TOWARDS A MEASUREMENT OF $\frac{?\,(gg\ ?\ \ t\bar{t})}{?\,(q\bar{q}\ ?\ \ t\bar{t})}$

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Outline

- ✍ Introduction
- ✍ The Technique (generator-level)
  - The difference…
  - The parameterization
  - The fit
  - The pseudo-experiments
- ✍ Looking at data
- ✍ Track Multiplicity
- ✍ Two approaches
- ✍ Approach II
- ✍ Outlook

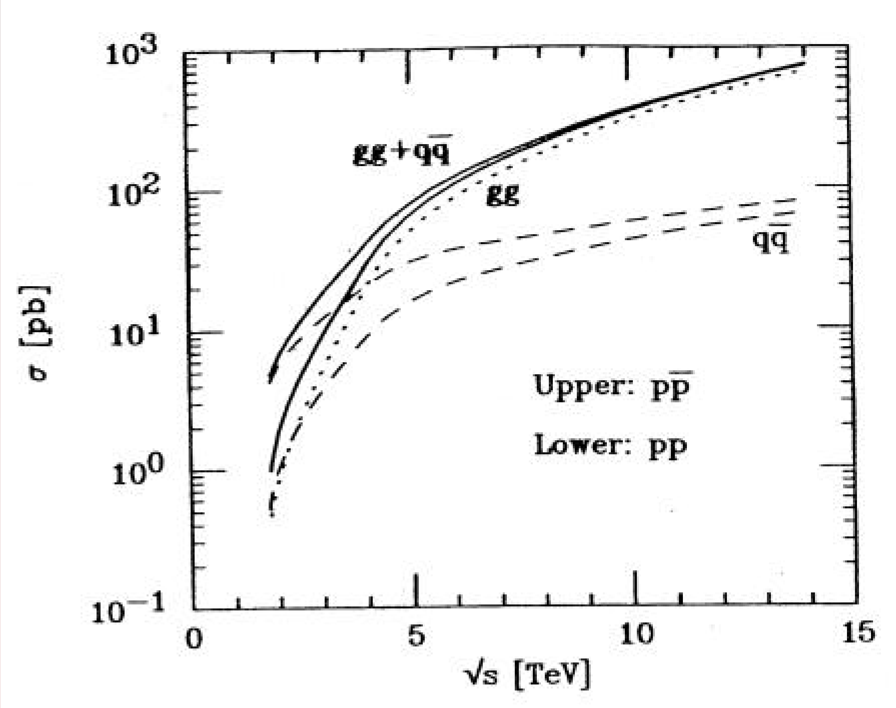
Introduction

- According to SM, in $p\bar{p}$ collisions at $\sqrt{s}$ ~ 2 TeV

  - gg ? $t\bar{t}$ ~ %15
  - $q\bar{q}$? $t\bar{t}$ ~ %85

- Measure ? $_{(gg ? \ t\bar{t})}$ / ? $_{(q\bar{q} ? \ t\bar{t})}$

  - Test of SM
  - $b\bar{b}$ production
  - Non-SM mechanisms

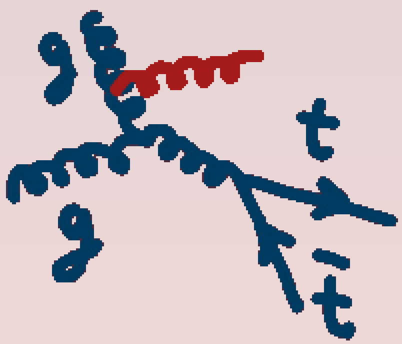


The Difference…

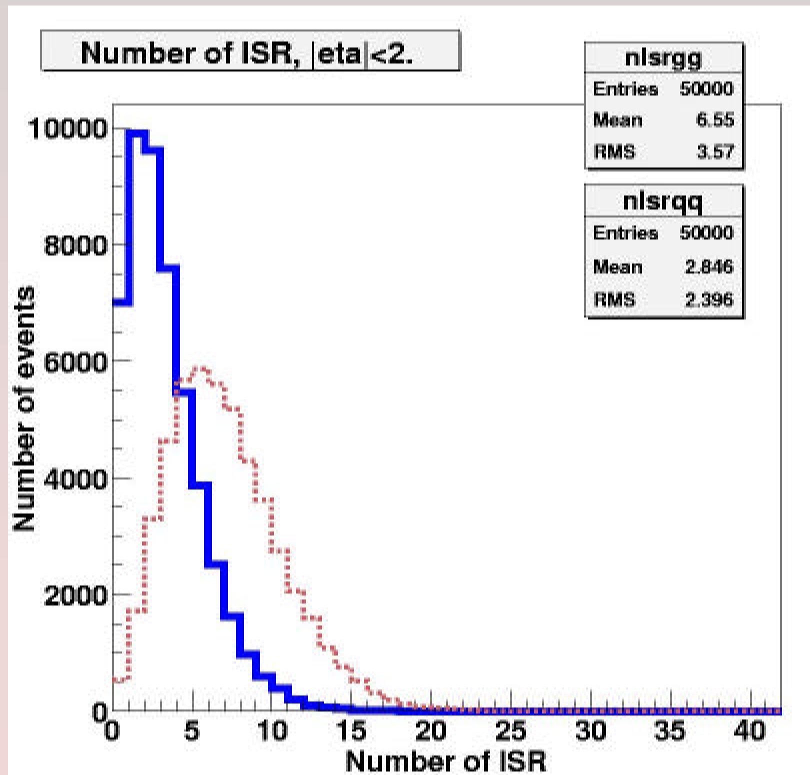
✍Quantities related to initial state

✍Looking at generator-level information

- Initial-State-Radiation (ISR)

