

# Status of Cluster ID Project:

Single particle efficiencies and fakes using a neural net.

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Oct 14, 2002

# Cluster ID concept

- Cluster cal hits together.
- Measure a set of special discriminator properties for each cluster.
- Use a set of cuts or a neural net to identify the cluster's type.
- Cluster types: (current) photon, charged hadron, neutral hadron, fragment.
- Cluster types: (future) various kinds of overlaps, electrons, muons.

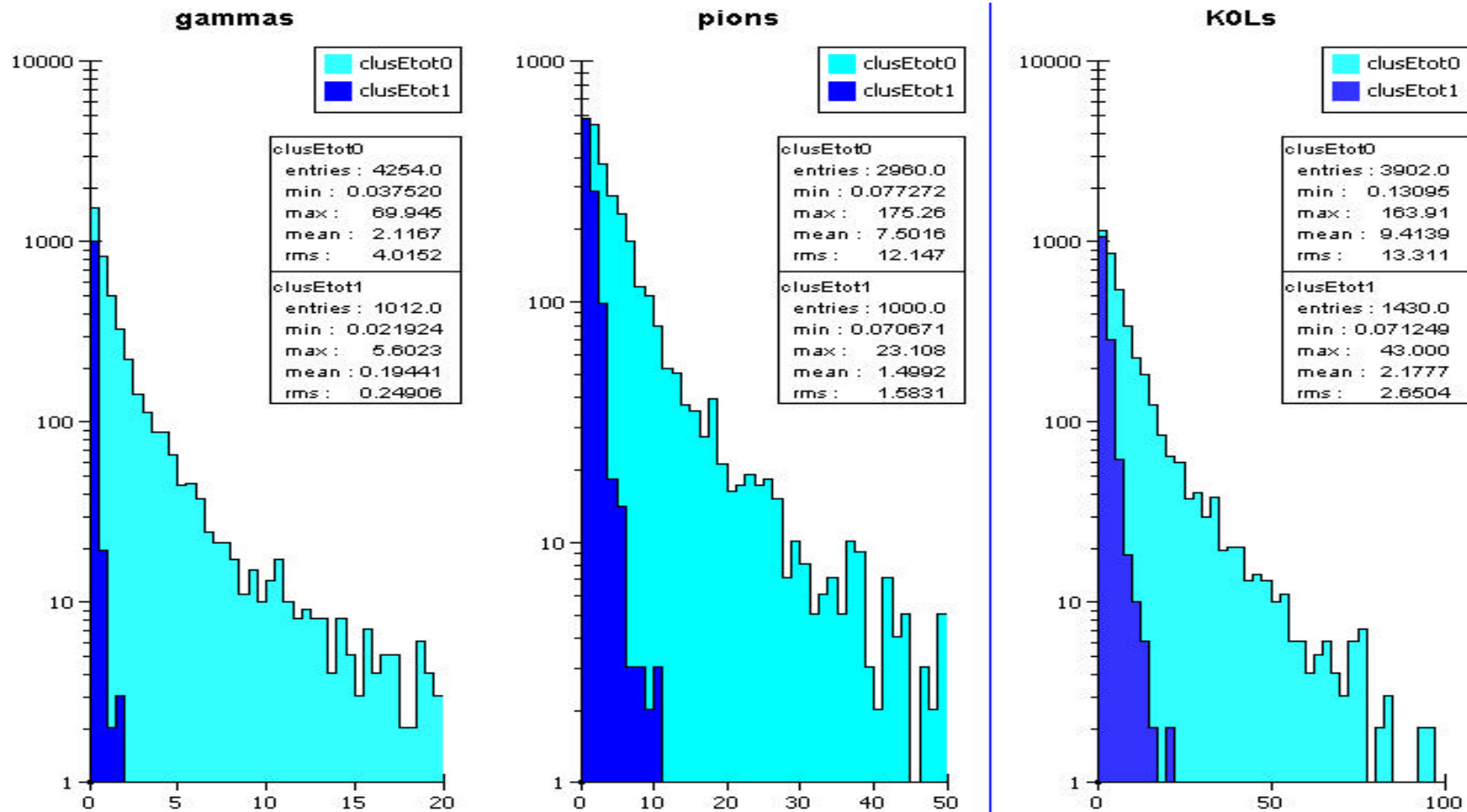
# 15 Discriminators

- 3 normalized energy tensor eigenvalues,  $ne1, ne2, ne3$ .
- $ne1/ne2, ne2/ne3$ .
- First layer hit, last layer hit, length of cluster,  $(firstL+1)/length$ .
- Angular separation between e1-axis and IP.
- Energy in first 5 layers.
- Nhits in first 2 layers.
- z-coordinate of center of energy.
- Nhits
- Measured cluster energy.

