

2010/09/29

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Status of QED Background Studies

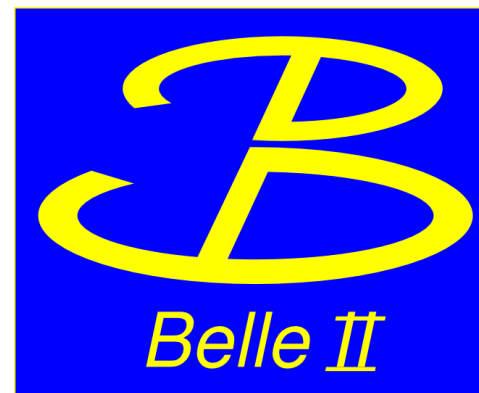
- QED as major source of PXD background ?
- Analysis: Idea, road map and results
- Future aspects of the analysis: basf2



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(Werner-Heisenberg-Institut)



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Two kinds of background are expected for Belle II

Machine background

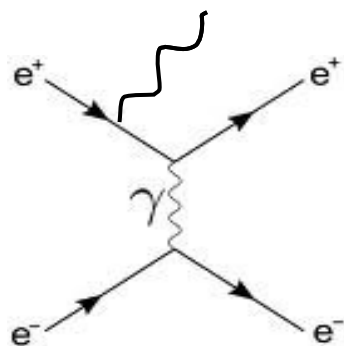
Beam – gas scattering (Bremsstrahlung and Coulomb scattering)

Touschek – effect (intra – bunch scattering)

Synchrotron radiation

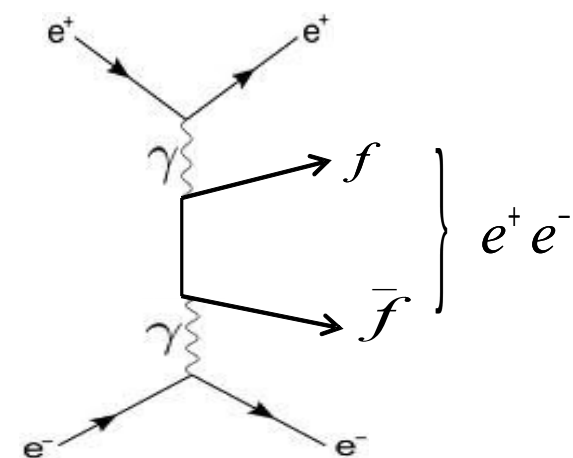
Luminosity related background

Radiative Bhabha scattering



$$\sigma \approx 50 \text{ nb}$$

Gamma/Gamma reactions



$$\sigma \approx O(10^7 \text{ nb})$$

Expected increase in rate

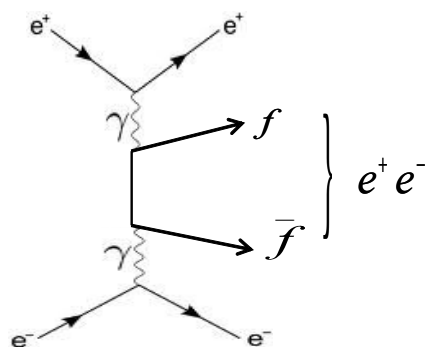
Machine

factor of **2** due to current

Luminosity – related


factor of **40** due to luminosity

Dominating QED background: **2 photon processes**



Expected occupancy of PXD

	SuperB (private communication)	BDK (Simulation)	KW (Simulation)
Tracks	13800	~800	~800
Occupancy	1.3 %	0.07 %	0.1 %

