# Update on the Work on MIND

Anselmo, Justo et al.

# What's under study?

- Generators:
    - Nuance
- Particle tracking:
    - GEANT4
- Digitisation
- Reconstruction:
    - Recpack

# Generators: Nuance

- First generator investigated by Lukas Lindroos in 2008
  - Used by SK so is well tested
  - Plan to generate separate files for iron and scintillator which G4 will sample from according to:
    - 1) what we're interested in at the time or
    - 2) A random generator weighted to the proportion of nucleons in each.

# Particle Tracking: G4

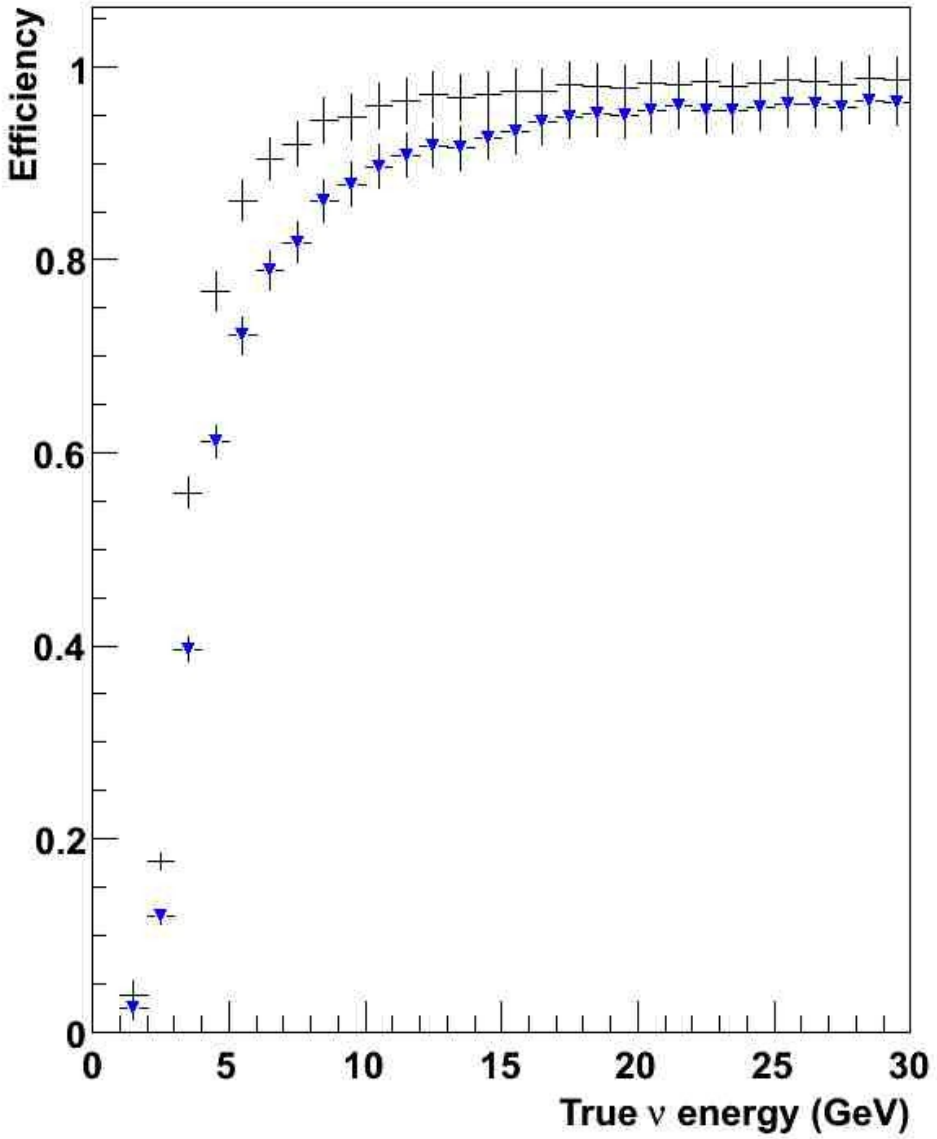
- Justo has created a G4 simulation which is in the debugging stage:
  - Currently tuning minimum tracking distance so that one event doesn't take three weeks to write
  - Should be in Andrew's grubby mits by Monday.

