Study of Primary Vertex Reconstruction in ATLAS

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Overview

- The ATLAS Detector
- PV distributions in data at E_{cm} = 7 TeV
- Study of PV reconstruction efficiency in simulation with pile-up
  - $\langle n_{PU} \rangle$ = 5 and W->τν signal
  - $\langle n_{PU} \rangle$ = 2 and Jet-Jet signal

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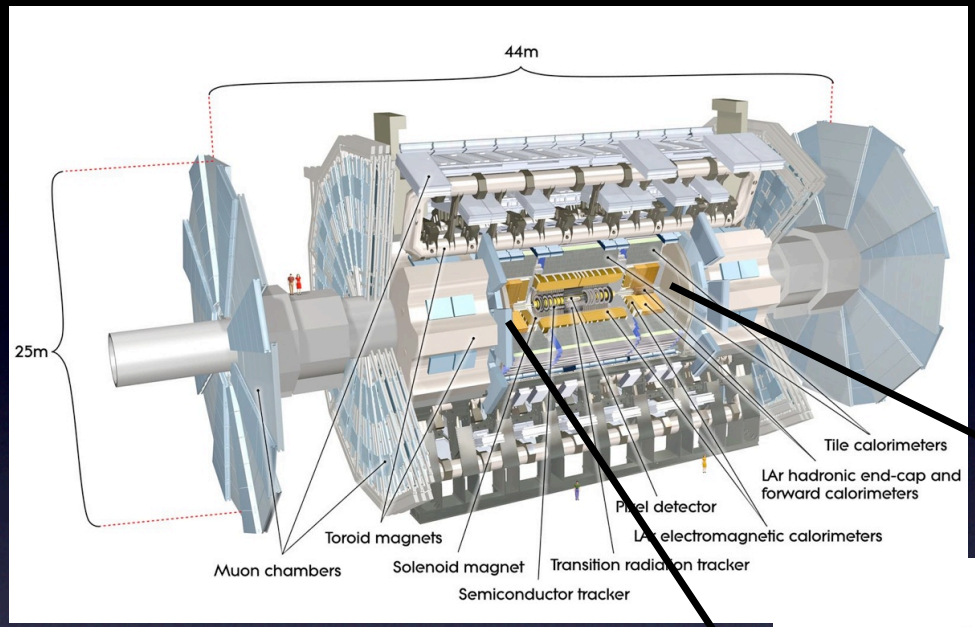
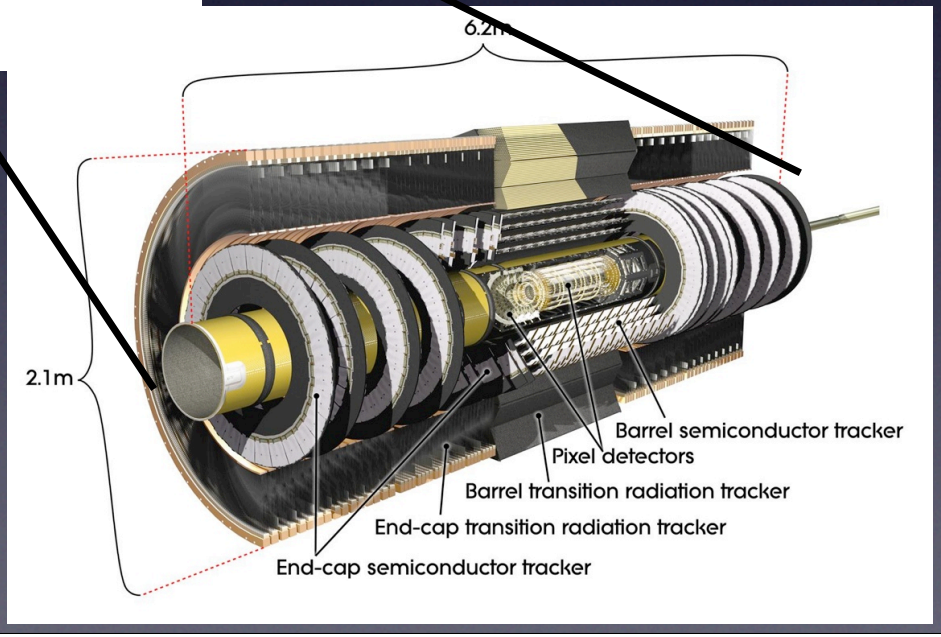
The ATLAS Detector





