Primary Vertex Selection

Ariel Schwartzman

Meenakshi Narain

DØ Global tracking and vertexing
Collaboration Meeting
26 April 2001

Outline:

- Introduction
- Primary vertex reconstruction in $t\bar{t}$, $z \rightarrow b\bar{b}$ and $z \rightarrow \tau\bar{\tau}$
- Discriminant variables and correlations for signal and minimum bias interactions.
- Efficiencies.
- Conclusions

Introduction

Primary Vertex Reconstruction at DØ

- Tear-down algorithm applied to all tracks with significance smaller than 3. Output stored in PRIMARY_RECO VertexCollChunk
- Selection algorithm finds the hard scatter vertex and "true" min bias vertices (remove fakes). Output stored in PRIMARY VertexCollChunk such that the first vertex in the chunk corresponds to the hard interaction.

The selected vertex is used for jet reconstruction and Pid

In p08, the selection criteria was:

- select the vertex with highest $\sum p_t$ and track multiplicity greater than 2 as Primary vertex
- select min bias vertices if
  1. separation along $z > 500\mu m$
  2. $\sum p_t > 5GeV$

This method works very good in $t\bar{t}$ events, but B-physics and tau-id gropus found a very low efficiency $z \rightarrow b\bar{b}$ or $z \rightarrow \tau\bar{\tau}$

Introduction

For p09 we optimized the selection algorithm for different physics process looking at vertex properties. The next step is to build a Likelihood.

How to distinguish PV from min bias? p_t spectrum for PV tracks wider than for min bias $\rightarrow$ weight high p_t tracks more.

Discriminat variables

- $\sum p_t$
- highest p_t track
- 2^{nd} highest p_t track
- $\sum \log p_t$

Montecarlo Samples

- 800 $t\bar{t}$, $zb\bar{b}$ and $z\tau\bar{\tau}$ events
- p05.00.04
- p08.03.00

Reconstructed vertices were matched (at least 2 gtracks in common) with MC vertices and RECO information was used for this analysis.

Primary vertex reconstruction efficiency

	$t\bar{t}$	$zb\bar{b}$	$z\tau\bar{\tau}$
acceptance region	0.926	0.949	0.828
central region	0.987	0.970	0.897
central region (3tracks)	0.996	0.985	0.976

Acceptance Region

- $|z| < 80cm$
- $p_t > 0.5GeV$
- $|\eta| < 3$

Central Region

- $|z| < 40cm$
- $p_t > 0.5GeV$
- $|\eta| < 3$

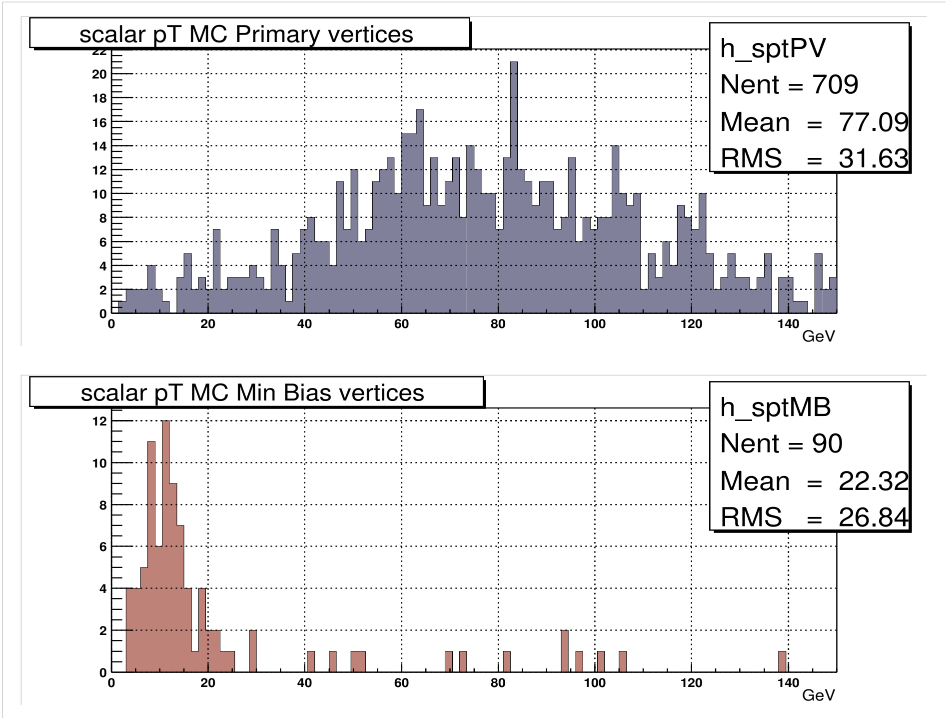
Central Region (3 tracks)

