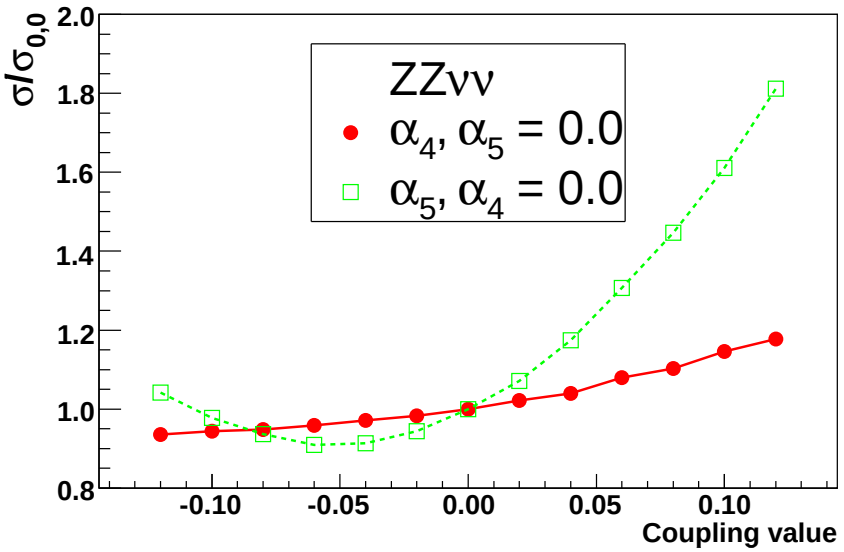


- **Physics parameters: anomalous couplings α_4 & α_5**

- **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**

WW/ZZ @ parton level

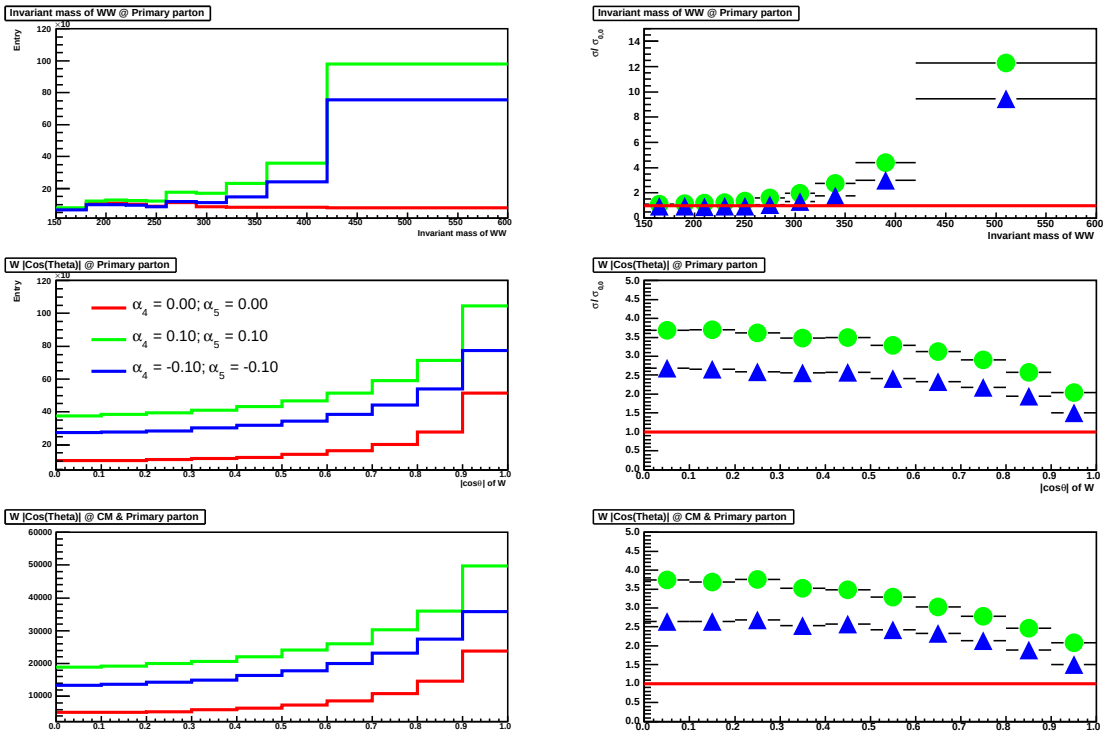




- $WW\nu\nu$ events are more sensitive than $ZZ\nu\nu$ events
- α_5 is more sensitive than α_4

