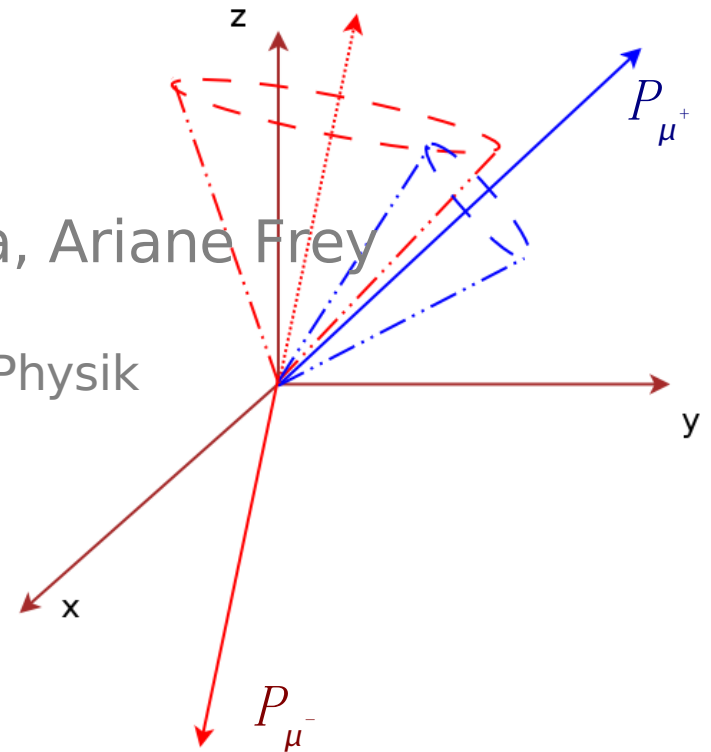# Analysis of Right-handed Smuon Production at ILC based on Full Simulation

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Outline

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- Introduction

- Events generation and Simulation

- Reconstruction

- Cuts

- Calculation of mass

- Polar angle distribution of smuon

- Summary & Conclusion

Introduction

- $e^+_L e^-_R \rightarrow \tilde{\mu}_R \tilde{\mu}_R \rightarrow \mu^+ \mu^- \tilde{\chi}^0_1 \tilde{\chi}^0_1$

  SPS1a scenario
  ~135fb at 500 GeV
    with P(e$^-$)~80%, P(e$^+$)~-60%

- Signal – 2 muons with
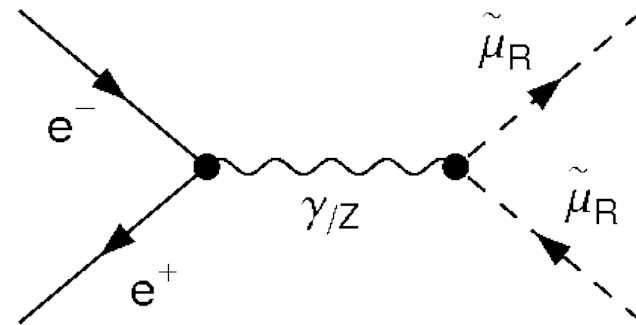 missing energy

- The energy spectrum of muons is flat.

- Backgrounds

  - Standard Model: $W^+ W^- \rightarrow l^+ \nu l^- \nu \,(81\text{fb})\,,\;\; Z^0 Z^0 \rightarrow l^+ l^- \nu \nu \,(57\text{fb})$
  - SUSY: $\tilde{\chi}^0_1 \tilde{\chi}^0_2 (20\text{fb})\,, \tilde{\chi}^+_1 \tilde{\chi}^-_1 (12\text{fb})$

- spin-0 particle, angular distribution $\quad \dfrac{d\sigma}{d\cos\theta} \propto \sin^2\theta$

Event Generation and Simulation

- Events generated with Pythia & ISAJET. 100 fb^{-1}.