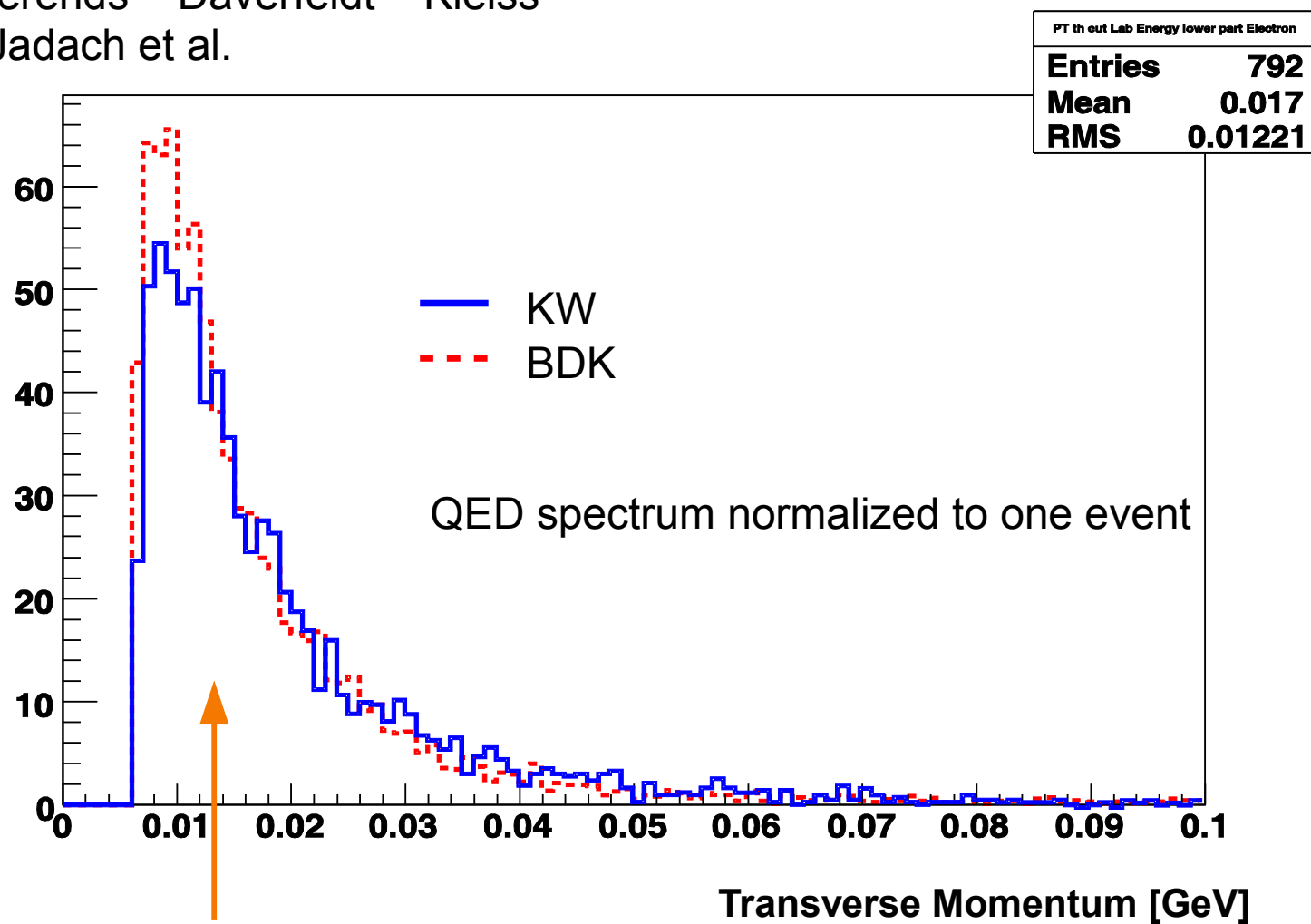


BDK: Berends – Daverfeldt – Kleiss

KW: S.Jadach et al.

BDK: Berends – Daverfeldt – Kleiss

KW: S.Jadach et al.



high rate at very low momentum
(~ 5 – 20 MeV)

