

Study of Single-W process

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—> Status & progress of my study

Motivations

- **Precise measurement of W boson mass**

Now trying

- measuring m_W to a few MeV in $W \rightarrow qq'$ decays

- challenging requirements on JER and calibration

- needs detector optimization

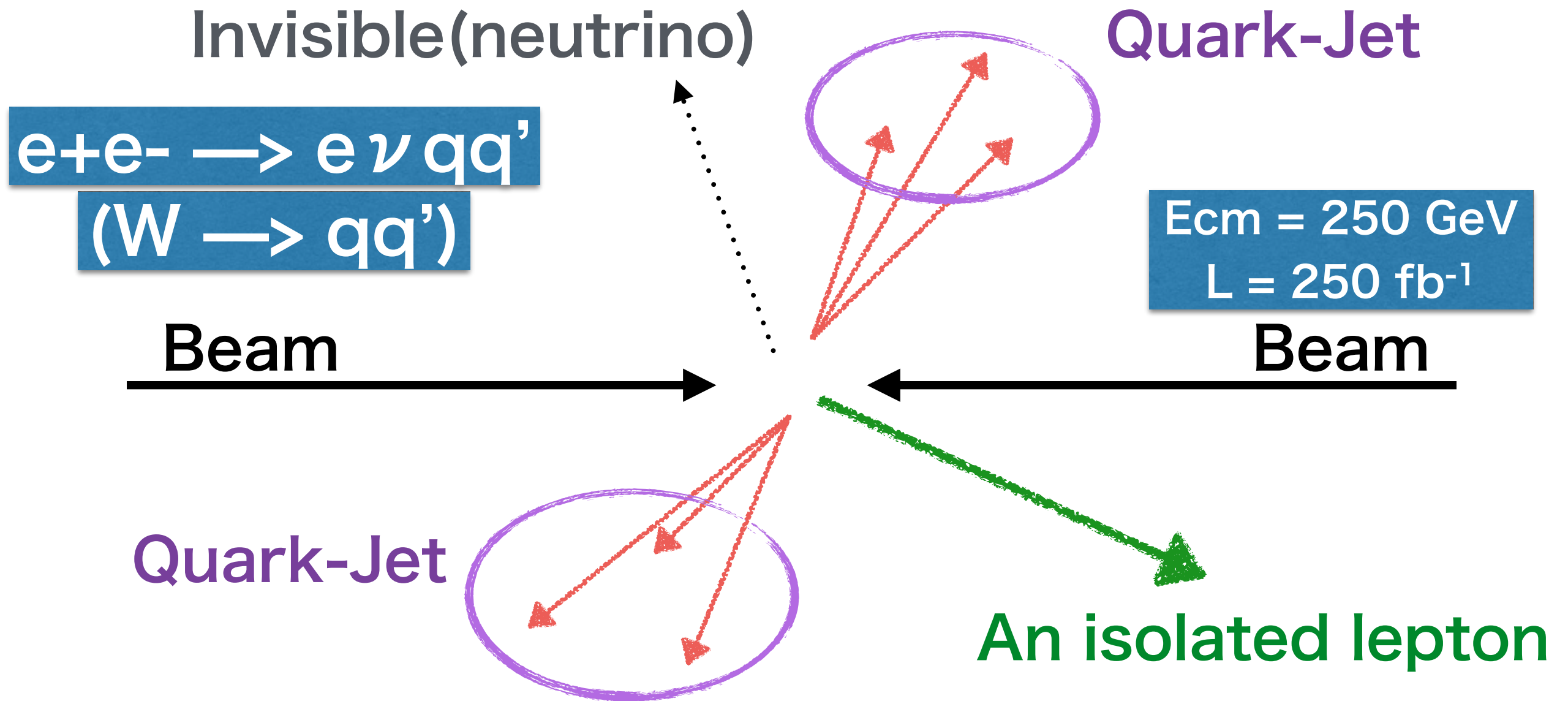
- comparison of performance among different options of calorimeters (e.g., Si or Scintillator ECAL)