- Full simulation with Mokka 06-05p02

- Detector Model: LDC01_05Sc

  - vxd01, sit01, Sftd02

  - tpc08

  - Secal02, Shcal03

  - Slcal01

  - tubeX01, maskX01, etd00, Scoil01, yoke03, SField01

Reconstruction

- Marlin v00-09-10

- Processors:

    - TrackDigi: MaterialDB, TPCDigiProcessor, VTXDigiProcessor, FTDDigiProcessor

    - Tracking: CurlKillerProcessor, LEPTrackingProcessor, SiliconTracking, FullLDCTracking

    - CaloDigi: MokkaCaloDigi, SimpleLCalDigi, SimpleMuonDigi

    - Clustering: PandoraPFAProcessor

    - Particle Identification: PFOID
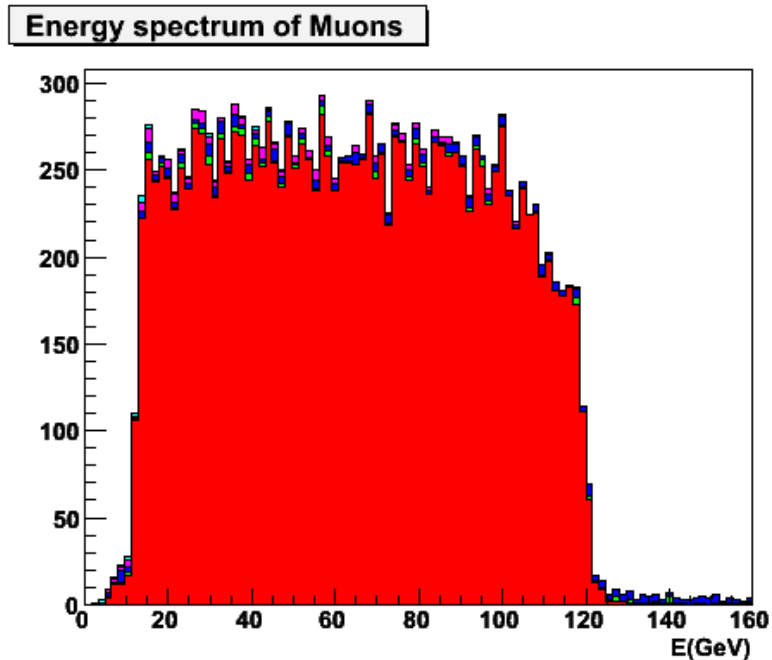
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Cuts

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- Cuts independent of the masses of smuons and neutralinos
  - Keep the event with 2 muons and at most 3 charged particles.
  - Reject soft muons
  - Angular separation of two muons.
  - Reject missing momentum in forward/backward region from particles lost in the beam pipe.

- Cuts depends on the masses of smuons and neutralinos
  - Missing Energy (Suppress backgrounds from W pairs)
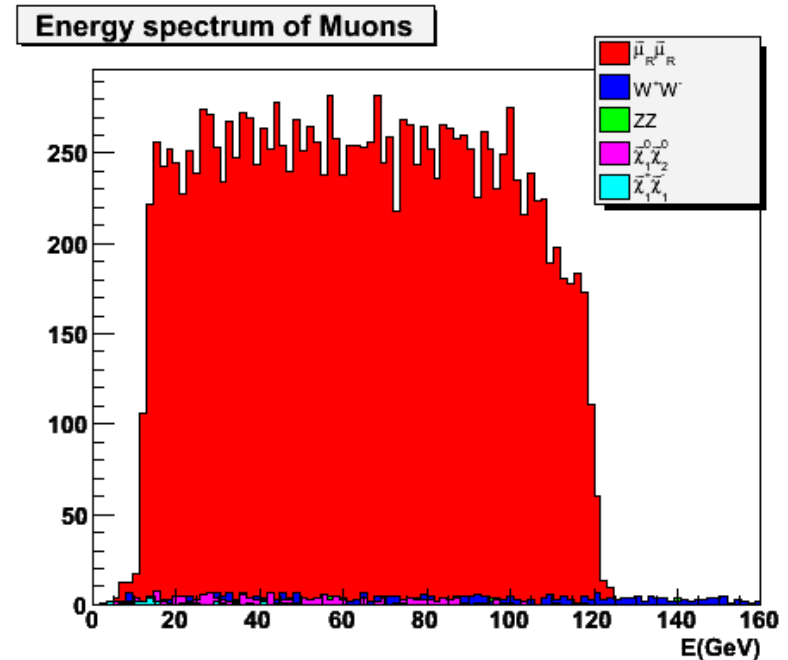 - Recoil Mass (Suppress backgrounds from Z pairs)