- MC vertex in central region with multiplicity greater than 2

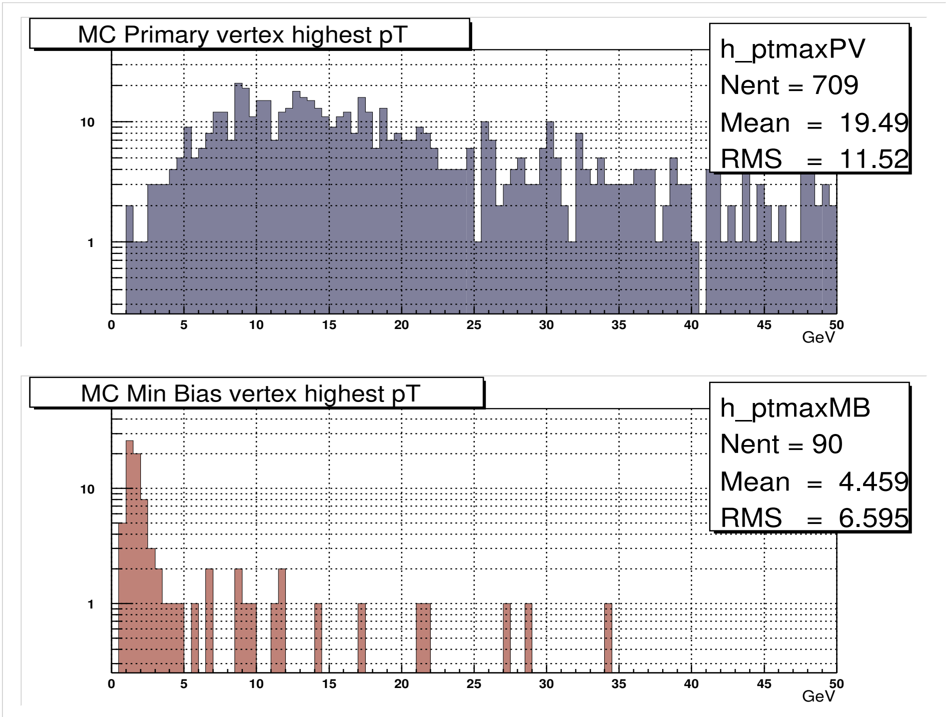
RECO-MC vertex matching: at least 2 tracks in common.

$t\bar{t}$ vertices (I)

$\sum p_t$

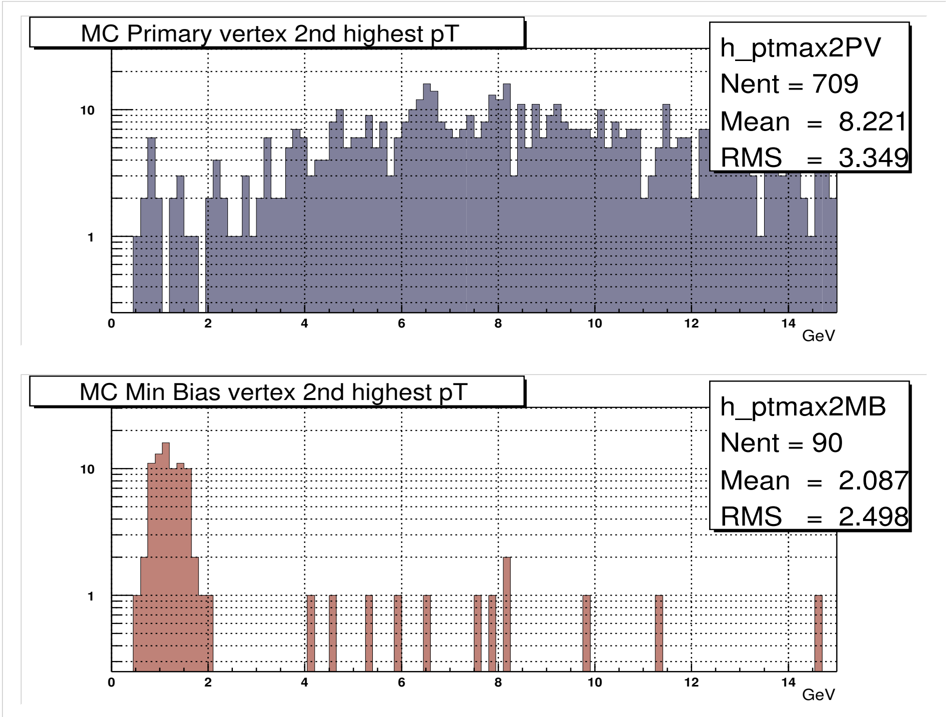


highest p_t

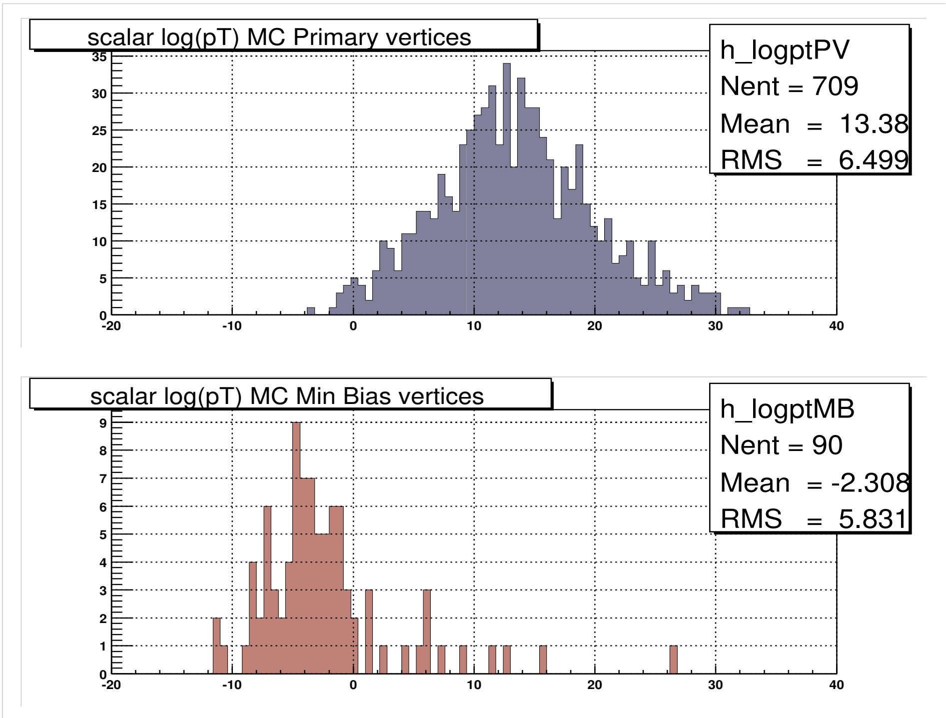


$t\bar{t}$ vertices (II)

