LC-TPC Tracking & Background Analysis

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Outline

Higgsstrahlung events

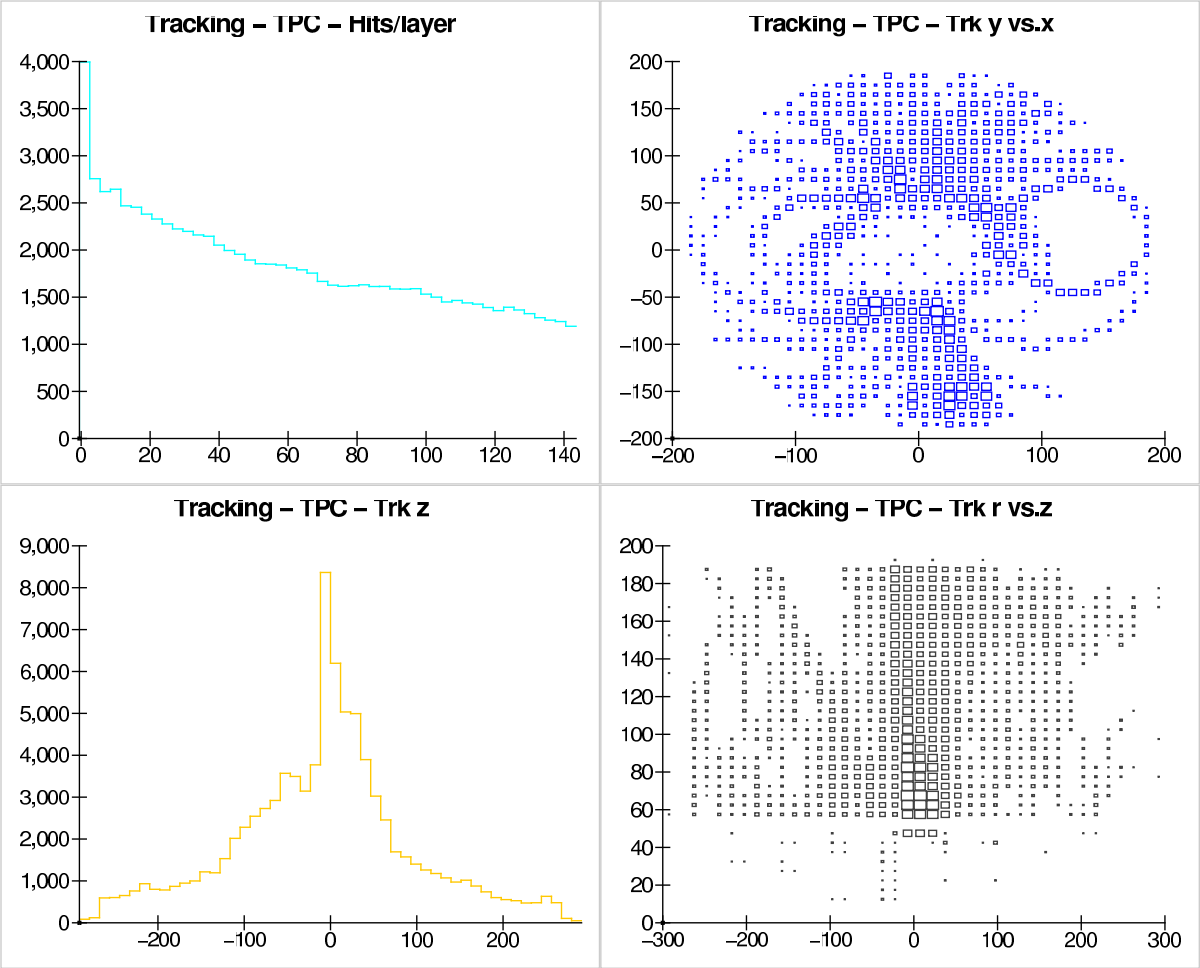
- TPC Tracking Analysis
  - Hit distributions
  - Reconstructed track distributions
  - Numbers of hits and tracks
- TPC Tracking Efficiency
  - Large TPC Tracking
  - Tracking efficiency

- Beamstrahlung e^+e^- pair backgrounds
  - Guinea Pig pair production
  - Direct pairs
- TPC Tracking w/ Beamsstrahlung backgrounds
  - TPC & VXD hit densities
  - TPC event displays

- Tracking w/ X5 random backgrounds
  - TPC & VXD hit densities
  - TPC event displays
  - Tracking efficiency $\approx$ 98%

