Plan by next weekend & some trials

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INTRODUCTION

- For ilcsoft v01-17-07

  - MUST include Particle ID modules

    - First, need to include dE/dx and shower profile informtion
    - And then, include PID modules
    - Coding done, need check and some debug
    - Will release next week

- Study for jet clustering

  - Jet clustering is the final piece for better physics results
  - Durham clustering is good in spite of its very simple formulation
  - But, it is not enough for better physics results
  - Need some idea
  - Try some to catch hints

- Plan for top workshop(&software workshop?)

PARTICLE ID

- Jenny's slide at last software meeting

  - Try to follow this suggestion

  - PID results will input into ParticleID class

  - But, about algorithmType, I don't know →so far assign "0"

  - In addition, will include posterior probability vector for each particle type

- Coding done

  - I can get results from ParticleID class now

Particle ID

- dE/dx processor: Track & Hits in, fill dE/dx and error in MarlinTrkTrack
  - needs to be adapted from MCTruth-based scheme
- attach to PFOs output of separate processors for:
  - dE/dx-based likelihood
  - cluster shapes based likelihood p > 1GeV
  - cluster shapes based likelihood p < 1 GeV
- pi0 and taus:
  separate collections pointing to main PFOs
- reminder PID & LCIO:
  - ParticleIDVec& ReconstructedParticle::getParticleIDs()
    vector of ParticleIDs assigned to a ReconstructedParticle,
  - same for Cluster, but not for Track!
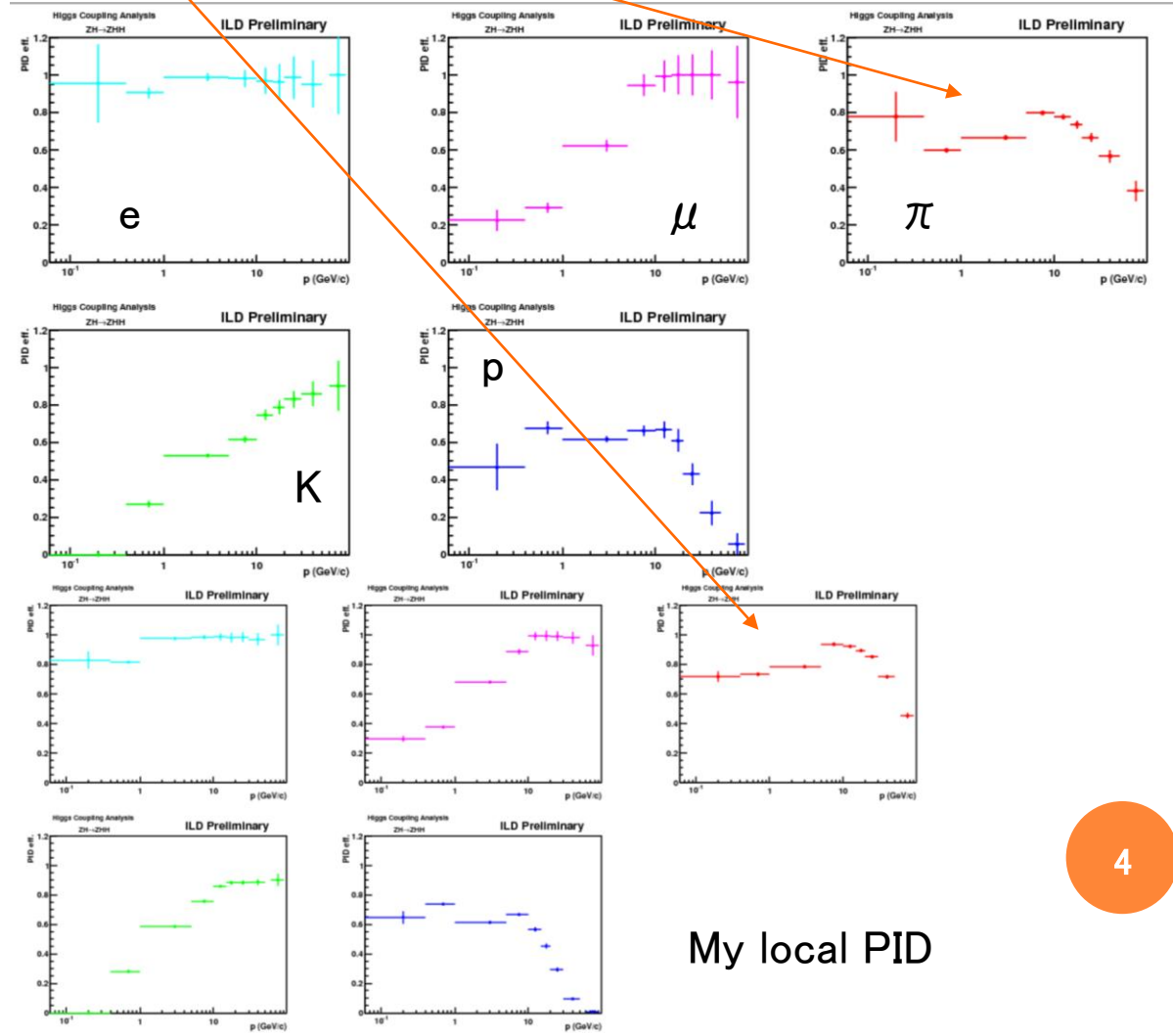 - class ParticleID:
    - getType()   -   ?
    - getPDG()   - eg 11
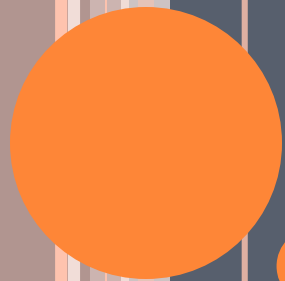   - getLikelihood()   -   eg 90%
    - getAlgorithmType() - eg dE/dx
  - need to define how to use this, eg see above!