WW/ZZ @ parton level

- **Interesting variables:** $d\sigma/dM_{WW}$, $d\sigma/d\theta_W$, $d\sigma/d\theta^{\star}_W$



WW/ZZ MC production

LC-PHSM-2001-038: 800 GeV @ TESLA

Channel	Events (ZZ$\nu\nu$)	Events (WW$\nu\nu$)
$e^+e^- \to ZZ\nu\nu \to qqqq\nu\nu$	2168 $\pm$ 10	
$e^+e^- \to WW\nu\nu \to qqqq\nu\nu$		5077 $\pm$ 23
$e^+e^- \to qqqq\nu\nu$ (background)	174 $\pm$ 5	509 $\pm$ 8
$e^+e^- \to WZe\nu \to qqqq\nu\nu$	993 $\pm$ 20	1728 $\pm$ 34
$e^+e^- \to ZZe^+e^-, ZZe^+e^- \to qqqq\nu\nu$	250 $\pm$ 60	257 $\pm$ 57
$e^+e^- \to WW/ZZ \to qqqq$	negl.	negl.
$e^+e^- \to t\bar{t} \to X$	143 $\pm$ 20	444 $\pm$ 75
$e^+e^- \to q\bar{q} \to X$	negl.	negl.

- **MC production @ LDC00Sc**
  - $WW\nu\nu, ZZ\nu\nu$: $\sim$ 180k for 8 samples with different (α_4, α_5); OK
  - $WZe\nu$: $\sim$ 40k; OK
  - $t\bar{t} \to X$: $\sim$ 140k; ongoing
  - $WWe^+e^-, ZZe^+e^- \to qqqq\nu\nu$: $\sim$ 100-200k not yet
- $\sim$ 600k @ LDC00Sc, $\sim$ 1800k for LDC01Sc, LDC00, and LDC01

Mokka jobs @ grid

$\sim$ 2400k events !!!, $\sim$ 6 days per 1000 events @ one CPU. use grid

Question: Detector simulation for one sample with 100 jobs @ grid

- **submit one job & and 100 jobs to the grid**
  - **one job: run_mokka.sh and submit_mokka.sh**
  - **100 jobs: "bsh total.sh" $\rightarrow$ job.ids**
- **check job status to the grid**
  - **"bsh count.sh $<$ job.ids"**
- **collect job output from the grid**
  - **"bsh collect.sh $<$ job.ids"**
- **read many small lcio files and write to one lcio file**
  - **"bsh read.sh"**

Calibration constants @ Pandora PFA

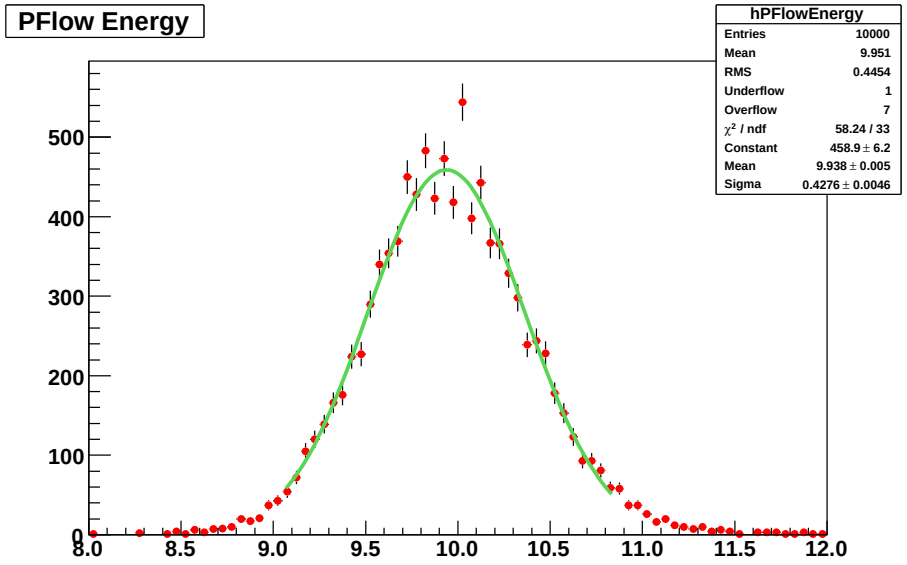
Mark Thomson: ECALEMMIPToGeV, ECALHadMIPToGeV, HCALEMMIPToGeV, HCALHadMIPToGeV

