

Study of Single-W process

Shinshu University

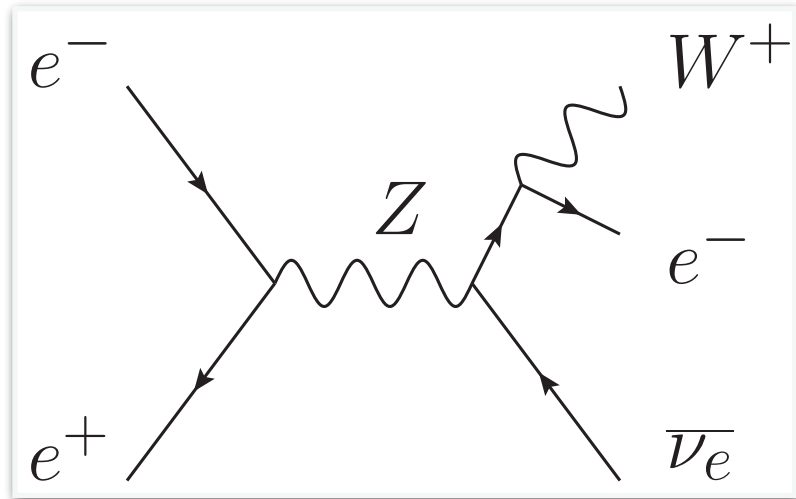
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18th, July 2014 :

—> Motivation in this process & progress of my study

semi-leptonic Single-W process

final state : e, ν, W



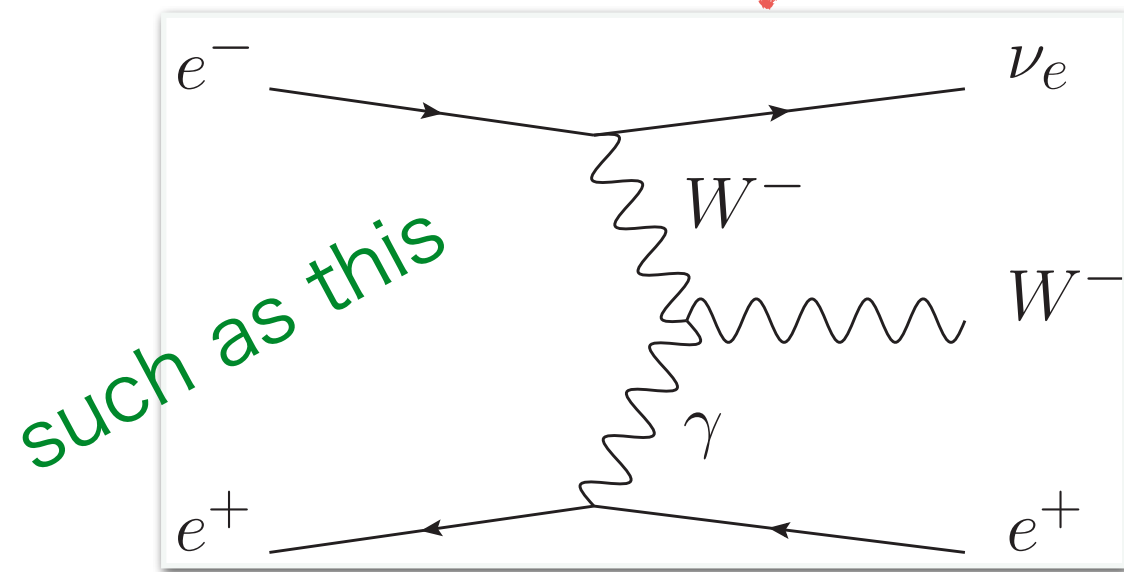
$W \rightarrow q q'$
 very simple 2-jet event

