Constructing gamma finder for pi0 reconstruction

Masakazu Kurata

08/01/2014

INTRODUCTION

- For flavor tagging improvement
  - Vertex mass is the key to separate heavy/light flavor vertex
  - Many pi0s will escape from B/D vertex → checked that using MC truth
  - Mass resolution will be degrade due to escaping neutrals
  - Is there possibility to recover pi0s which escape from vertices?

- Building π^0 finder – many components are necessary
  - Gamma finder – using shower profile in calorimeters
  - π^0 finder – solving gamma pairing
  - Vertex finder – which vertex is the π^0 coming?

- First step is to find gammas – distinguish from neutral hadrons
  - Similar to lepton ID
  - Basically same method as lepton ID
  - Using Bayesian approach(naïve Bayes)
  - Checking ID eff. & background eff.

Key issues

- Using shower profile in calorimeters
  - Same as Lepton ID
  - χ^2 of fit, shower max, absorption length, xI20
- Using traditional variables
  - E(γ), Ecal/(Ecal+Hcal)
  - Can't use cone energy because not isolated

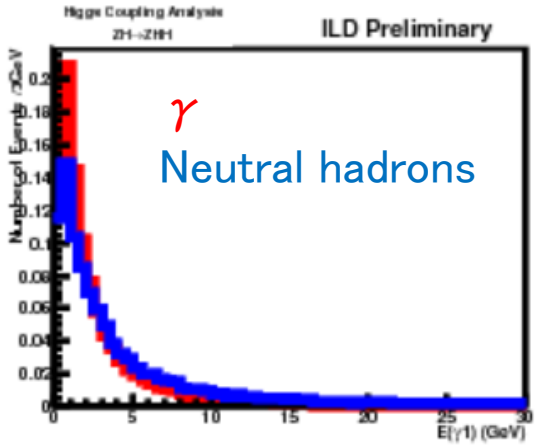
Gamma ID

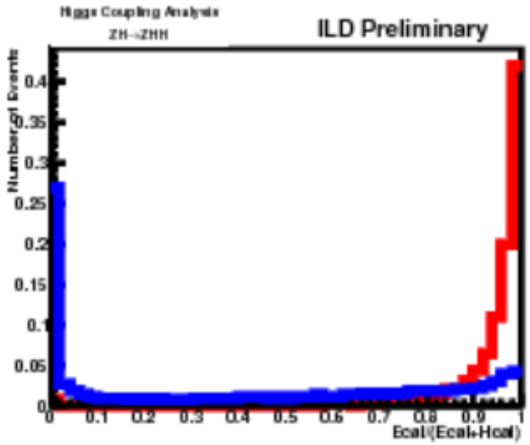
- Using naïve Bayes
  - Posterior probability: $P(\gamma|x) = \frac{P(x|\gamma)\cdot P(\gamma)}{P(x)} = \frac{P(x|\gamma)\cdot P(\gamma)}{P(x|\gamma)\cdot P(\gamma)+P(x|had)\cdot P(had)}$
  - Identify as gamma with $P(\gamma|x)$>threshold (need to optimize)

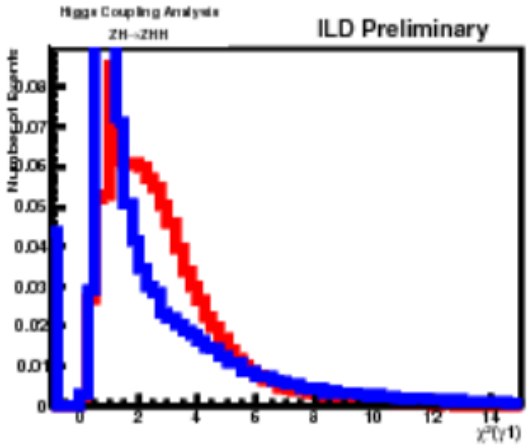
- Specific for this study:
  - Check 2 gammas at the same time because of correlation between 2 gammas
  - Preparing P.D.F.s for 1st gamma(large energy) and 2nd gamma(small energy)
  - Choosing pi0s from primary vertex(L_{decay}<0.3mm)