- **Study of anomalous triple-gauge-boson couplings**

- mainly $WW\gamma$ and WWZ couplings

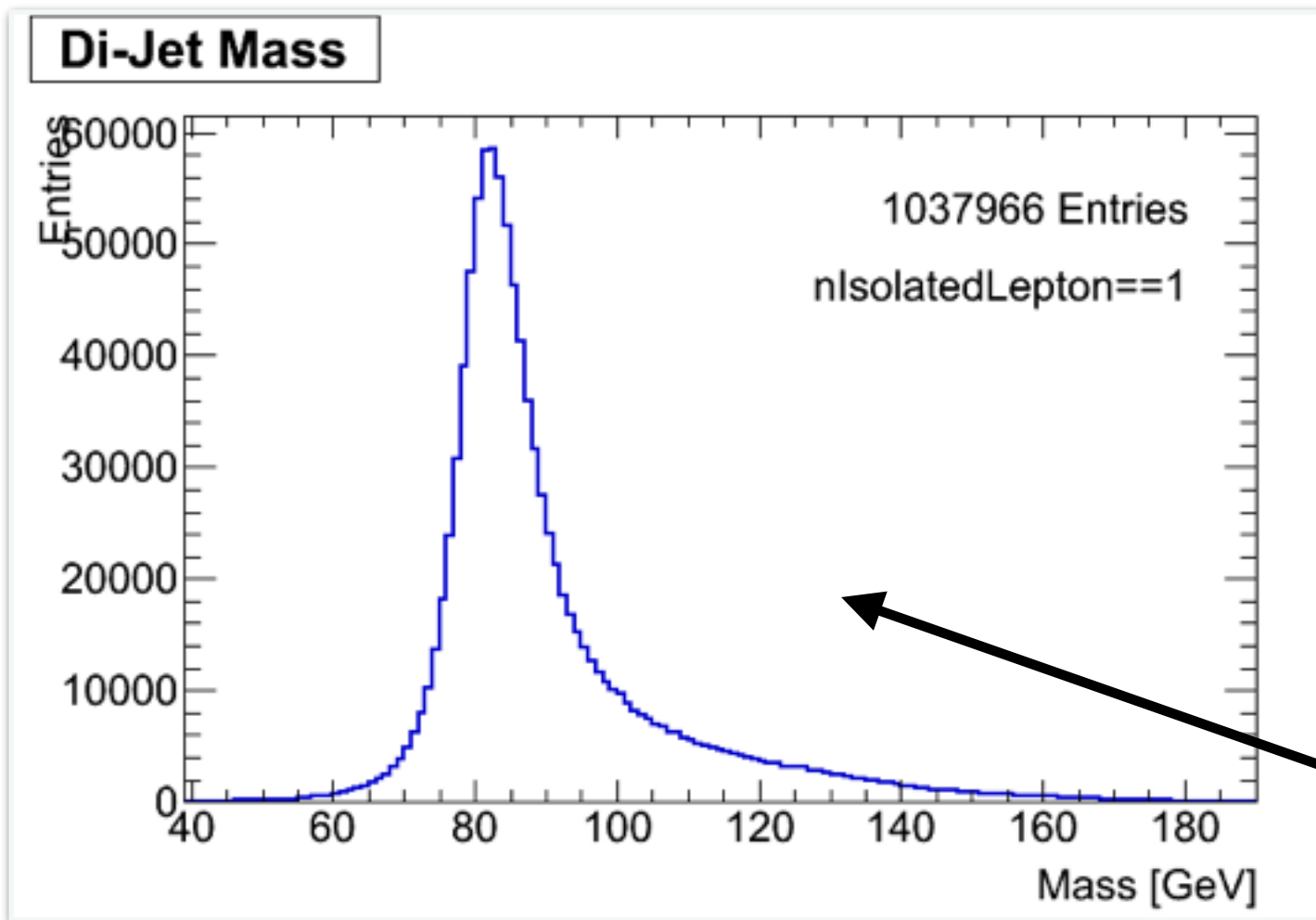
- signal of new physics beyond the SM

Analysis flow



1. First, require only one isolated lepton(electron/positron)
2. Force remainder of PFOs into 2-jet with Durham algorithm.
3. Invariant mass of 2-jet should be equal to m_w .