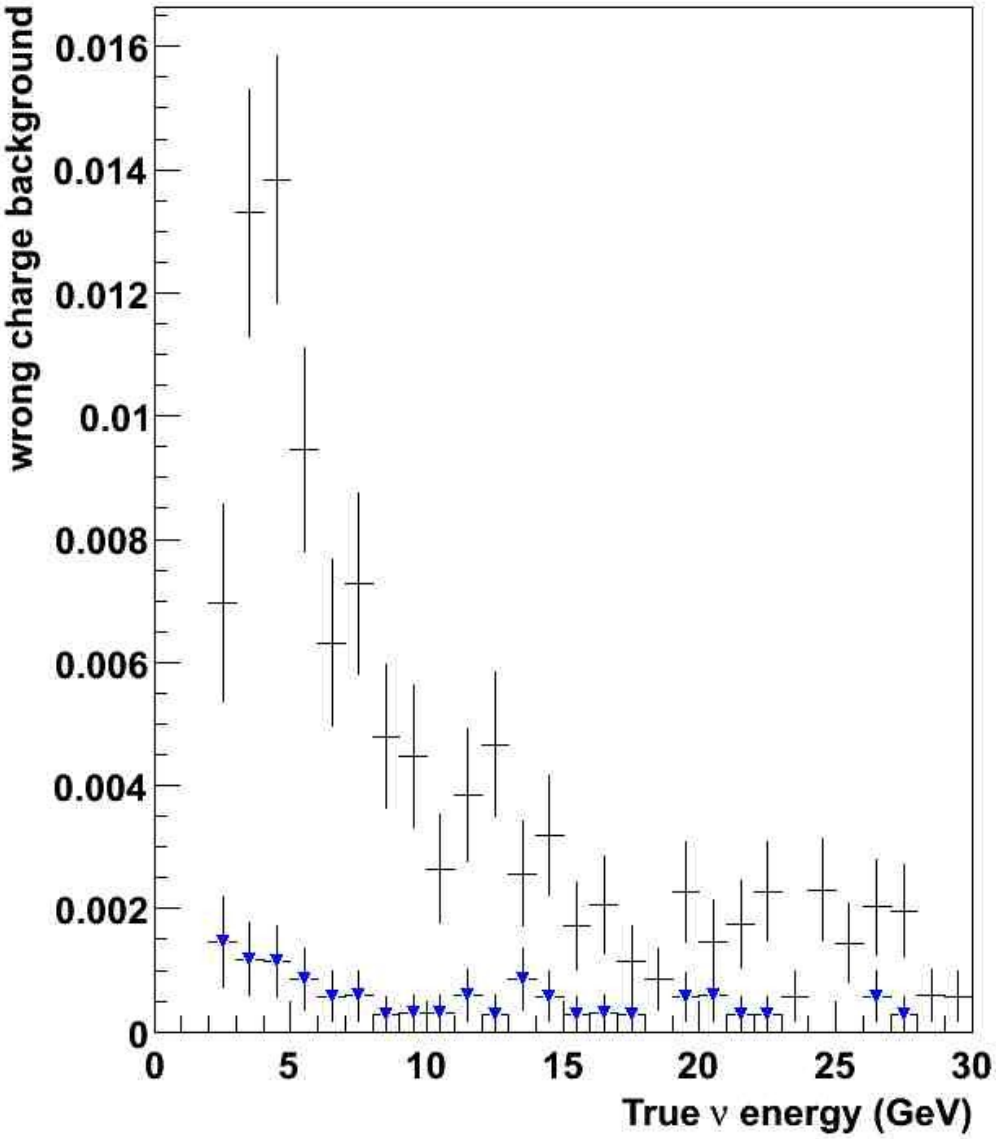
# GEANT4 Plan

- Plan from grubby mit day:
  - Understand output and add any additional information needed, general debugging.
  - 2007 smearing analysis with nuance DIS only followed by full spectrum
    - Analysis code written in March, some debugging required but shouldn't be a long process
  - Single particle gun to understand energy:
    - Fire large data set of muons and pions (and electrons and Kaons?)
    - Use truth and Recpack measurement (see next) to understand muon range/momentum relation.
    - Similar plan for Hadron visible/true energy relation.