easy to recognize

direct measurement of m_W
 via hadronic system

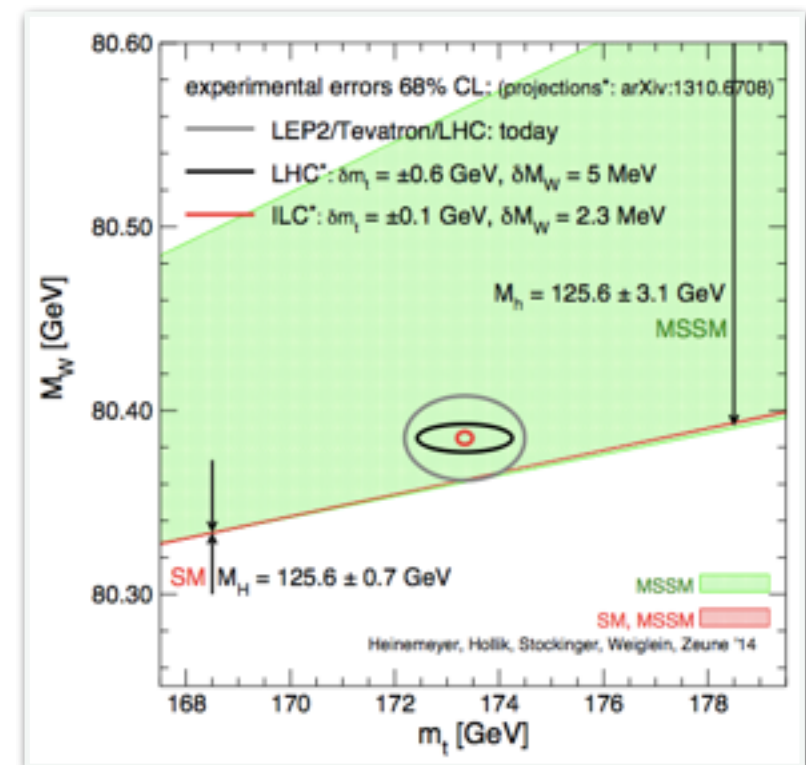
tunable with
 initial polarization

result of precise m_W measurement
 can test the consistency of MSSM



such as this

anomalous gauge coupling



Motivations

- **Precise measurement of W boson mass**
 - 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

Trying m_w measurement

Now I'm training and searching better analysis method.

Simulation condition

- $\sqrt{s} = 250$ GeV, Luminosity : 1000 fb^{-1}
- Beam polarization : eLpL(-1.0, -1.0), eLpR(-1.0, +1.0)
- No backgrounds so far
- Detector model : ILD_o1_v5
- ILC soft version : v01-17-05

All final states of this process are :