# Cluster selection for single particle test

- Use simple (contiguous hits) cluster builder combining across EM and Had.
- Highest energy cluster in event is defined to be a cluster of the type of the input particle.
- Second highest energy cluster in event is defined to be a fragment of the input particle type.

# Highest and 2<sup>nd</sup> highest energy clusters



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ClusterID: Bower,Cassell,Pathak

# Single particle cluster ID with cuts

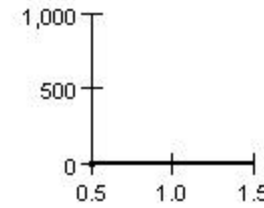
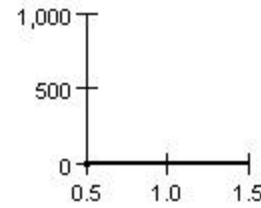
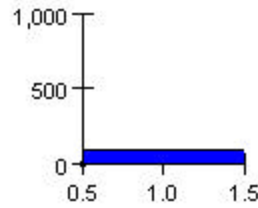
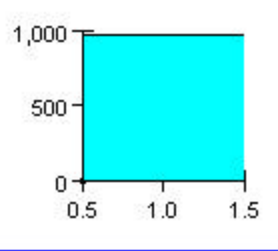
- One gamma, pion or K0L per event.
- Energy distribution uniform 0-50GeV.
- Perpendicular to beam from IP.
- Physical gap between EM and Had Cals.

# (Santa Cruz) ID result with cuts:

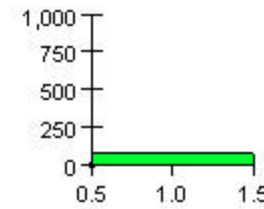
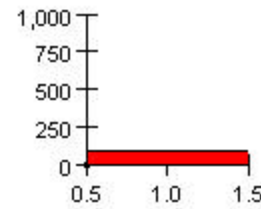
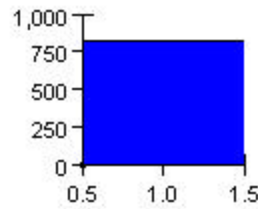
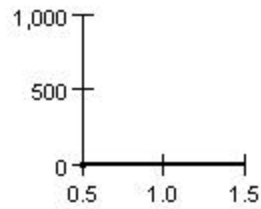
gamma      piminus      KOL      fragment

Input:

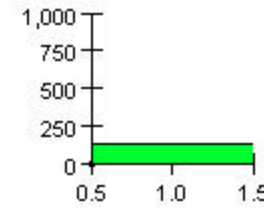
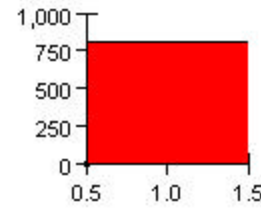
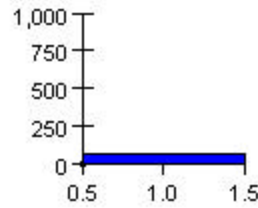
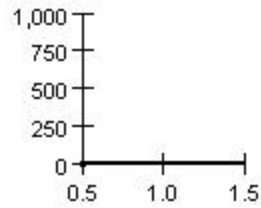
gamma



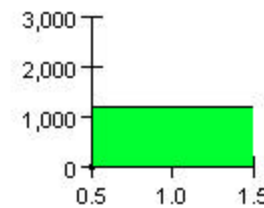
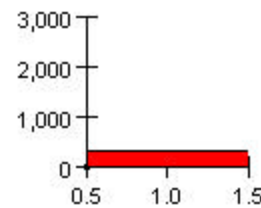
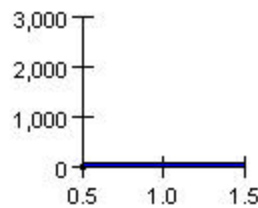
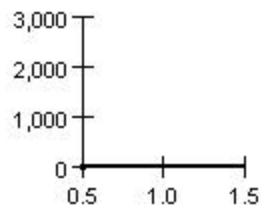
piminus