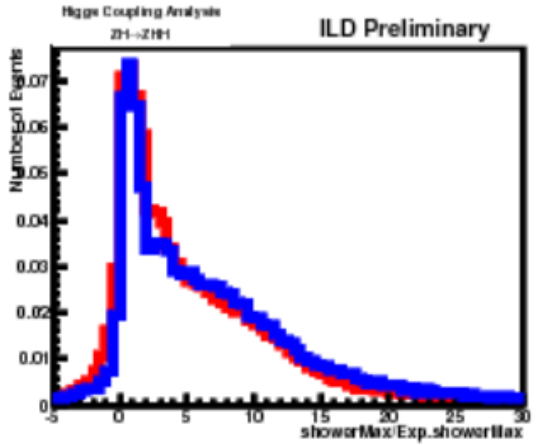
VARIABLES TO BE USED

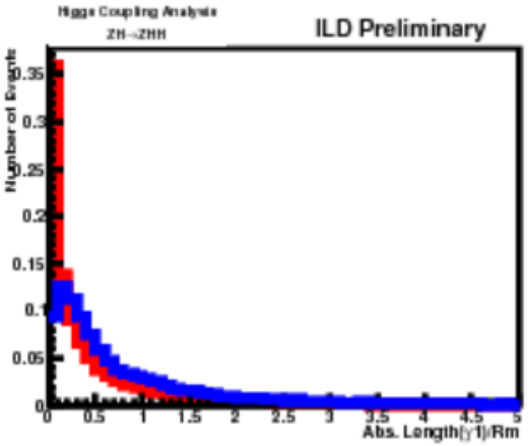
- For 1st gamma finding
- Signal: gamma with large energy from pi0(come from primary vertex)
- Background: neutral hadrons