m_W reconstruction



Selection	Number of events
None	1474541
Pre-cut ?	1473035
One isolated lepton	1037966

The peak seems to be a bit larger than m_W true (=80.5GeV) but I couldn't understand why.

Effect of $W \rightarrow \text{leptonic}$

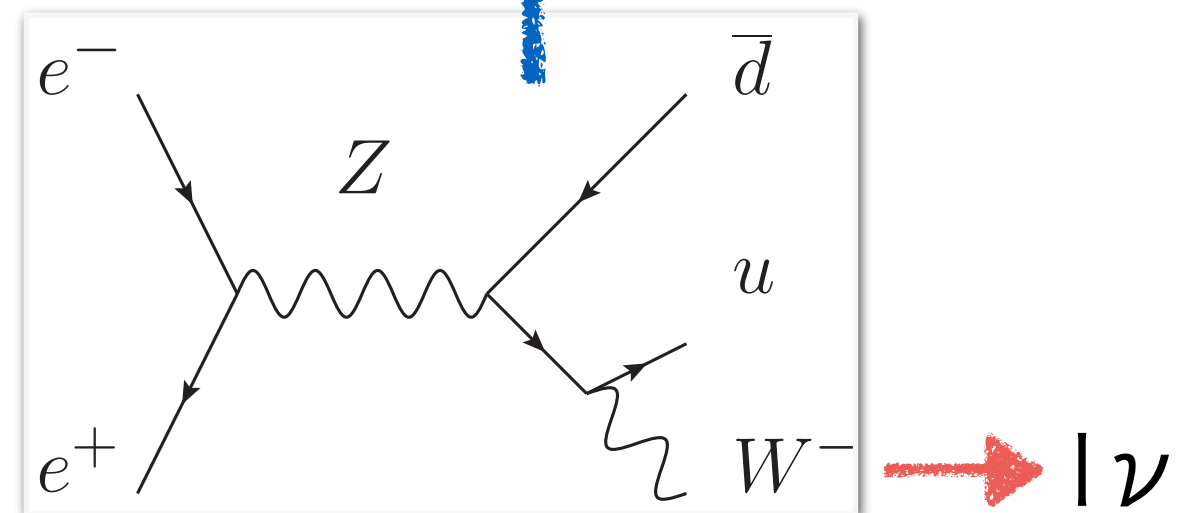
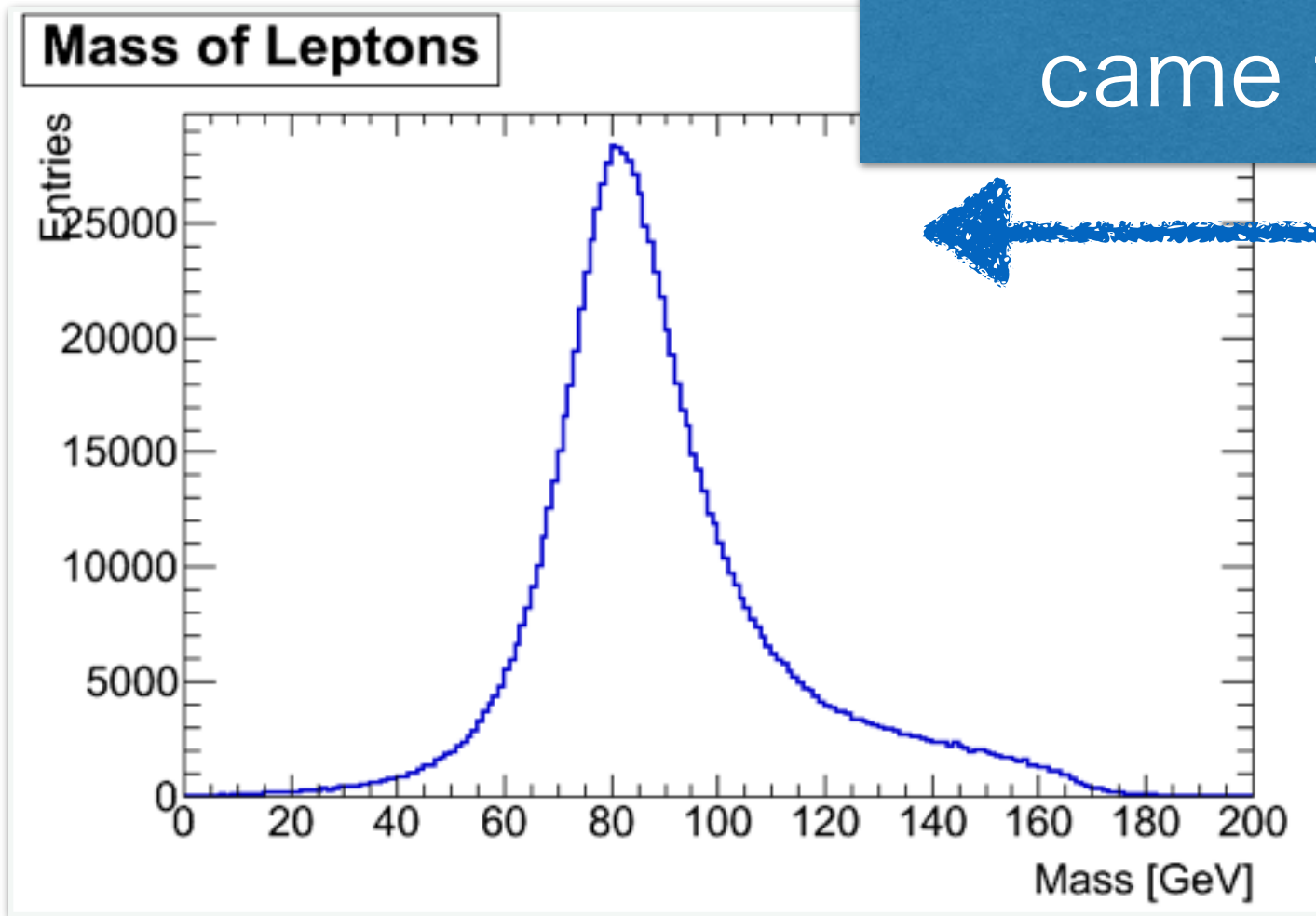
$$p_{CM} = p_u + p_d + p_l + p_\nu$$