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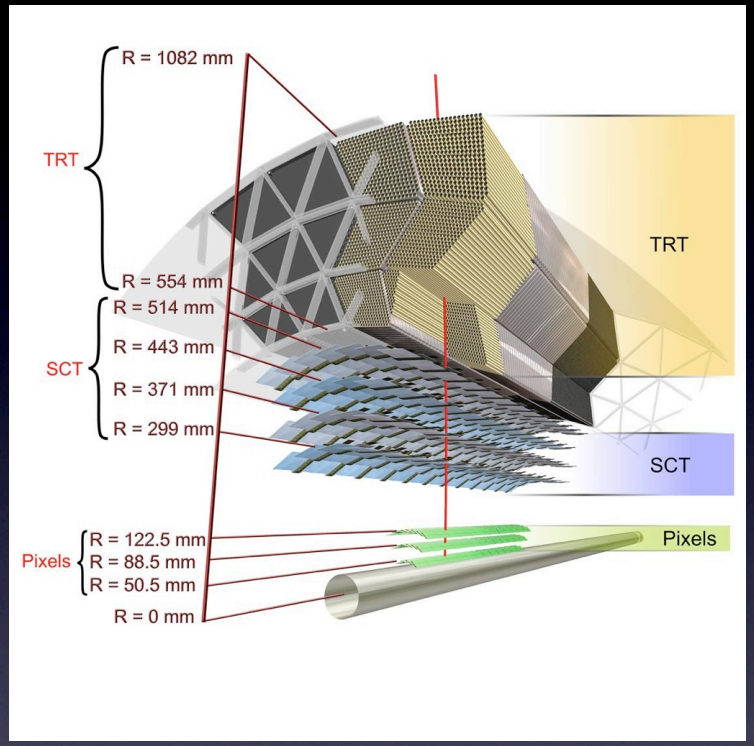
