Higgs self-coupling analysis with H→WW*

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04/04/2014

Status

- dE/dx – working with Astrid to digitize the dE/dx correctly
  - Check the fluctuation of dE/dx
    - With several particles and momentum range
    - I mistook estimation of RMS(90)/Mean
  - Start to check dE/dx
    - For first trial, checking Isolep/Fakes

- Shower profile – going on
  - Introducing new variable – related to shower creation
  - Start to check fake leptons precisely

dE/dx

dE/dx

- I mistook estimation of RMS(90)/Mean
  - Use Daniel-san's code and re-estimate
  - With several particles and momentum range

- dE/dx definition:
  - $\frac{dE}{dx} = \frac{energy\ deposit}{flight\ path\ in\ the\ hit(TPC)}$
  - dE/dx can be calculated at any hit point
  - Truncated mean is calculated as track dE/dx

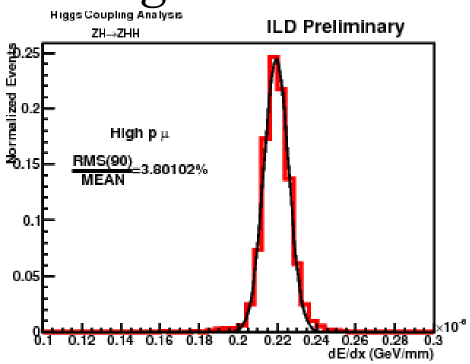
  $\left\langle \frac{dE}{dx} \right\rangle = \sum_i^n \frac{dE_i}{dx_i}$ upper 30%, lower 8% hits are discarded

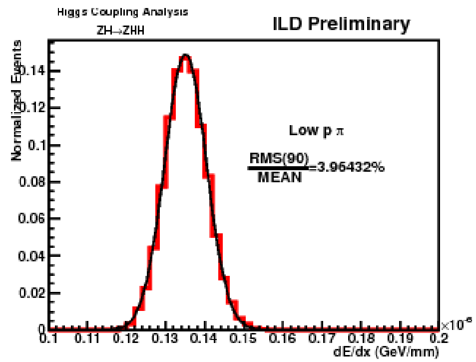
  to avoid Landau tail

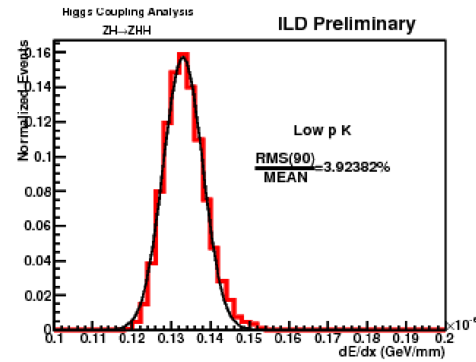
  →optimization is necessary

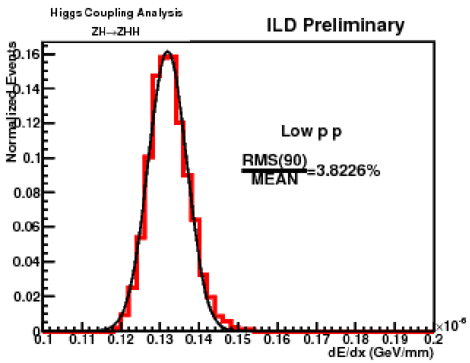
dE/dx fluctuation

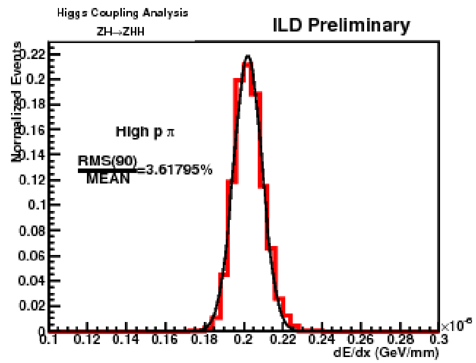
- Fluctuation of dE/dx using various type of tracks
  - Using truncated mean