Tracking Analysis

TPC Tracking



a.) Number of TPC hits/layer summed over 100 events

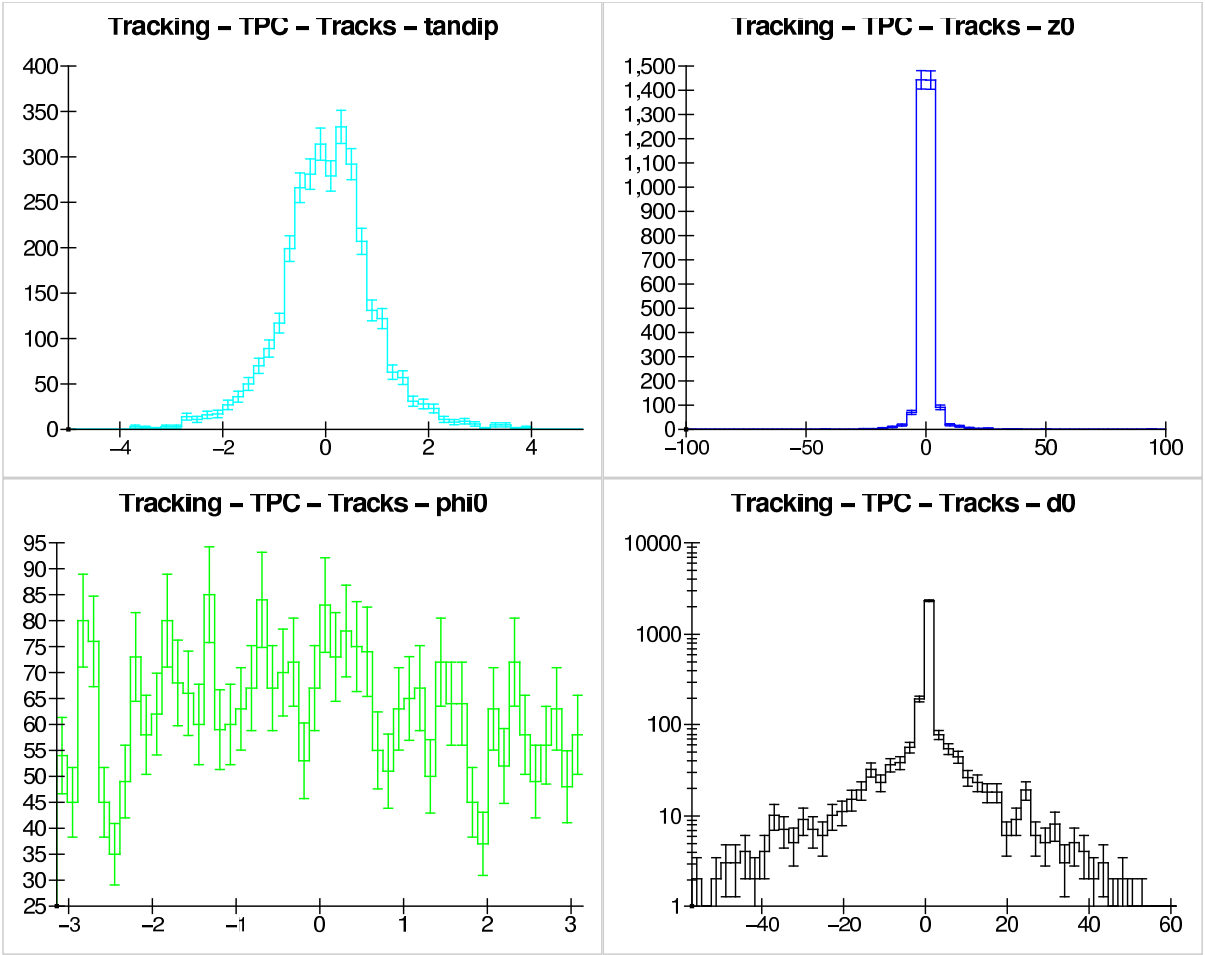
b.) TPC hit x-y distribution for one event

c.) Inner most track point in z

d.) TPC hit r-z distribution for one event

Typically find 10-30 TPC hits per layer. Present Large TPC detector model has 144 layers.

TPC Tracks



Reconstructed TPC tracks

a.) Track dip angle distribution - tandip

b.) Track deviation from origin in z - z0 (cm)