$e, \nu, W \rightarrow qq'(\text{jet})$

Analysis method

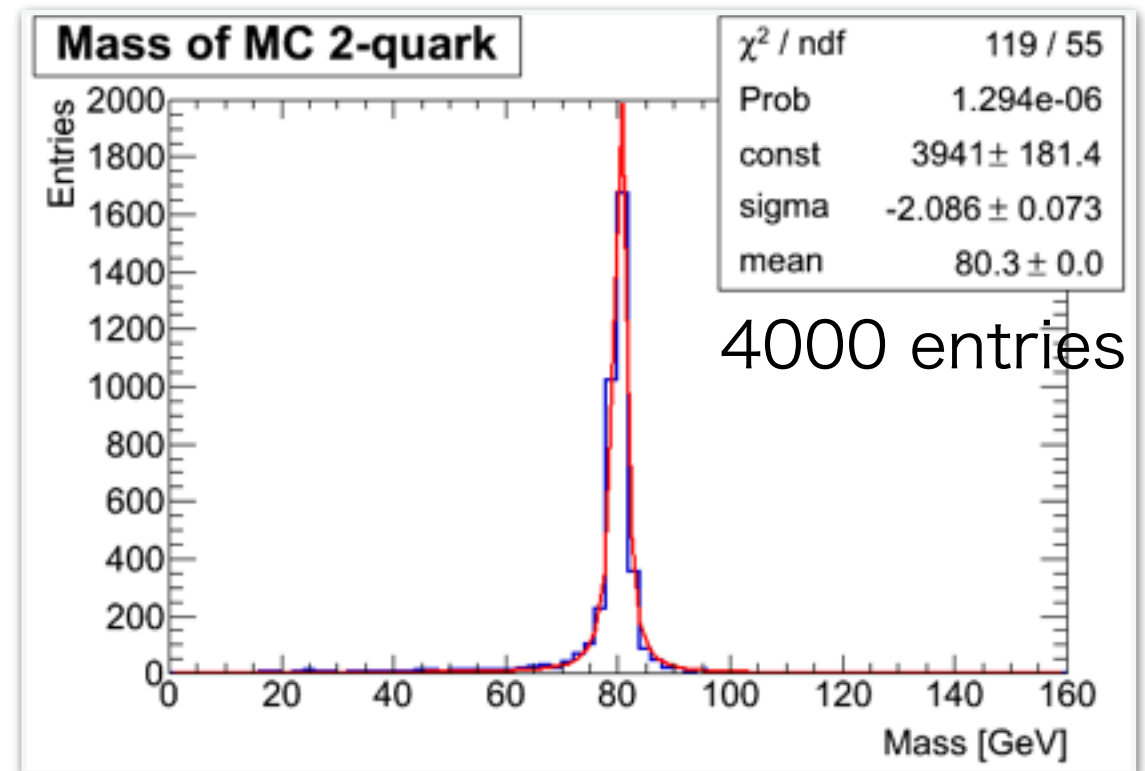
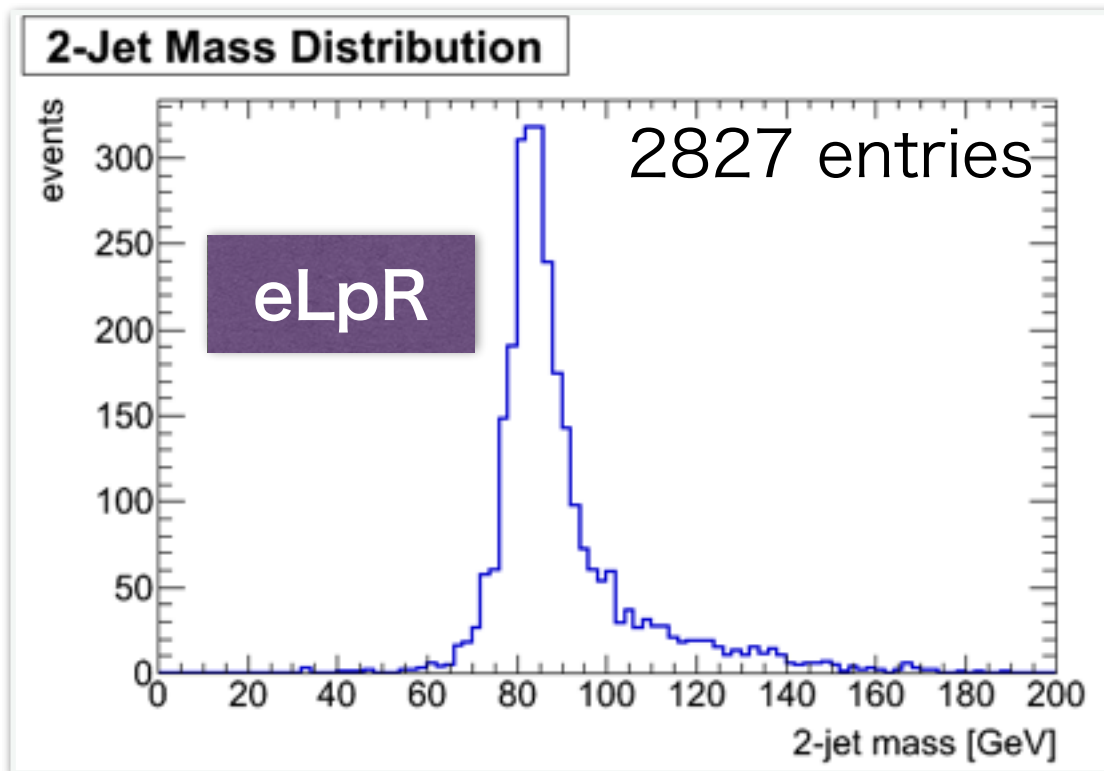
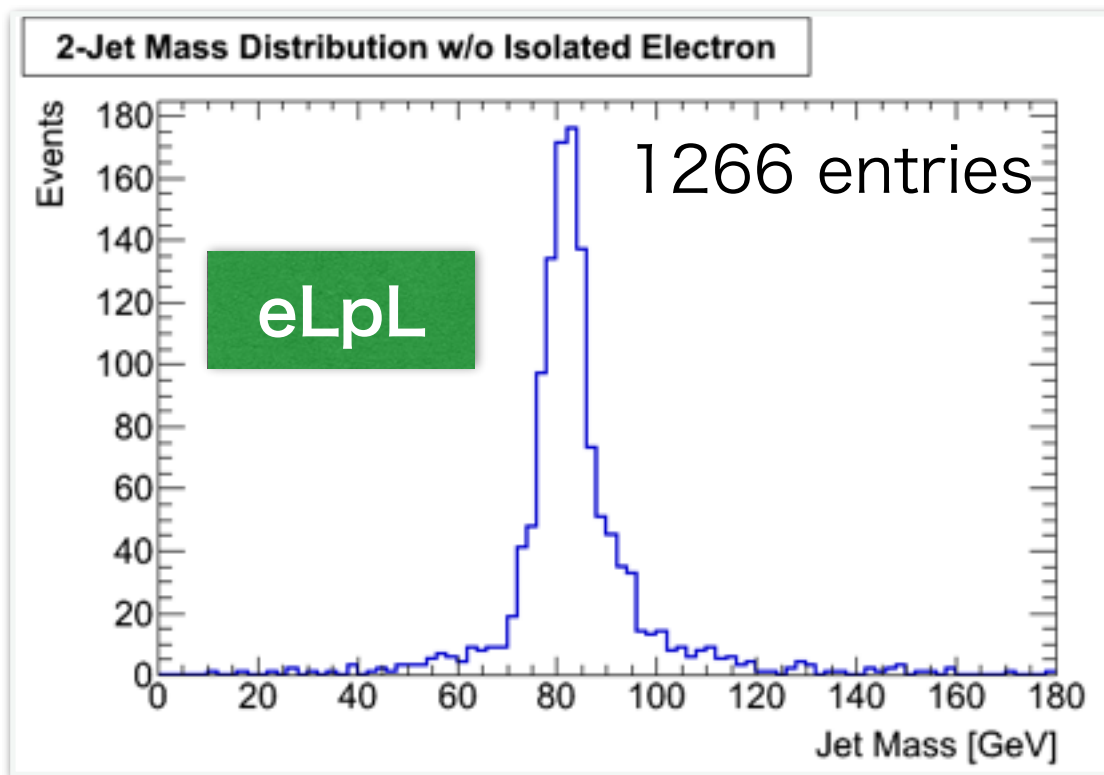
1. Require one isolated electron or positron by using lepton finder of MarlinReco *I think these have characteristic feature.*
2. Force remainder of PFOs into 2 jets with Durham algorithm
3. Reconstruct the invariant mass of di-jet