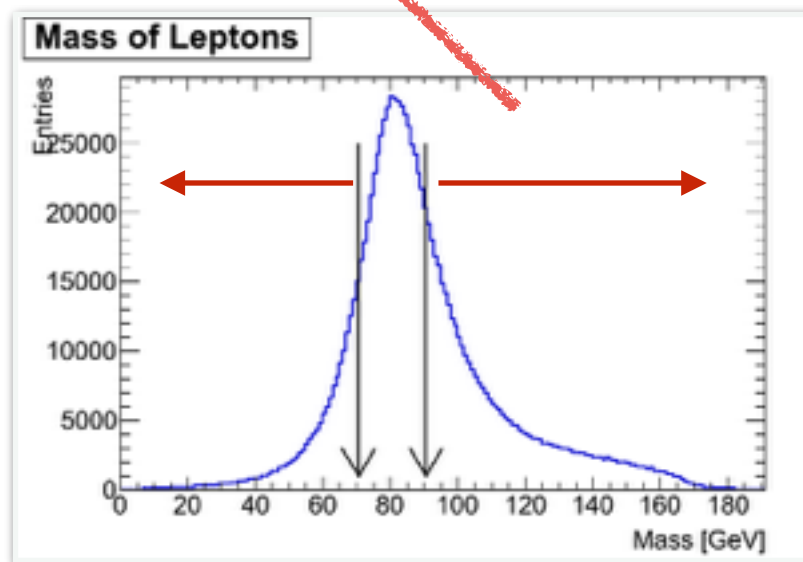
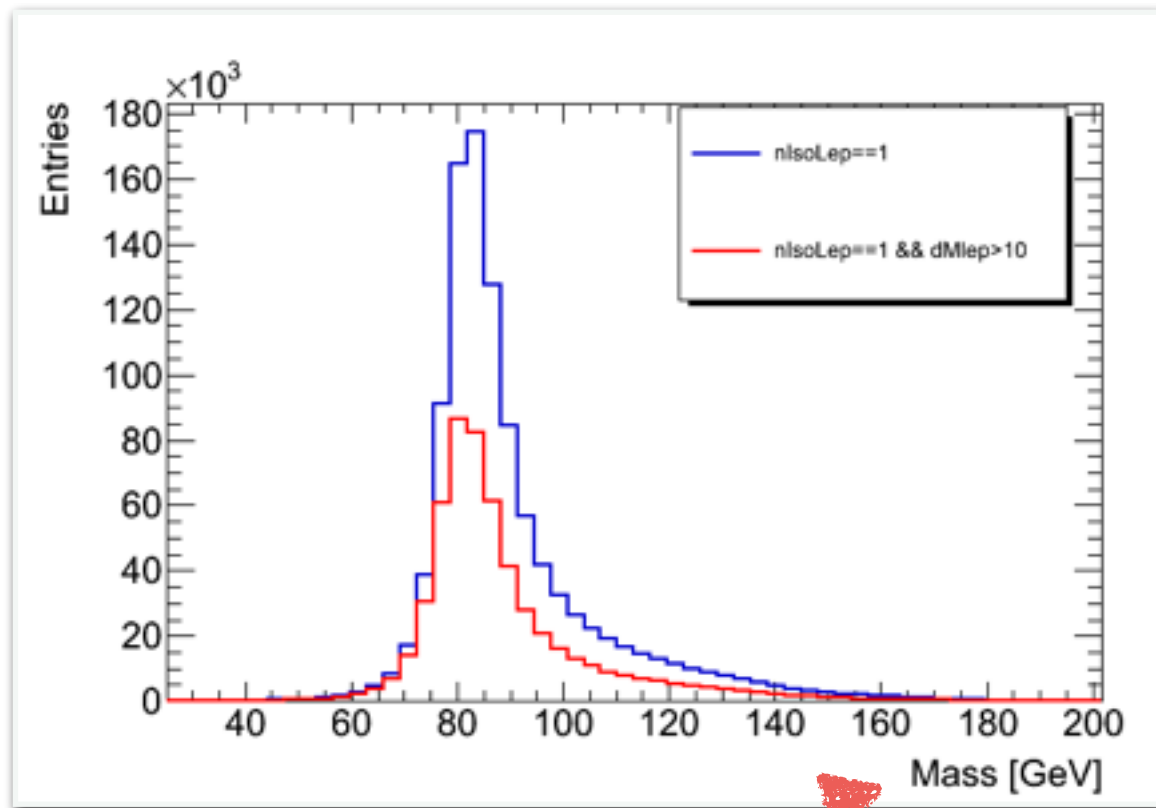
(When only one isolated lepton was found.)