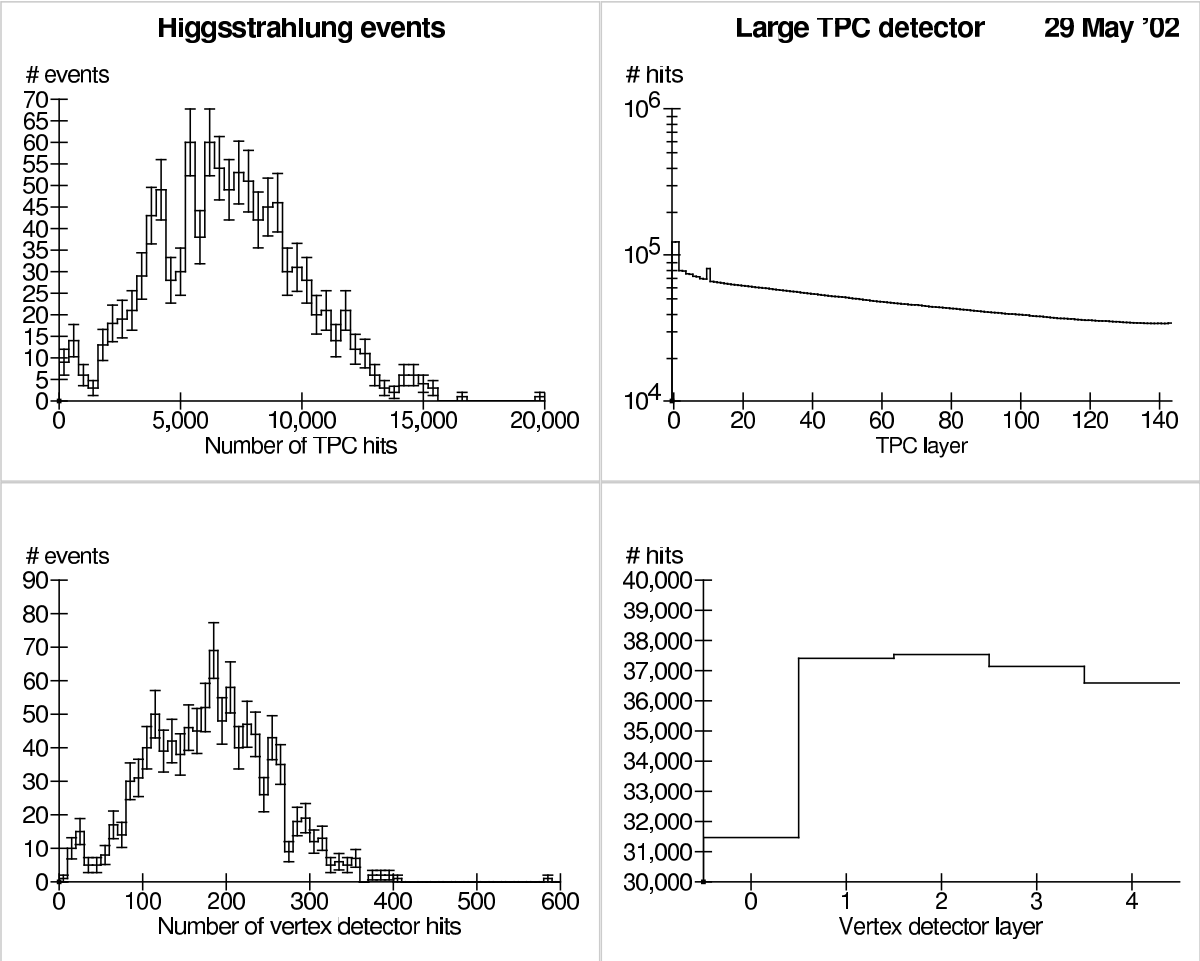
c.) Track azimuthal distribution - phi0

d.) Distance of closest approach - d0 (cm)

Tracks being found with xy displacements up to the TPC inner radius at 50 cm.