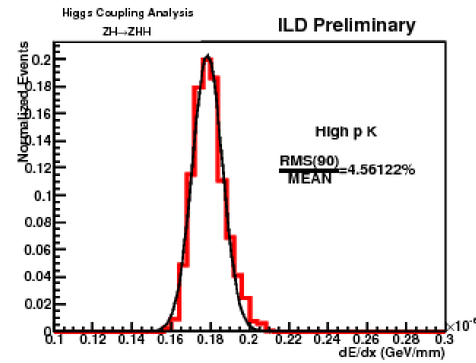


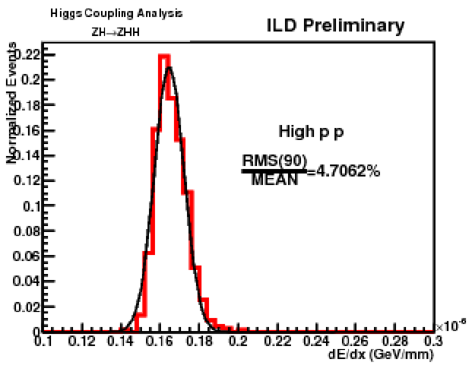












High: p >20GeV/c
Low: π 0.3GeV/c<p<0.6GeV/c
K 1.0GeV/c <p<3.0GeV/c
p 2.0GeV/c<p<4.0GeV/c