2^{nd} *highest* p_t

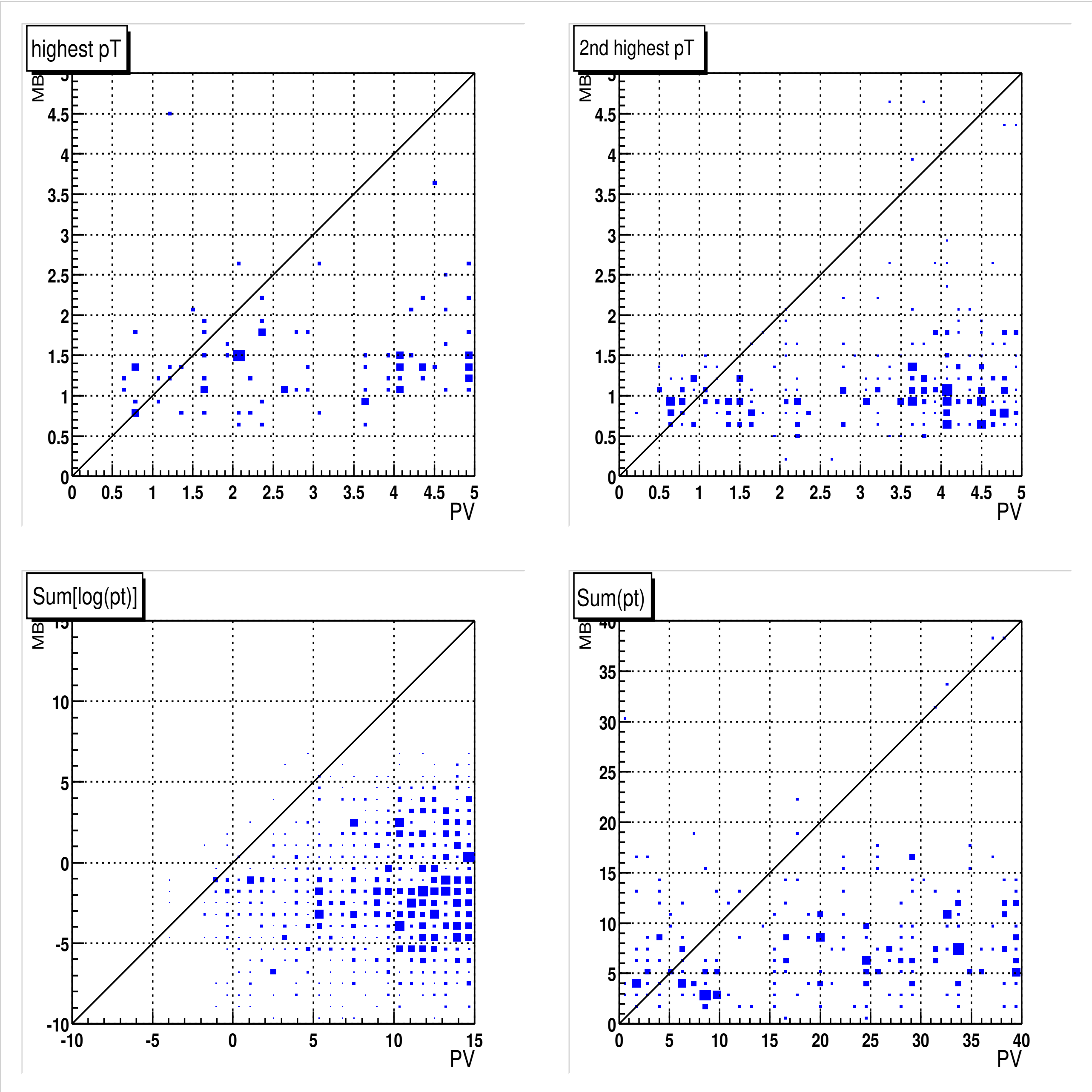


$\sum \log p_t$



$t\bar{t}$ vertices (III)