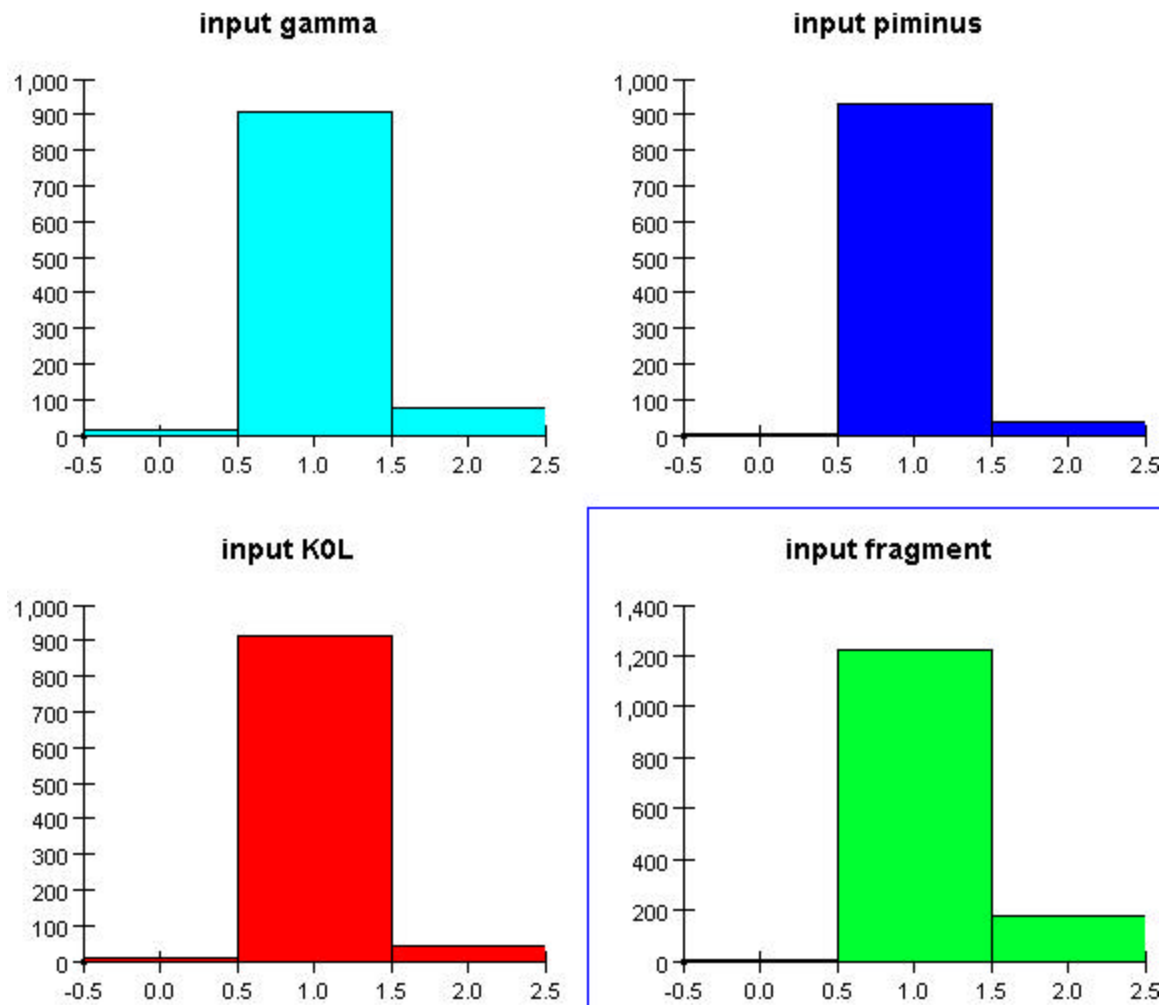
KOL



fragment



# Multiple ID rates with cuts



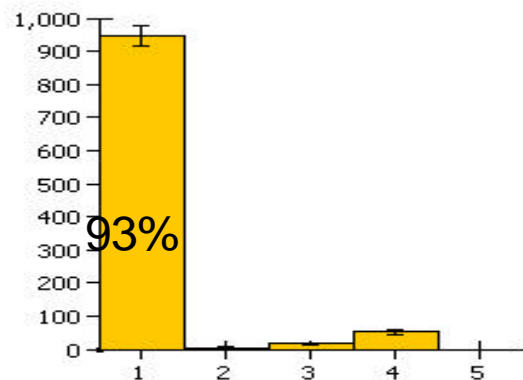


# Single particle cluster ID with NN

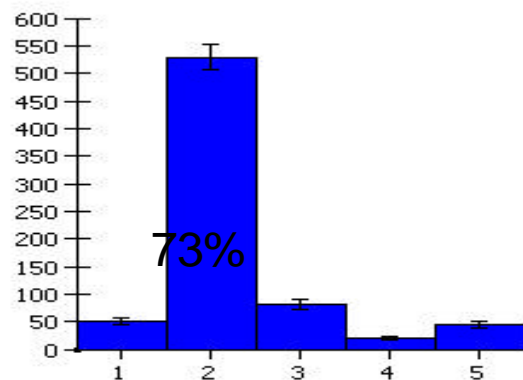
- One gamma, pion or K0L per event.
- Energy distribution of ttbar events.
- Random direction.
- No physical gap between EM and Had Cals.