$$\underline{(p_l + p_\nu)^2} = (p_{CM} - p_u - p_d)^2$$



This peak nearby $\sim 80\text{GeV}$, mainly came from $W \rightarrow \text{leptonic}$?





To exclude $W \rightarrow l \nu$ events.

Selection	Number of events
None	1474541
Pre-cut ?	1473035
One isolated lepton	1037966
$70.5 < \text{Mass of } (l \nu) < 90.5$	548035

Summary

- I'm trying to reconstruct invariant mass of 2-jet from W boson decay in single- W process.
 - Reconstructed m_W peak was a bit larger than that I expected.
 - I have thought that the difference between reconstructed m_W & MC true is due to the effect of leptonic decays ($W \rightarrow e \nu$), but are there more reasons?

Back up slides

Trying m_W measurement

Now I'm training and searching better analysis method.

Simulation condition

- $\sqrt{s} = 250$ GeV, Luminosity : 250 fb^{-1}
- Beam polarization : $(e^-, e^+) = (-0.8, +0.3)$
- No backgrounds so far
- Detector model : ILD_o1_v5
- ILC soft version : v01-17-05

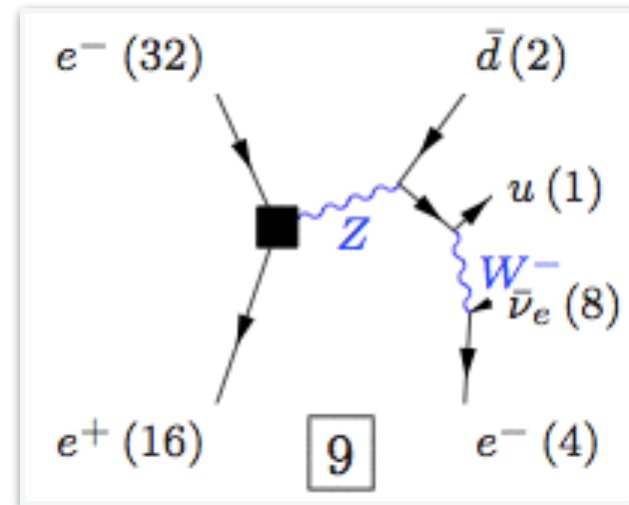
All final states of this process are : e, ν, W

Analysis method

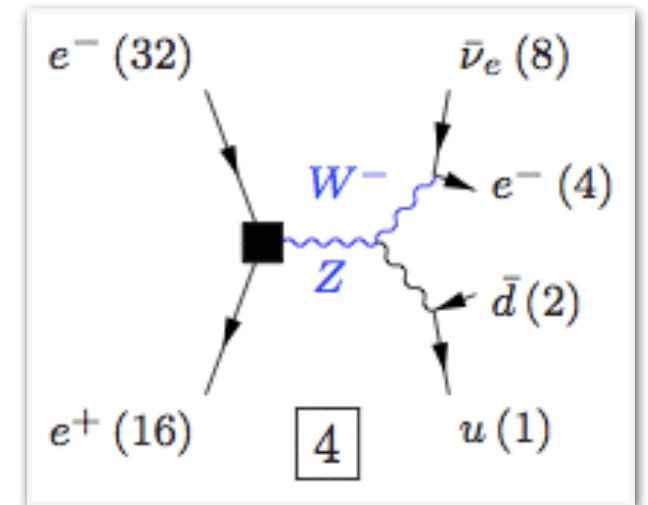
1. Require one isolated electron or positron by using lepton finder of MarlinReco
2. Force remainder of PFOs into 2 jets with Durham algorithm
3. Reconstruct the invariant mass of di-jet

$$W \rightarrow e \nu$$

Mass of 2-jet doesn't
equal to m_w .