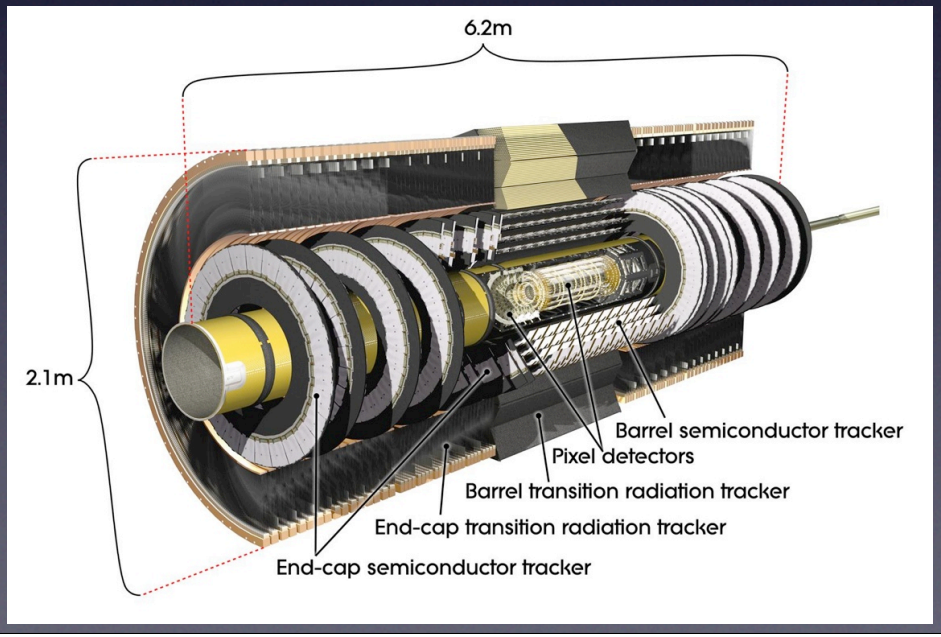
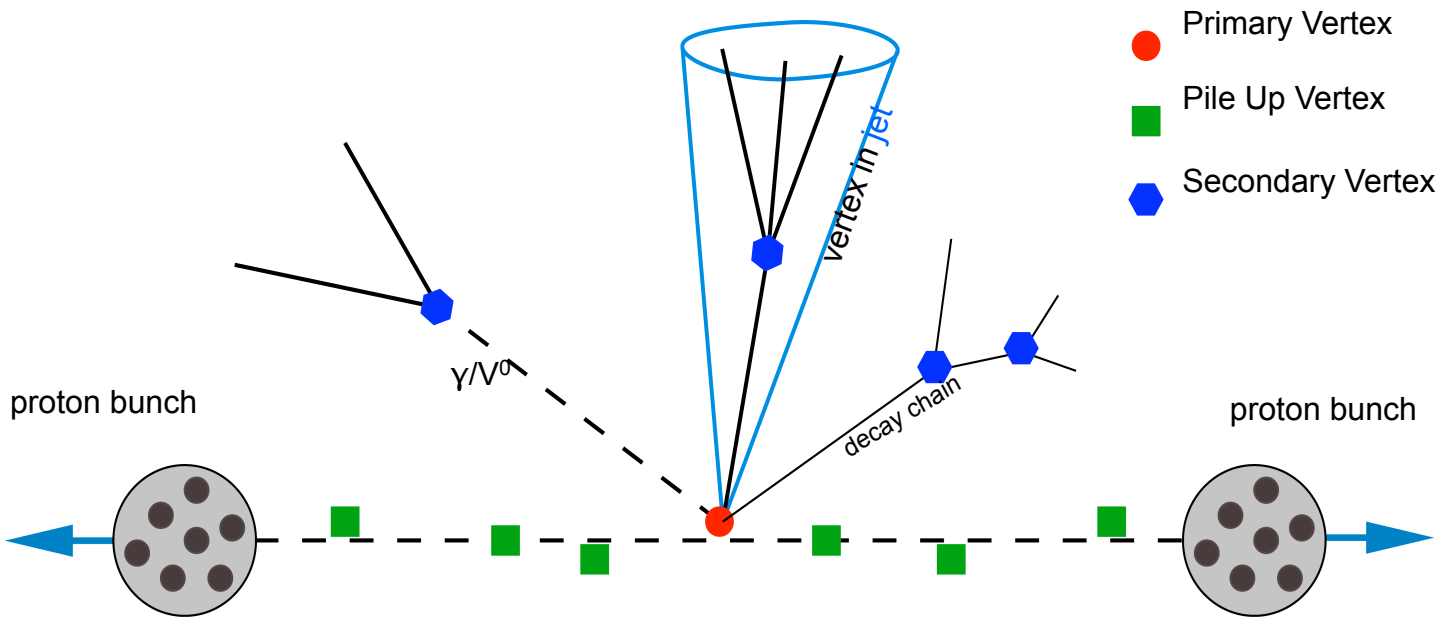