# Efficiencies and fakes with NN

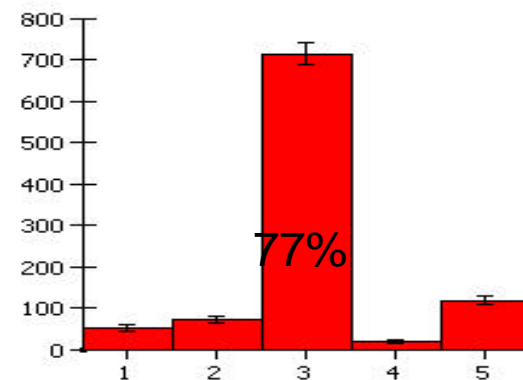
input gammas - NN selects:



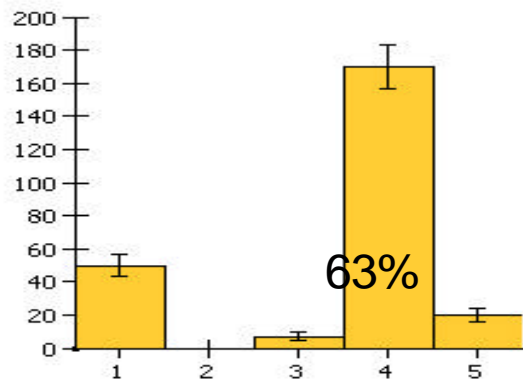
input pions - NN selects:



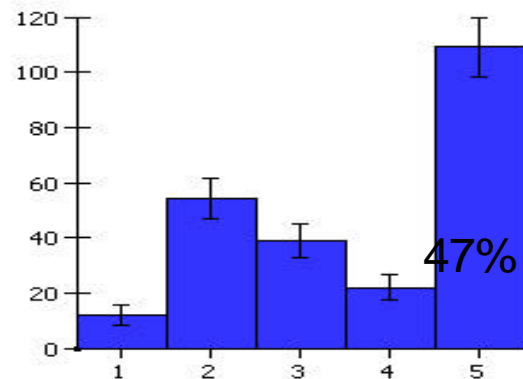
input K0Ls - NN selects:



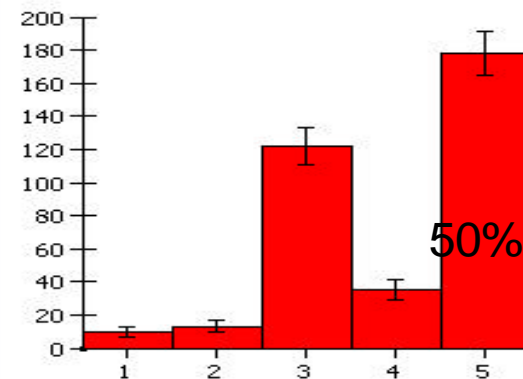
input gammafrags - NN selec...



input pionfrags - NN selects:



input K0Lfrags - NN selects:

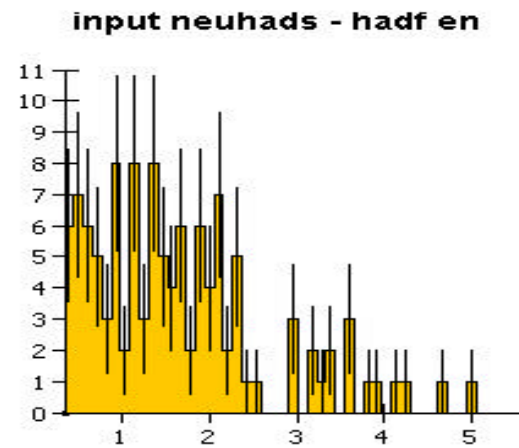
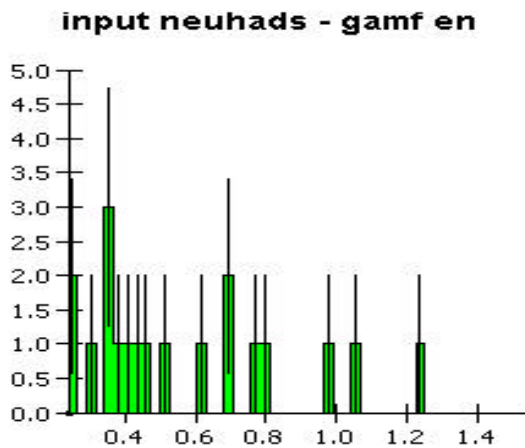
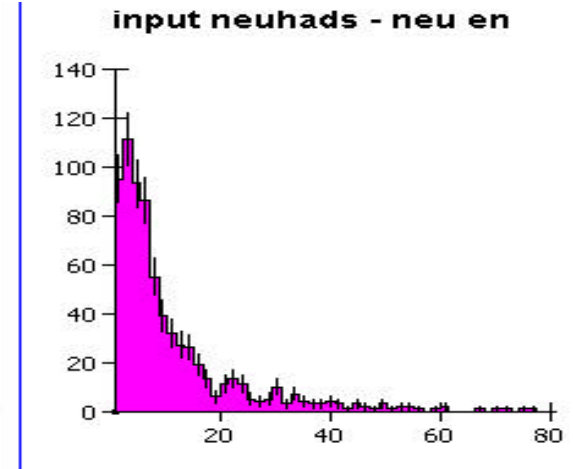
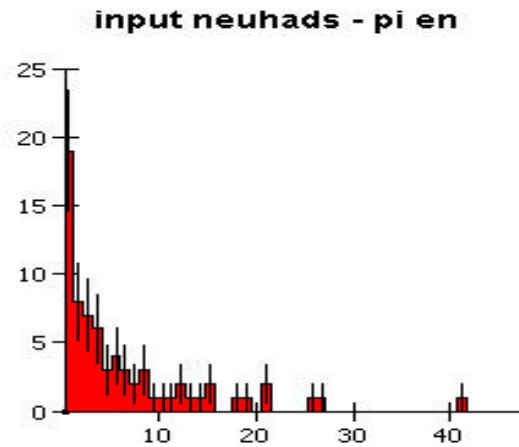
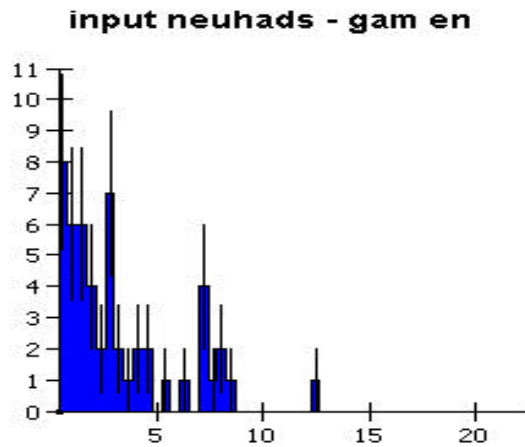