VALIDATION PLOT

○ $\mu - \pi$ separation becomes worse than my local PID

- $\sim$5-10% worse in π case
- Because some variables can't be included so far(coding is necessary)
- By next release(v01-17-08?), will be included
- Other, looks OK

My local PID

Jet clustering

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TRYING DIPOLE BASED JET CLUSTERING

- All other jet clusterings are 2→1 clustering
- But in dipole based clustering, 3→2 clustering performed
  - So, will include color information
  - Especially, in soft gluon emission, it will be better picture than 2→1

- This is called DICLUS
  - Construct this procedure and try jet clustering using DICLUS
  - Is there some hint for better jetclustering?

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CLUSTERING PROCEDURE

- Look for 3 jet combination with minimum transverse momentum:

$$p^2_{\perp i(jk)} = \frac{(s_{ji} - (m_i + m_j)^2)(s_{ik} - (m_i + m_k)^2)}{s_{ijk}},$$

- Boost them in their rest frame
- Define clustering axis according to the formula:

$$\psi = \frac{E^2_k}{E^2_j + E^2_k}(\pi - \theta_{jk})$$
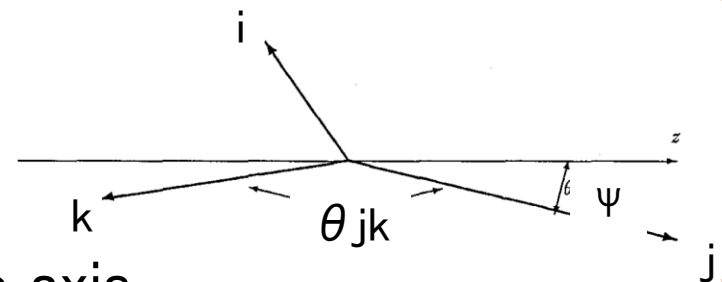
- Clustering 3 jets into 2 jets along the axis
  - Clustered from particle level of all jets
  - Cluster tracks back-to-back

- Finally, boost back the clustered jets
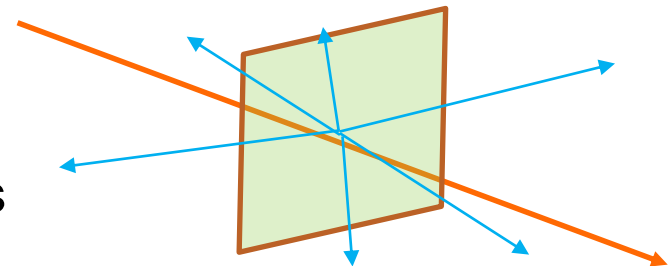
- In original procedure, replace mass-less jets back-to-back, but it will be inconvenient
  - Jet content information will be lost

Jet direction

- Starting from 20 jet clustering with DURHAM
- First trial, check jet direction event by event
- Using qqHH→qqbbbb events, 6 jet clustering
- These are good events for DURHAM clustering
- Slight difference, but not so bad