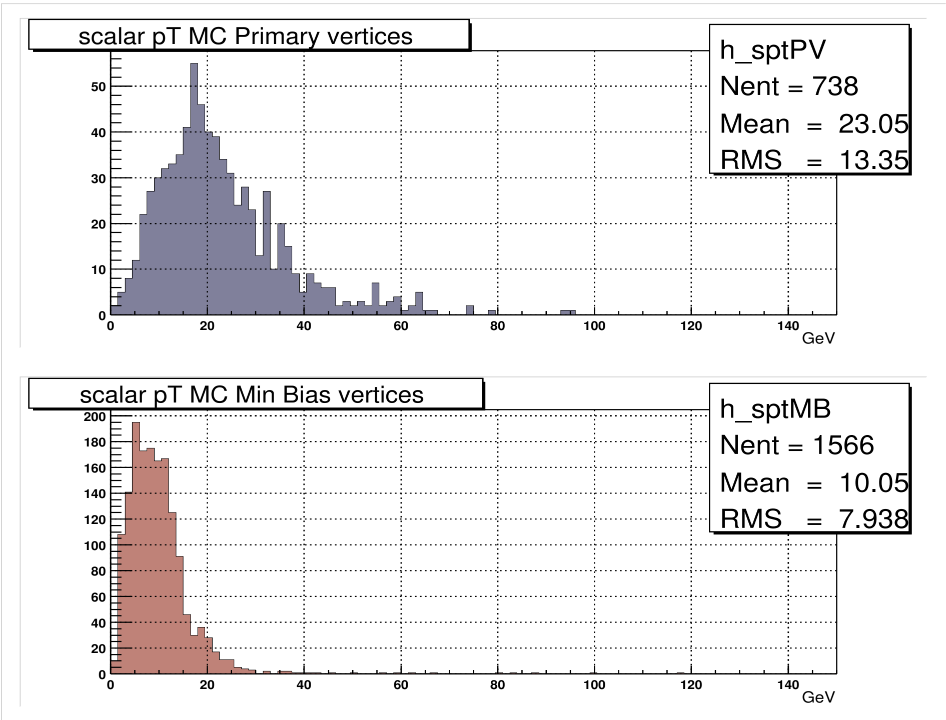
PV - MB correlations



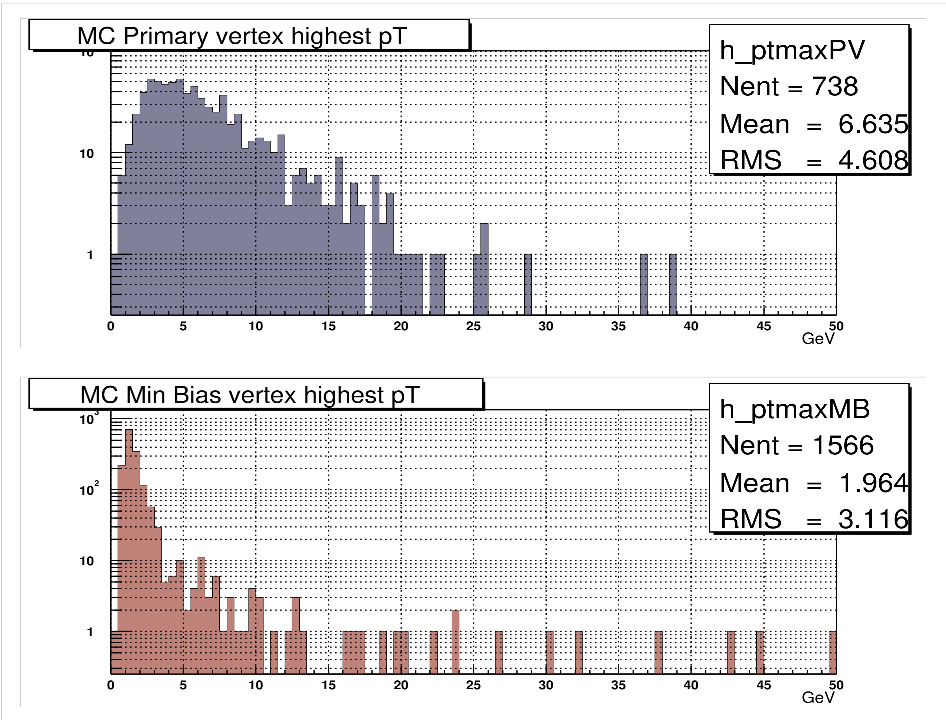
for each PV (x-axis), all MB in y-axis

$zb\bar{b}$ vertices (I)