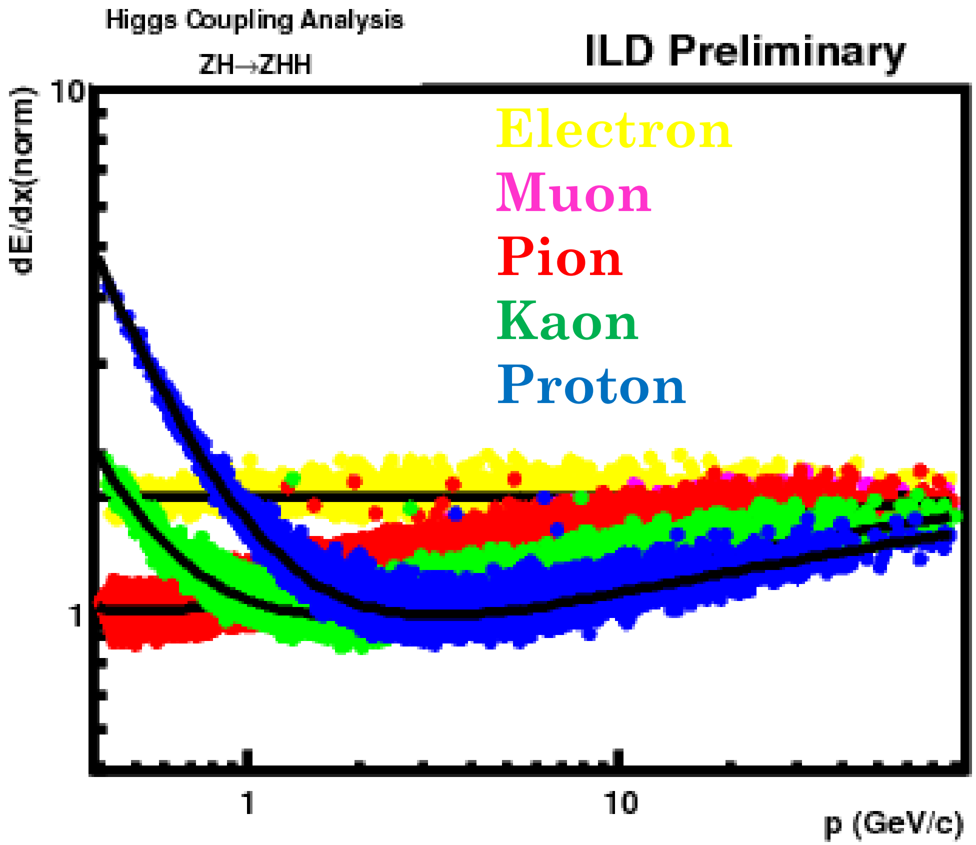
90% RMS

Next step

- dE/dx fluctuation is ok on standard simulation!
  - Without any correction of dE/dx
  - My study: 3-5%
  - Astrid's study: 3-4% → **good agreement!!**
- So far, I don't impose any smearing effect coming from detector measurement
  - So far, there is no estimation of detector effect
  - Astrid said detector smearing effect is smaller than natural dE/dx fluctuation
- It is necessary to show the significance and advantage of using dE/dx
  - It is very important!
  - For first trial, check dE/dx for Isolep/fakes

dE/dx DISTRIBUTION

- For each particle
  - Polar angle dependence corrected
  - Num. of Hits dependence corrected
  - Scale to $\left\langle \frac{dE}{dx} \right\rangle = 1.0$ for MIP pion