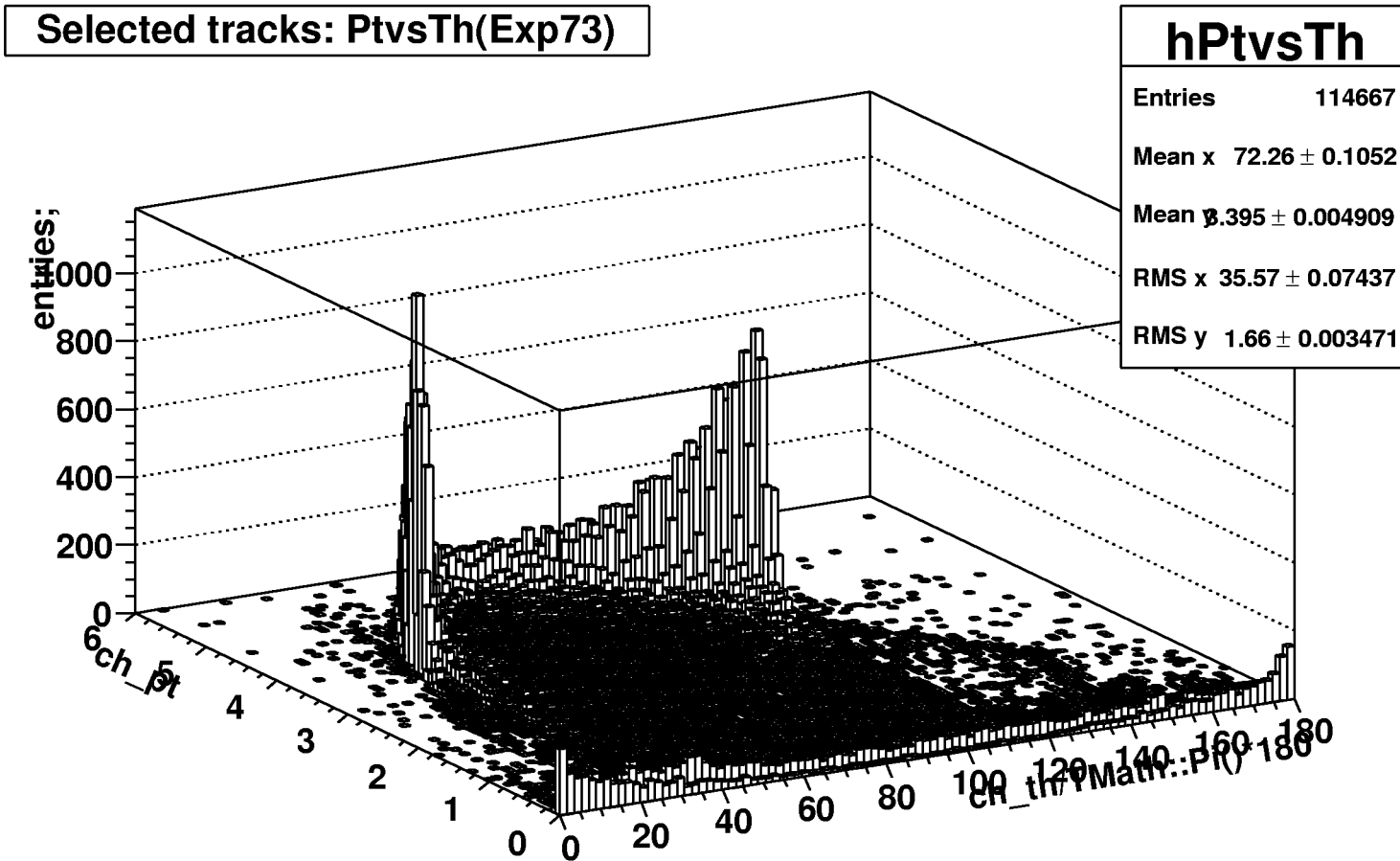
energy > 5.8 MeV will hit the PXD

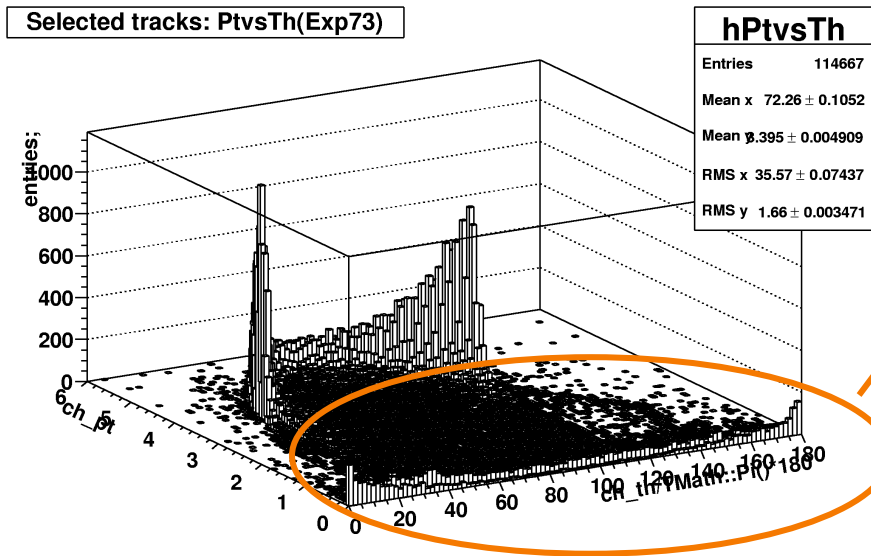
SVD : > 40 MeV

CDC : > 100 MeV

Real data to clarify situation: Special QED runs taken at May 28th at Belle

- Idea:** Measure QED background
- Problem:** A few MeV cannot be triggered at Belle
- Solution:** Random Triggers (unbiased background)





Taken **background events** consist of

- B – physics (few)
- Machine background
- QED

Analysis follows two paths:

QED run data

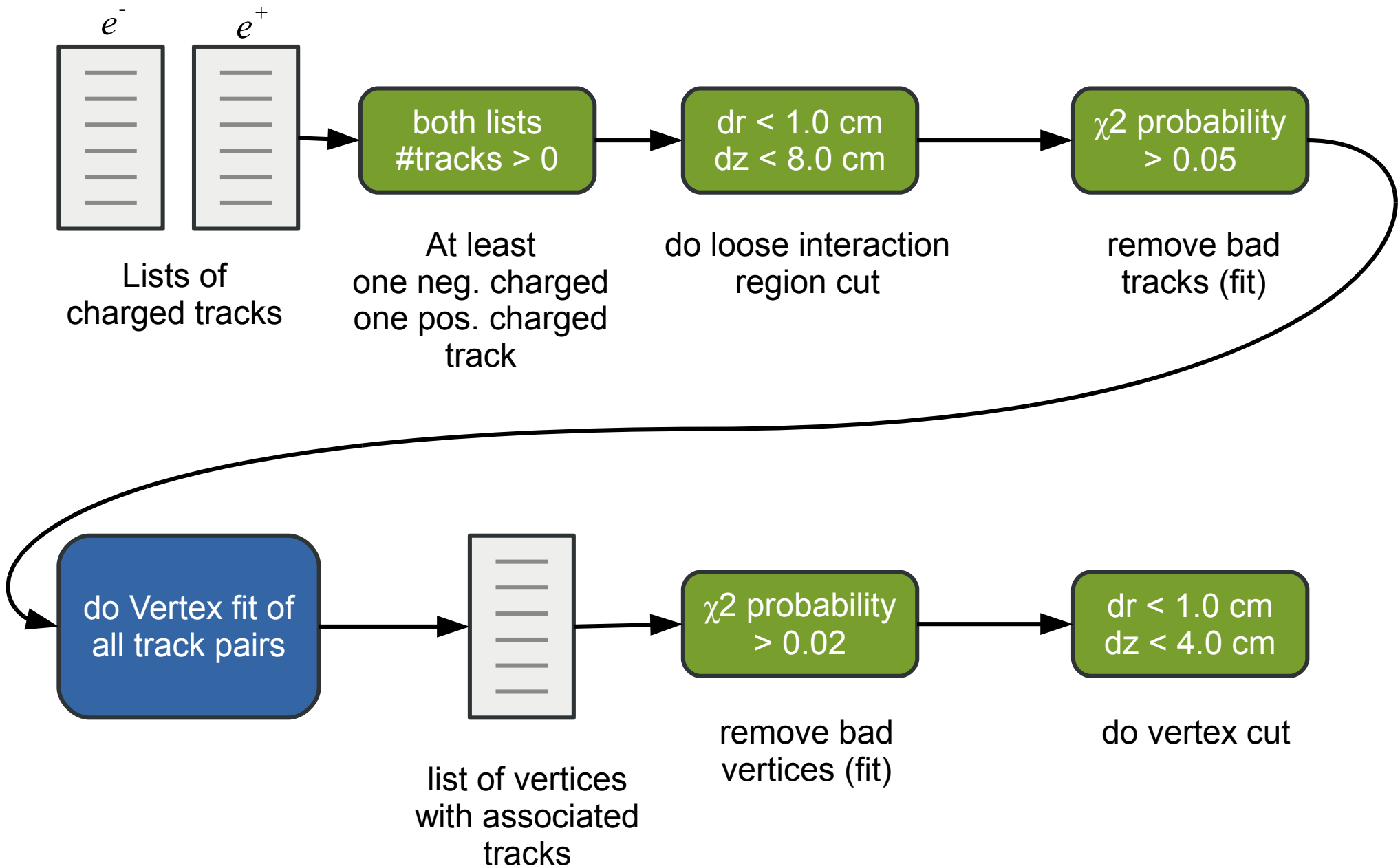
Study hit distributions in SVD and CDC
(done by Elena Nedelkovska)

Study reconstructed tracks
(done by me)