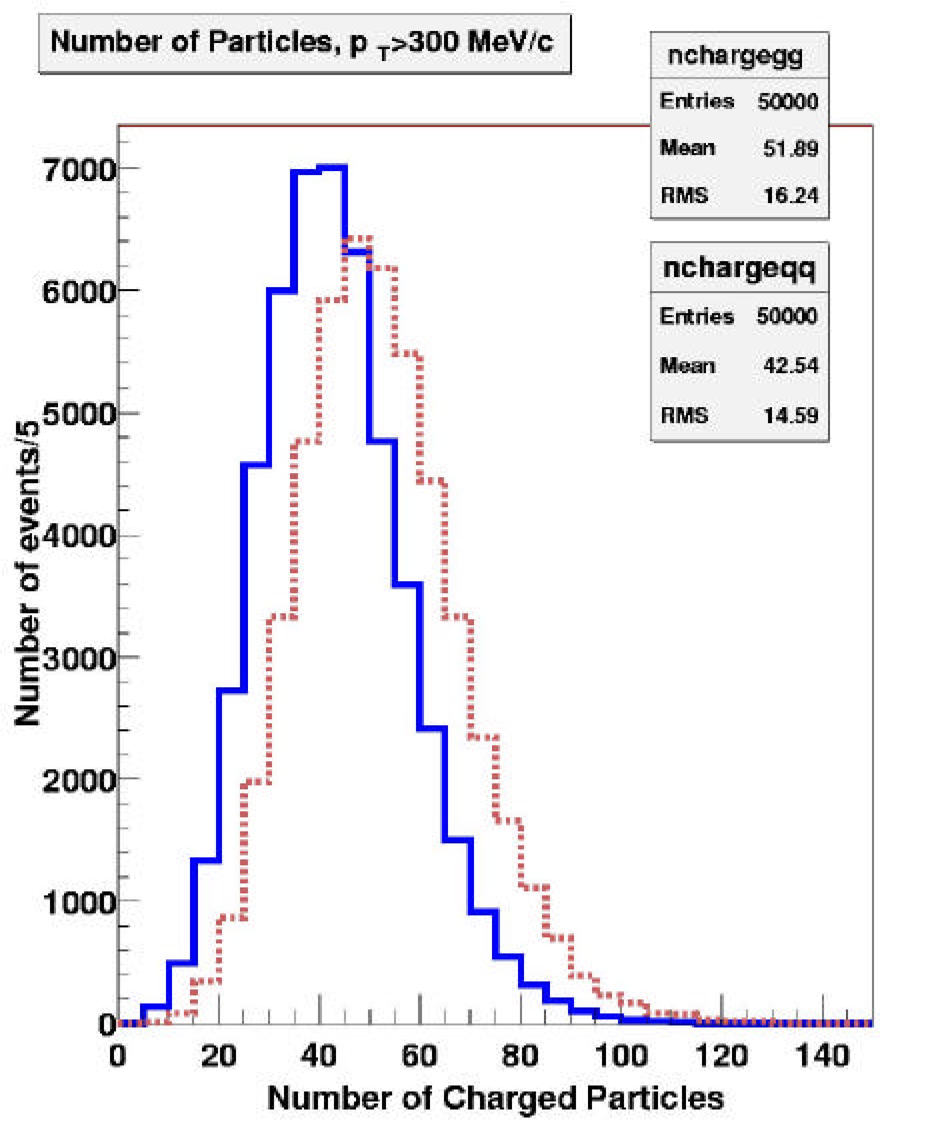


at $|?|\ ?\ 2$



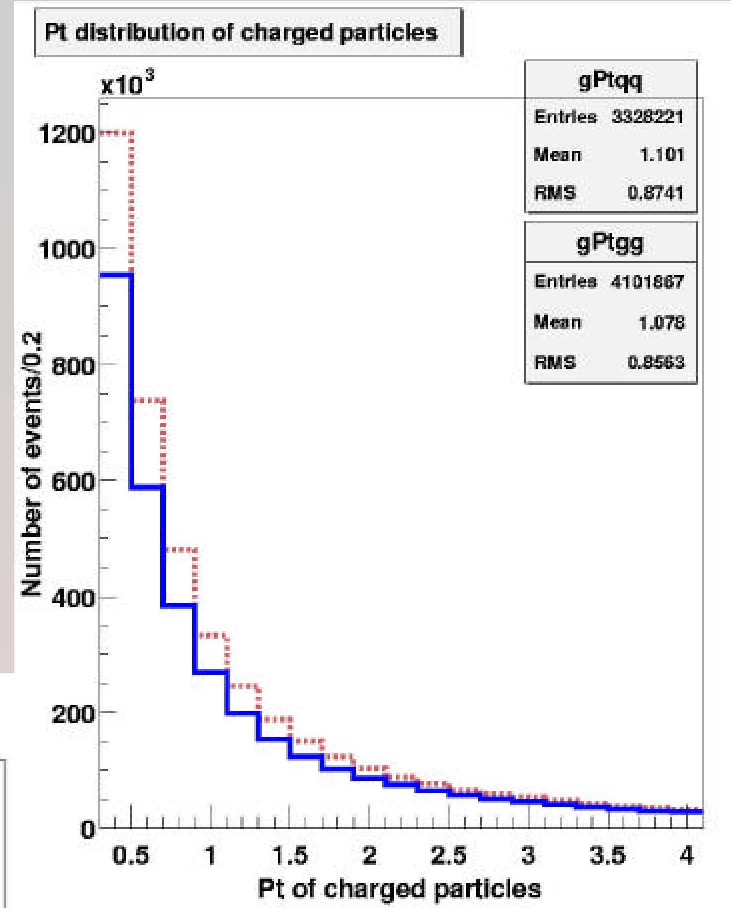
…the Difference…

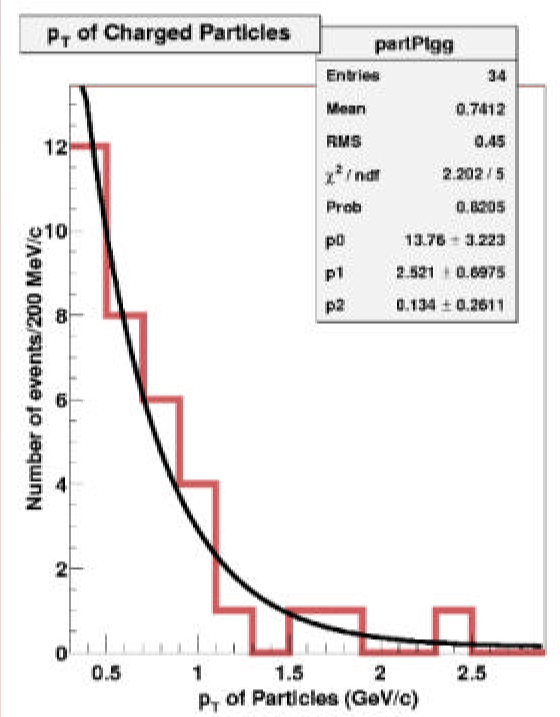
- Larger ISR
  - Larger number of stable particles
  - Larger number of charged particles
- Charged particle multiplicity
  - separated from daughters by $R ? \sqrt{(? ?)^2 ? (? ?)^2} ? 0.4$
  - p_T ? 0.3 GeV/c
  - $|?| ? 2$