TPC Tracking Efficiency Studies

Higgsstrahlung hit densities



a.) Number of TPC hits/event

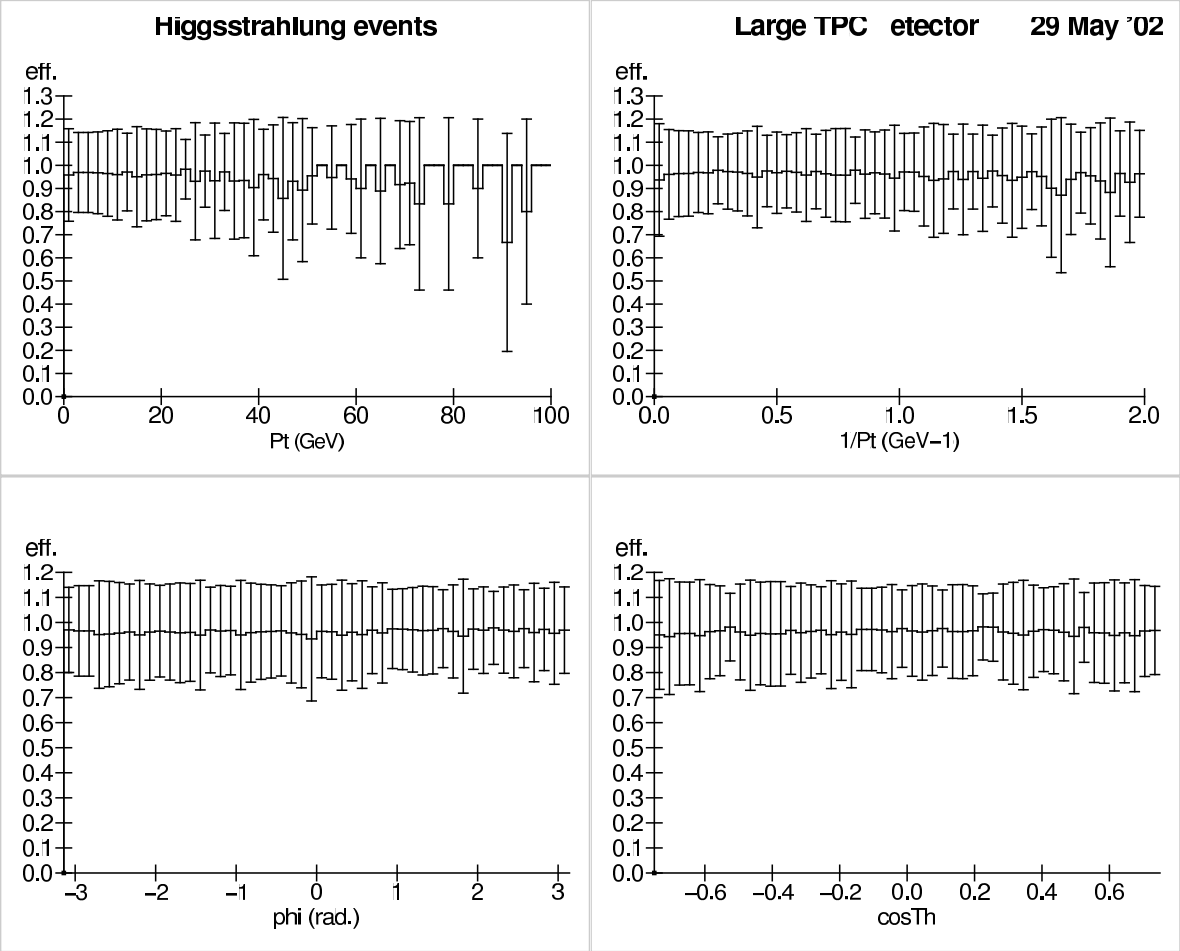
b.) TPC layer hit distribution

c.) Number of Vertex detector hits/event

d.) Vertex detector layer hit distribution

Magnetic field reduces track hit density at larger radius.

Tracking efficiency w/ no backgrounds



Tracking efficiency vs.

a.) Pt (GeV)

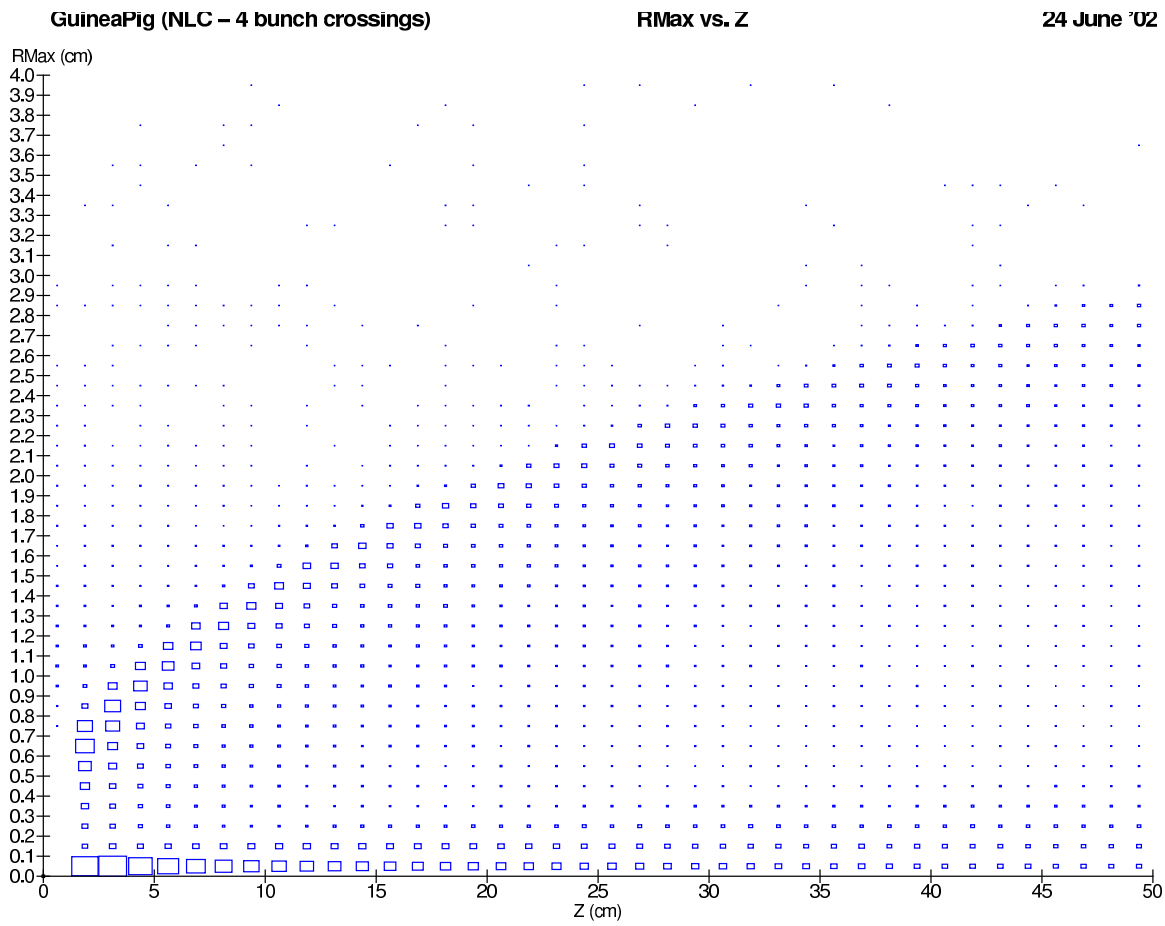
b.) 1/Pt (GeV-1)