$\sum p_t$

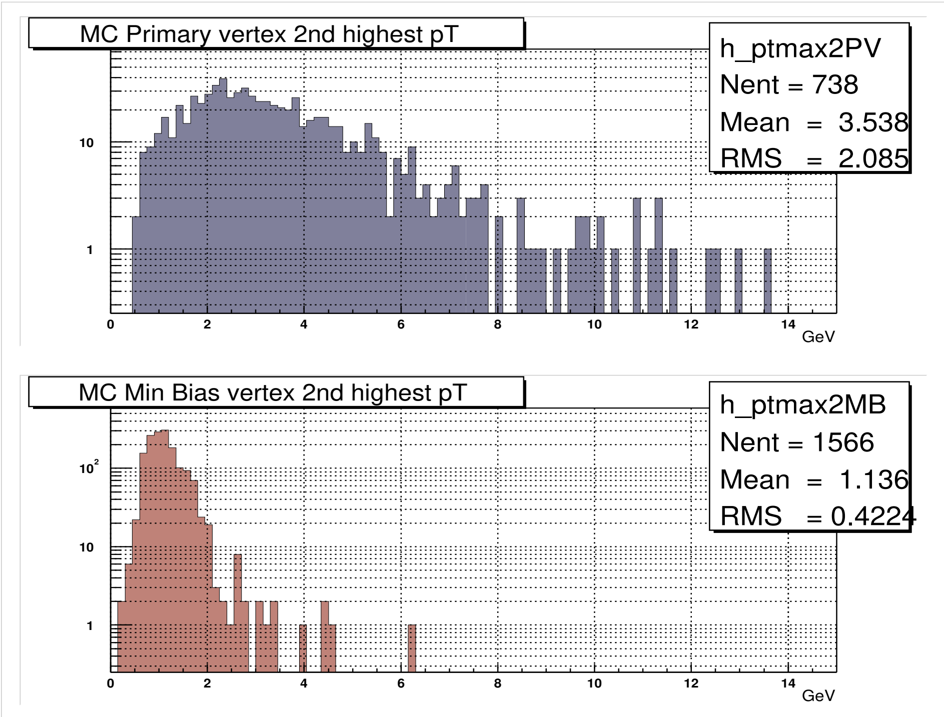


highest p_t

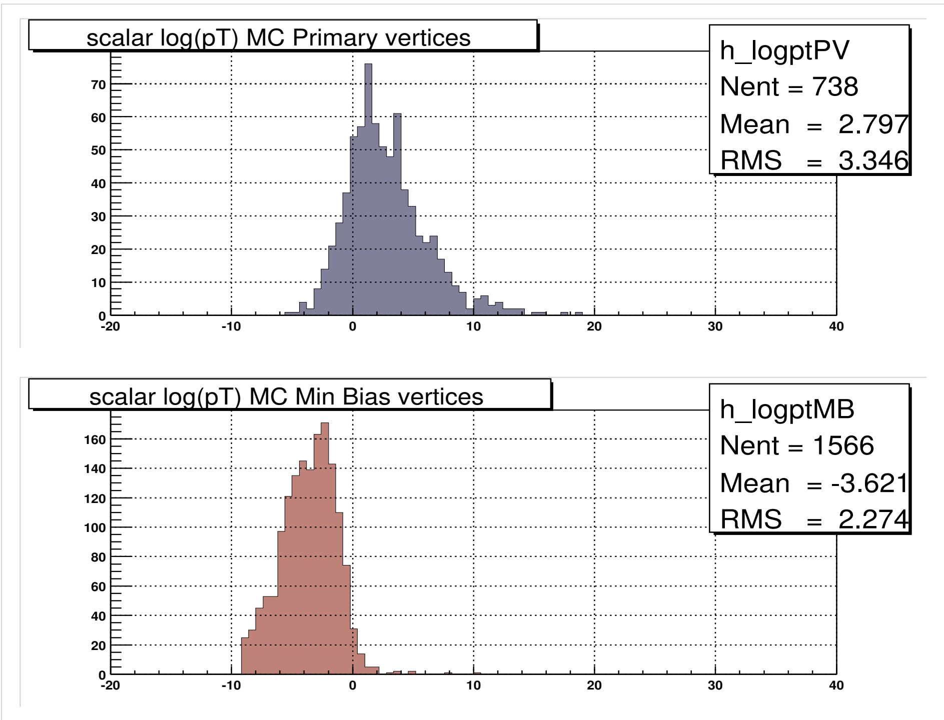


$zb\bar{b}$ vertices (II)

2^{nd} *highest* p_t

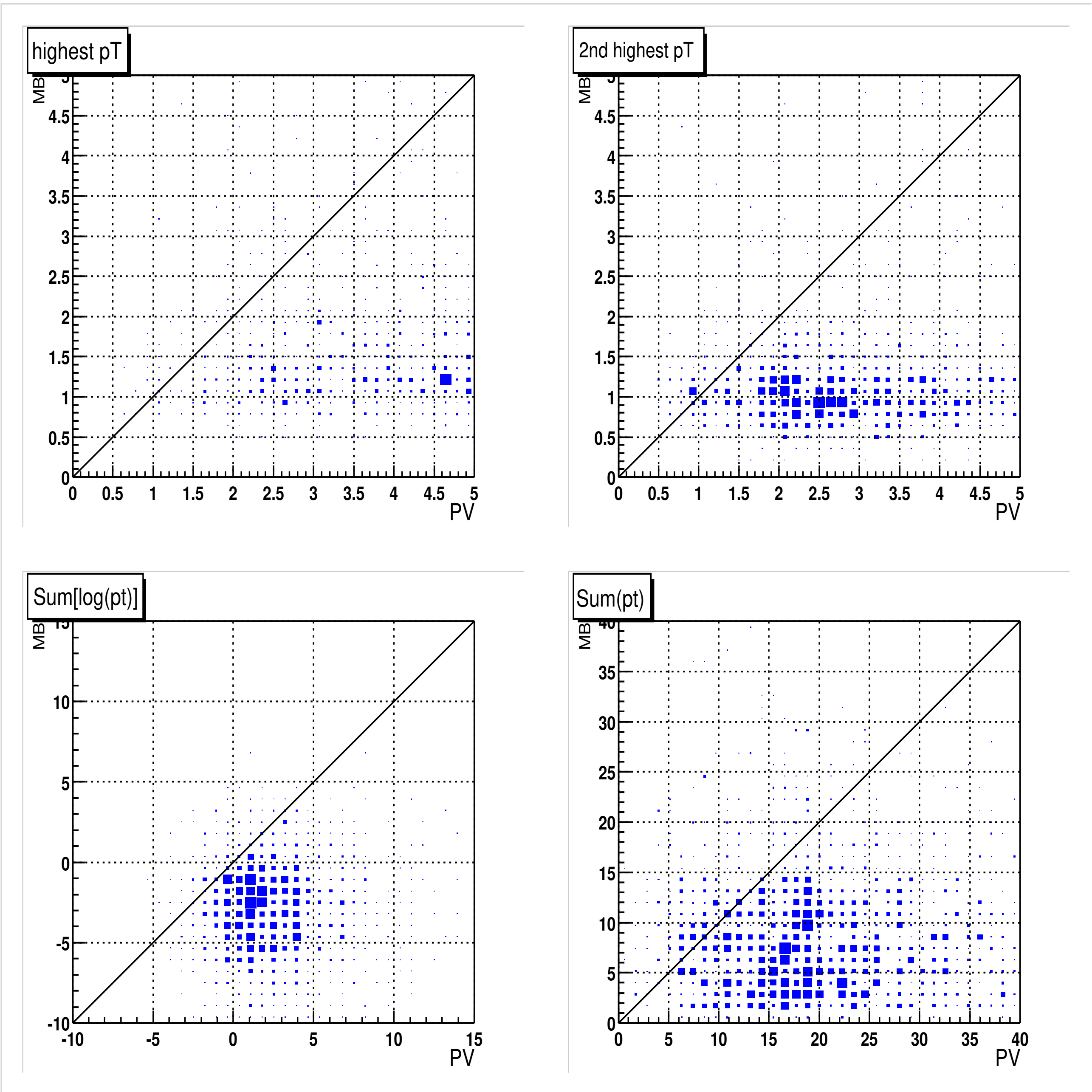


$\sum \log p_t$



$zb\bar{b}$ vertices (III)