Energy Spectrum of Muons (after cuts)

Stacked view

Non-stacked view

Subtracting of Backgrounds

- Total = Signal(events of smuon) + Noise (other events)

- Backgrounds sample of 200 fb^{-1} for the fit function.

- Scale the backgrounds in following analysis according to the luminosity.
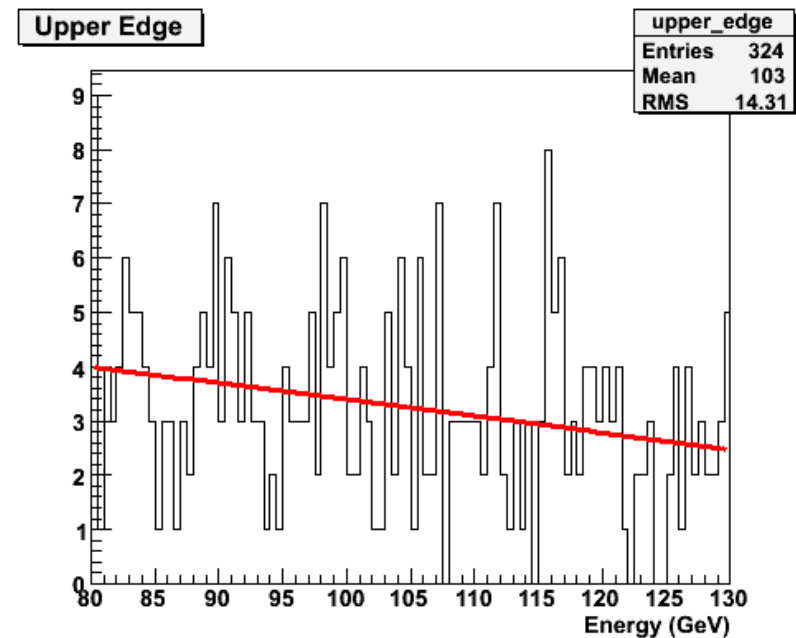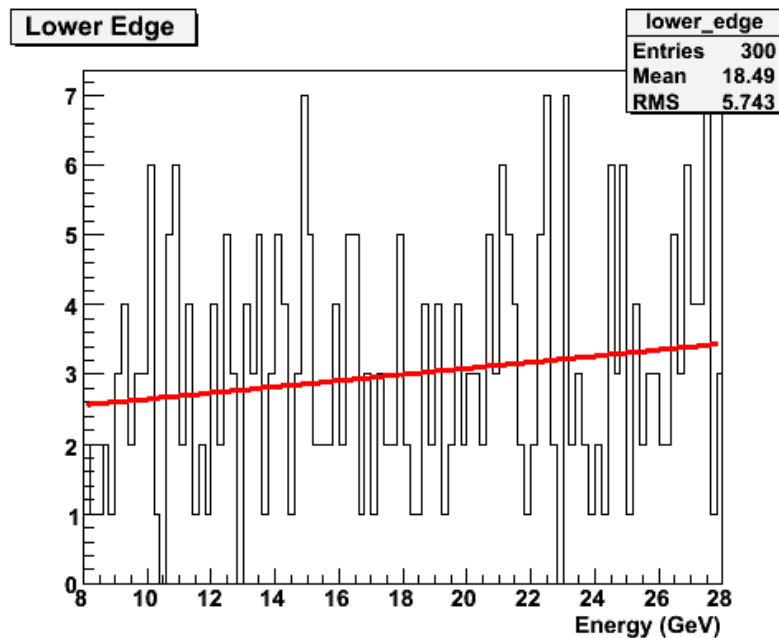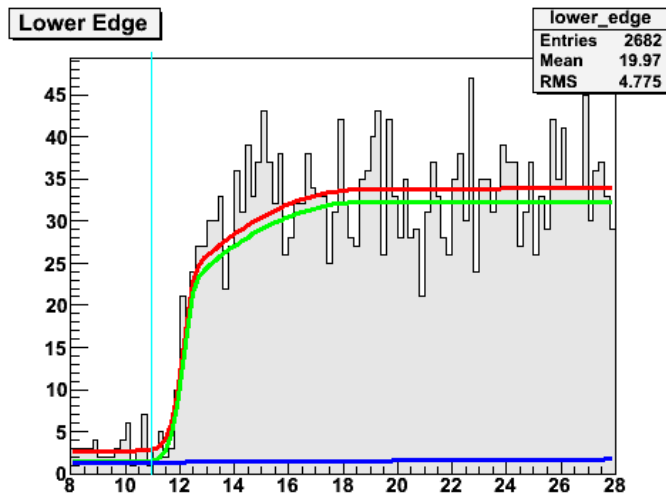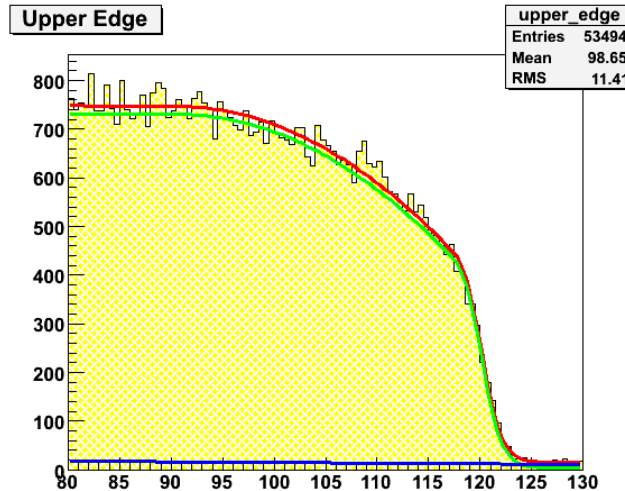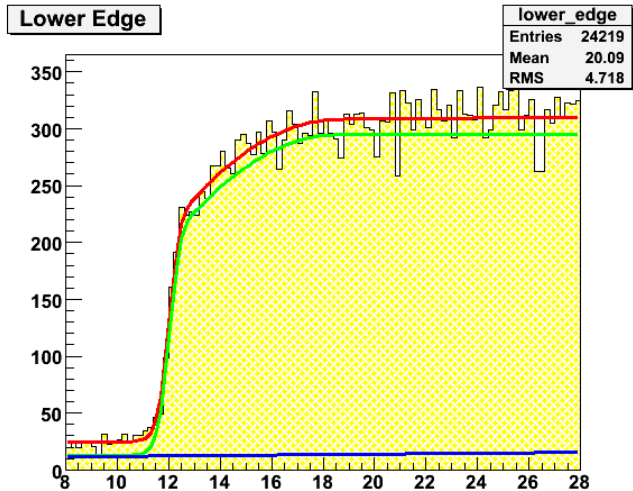
Fit the Edge of the Spectrum