c.) phi (radians)

d.) cosTh within central tracking region

The average TPC tracking efficiency of 96% is probably an under-estimate due to Monte Carlo tracks that interact in different ways.

GuineaPig e^+e^- pair background

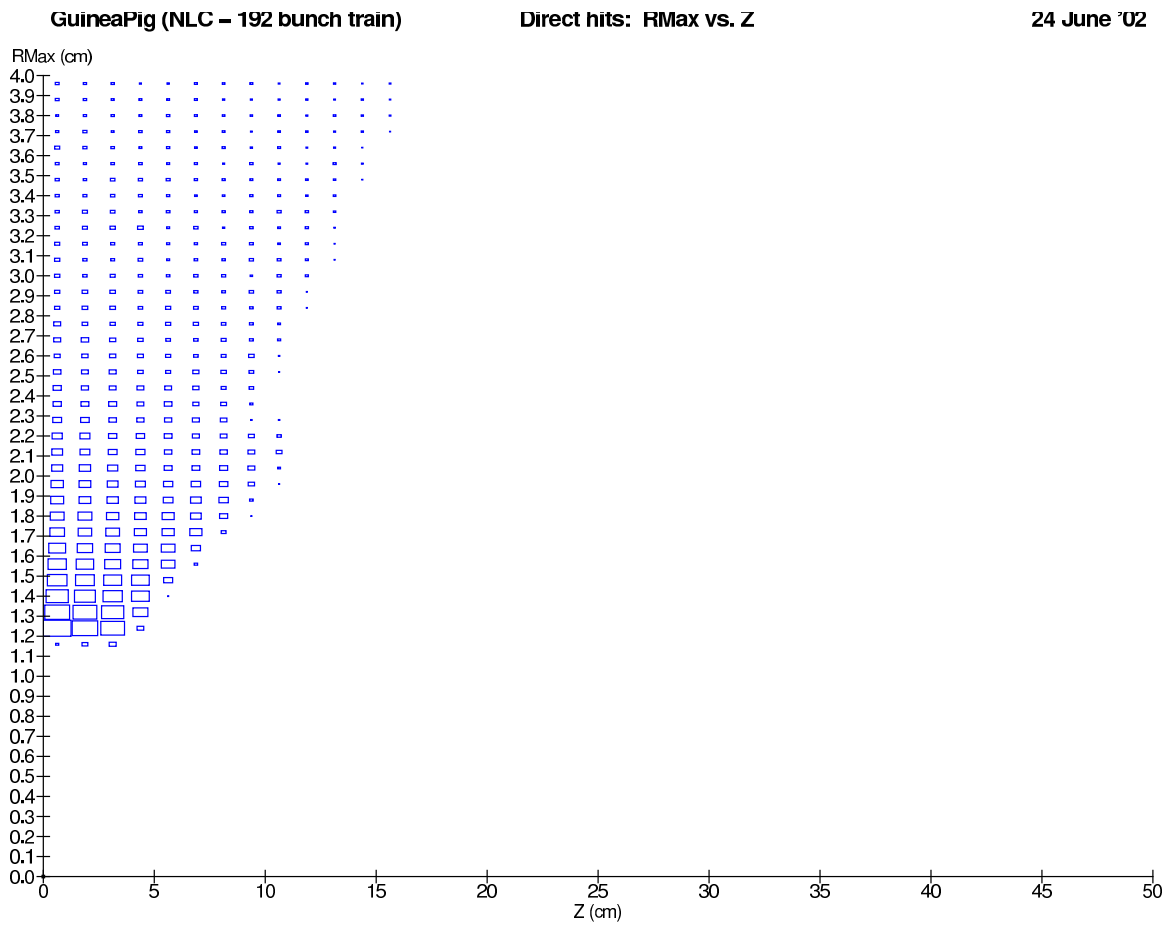


Plot displays rmax vs. z for all produced e^+e^- pairs from 4 bunch crossings.

Note: In Java 2D histograms, the squares are proportional to the number of entries.