QED background

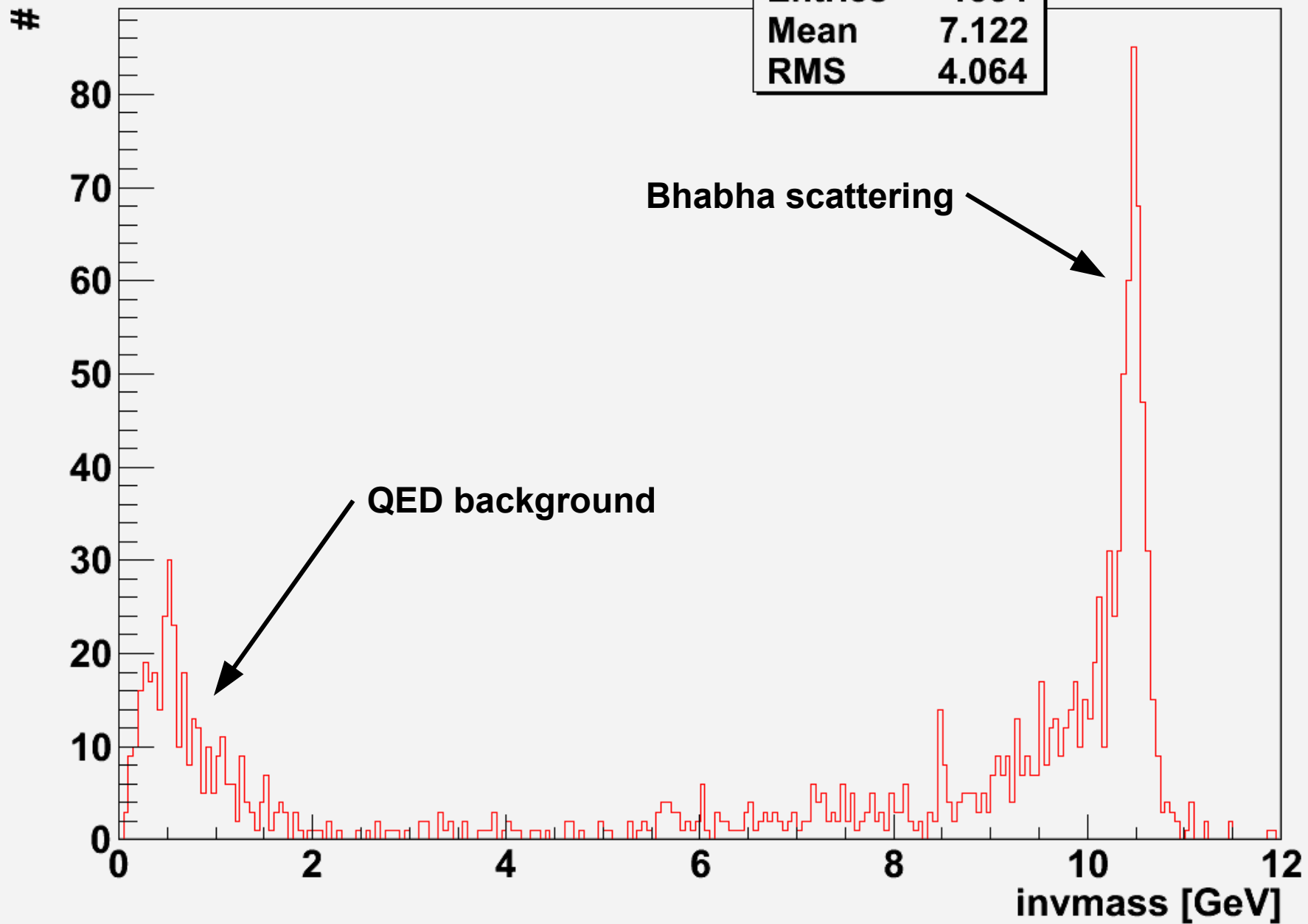
reconstructed tracks

Used software: **Belle Analysis Framework (BASF)**