Vertex Reconstruction

- After the collision, different vertex topologies are produced:



- All are important for combined reconstruction and physics analyses
- My project: study reconstruction of primary and pile up vertices

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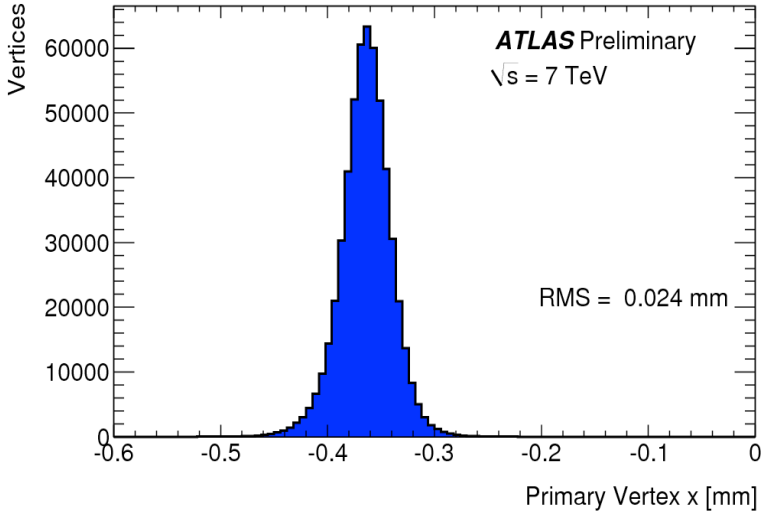
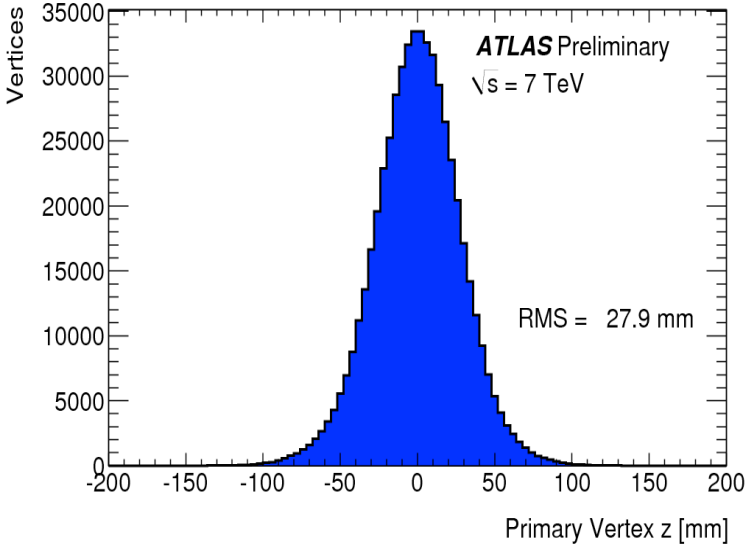
Primary Vertex Dist.