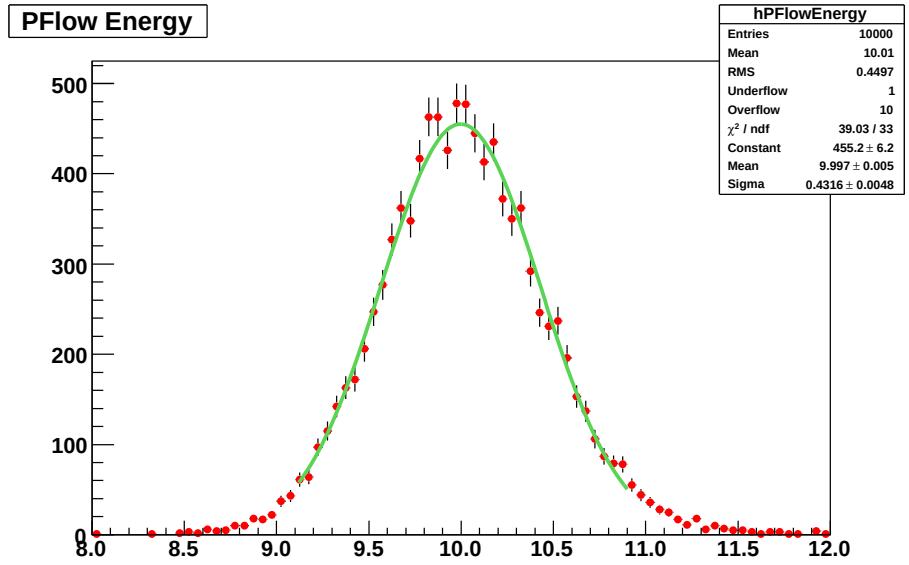
10.0 GeV gamma at IP (0, 0, 0) → ECALEMMIPToGeV