Distribution shows large inherent angle pairs at large radius for low z which produce direct hits in the vertex detector. Most e^+e^- pairs are produced with low p_t. Like-sign pairs receive a large transverse kick from the E,M fields of the opposing beam and hit detector elements at small angles. Opposite-sign pairs hit downstream machine elements producing only indirect hits.

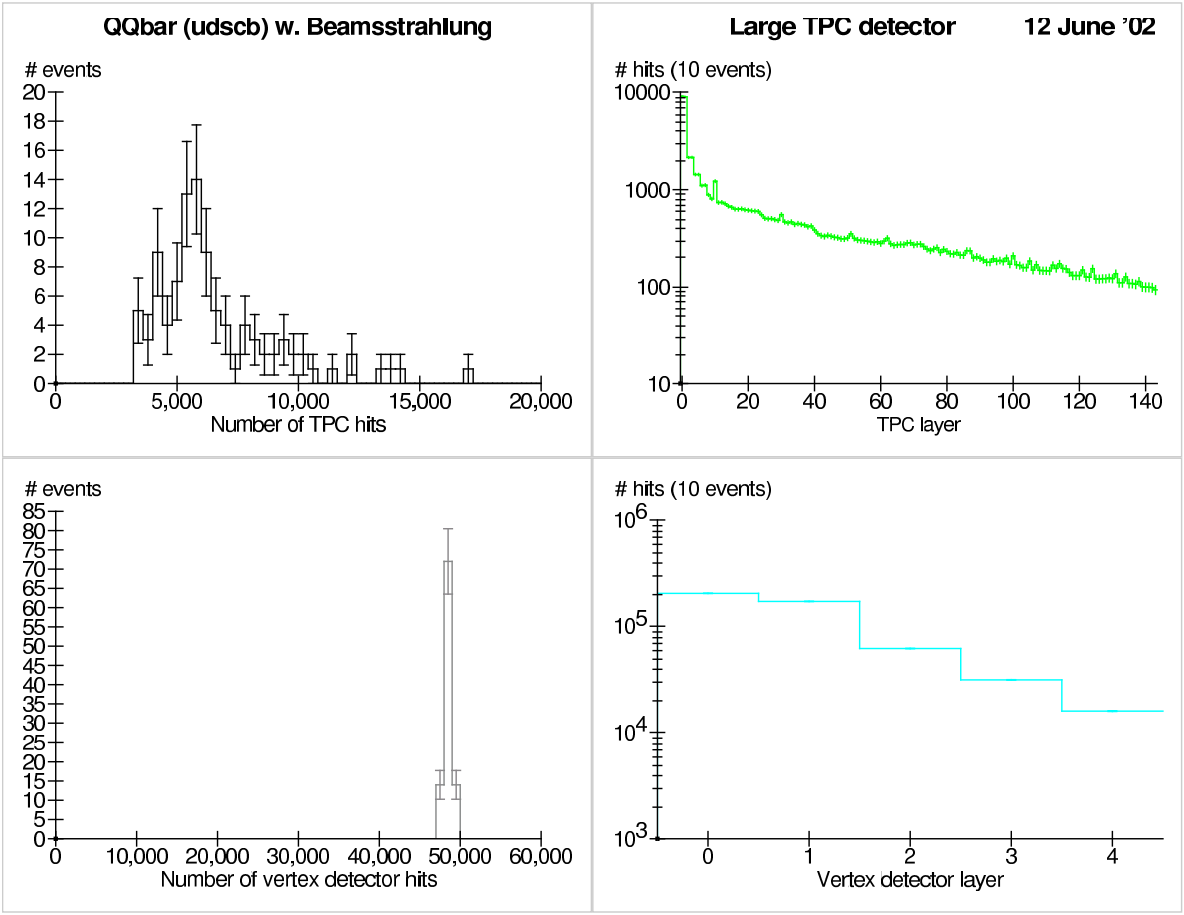
Direct GuineaPig e^+e^- pair background



Plot displays rmax vs. z for e^+e^- pairs producing direct hits for a full bunch train (192 X ∼100 entries).