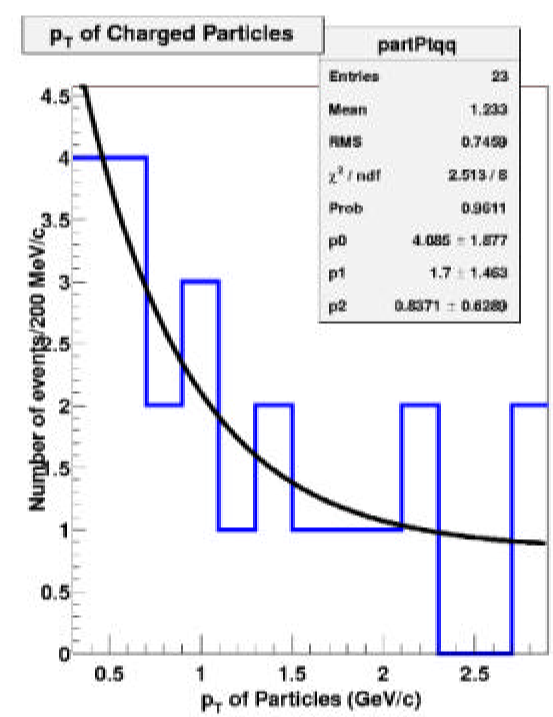


...the Difference...

- p_T distribution
- $f(p_T)$? ? ? $e^{? ? p_T}$? ?
  - Slope ß
  - Event-by-event basis

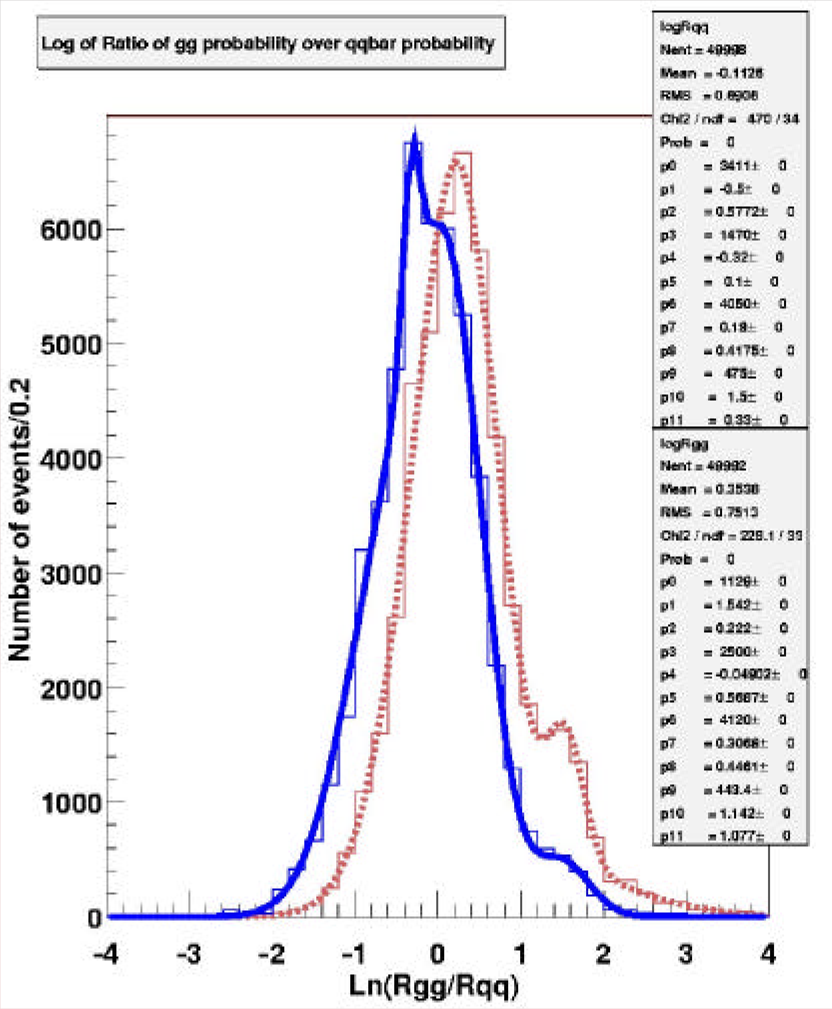






The Parameterization

- 2D distribution of slope vs. number of charged particles
  - 0.3 ? p_T ? 2.9 GeV/c
- Assign probabilities
  - R_{gg}
  - $R_{q\bar{q}}$
- Get distribution of ? ? $\ln(R_{gg}/R_{q\bar{q}})$
- Parameterize the distributions with 4 Gaussian distributions