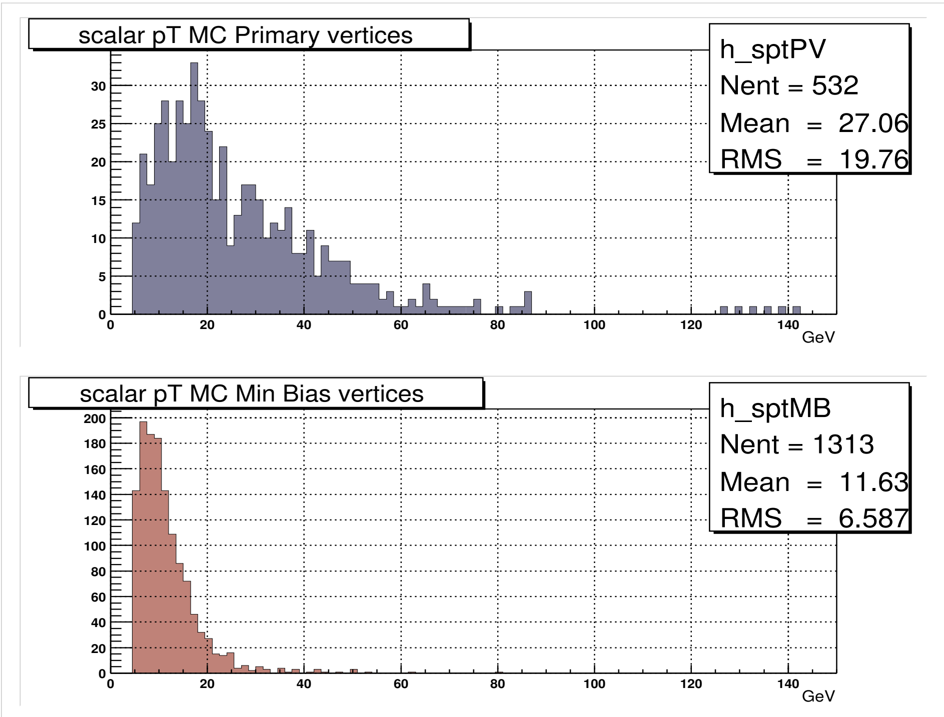
PV - MB correlations



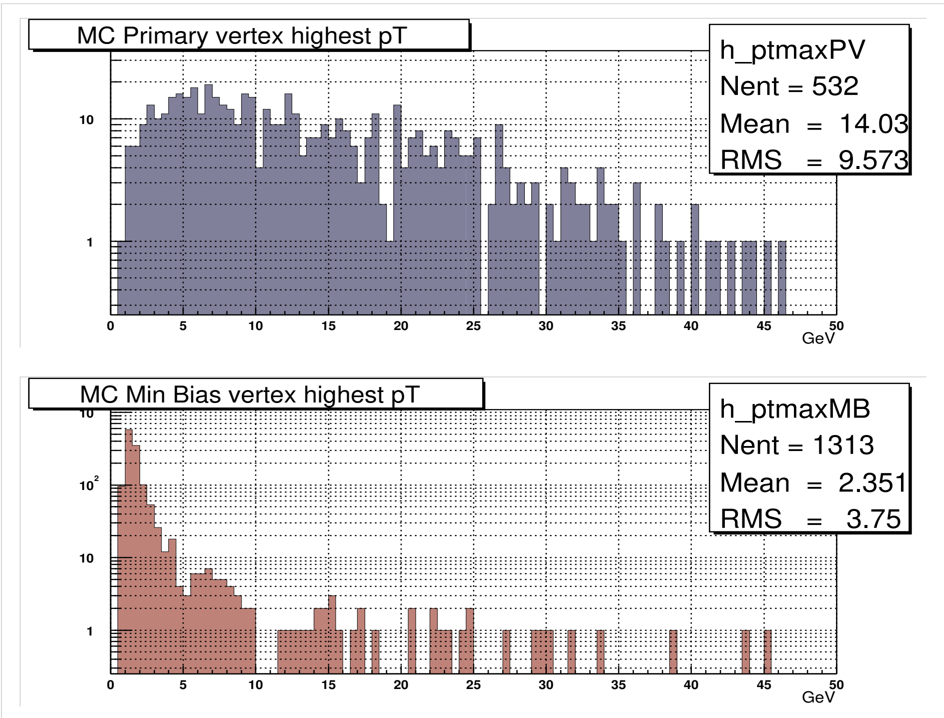
for each PV (x-axis), all MB in y-axis

$z\tau\bar{\tau}$ vertices (I)