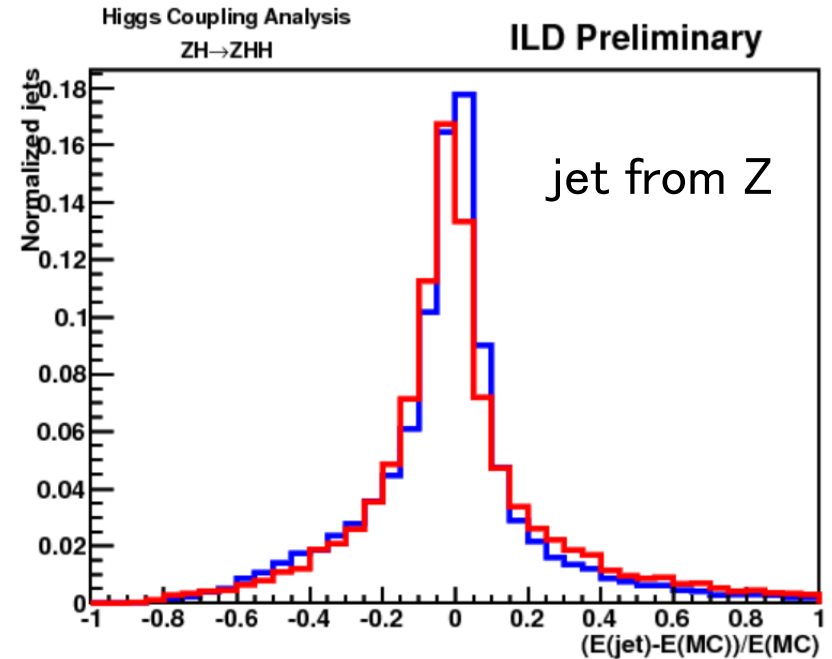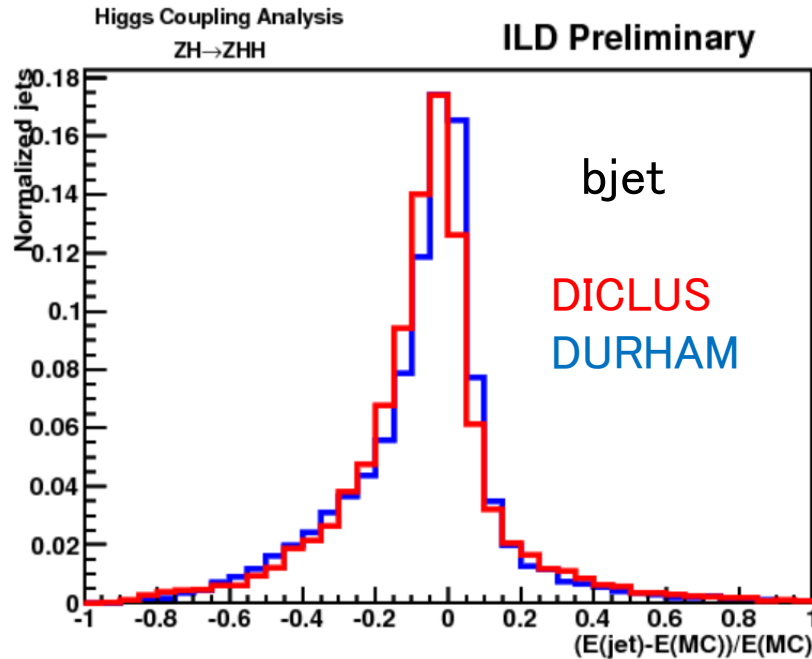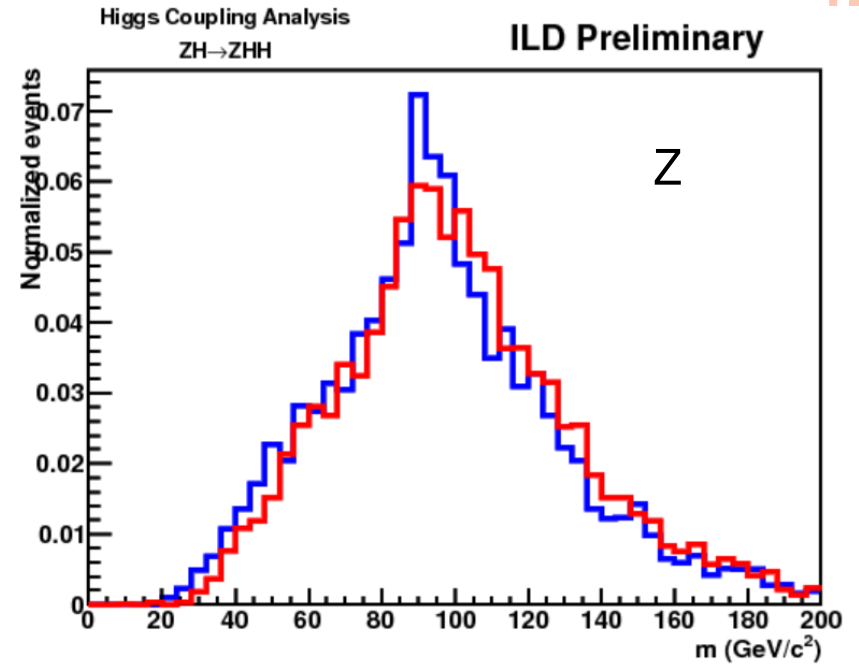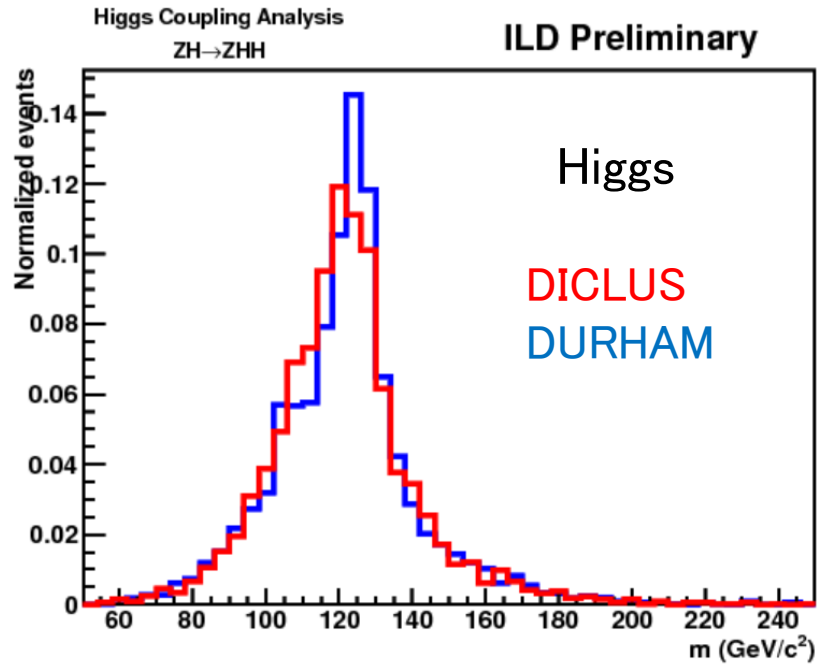- @Higher pt, diclus is not good