900fb^{-1}

Scale the
fitting function

100fb^{-1}
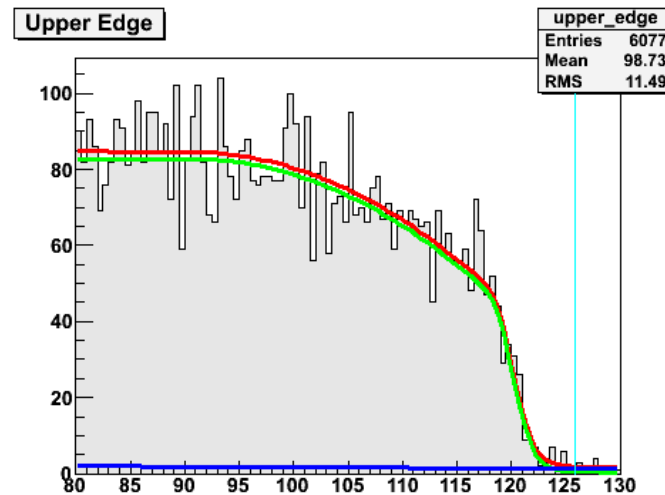
End point energy.   End point energy.

Calculation of Mass

Calibration of Lower Edge Energy

$E_-(M) = 10.96 \pm 0.065$

$E_-(T) = 11.96 \pm 0.067$

Measured Value (GeV) — Theoretical Value (GeV)
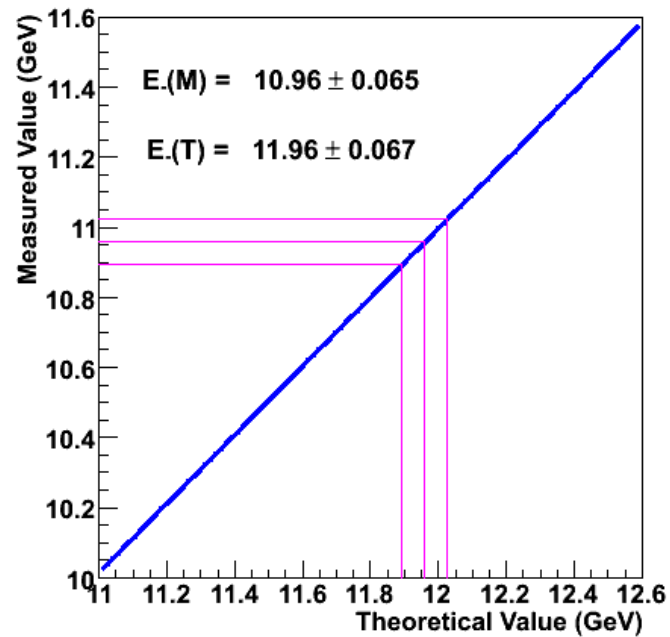
Calibration of Upper Edge Energy

$E_+(M) = 125.82 \pm 0.14$

$E_+(T) = 121.34 \pm 0.15$

Measured Value (GeV) — Theoretical Value (GeV)
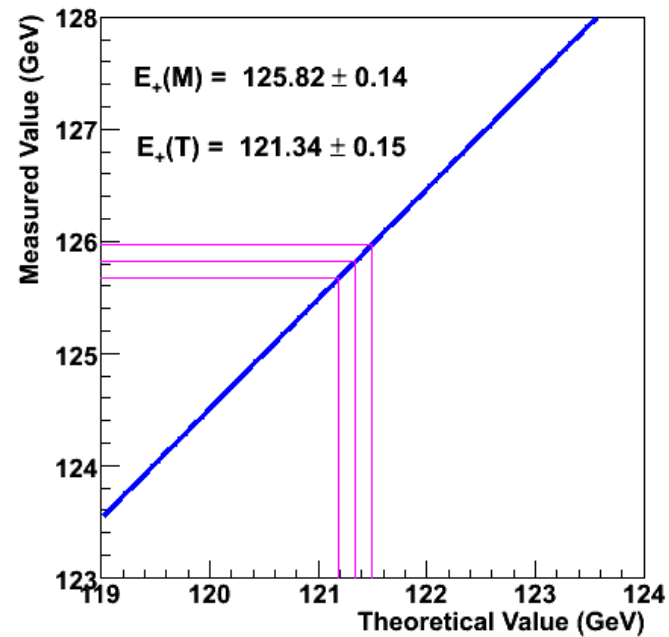
Input: $m_{\tilde{\mu}_R} = 142.52\,GeV$