W boson mass reconstruction

started with sample 4000 events

Statistics changes due to the different compositions of effective diagrams, which are determined by beam polarization.

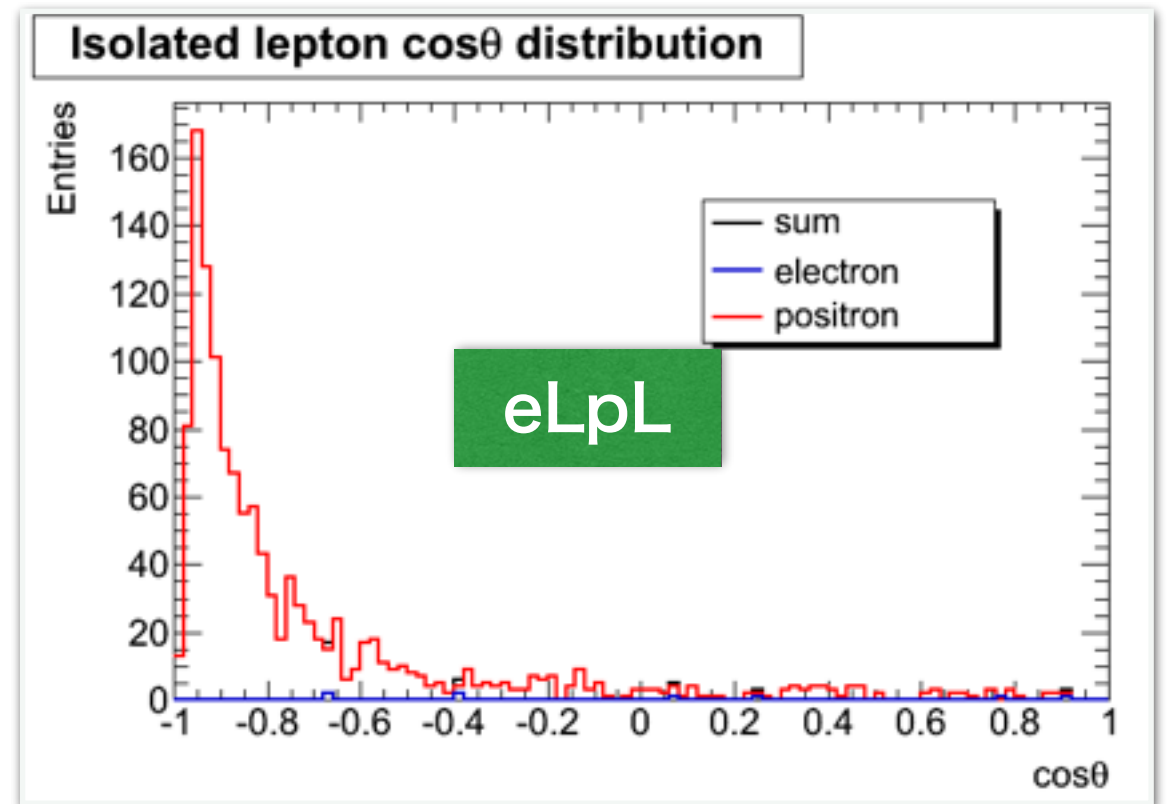
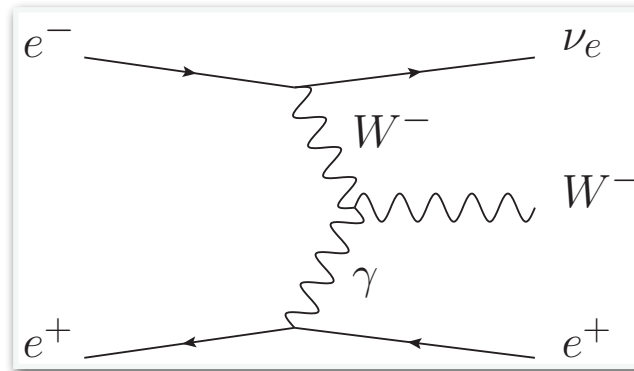
Both peaks are nearly $\sim 80\text{GeV}$, but a bit larger than m_W