Left plot: input: 0.004785 → Mean: 9.938

Expect: ECALEMMIPToGeV = 0.004785 * 10.0 / 9.938 = 0.004815

Right plot: output: 0.004815 → Mean: 9.997

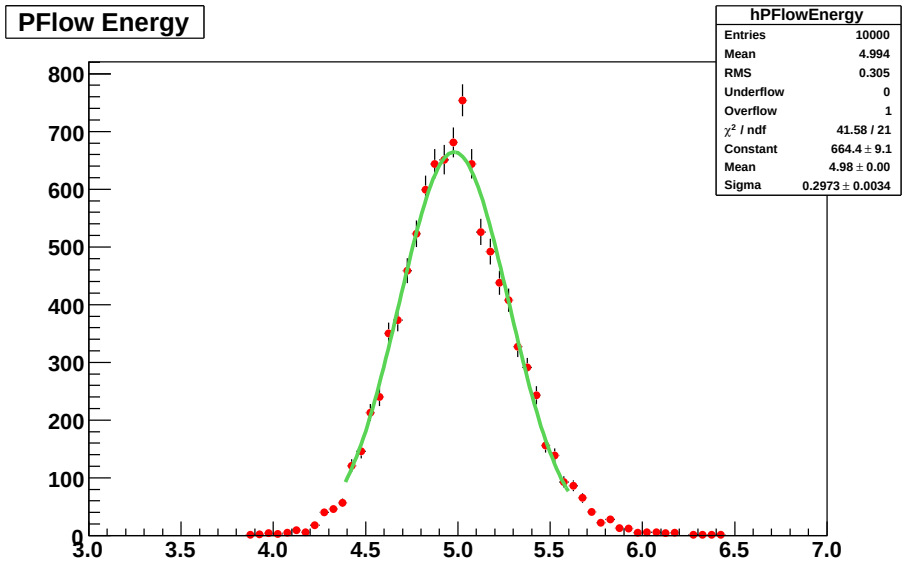


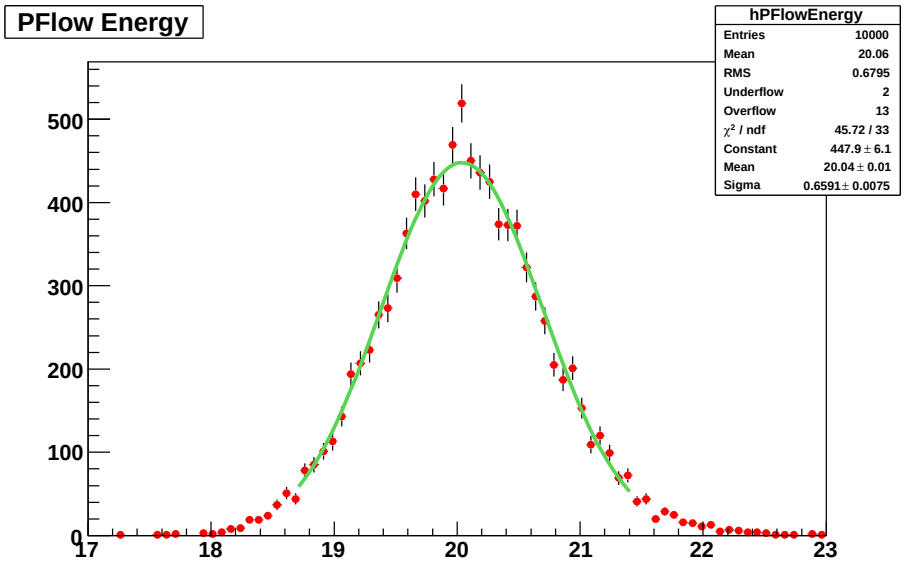


Calibration constants @ Pandora PFA

Left plot: 5.0 GeV gamma; Mean = 4.98

Right plot: 20.0 GeV gamma; Mean = 20.04



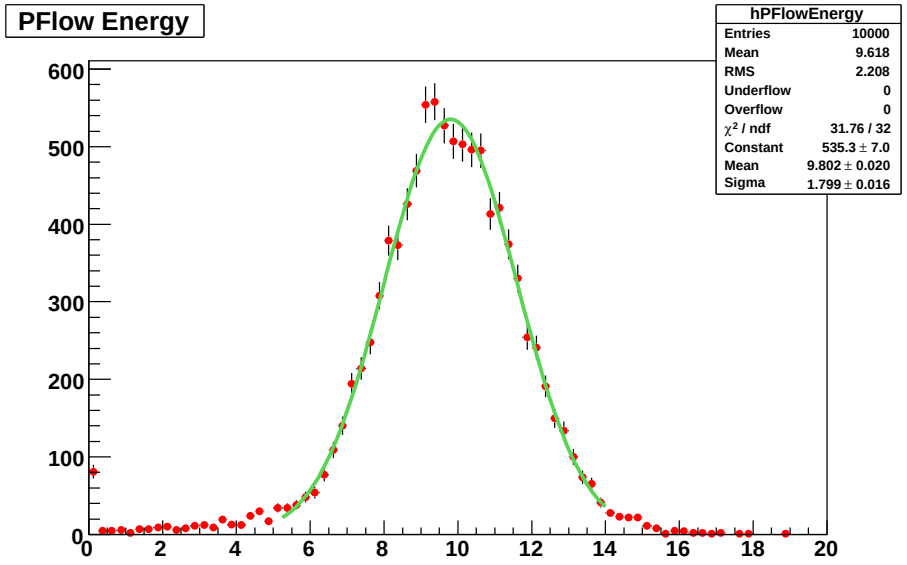


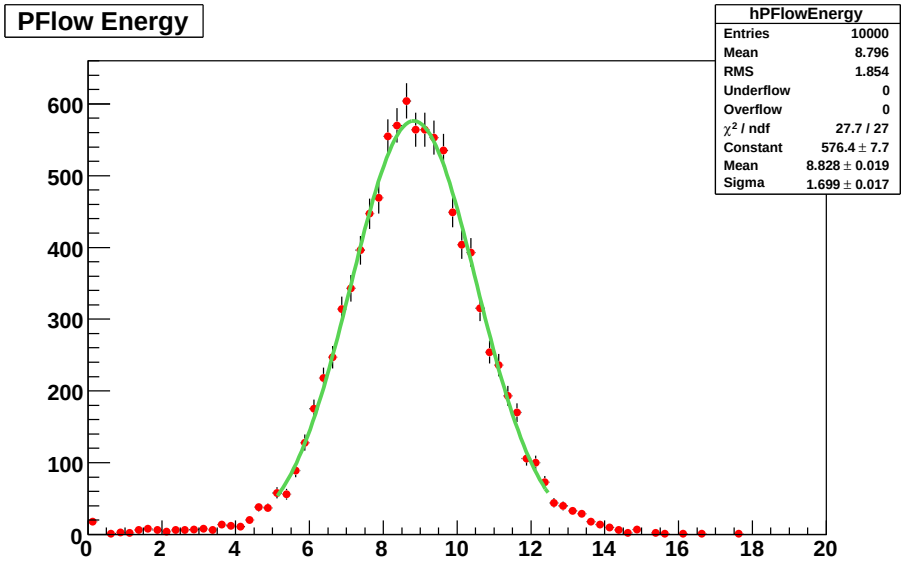
Calibration constants @ Pandora PFA