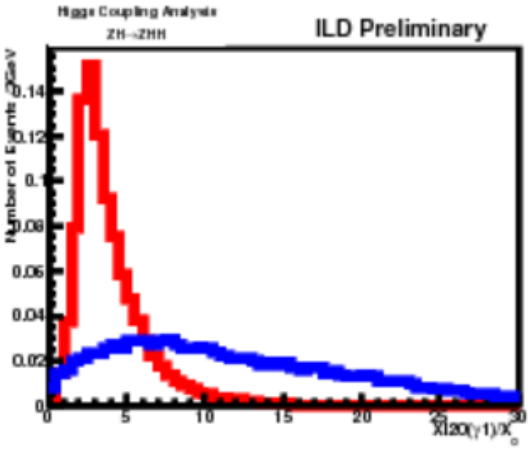






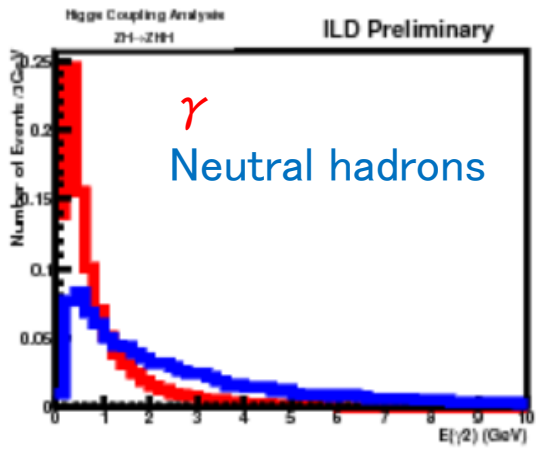


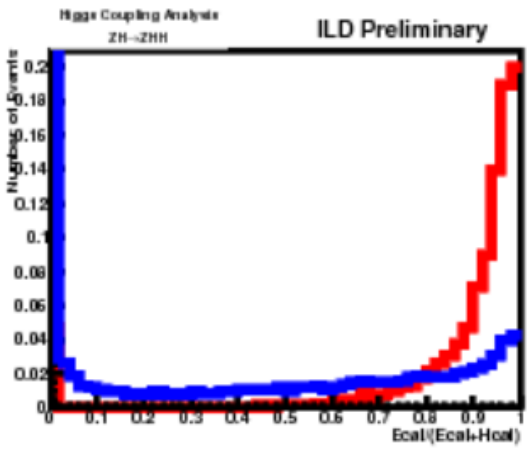


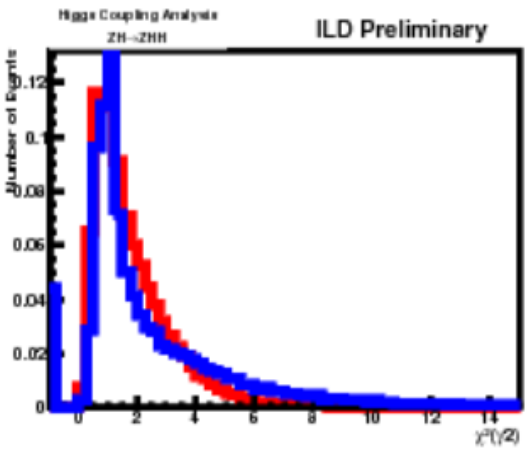


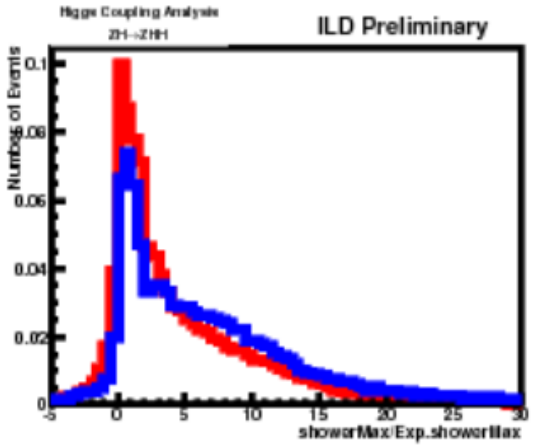
VARIABLES TO BE USED

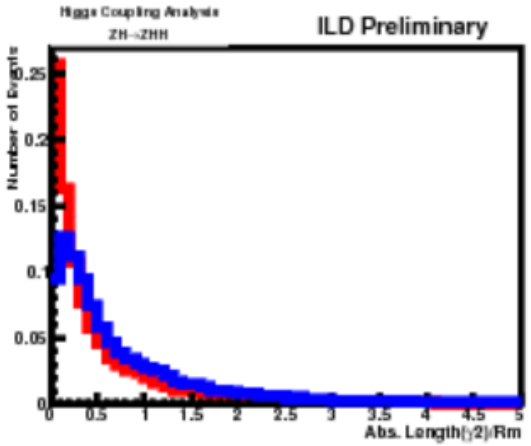
- For 2nd gamma finding
- Signal: gamma with small energy from pi0(come from primary vertex)
- Background: neutral hadrons(same as previous page)

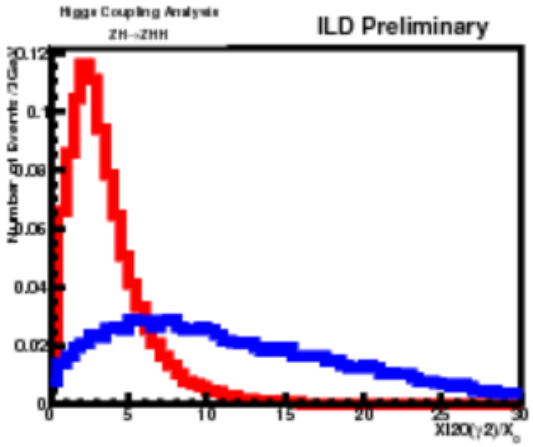










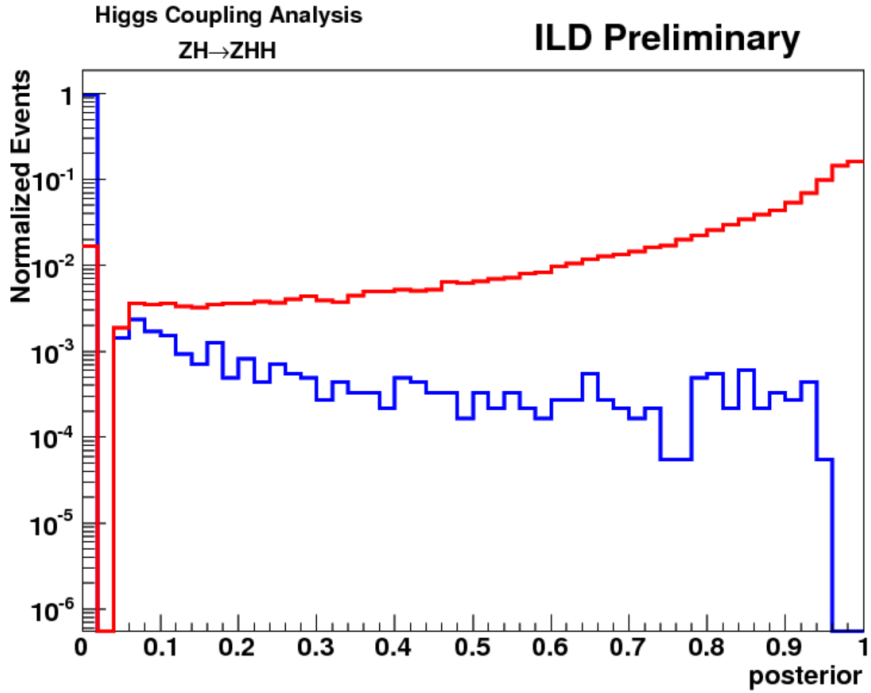


RESULTS

- Gamma ID eff. & background suppression eff.

sample	Signal	background
First γ eff. (%)	98.4±0.3	2.3±0.1
Second γ eff.(%)	98.9±0.3	2.4±0.1
γ pair eff. (%)	97.3±0.3	2.0±0.1

- γ pair eff. for background is the case when both of the gamma candidates are fake



Posterior distribution for γ 1

γ

Neutral hadrons

TODO

- Optimization
  - Input variable set for better separation
  - Other good variables for separation?
  - Set the threshold for better separation
- TMVA is better?