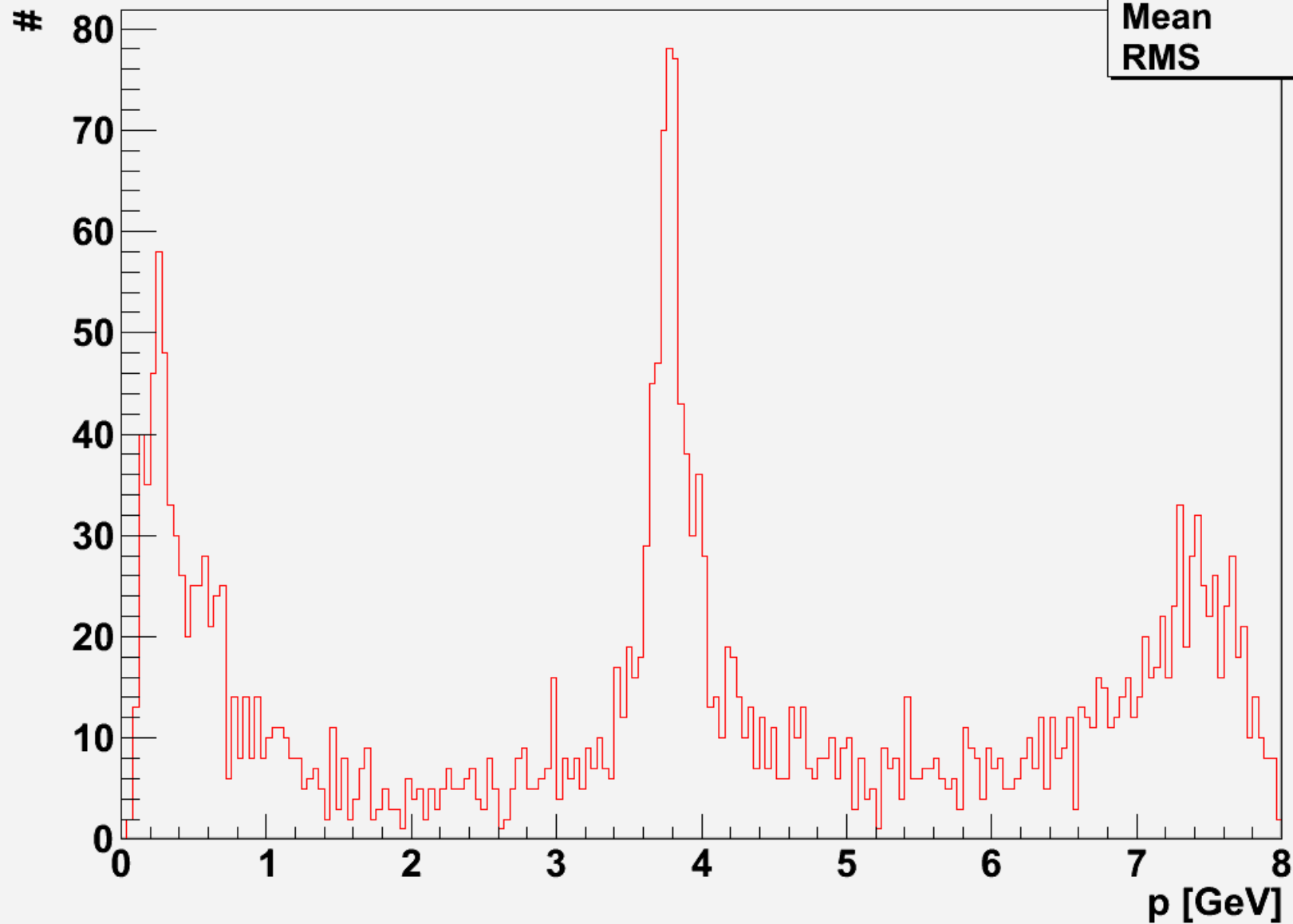


Invariant mass

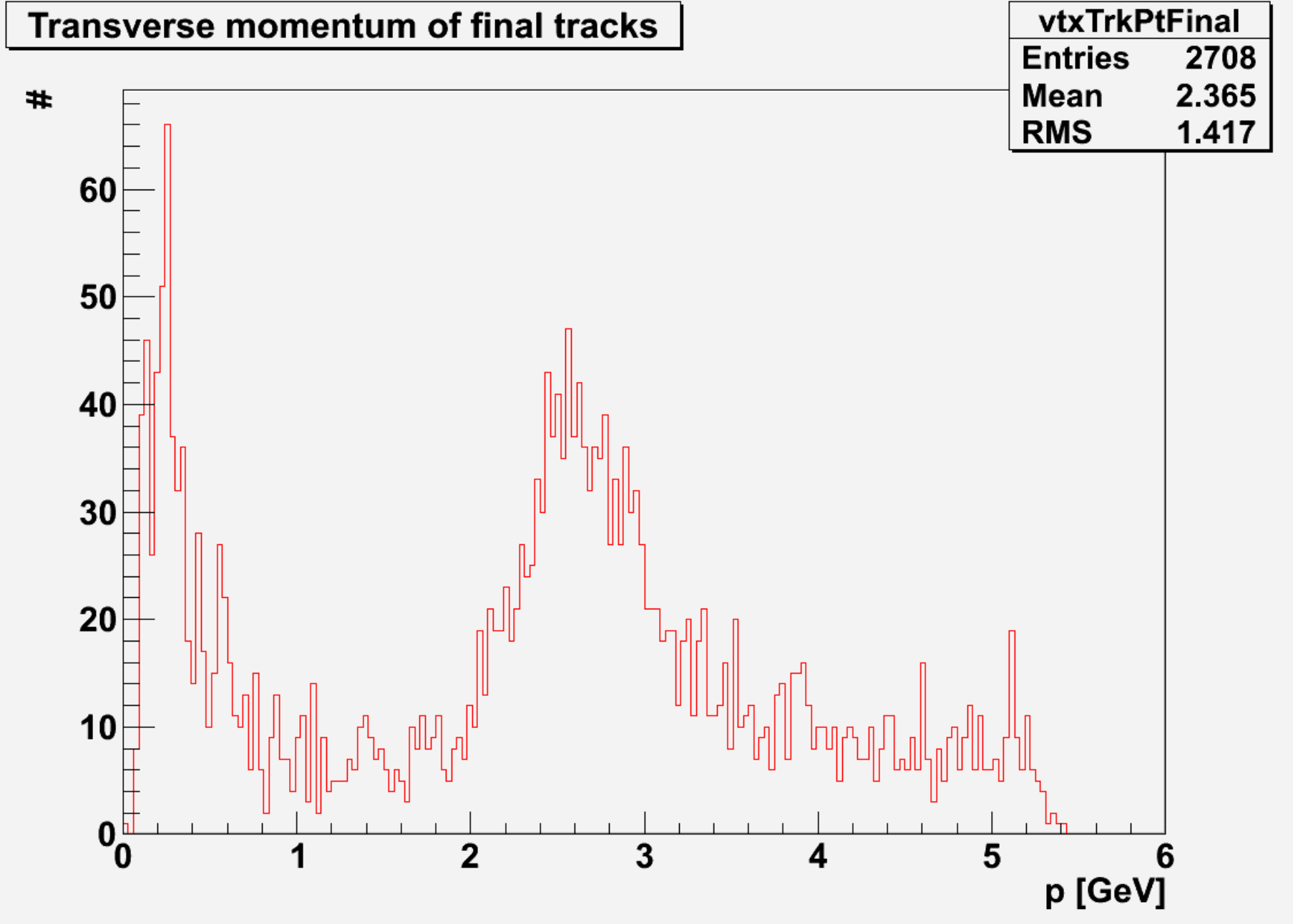
invMass	
Entries	1354
Mean	7.122
RMS	4.064