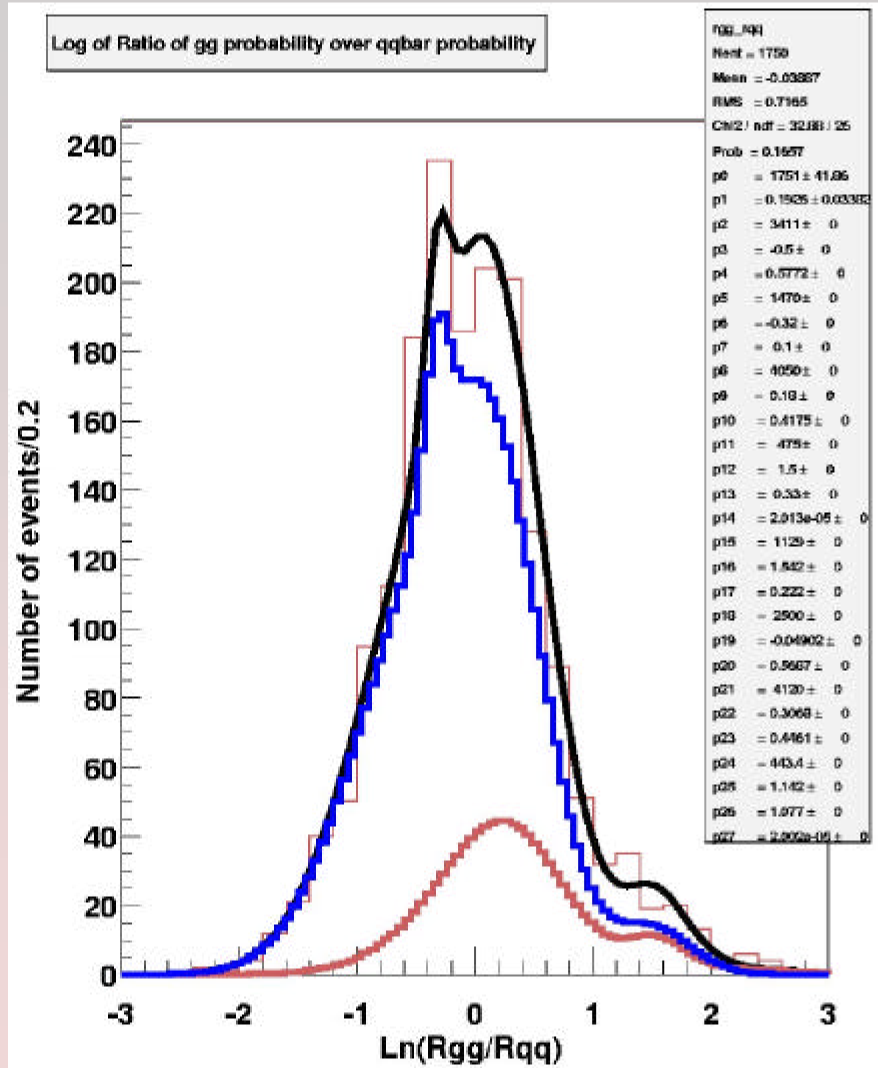


The Fit

$$F(?)\,?\,N_{t\bar{t}}[r_{gg}F_{gg}(?)\,?\,(1\,?\,r_{gg})F_{q\bar{q}}(?)]$$

where r_{gg} is the *gg* fraction and $N_{t\bar{t}}$ is the total number of $t\bar{t}$ events.

$F_{gg}(?)$ and $F_{q\bar{q}}(?)$ are the normalized 4-Gaussian functions for *gg* and $q\bar{q}$ events, respectively



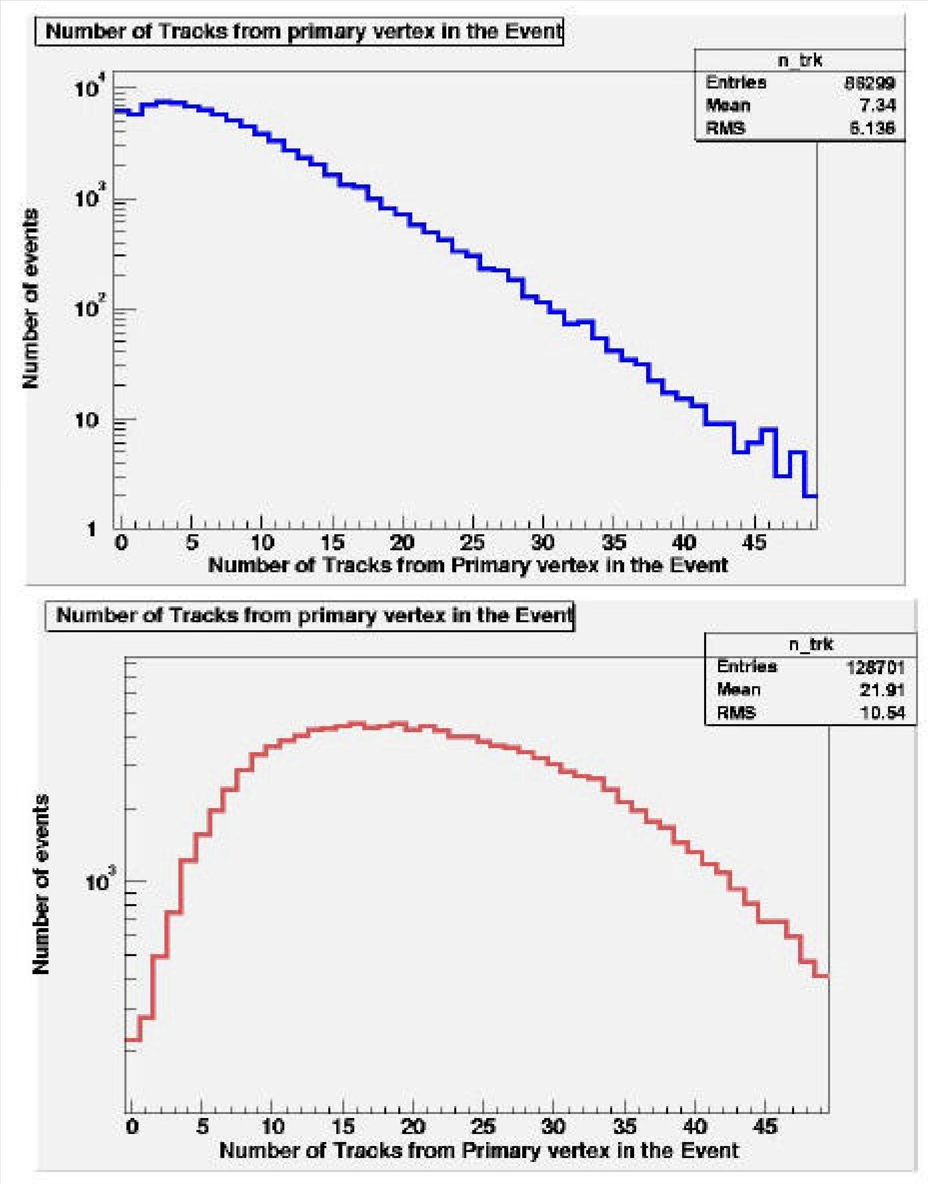
The pseudo-experiments

- Experiments with different r_{gg} fraction
  - Ranging from 0 to 1 with 0.1 increments
- 20 experiments with different number of $t\bar{t}$ events for same r_{gg}
- The uncertainty in r_{gg} depends on the total number of $t\bar{t}$ events
- There is a systematic shift in the fraction of *gg* events given by the fit parameter
  - Overestimating the r_{gg} for samples with less than 70% *gg* events
  - Underestimating the r_{gg} otherwise

Looking at data

✍Choosing data samples

- W events ? High p_T lepton sample
  - ✍Mainly $q\bar{q}$ (specially for W with no jet events)
- Jet production ? Jet50 sample
  - ✍Mainly gg and qg (for jet E_T of 50-100 GeV)