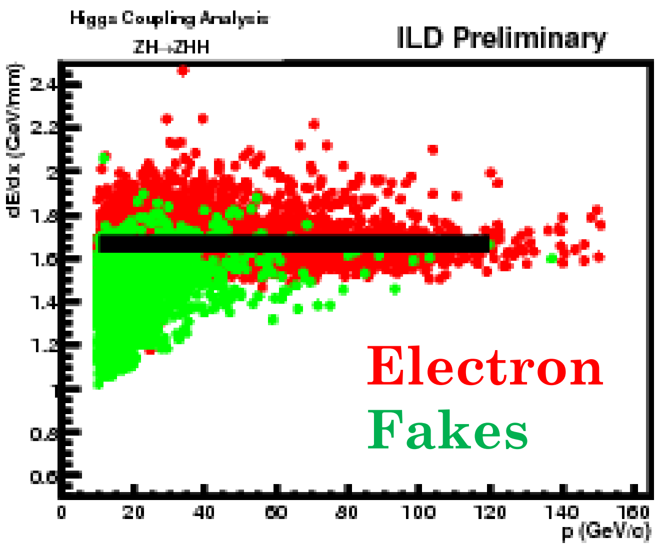


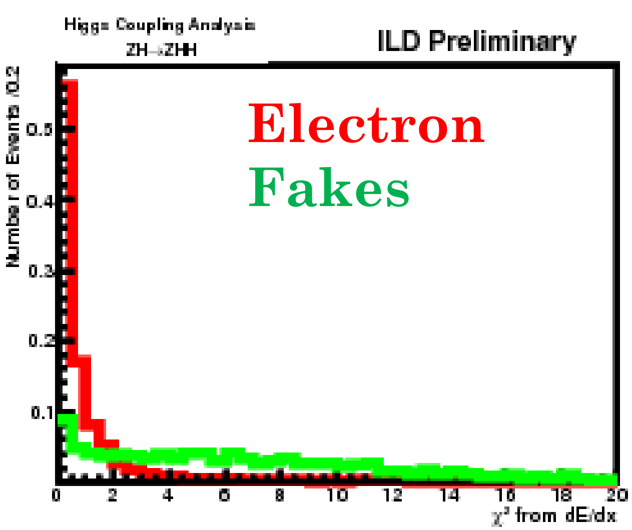
dE/dx distribution for Isolep/Fakes

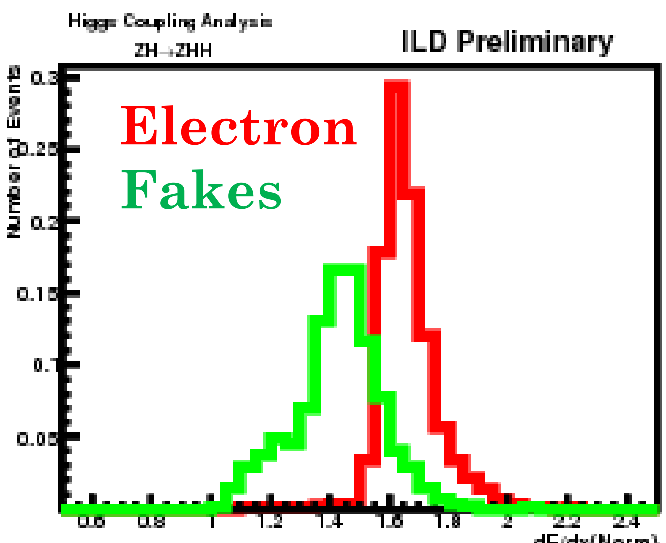
- Normalized dE/dx
  - Hadron tracks has low dE/dx value
  - Exp. mean with electron hypothesis is almost constant
- dE/dx distribution(1D)
  - Looks some difference →good for leptonID?
- X2 distribution with electron hypothesis:

$$\chi^2 = \left(\frac{\frac{dE}{dx} - \frac{dE}{dx}_{exp}}{\sigma}\right)^2$$

5% error imposed







TODO

- Include dE/dx into lepton ID for electron type
- Muon type is apparently hard(mainly μ/π separation)

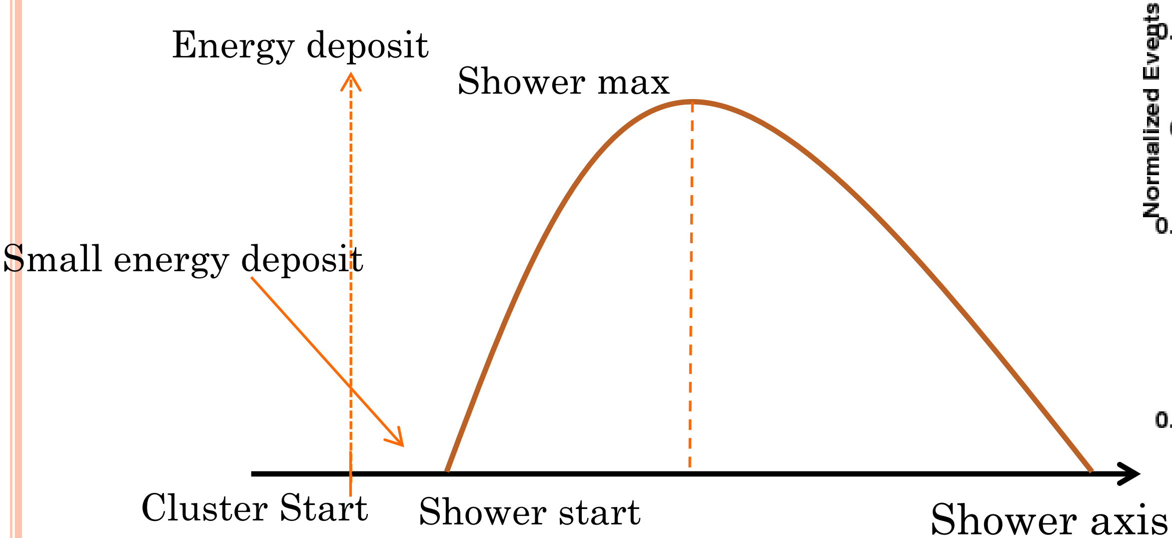
- Some new idea using dE/dx?
  - Low momentum track energy correction?