DICLUS
DURHAM
TRUTH
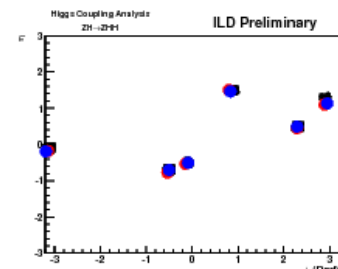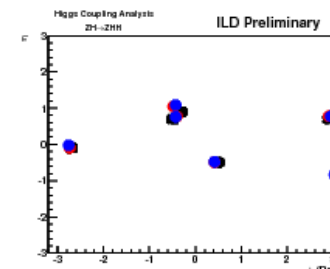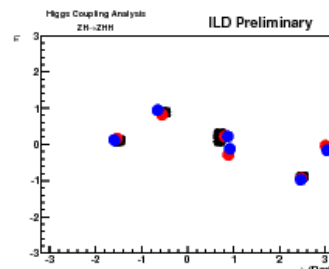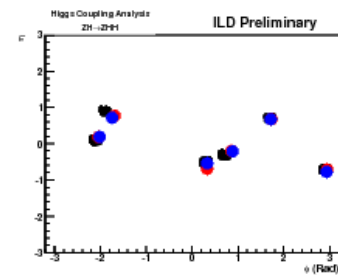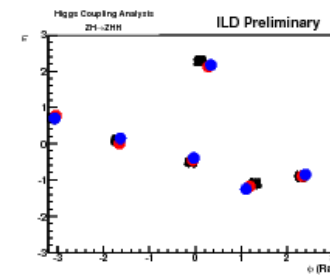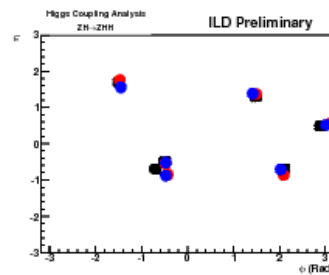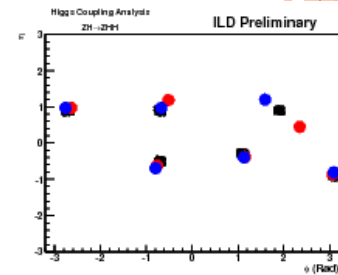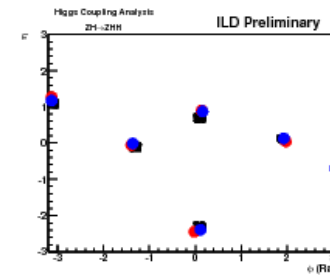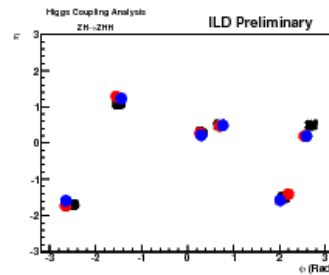
JET ENERGY RESOLUTION