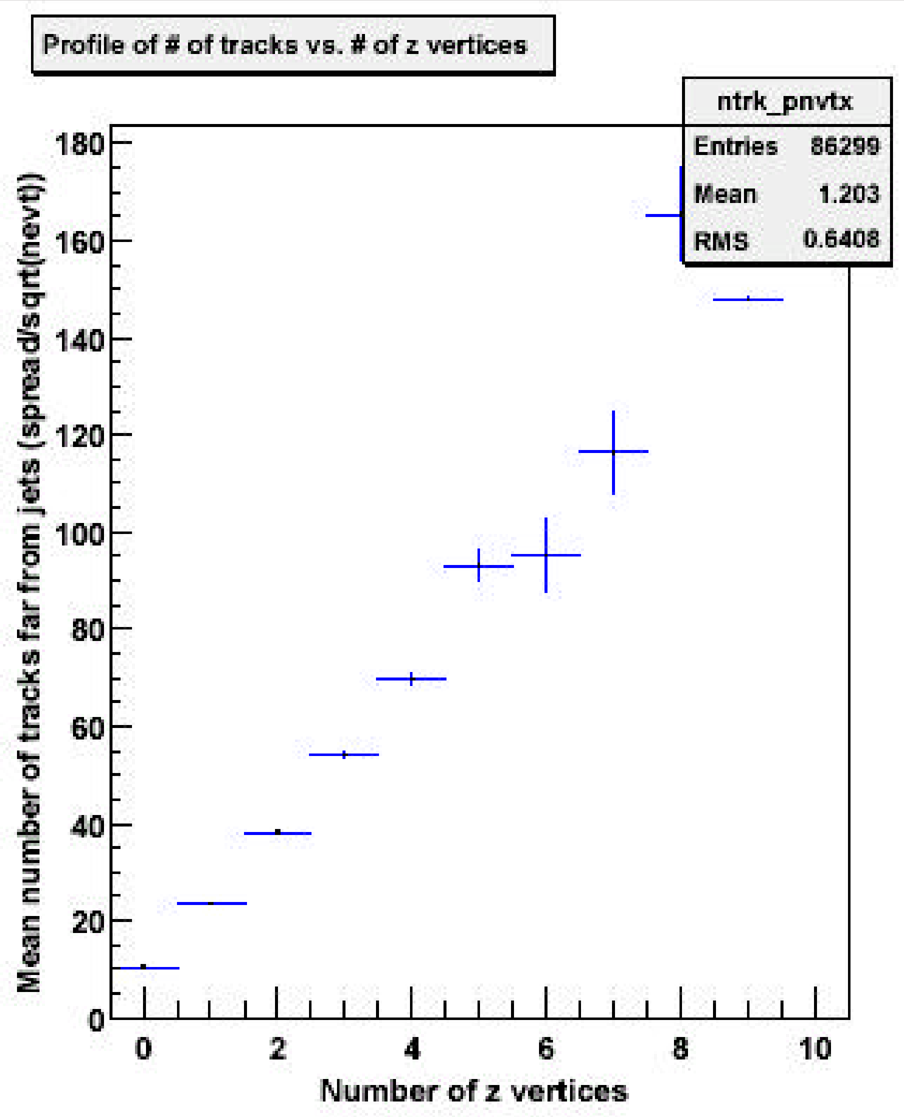


Track Multiplicity

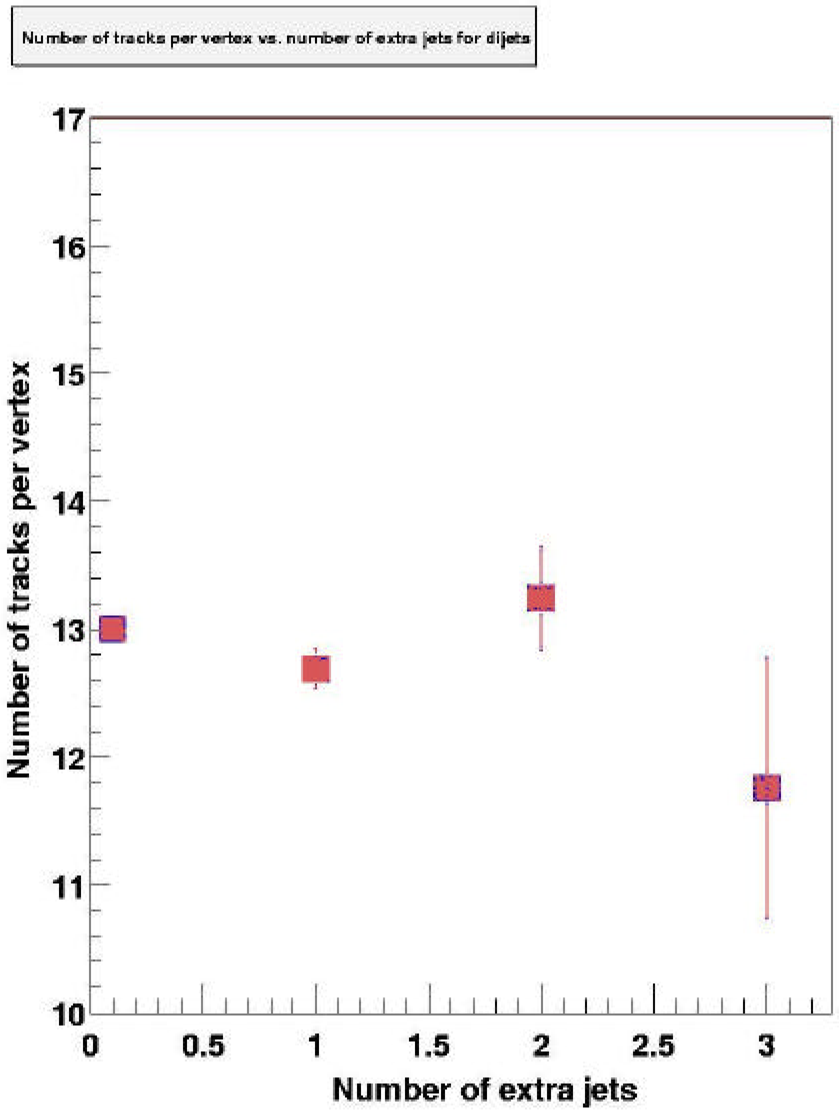
- We want it to be:
  - independent of number of interactions
    - Number of z vertices
  - independent of number of jets in the event
- We need to understand:
  - the contribution due to each extra vertex
  - the contribution due to each jet
- We look at number of tracks as a function of:
  - number of vertices
  - number of jets