Example distributions of x and z coodination in 7 TeV data



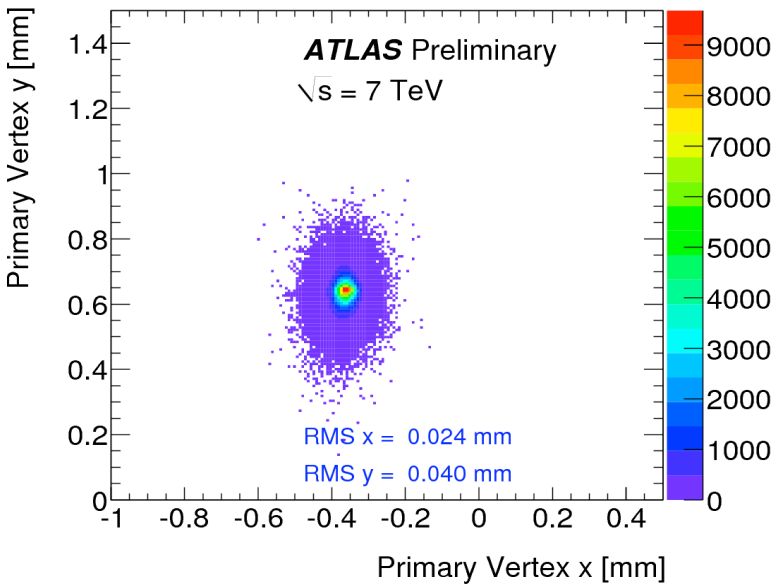
Position of primary vertex in X

Position of primary vertex in Z

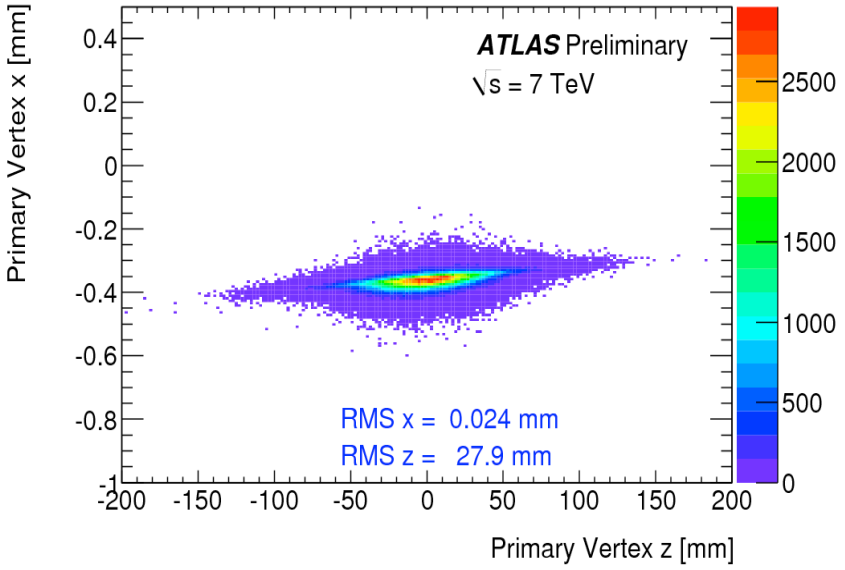


PV in x-y and x-z

- Primary vertex reconstruction is also input to measure the "luminous region" (i.e. beam spot) of the pp collision in ATLAS
- E.g. x-y and x-z scatter plots of the primary vertices in 7 TeV data



Scatter plot x-y plane



Scatter plot x-z plane
A tilt of the luminous region is observed (and expected)

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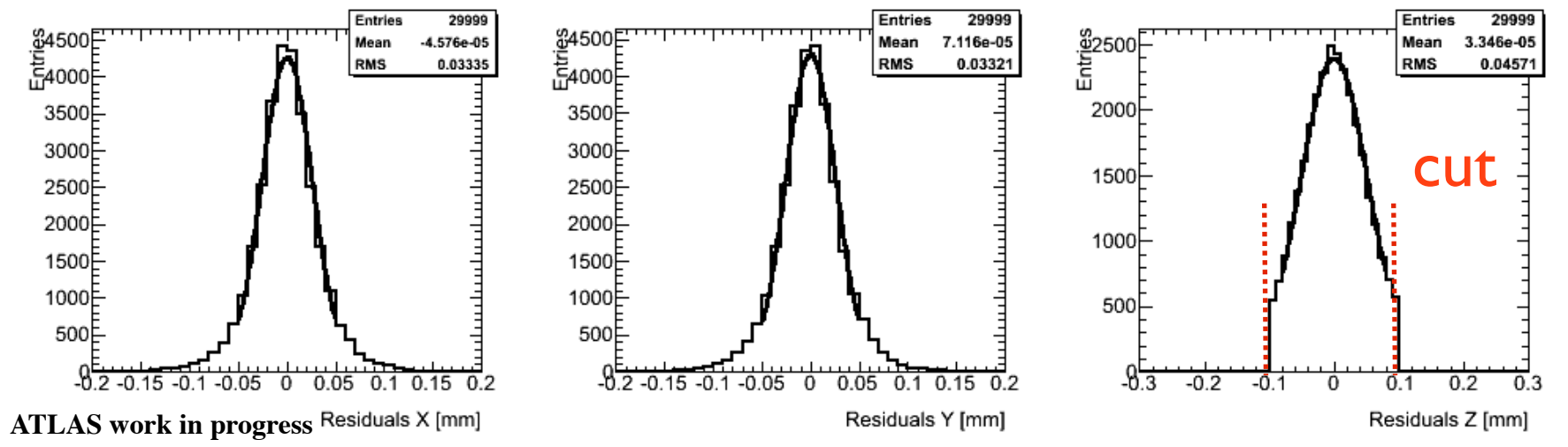
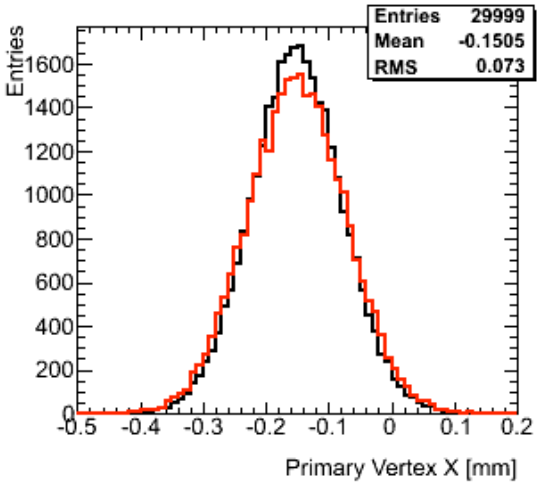
W->τν Residuals (reco - truth)