Momentum of final tracks

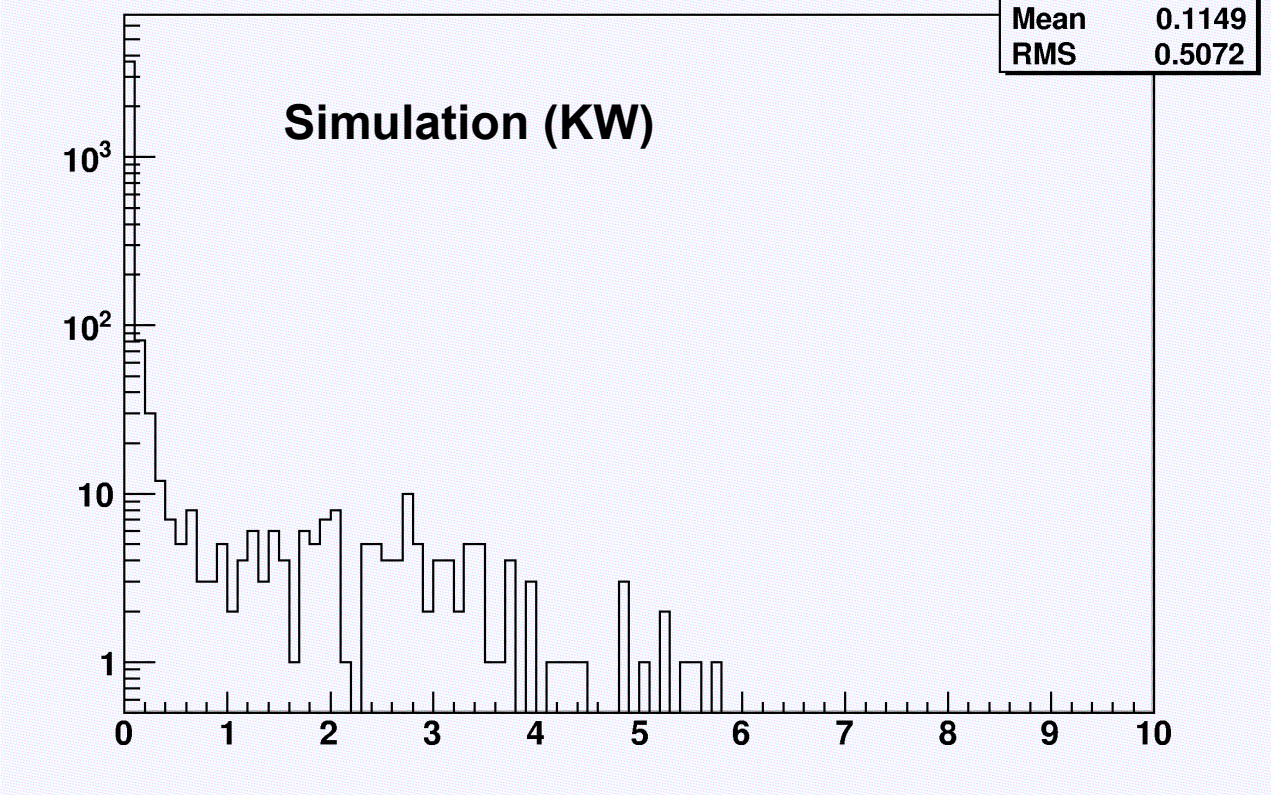


vtxTrkPFinal	
Entries	2708
Mean	3.929
RMS	2.483

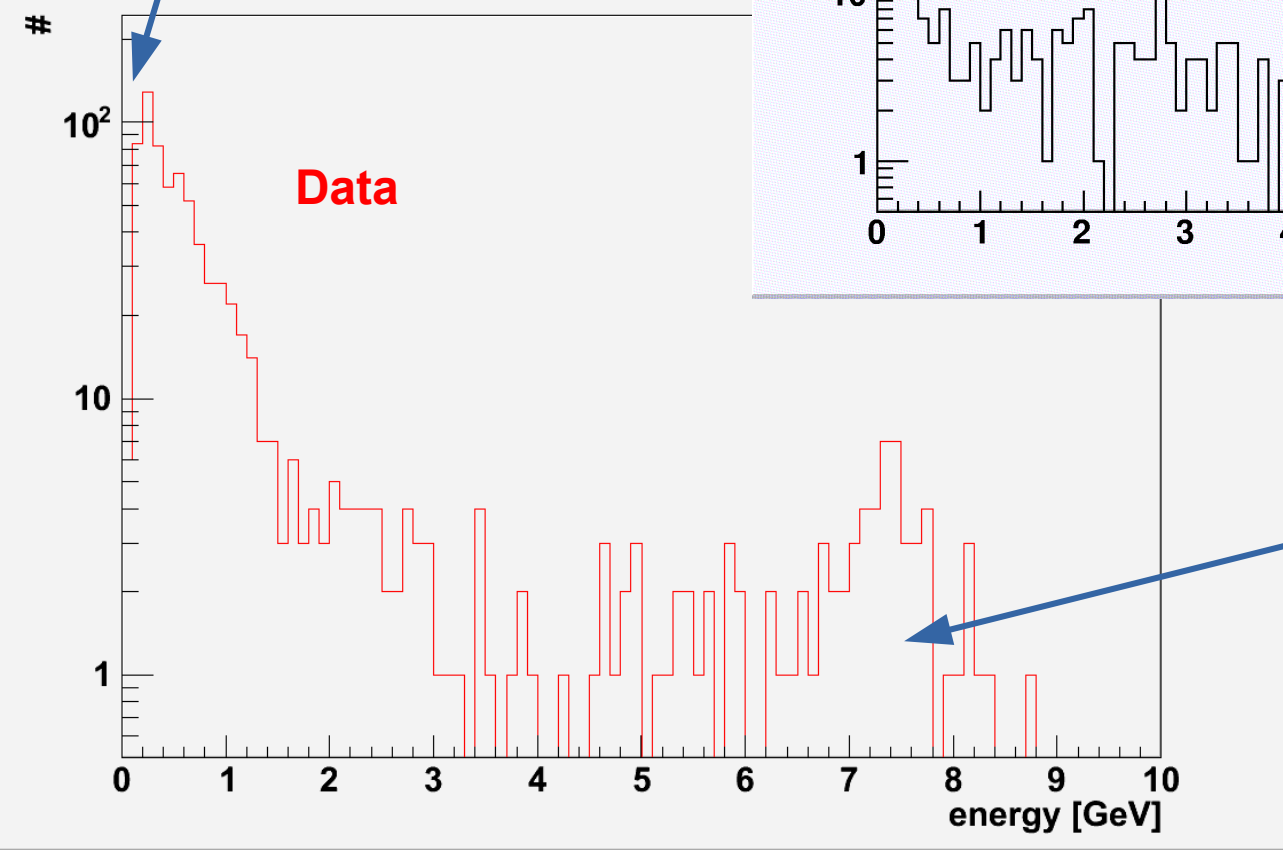