Here we find mainly large inherent angle pairs which produce direct hits in the vertex detector. Negligible main tracker backgrounds are produced when only direct GuineaPig pair backgrounds are considered. Full Geant4 IR simulations will be needed to study detector backgrounds.

QQbar Hit densities w/ Beamsstrahlung backgrounds



a.) Number of TPC hits/event

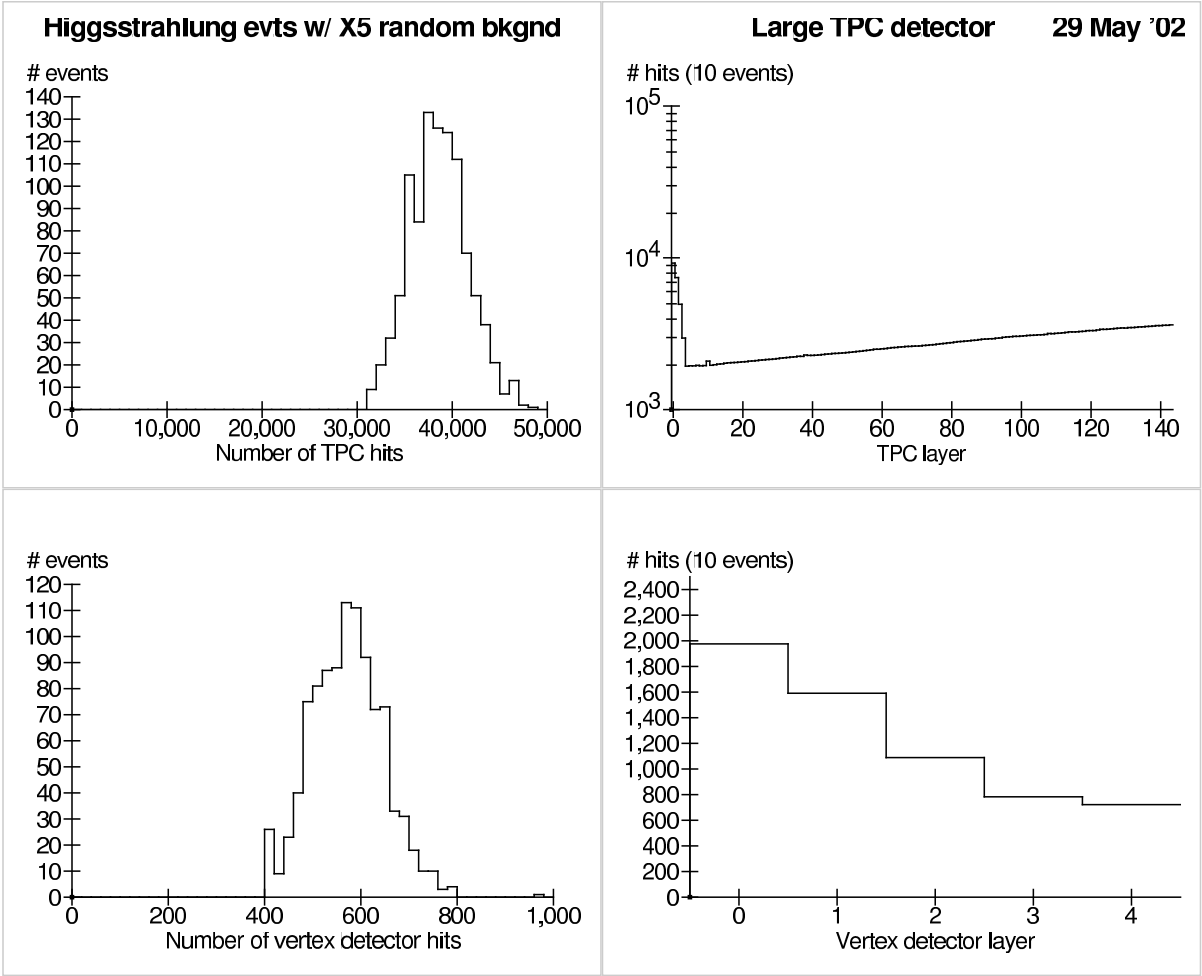
b.) TPC layer hit distribution

c.) Number of Vertex detector hits/event

d.) Vertex detector layer hit distribution

While the Vertex Detector hit density, up to 20K hits/layer at the innermost layer, is much higher with Beamsstrahlung backgrounds included, the TPC outer layer hit density, of 10-30 hits/layer, is nearly unaffected. The innermost TPC layers have relatively large hit densities of up to 1K hits/layer.