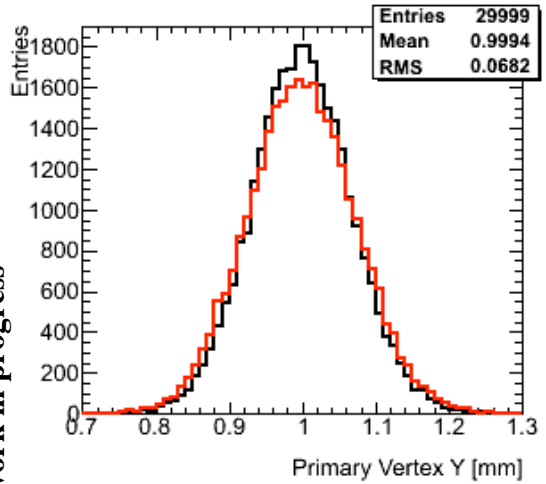


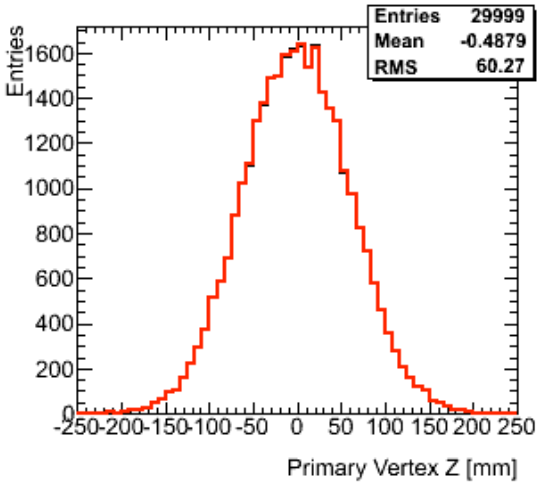
[mm]	x	y	z
mean	-1.23×10^{-4}	2.62×10^{-5}	-1.66×10^{-4}
σ	2.61×10^{-2}	2.58×10^{-2}	5.23×10^{-2}

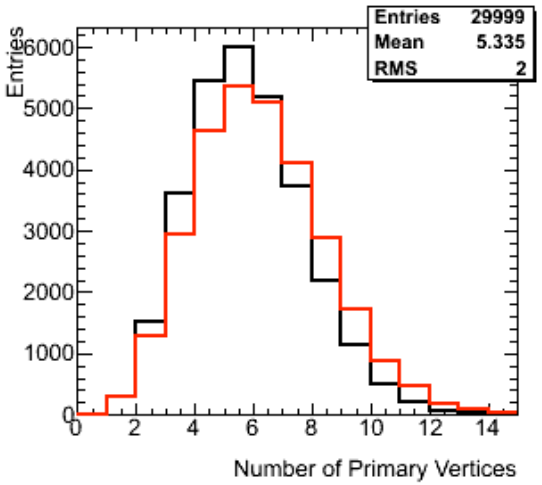
Define PV as properly reco'ed if: $z_{rec} - z_{truth} < 100\mu m$