PT th cut Lab Energy

PT th cut Lab Energy Electron	
Entries	3968
Mean	0.1149
RMS	0.5072



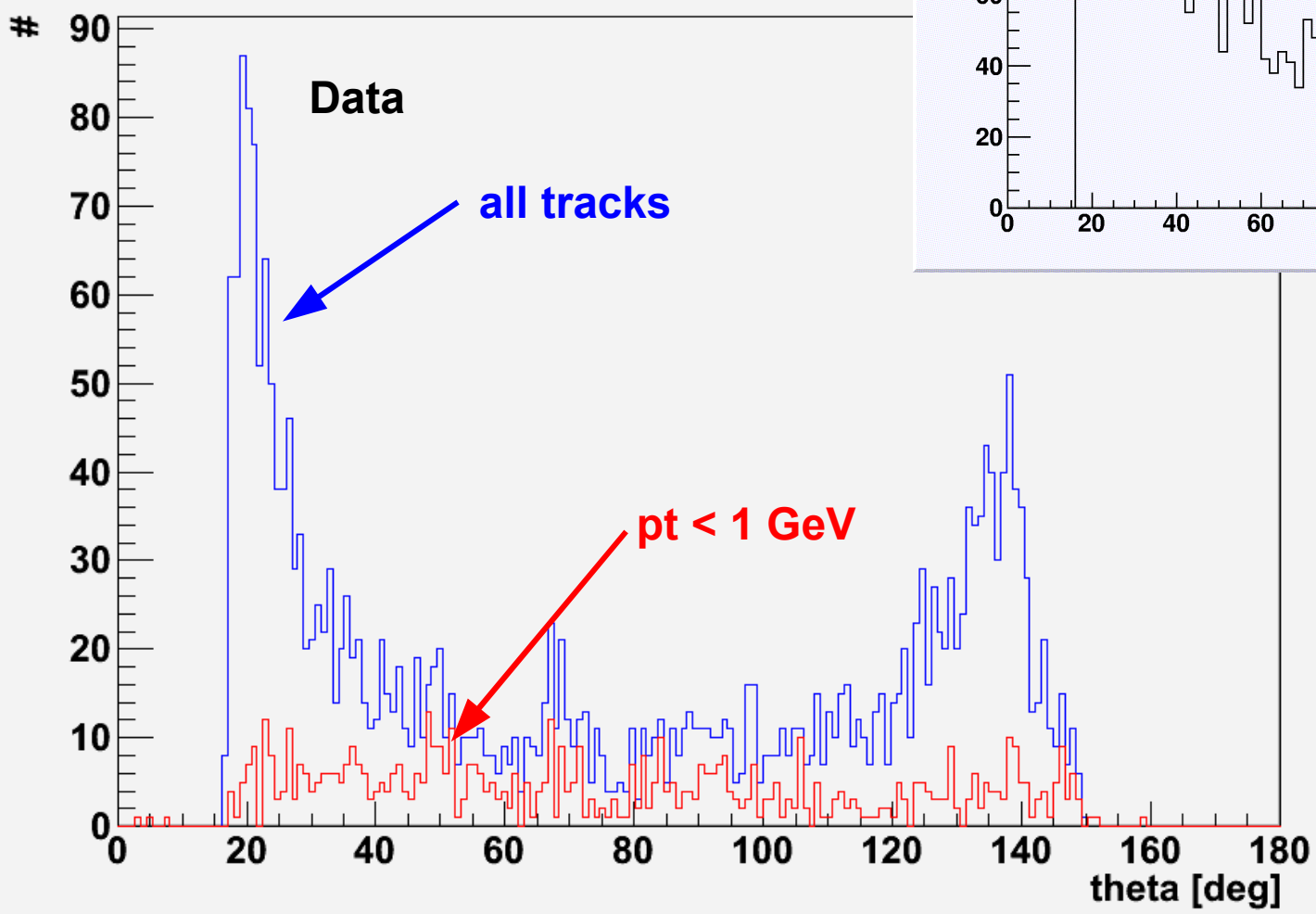
Energy (tracks pt < 1.GeV)