$m_{\tilde{\chi}_1^0} = 97.36\,GeV$

Calculated: $m_{\tilde{\mu}_R} = 142.89 \pm 0.33\,GeV$

$m_{\tilde{\chi}_1^0} = 97.63 \pm 0.22\,GeV$

Statistical error δm< 1%
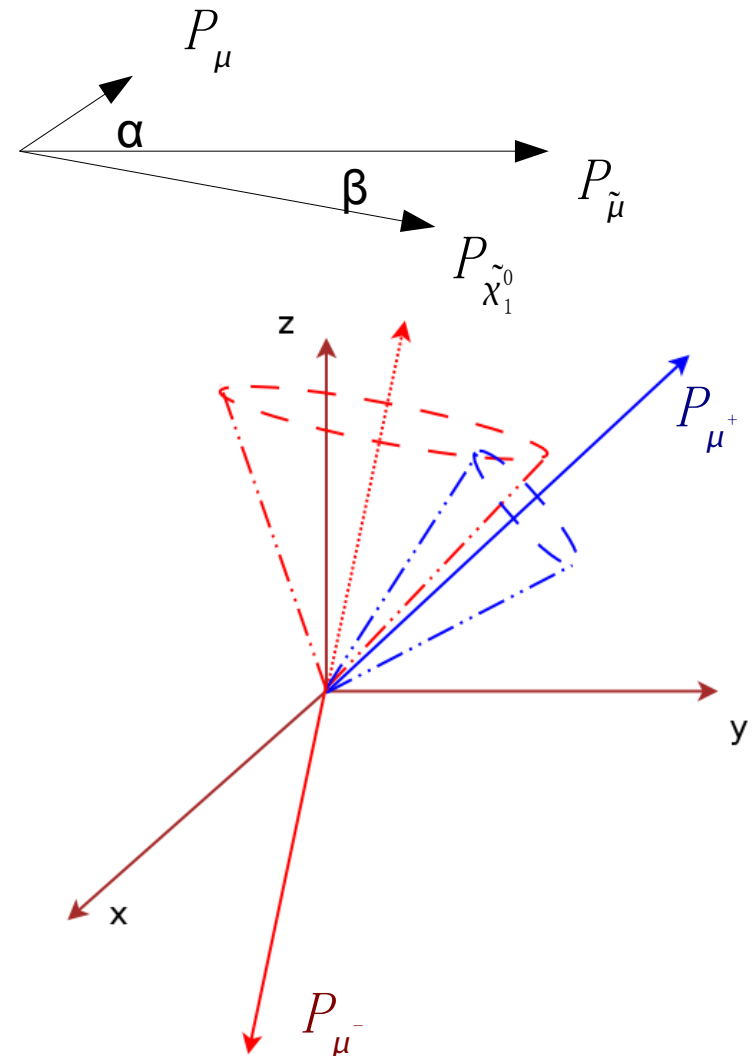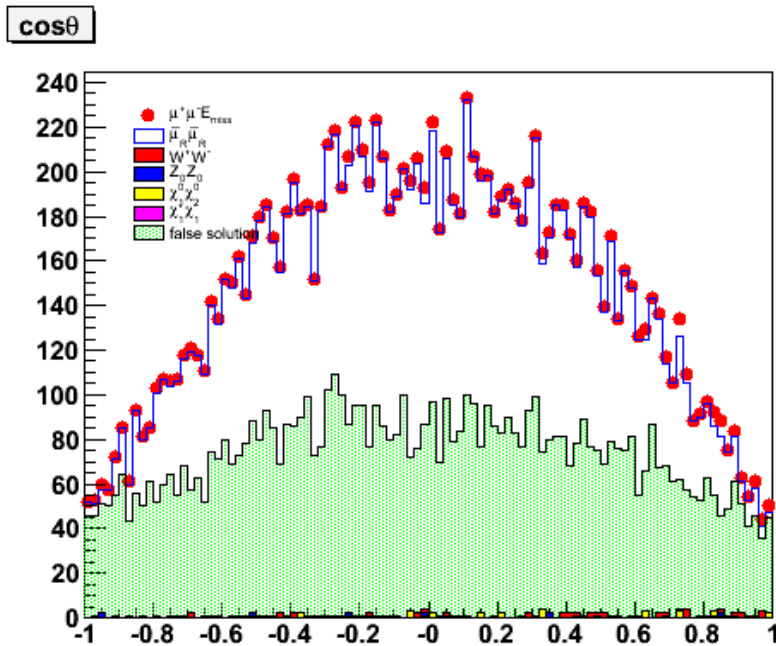The integrated luminosity is 100 fb⁻¹!