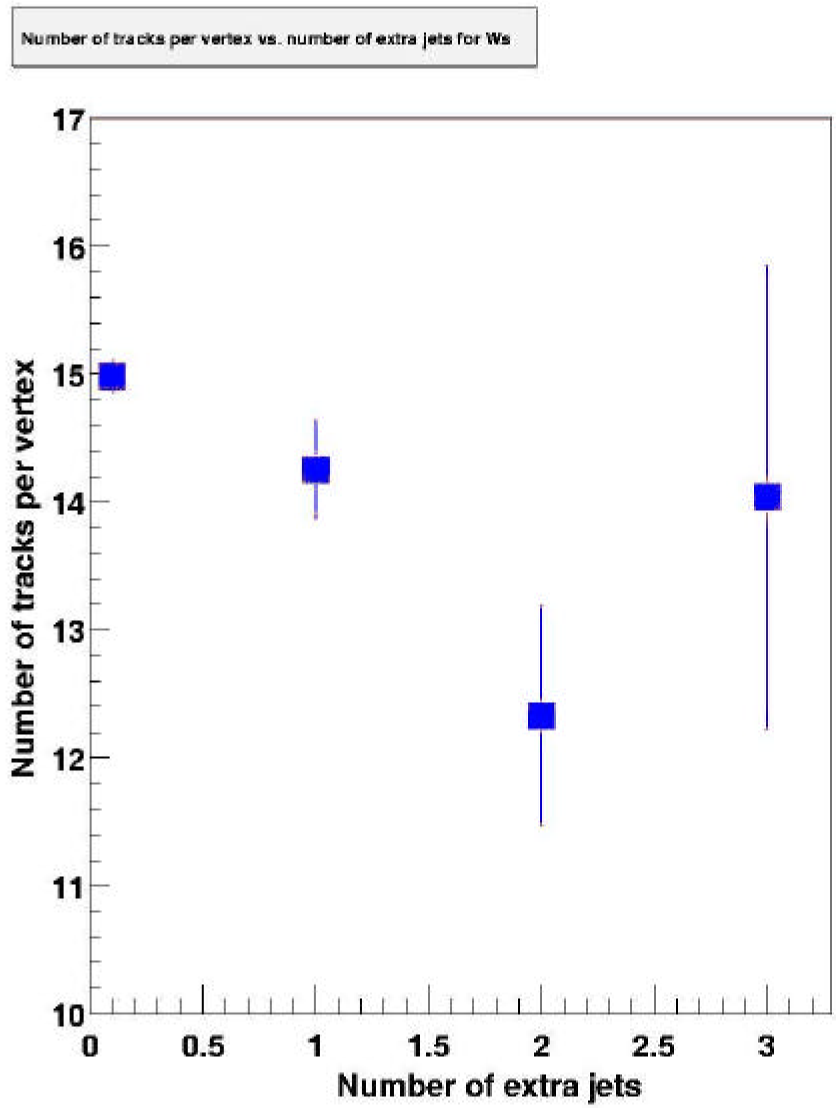
Track vs. z vertex multiplicity

- ✍Categorize the sample with the number of (extra) jets in the event
- ✍Look at track multiplicity vs. number of z vertices in the event
- ✍Find the slope for each category
- ✍We get the contribution of each z vertex