Effect of track efficiency

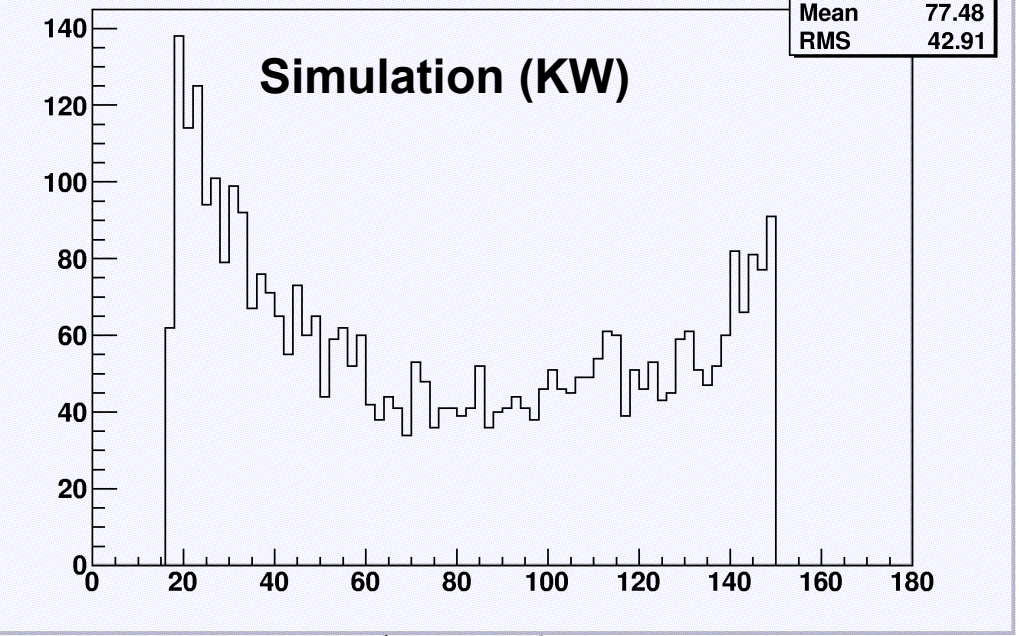
Still Bhabha events left

Theta of final tracks

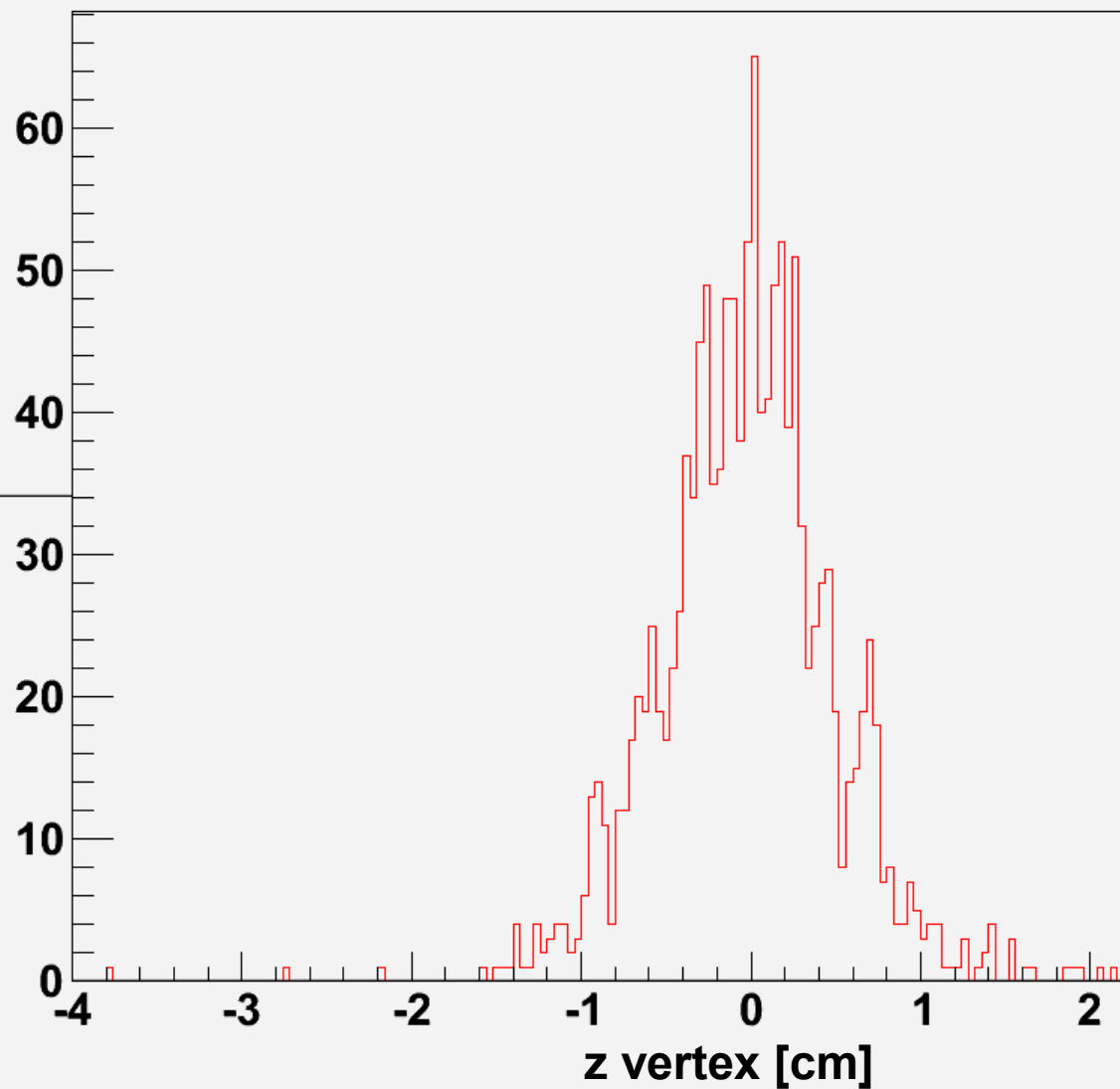


PT th cut Lab Polar angle

PT th cut Lab Polar angle Electron	
Entries	3968
Mean	77.48
RMS	42.91

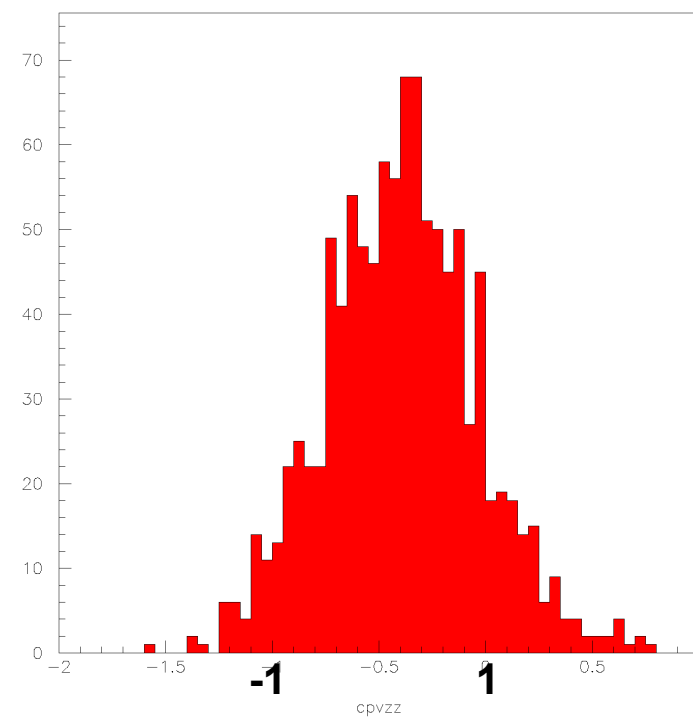


Z position of the final Vertex



vtxZFinal	
Entries	1354
Mean	-0.02161
RMS	0.5294

Compare to hadron events



Next steps

The future of the analysis

Track reconstruction in the BELLE software framework (BASF)

- Tracking efficiency breaks down at **about 100 MeV**
- Very hard to **tune** pattern recognition and track fitting

➔ Need more control over pattern recognition and track fitting

Use the Belle II software framework **basf2**

- ✓ Pattern recognition optimized for low momentum
 - ✓ Flexible track fitting framework (GENFIT)
 - ✓ Used for background simulation
- } **under development**

Required steps:

- **Convert QED** data from BELLE to Belle II
- Implement **geometry** of the BELLE tracking detectors in the new framework
- Test, verify and use new

pattern recognition code

track fitting code

- (Implement), verify and use new **vertex fitter** (RAVE)

Beneficial side effects:

- Establish workflow to convert BELLE data to Belle II
- Start implementing BELLE detector in basf2

- ✓ Two analysis paths: hit distributions & track reconstruction
- ✓ First look into reconstructed tracks for QED background data
- ✓ Found about 330 ($p < 1$ GeV) two track events
- ✓ Working on improving the analysis by porting it to basf2