Polar Angle Distribution

- $$\frac{d\sigma}{d\cos\theta} \propto \sin^2\theta$$

- Calculation of Polar Angle

  - Masses are known.

  - Conservation of energy and momentum.

  - Angle between the momentum of muon and smuon.

  - Twofold ambiguity
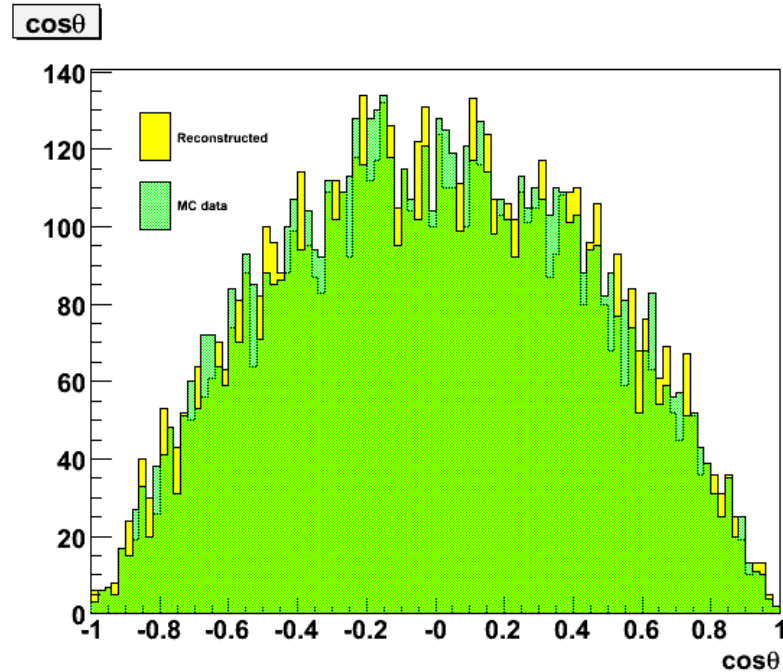
Polar Angle of Smuon

Polar angle distribution with false solution and backgrounds.

Comparison with the MC data after false solution removal.

$$\frac{d\sigma}{d\cos\theta} \propto \sin^2\theta$$

Summary and Conclusion

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- Analysis of right-handed smuon production at ILC was finished based on full simulation and reconstruction chain.

- Detector model LDC01_05Sc and PandoraPFAProcessor were used.

- Masses are consistent with the input value (a little larger). The statistical error is smaller than 1%.

- Polar angle distribution of the smuon was studied. The result shows that smuon is a spin-0 particle.