$\sum p_t$

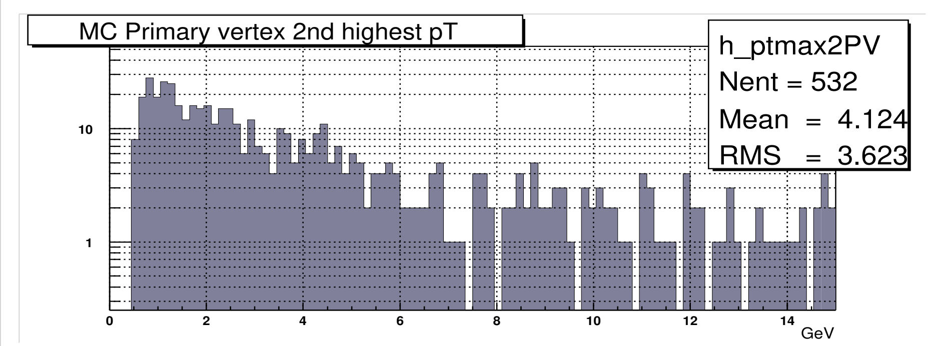


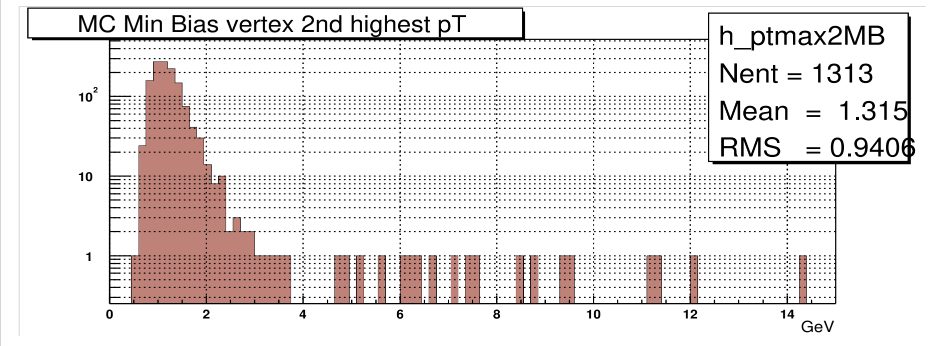
highest p_t



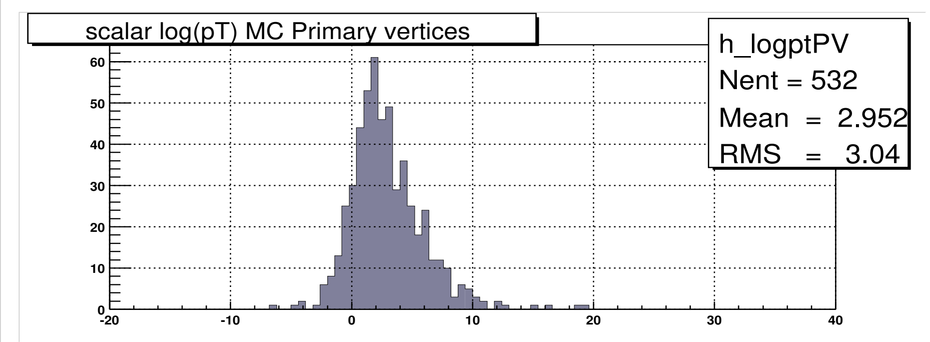
$z\tau\bar{\tau}$ vertices (II)

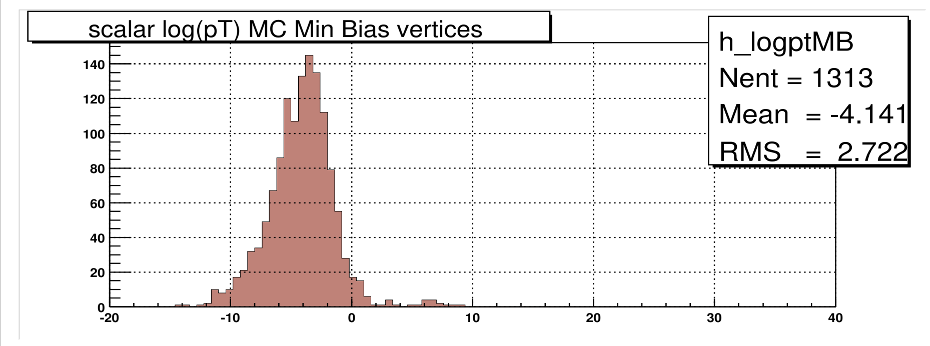
2^{nd} *highest* p_t





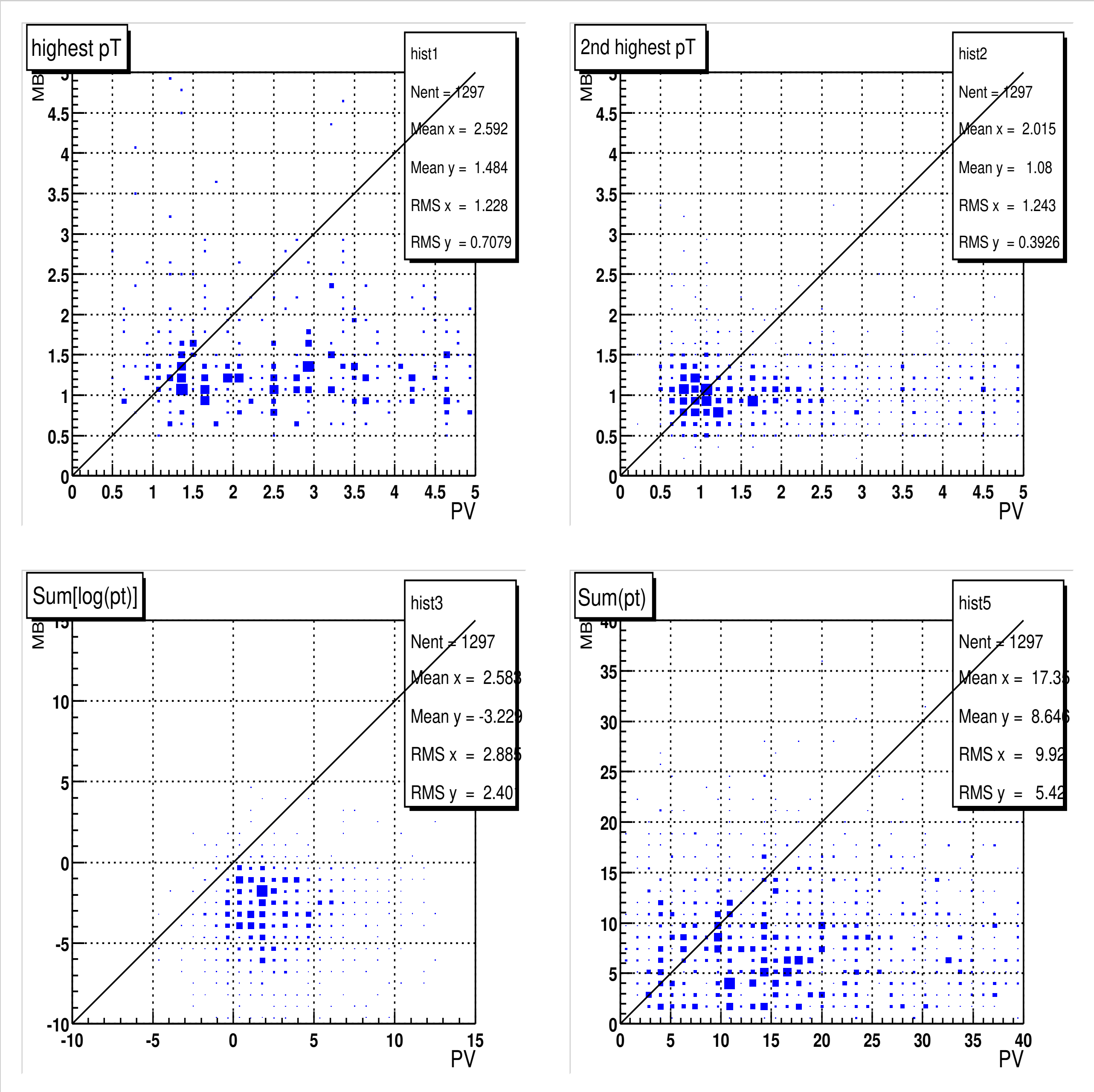
$\sum \log p_t$





$z\tau\bar{\tau}$ vertices (III)