- If direction is ok, most important is jet energy resolution
  - Is there some difference? Jet matching is performed

- DICLUS makes more symmetric distribution
- DURHAM has better resolution, especially light flavor jet
- But, difference is very slight···

MASS RESONANCE?

- Worse…
  - Vertex information does not use correctly yet

QUARK & GLUON JET IDENTIFICATION
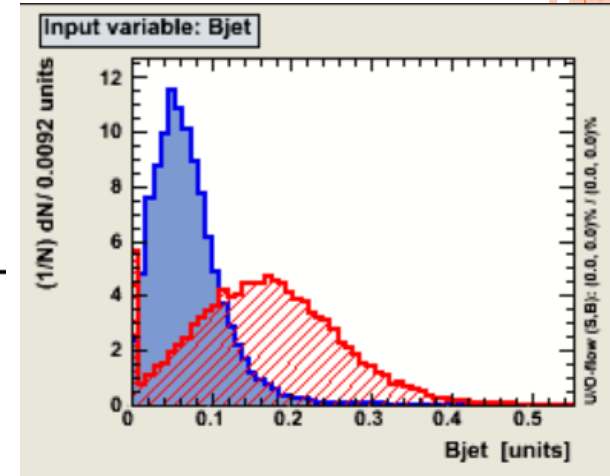
○ Try to separate quark and gluon jets

- 20 jet clustering using Durham(qqHH→qqbbbb sample)

- Separate candidates of quark core jets and gluon jets

- Basic idea: gluon jets spread wider than quark jets(due to color flow)

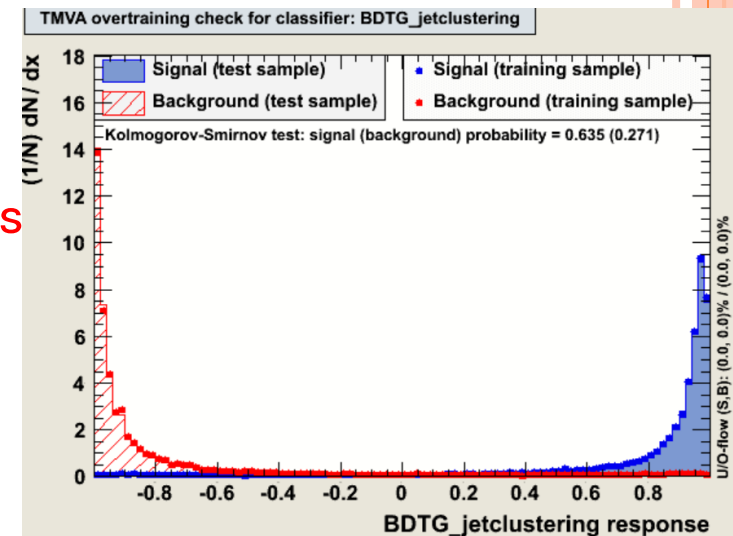 jet content is different

- e.g.) jet broadening

$$B_{\mathrm{jet}} = \frac{\sum_i |\vec{p}_i \times \hat{n}_{\mathrm{jet}}|}{\sum_i |\vec{p}_i|} = \frac{\sum_i |\vec{k}_T{}_i|}{\sum_i |\vec{p}_i|}$$

- Construct the separator

○ Can separate well

But, this classifier can't be identified core jets

Perfectly···

PLANS WITHIN A MONTH

- PID included in ilcsoft v01-17-07
  - Will release in next week

- For top workshop, LCFIPlus study is necessary
  - Focus on vertex charge using AVF. Check eff. using PID
  - I don't know I can try an idea…

- For software workshop
  - Clean my codes for public use as much as possible
    - So many files so far…