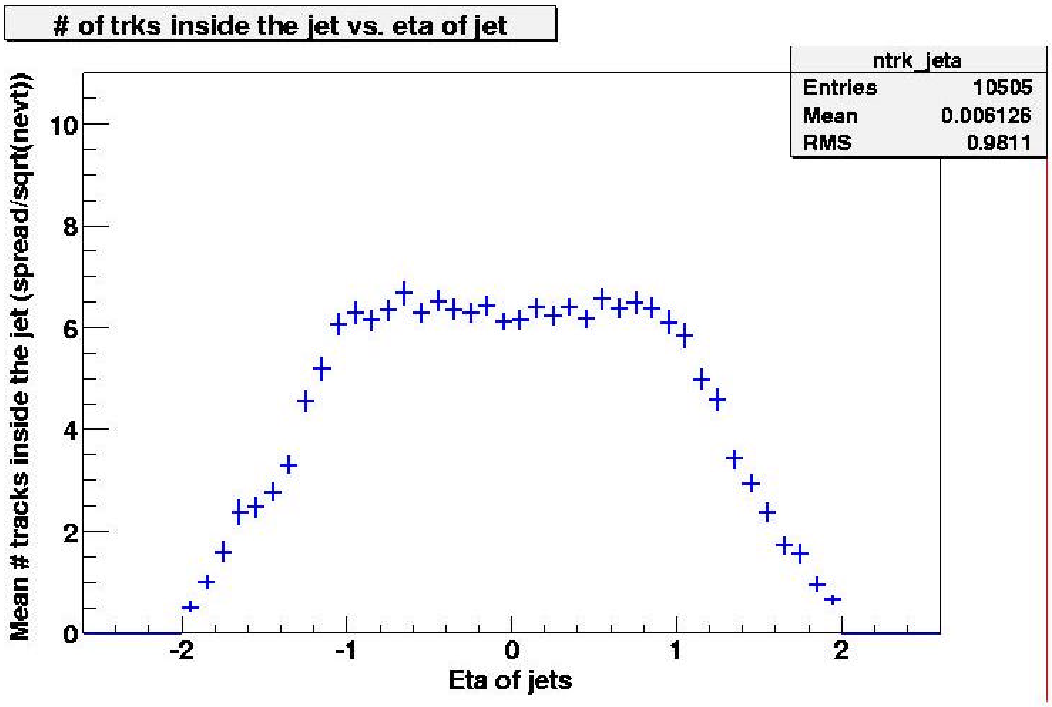


Number of Tracks per Vertex



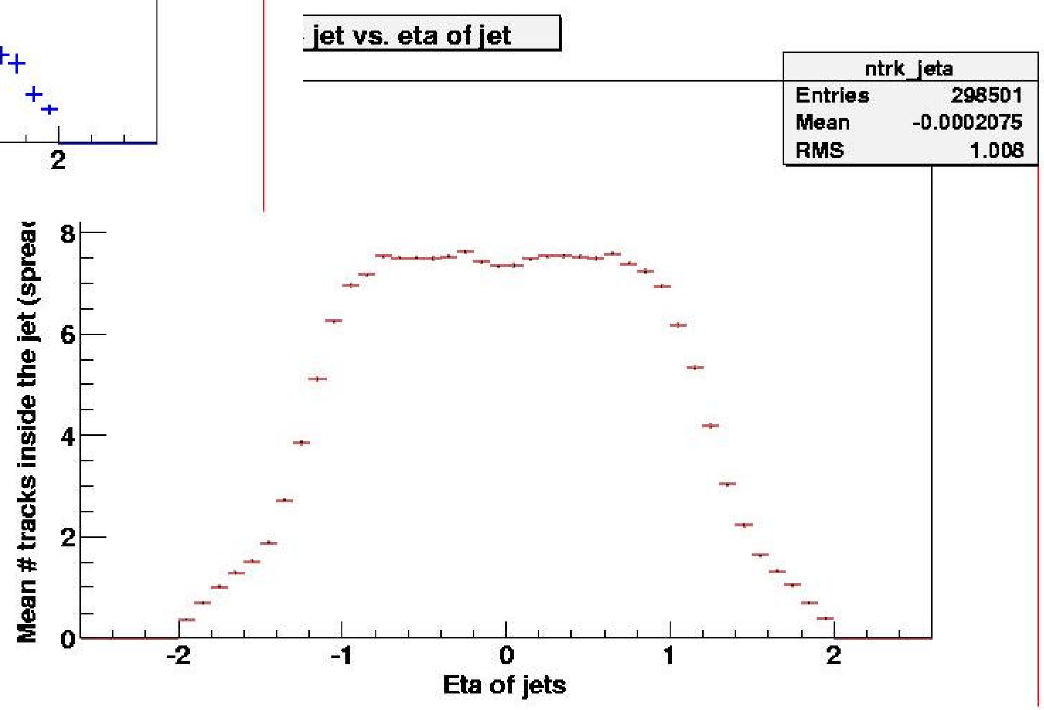


Number of Tracks per Jet



Tracks within R=0.4

What are the contributions out-of-cone?



Can we make corrections without calculating R?

Two approaches

✍ Approach I

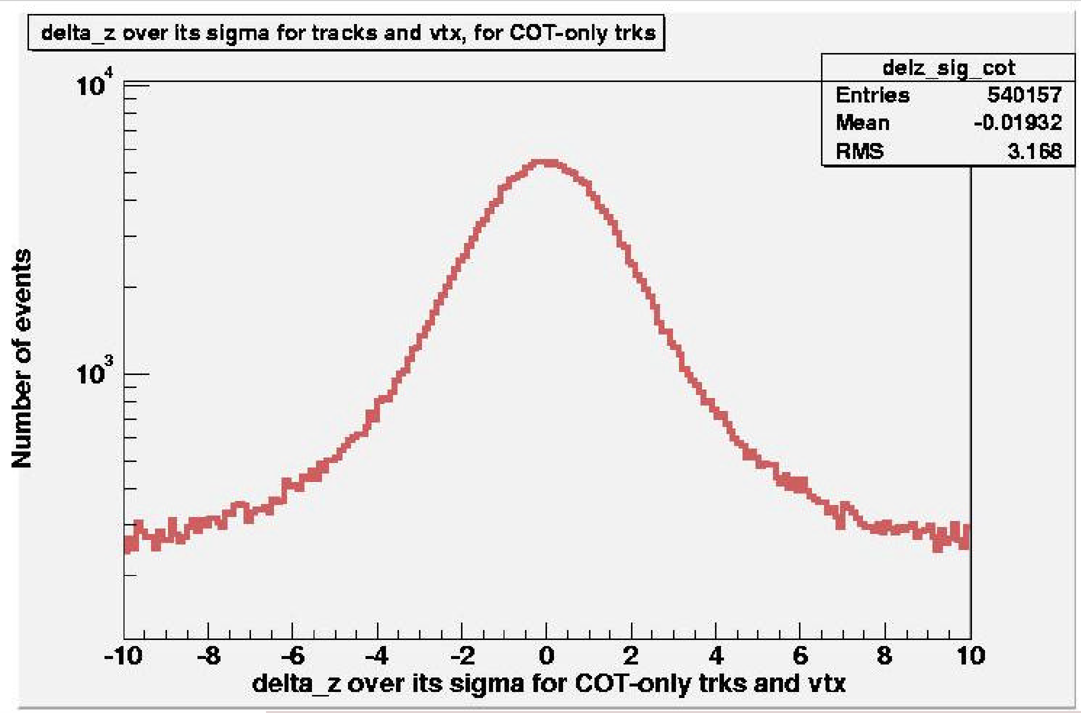
- Get track multiplicity, vertex multiplicity and jet collection
- Apply corrections for each vertex
- Apply corrections based on jet ?

✍ Approach II

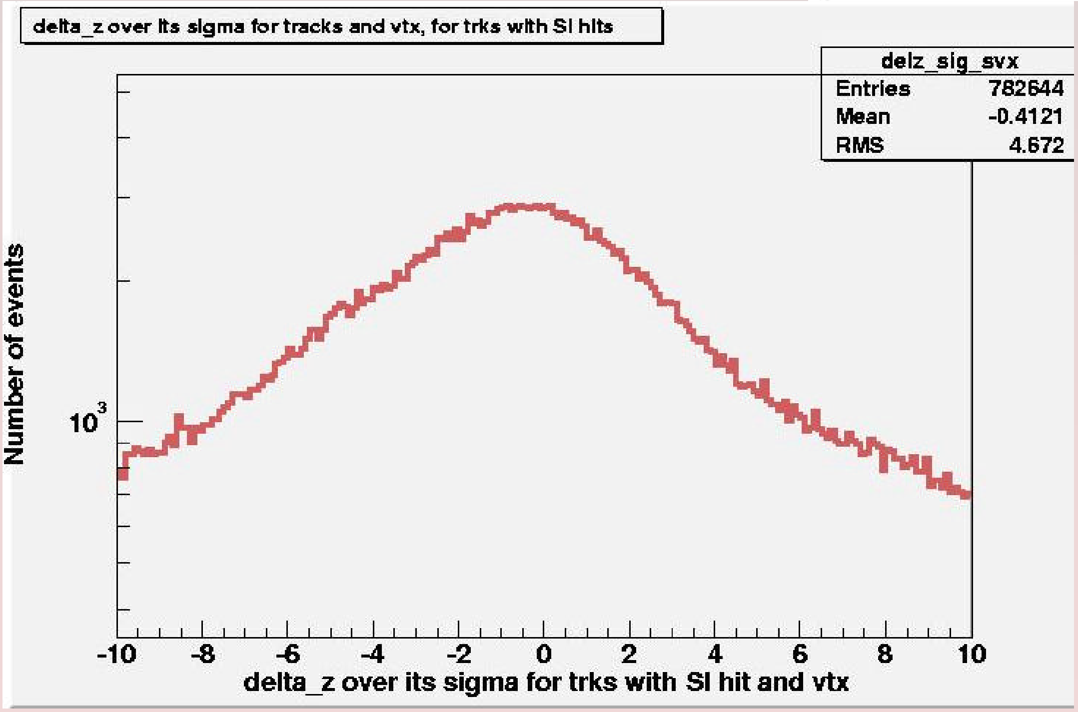
- Find the primary vertex and tracks coming from it
- Exclude those tracks matched to primary vertex which are within R=0.4 of jets in the event