Guide: 1=gamma, 2=pion, 3=K0L, 4=gamma fragment, 5=hadron fragment

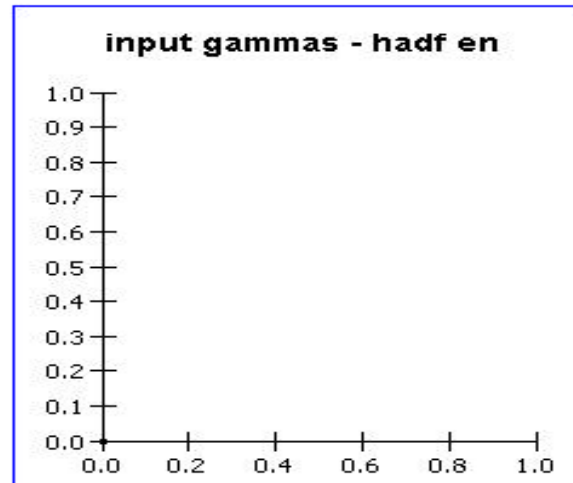
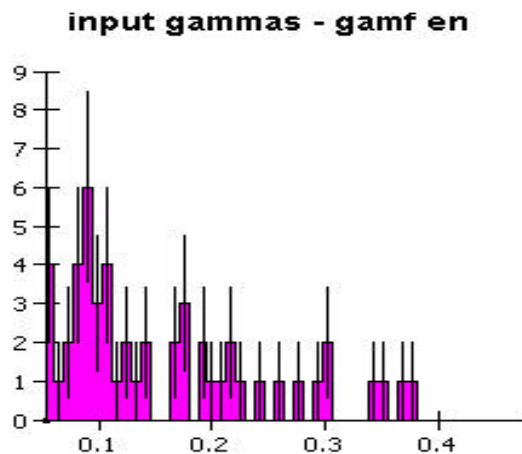
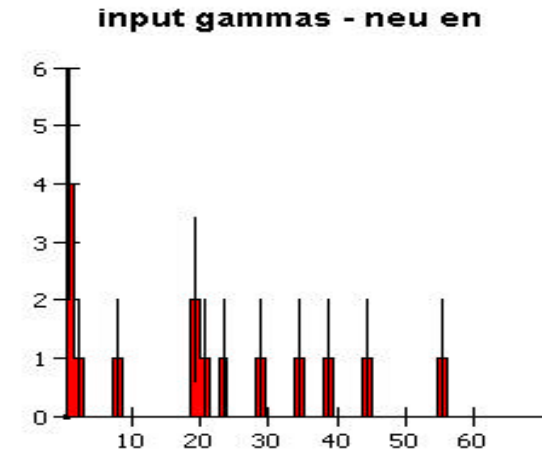
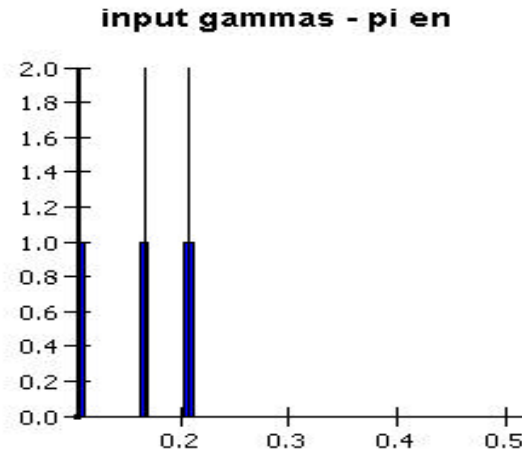
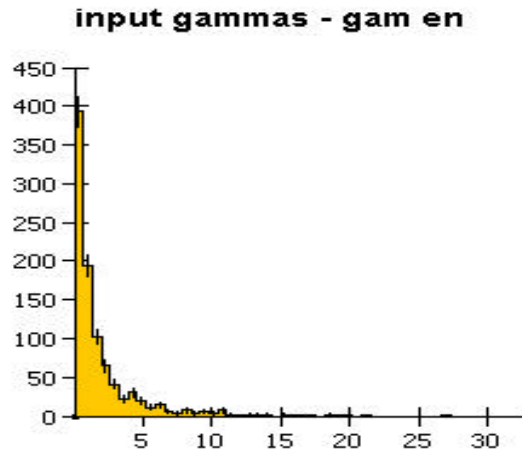
# Energy distributions: full disclosure

- In general, the energy distribution of the mis-IDed clusters is lower than the correctly IDed clusters.
- One exception is high energy gammas which are consistently mis-IDed as neutral hadrons.
- This case has not been investigated yet (the NN was just applied to single particles for the first time last week.)

# IDed K0L energy distributions



# IDed gamma energy distributions



# Last slide

- Neural net is working very well.
- Expect results for signal events to be better with NN than with cuts.
- Working on general user interface for Cluster ID.
- Goal: beta test version ready two weeks before Nov 7.