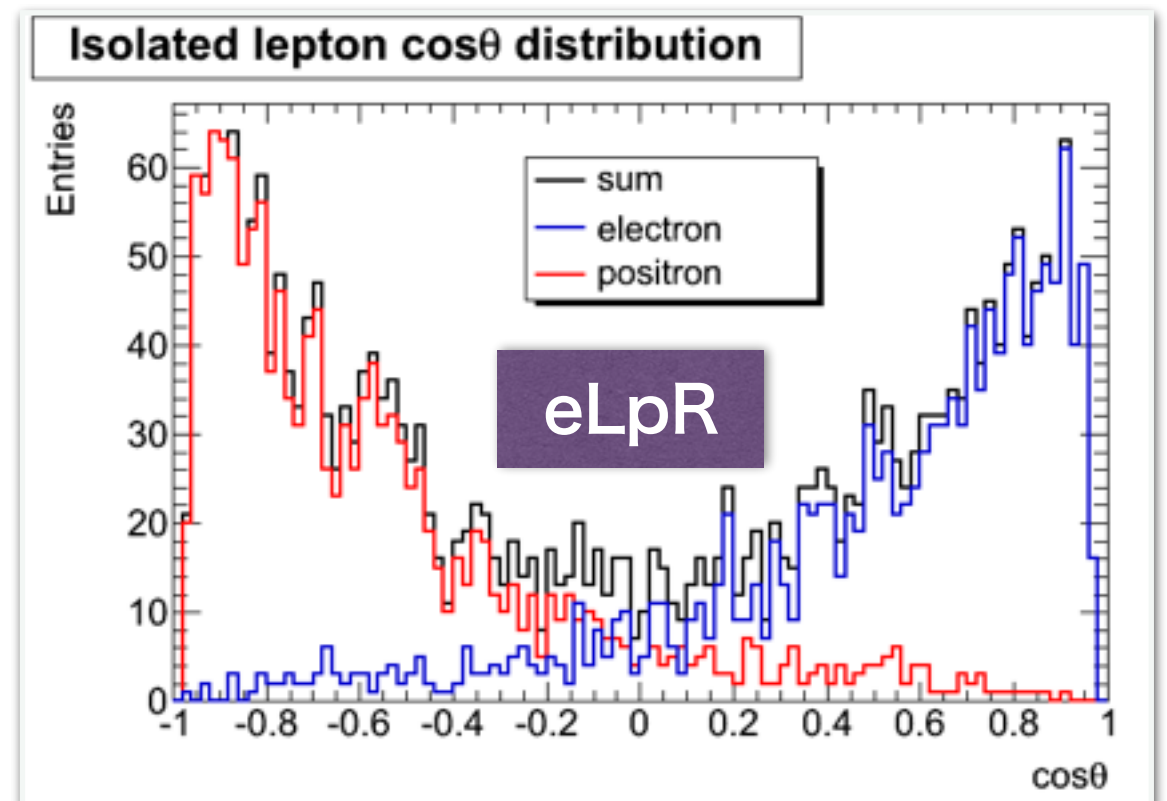
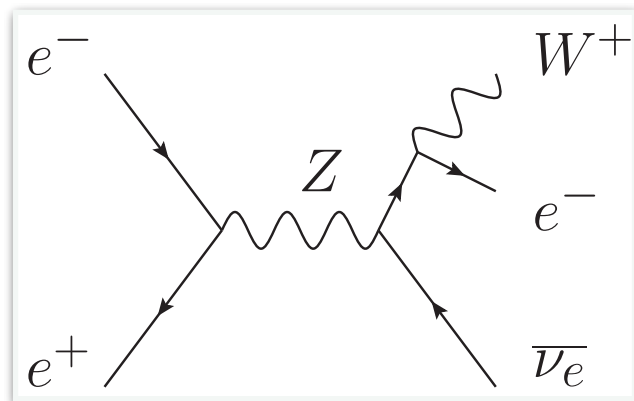
Characteristic electron/positron feature

In case of eLpL, these are mainly from t-channel diagrams

like this, but only $e^+e^- \rightarrow e^+, \text{anti-}\nu, W^-$ due to polarity



but for eLpR, both above and following types are included



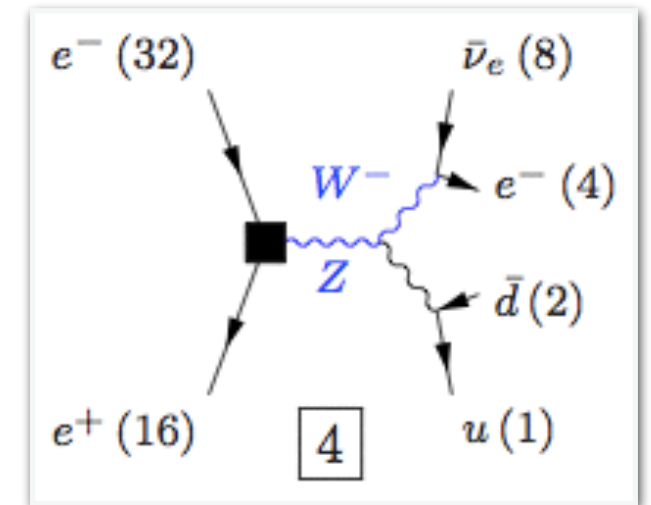
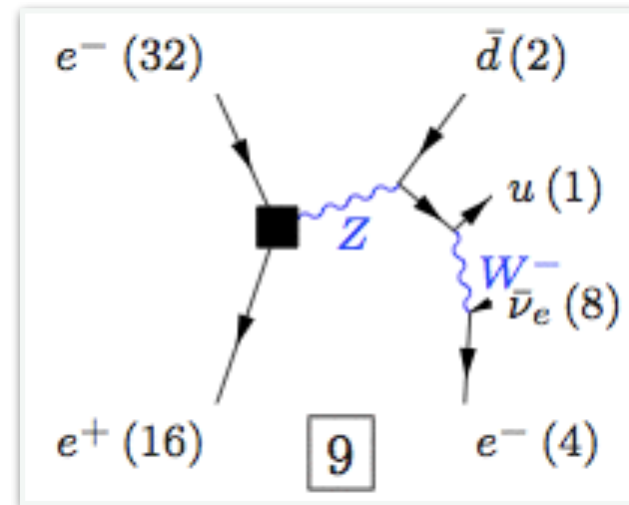
We can select signals by using those features.