Approach II

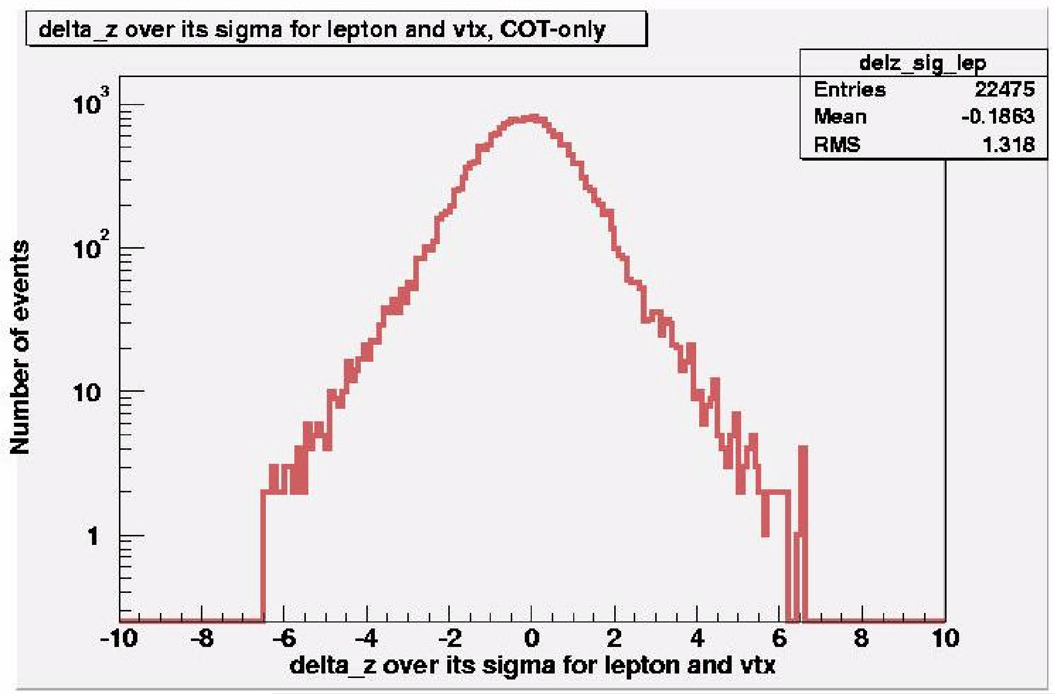
- Started with a simple algorithm
  - Matching tracks and vertices within a few s of ? z of track and primary vertex
  - Matching tracks and vertices within a few cm
- Checked different track qualities
  - defTracks
  - Good COT tracks (at least 25 hits in axial and stereo)
    - With SI hits
    - Without SI hits
    - Either
- About 60-80% of tracks match with primary vertex
- ? z/s distribution is very wide

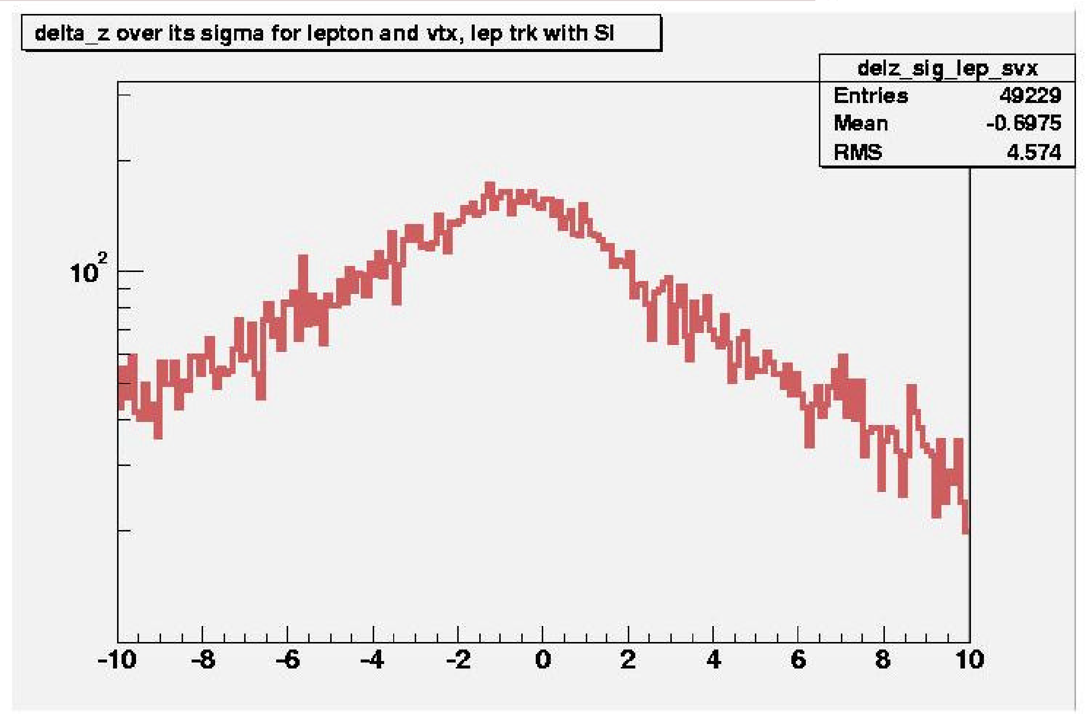


delta_z over its sigma for tracks and vtx, for COT-only trks
delz_sig_cot
Entries 540157
Mean -0.01932
RMS 3.168
Number of events
delta_z over its sigma for COT-only trks and vtx



delta_z over its sigma for tracks and vtx, for trks with SI hits
delz_sig_svx
Entries 782644
Mean -0.4121
RMS 4.672
Number of events
delta_z over its sigma for trks with SI hit and vtx


delta_z over its sigma for lepton and vtx, COT-only
delz_sig_lep
Entries 22475
Mean -0.1863
RMS 1.318
Number of events
delta_z over its sigma for lepton and vtx


delta_z over its sigma for lepton and vtx, lep trk with SI
delz_sig_lep_svx
Entries 49229
Mean -0.6975
RMS 4.574

Outlook

- A trustworthy Track-Vertex Matching algorithm is needed
  - OBSP studies
- Finding the algorithm, then we look at the characteristics of tracks from primary vertex in the two data sample
- The idea is to use these two data samples as a way of calibration for the technique improved at the generator-level