Hit densities w/ X5 random background



a.) Number of TPC hits/event

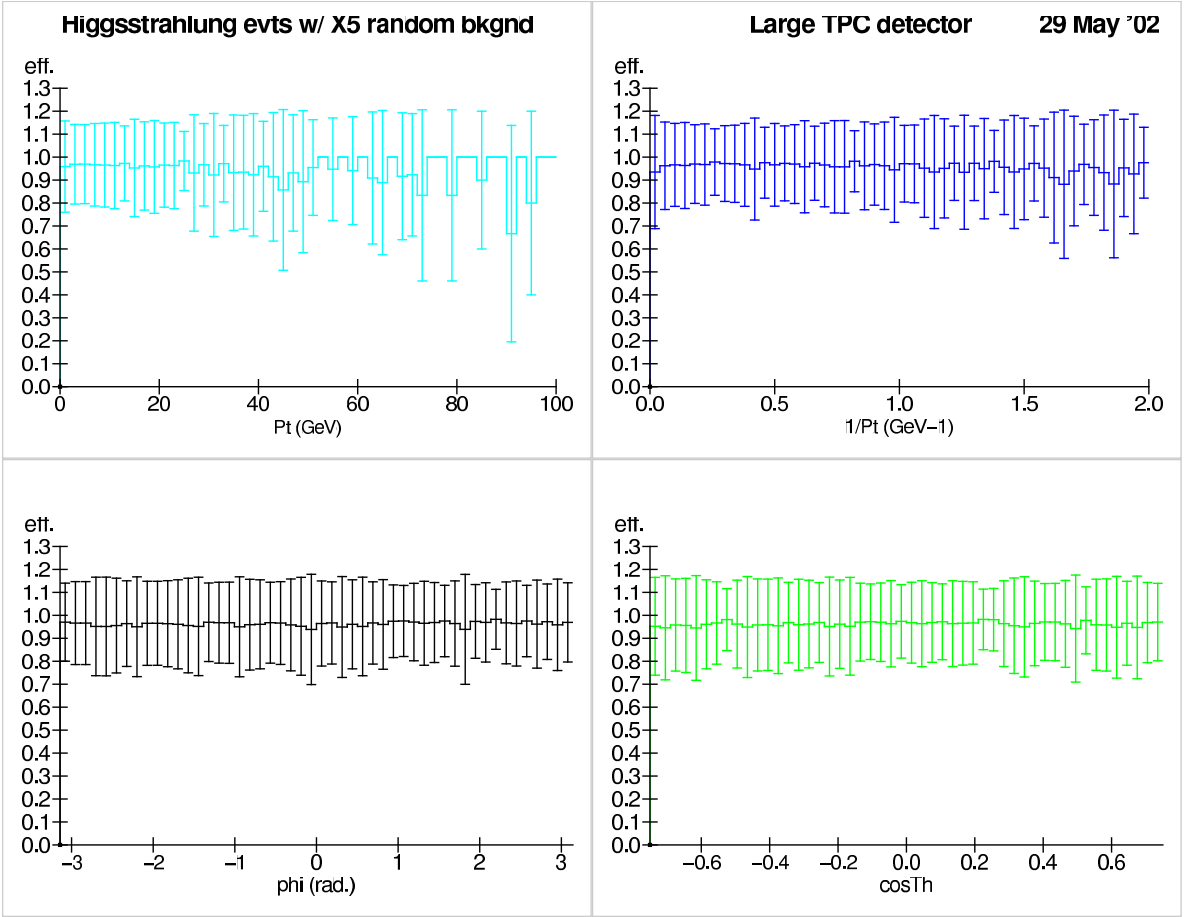
b.) TPC layer hit distribution

c.) Number of Vertex detector hits/event

d.) Vertex detector layer hit distribution

The TPC hit density is flat at large radius in the present random background model.

Tracking efficiency w/ X5 random backgrounds



Tracking efficiency vs.

a.) Pt (GeV)

b.) 1/Pt (GeV-1)

c.) phi (radians)

d.) cosTh within central tracking region

The average TPC tracking efficiency of 96% is unaffected by simulated random backgrounds at the level of over 5 times nominal hit densities.

Summary

- New LC-TPC tracking studies and improvements are in progress.
  - Multi-jet pattern recognition is excellent but can be improved.
  - Tracking parameters are being tuned following studies of different final states.
  - Consideration of real detector effects will be included.

- Detailed machine-background detector studies have begun.
  - Direct hits from beamstrahlung e^+e^- pair backgrounds are NOT a problem for TPC based tracking.
  - Studies of pair backgrounds require full Geant4 simulations.