W->τν
MonteCarlo Simulation







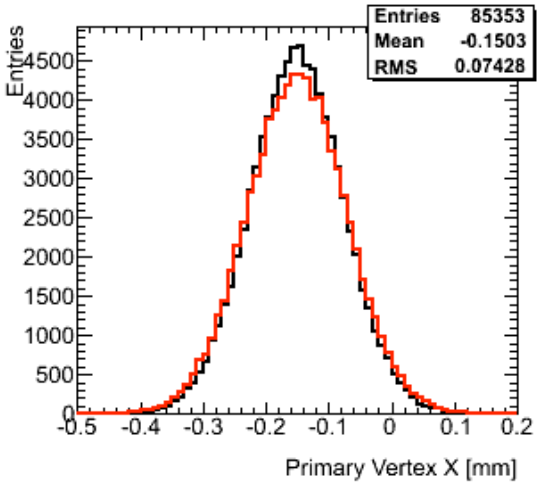


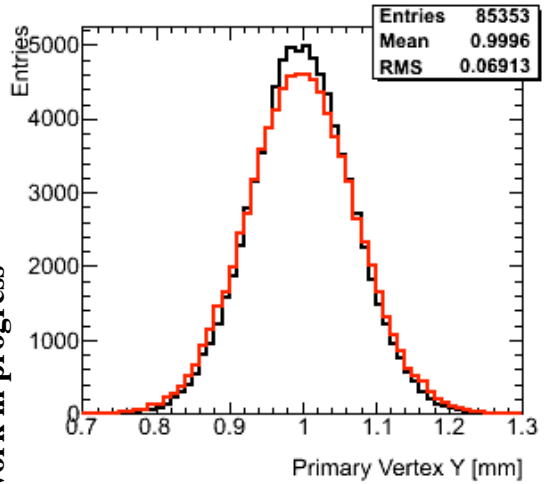
ATLAS work in progress

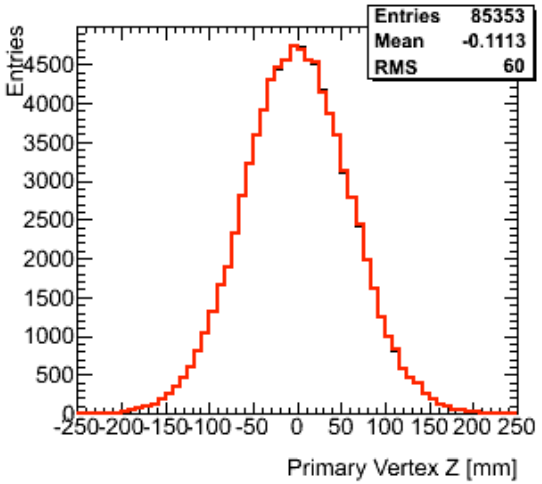
black line = true PV

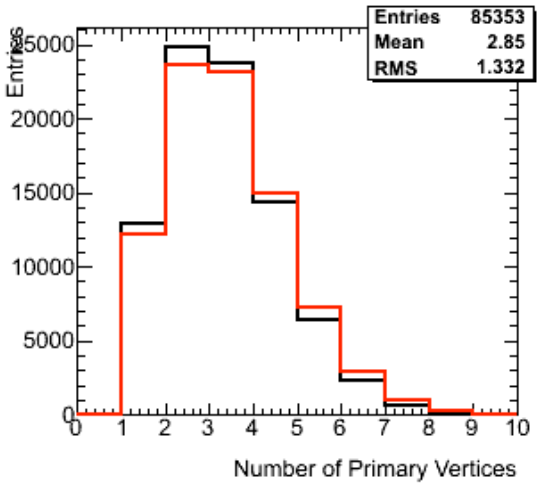
red line = reco'ed PV

Jet-Jet Sample MonteCarlo Simulation









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Reco Efficiency

$$\text{Eff} = N_{rec,PV}/N_{true,PV}$$

where $N_{rec,PV}$ is defined as all PV with $|z_{rec} - z_{truth}| < 100\mu m$

W->τν with $\langle n_{PU} \rangle$ = 5: Eff = 0.60
Jet-Jet with $\langle n_{PU} \rangle$ = 2: Eff = 0.85

Efficiency includes:

reconstruction efficiency AND identification of PV among pile-up

Efficiency in jet-jet is better due to:

less pile up and higher p_t and more tracks in jet-jet signal

Also:

no acceptance cuts or alike have been applied so far

Thank you!