PV - MB correlations



for each PV (x-axis), all MB in y-axis

Efficiencies

- $t\bar{t}$

	$\sum p_t$	$highest \quad p_t$	$2^{nd} \quad highest \quad p_t$	$\sum \log p_t$
central region	0.971	0.878	0.968	0.974
found by reco	0.984	0.890	0.981	0.987

- $zb\bar{b}$

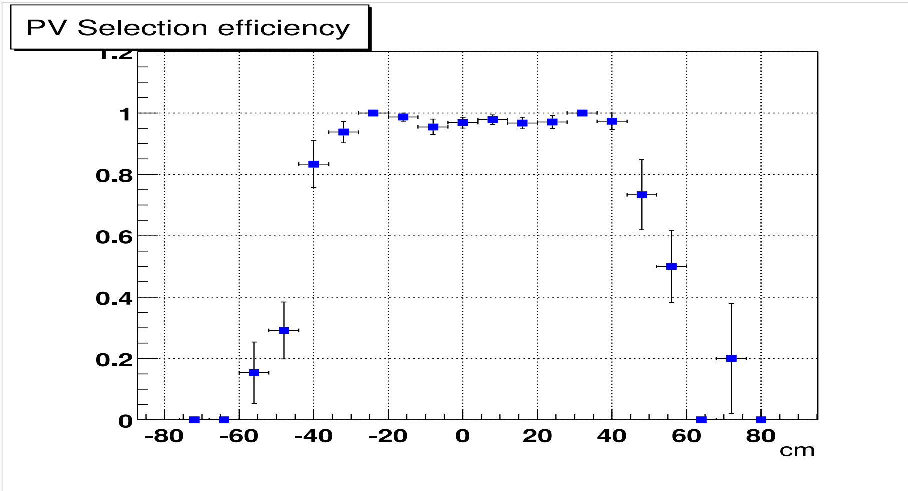
	$\sum p_t$	$highest \quad p_t$	$2^{nd} \quad highest \quad p_t$	$\sum \log p_t$
central region	0.737	0.777	0.855	0.823
found by reco	0.759	0.801	0.881	0.849

- $z\tau\bar{\tau}$

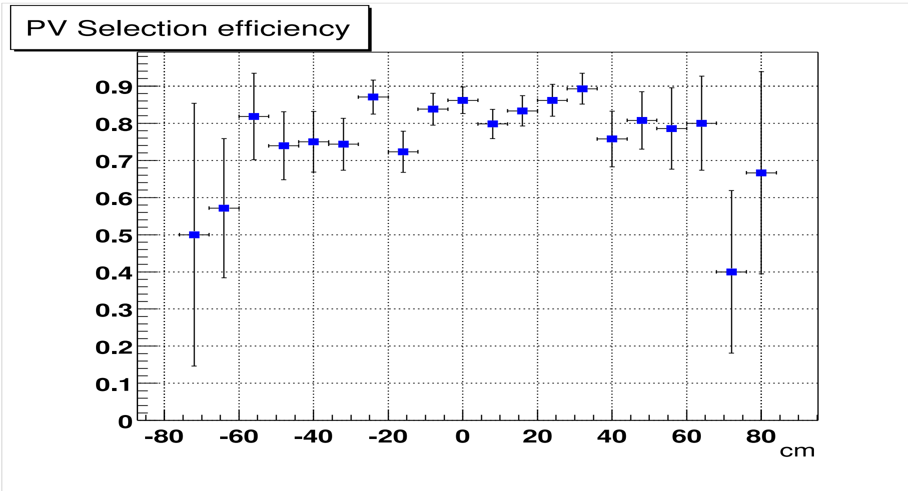
	$\sum p_t$	$highest \quad p_t$	$2^{nd} \quad highest \quad p_t$	$\sum \log p_t$
central region	0.708	0.802	0.693	0.827
found by reco	0.790	0.894	0.773	0.922

Efficiencies vs. Z

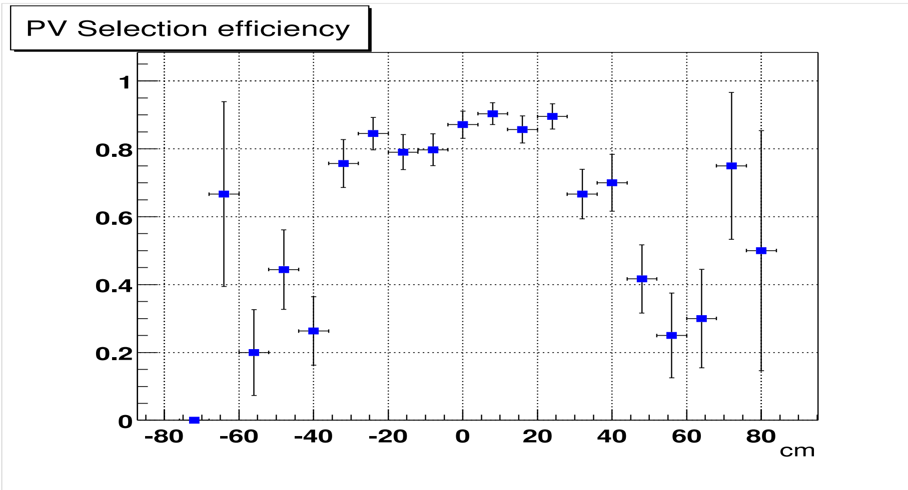
- $t\bar{t}$



- $zb\bar{b}$



- $z\tau\bar{\tau}$



Summary

- $\sum \log p_t$ improves the primary vertex selection efficiency for all samples analyzed. The greatest improvement is for $z\tau\bar{\tau}$ (12 percent)
- Next: Likelihood method.