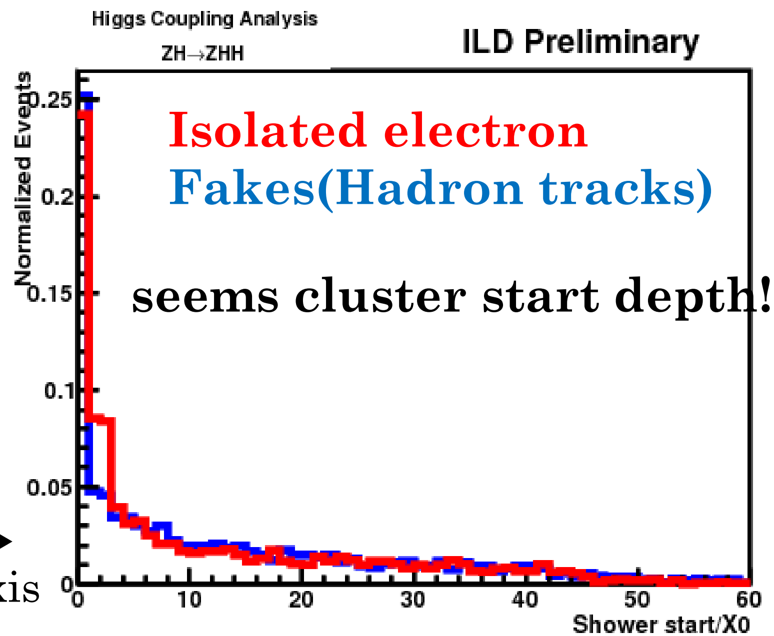
- It is necessary to show the significance and advantage of using dE/dx

Shower profile

NEW VARIABLE

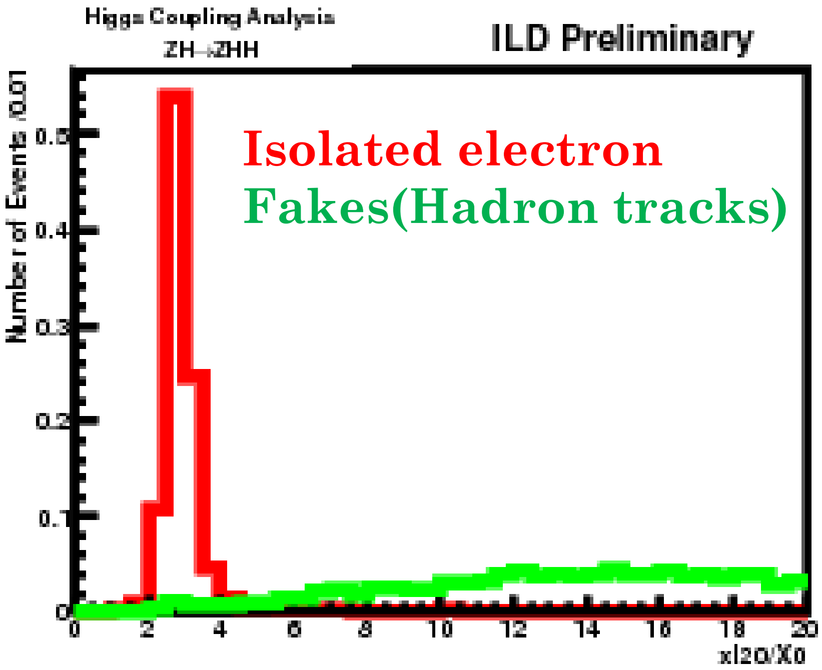
- Shower start depth(length) from calorimeter surface
  - Expectation: very shallow for EM, deeper for hadron…
- Very similar distribution…
  - **Need to form the variables to identify the real shower start**
  - Last time's distribution seems cluster start…





XL20

- Introduce xl20
  - Depth which has 20% of total energy deposit
  - Measure from cluster start(integrate deposit energy along the shower axis)
  - Looks good variable for separation!
    - EM shower is shallow, and hadron shower is deeper…



TODO

- More study of fake lepton sample
  - Components of fake lepton candidates
    - Pion? Kaon? Proton? - fraction
  - Is there any difference between fake lepton components?
    - Overall distribution doesn't have any difference…
- Apply to lepton ID
  - Performance check
- Study for muon type
  - Any difference between muon and (I guess) punch-through pion?
- Integrating Ecal/Hcal - good estimation in Hcal
  - Very difficult!!
  - Fit function gives up fitting…