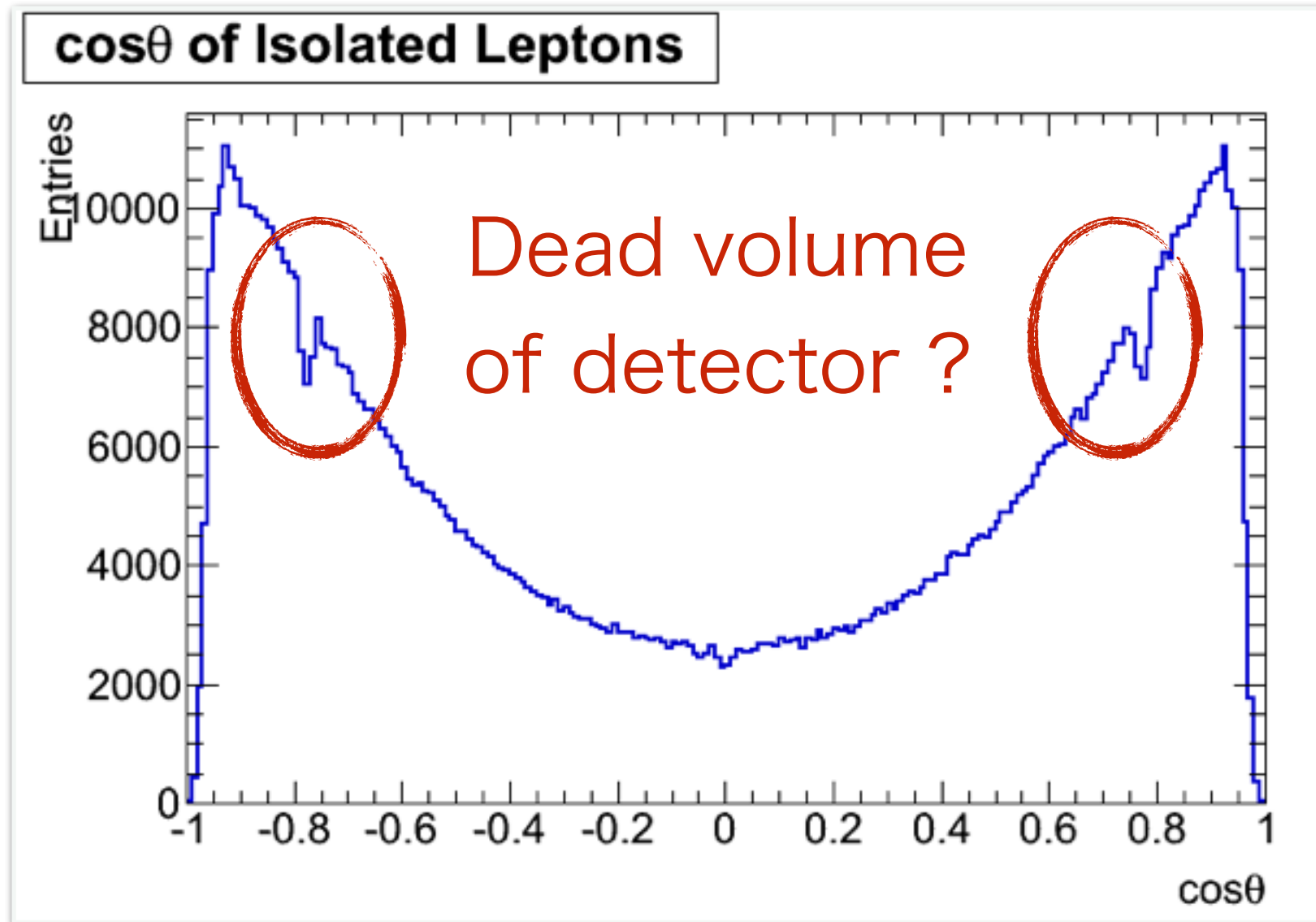
qq' jets from Z



qq' jets from off-shell W

We need to research number of these
events and know how to tag them.

Isolated leptons' feature



The effect of the volume in calorimeter between the end cap and the barrel ?