Examples of background

$$W \rightarrow e \nu$$

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

These becomes Backgrounds.



qq' jets from resonance Z

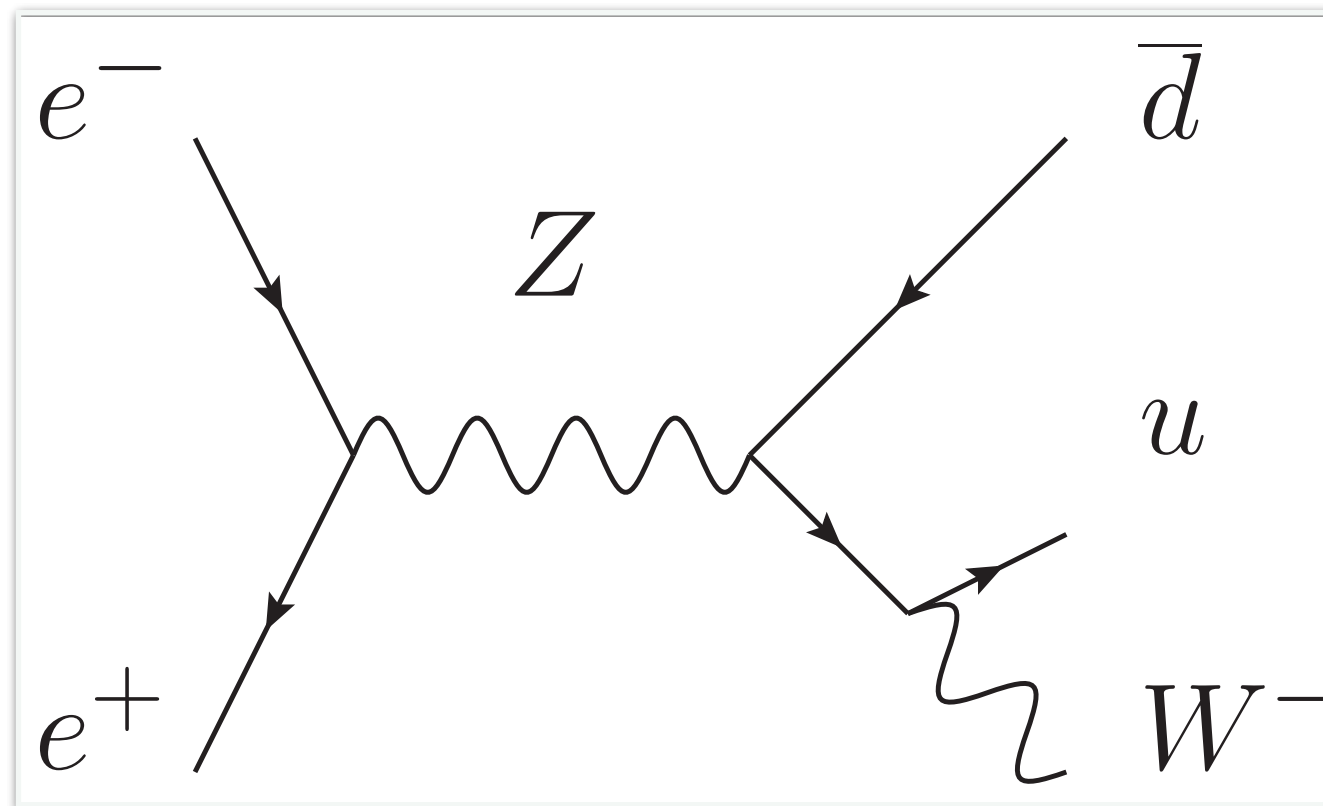
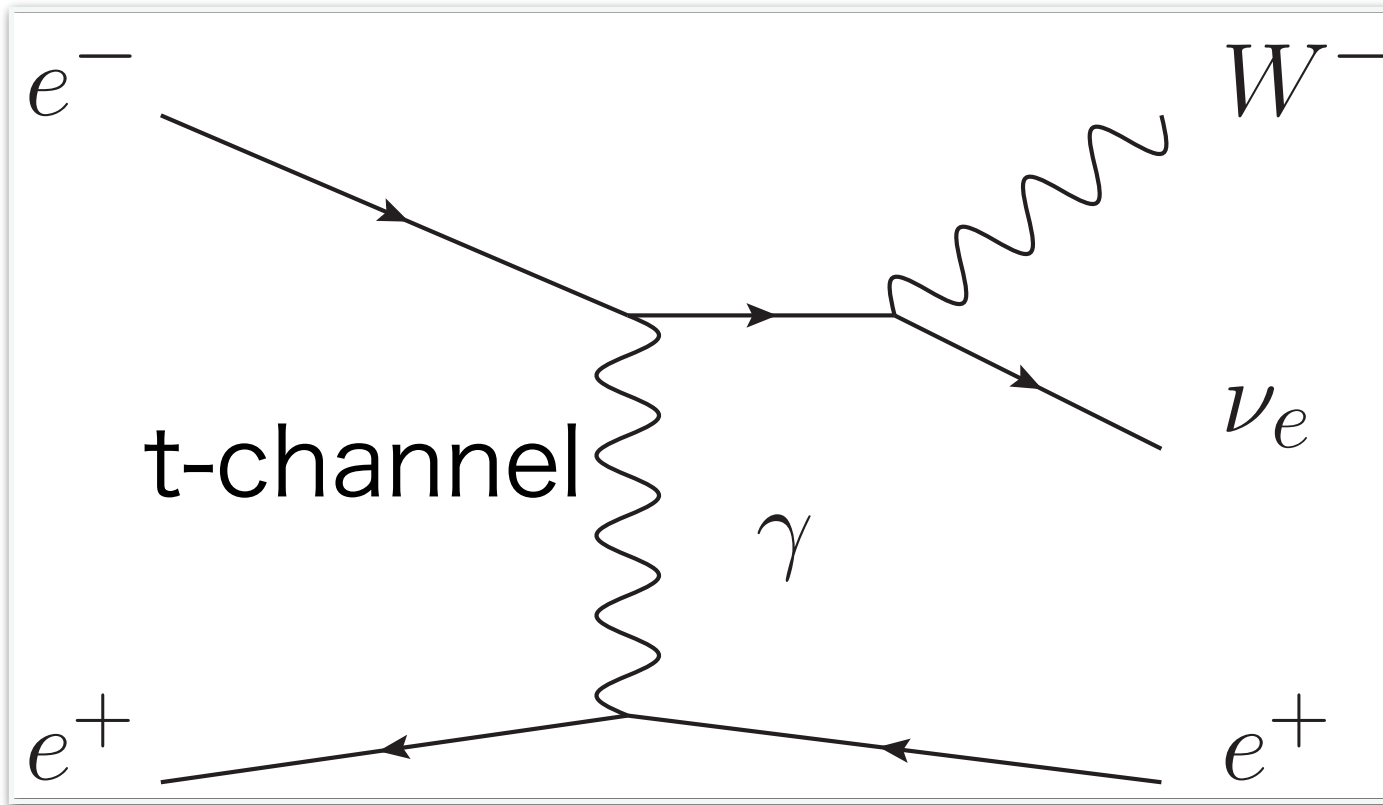
qq' jets from off-shell W

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

Summary and Next stage

- I reconstructed invariant mass of 2-jet from W boson decay in single-W process.
 - With my selection criteria, leptonic decays ($W \rightarrow e \nu$) become the backgrounds of reconstructing W boson mass.
 - Reconstructed m_w were a bit larger than 80MeV, I think this is due to these backgrounds above.
- Next, I will keep trying to analyze m_w measurement, and search better selection criteria.

Back up slides



leptonic decay

e, ν