Left plot: 10.0 GeV klong; Mean = 9.80 GeV

Right plot: 10.0 GeV neutron; Mean = 8.83 GeV

Neutron: effective energy $E_{neutron} - M_{neutron}$ = 9.06 GeV

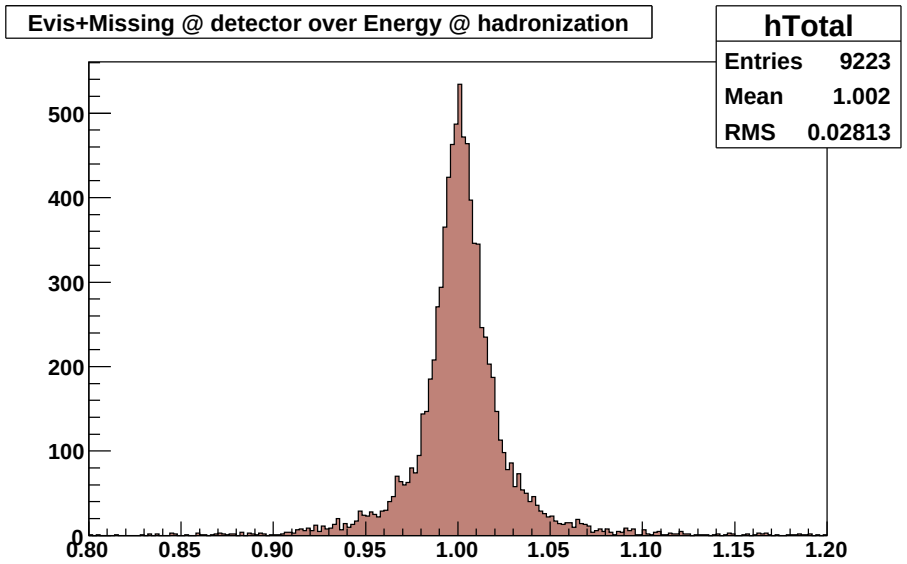


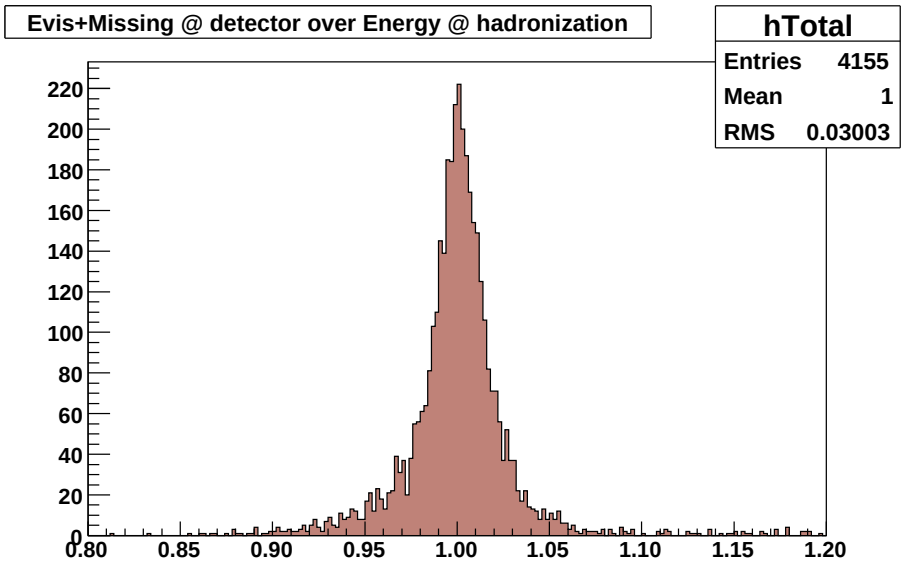


Calibration constants @ Pandora PFA

Left plot: WW$\nu\nu$ @ LDC00Sc Mean = 1.002

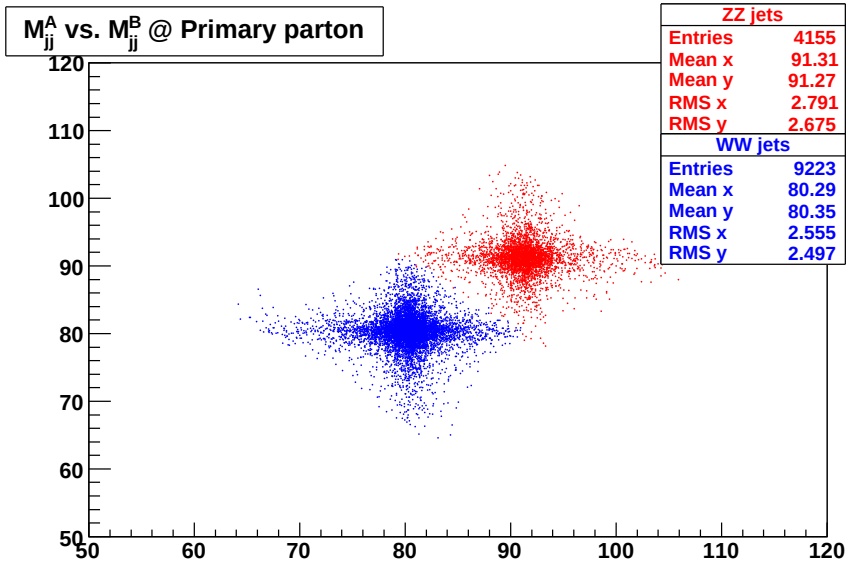
Right plot: ZZ$\nu\nu$ @ LDC00Sc Mean = 1.0

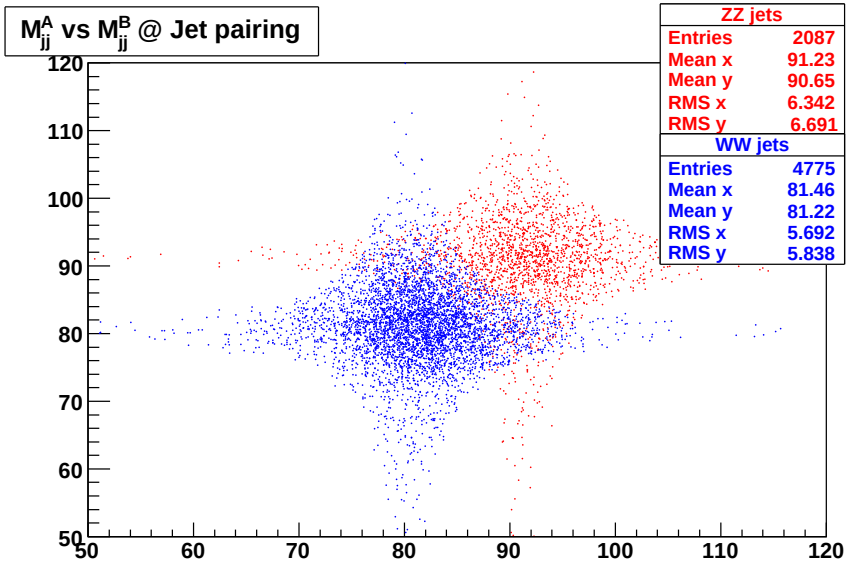




WW/ZZ separation @ LDC00Sc

- **WHIZARD: WW/ZZ events @ 1000 pb^{-1}**
- **WW/ZZ: SAME selection @ detector level**





Summary and outlook

- **summary**
  - **interesting variables @ ww/zz events**
  - **ww/zz MC production**
  - **shell scripts for running mokka jobs at grid**
  - **calibration constants @ Pandora PFA for LDC00Sc**
  - **ww/zz separation @ LDC00Sc**

- **outlook @ near furture**
  - **run new version Pandora PFA**
  - **run WOLF PFA**
  - **ww scattering @ LDC01Sc**
  - e^+e^-WW, e^+e^-ZZ **production**