# Reconstruction: Recpack

- Currently the most developed part of the simulation.
  - Charge mis-ID presented at CERN
  - Current force of investigation is:
    - Recovering low energy statistics (Cellular Automaton)
    - Likelihood methods for improved NC suppression


Efficiency
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
True ν energy (GeV)


wrong charge background
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0
5
10
15
20
25
30
True ν energy (GeV)

# Cellular Automaton

- Pattern Rec. based on Kalman filter requires at least 5 hits to form a reliable seed for the filtering
- Cellular automaton can extract possible tracks from the more complicated events which are then subject to tests on length, curvature etc. to select one (or zero) possible muon track

# Basic structure of cell auto

- Based on that designed for the HERA-B tracker:
  - D. Emeliyanov, et. al., OTR/ITR-CATS: Tracking based on cellular automaton and kalman filter.
  -
- Currently optimising algorithm based on liner neighbourhood function
  - A measurement can be added to a trajectory if it is within a predetermined transverse distance of the point predicted in that plane by the straight line joining the two previous points (similar function used in T2K

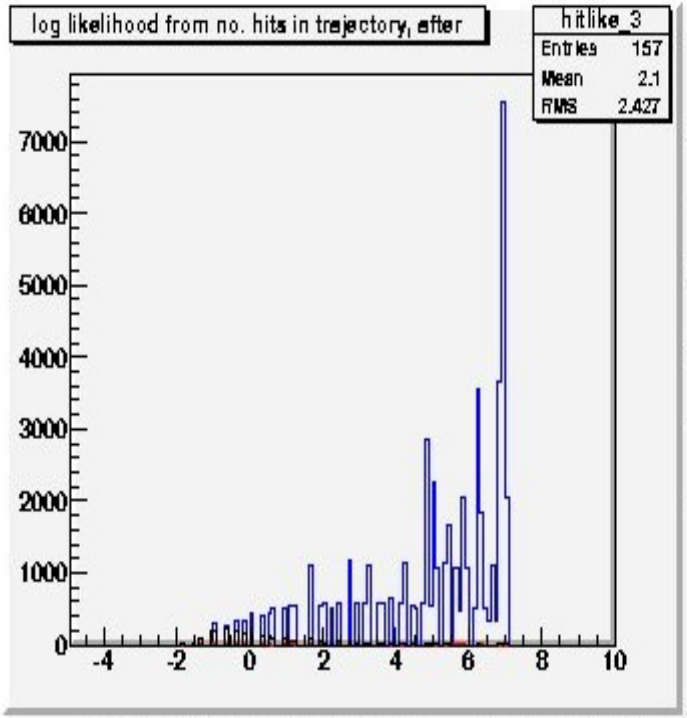
# Cuts

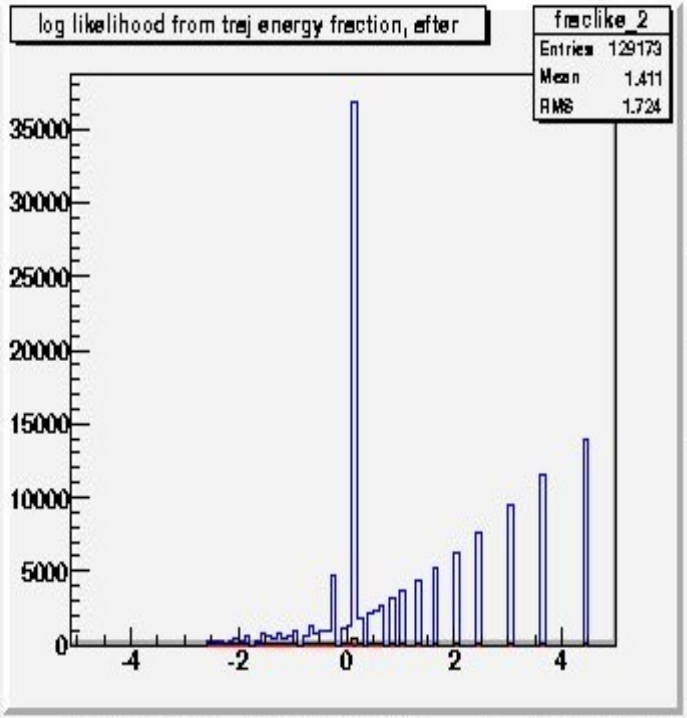
- Identified two main offline cuts:
  - Relative error on curvature: ($\sigma_p$/p)
  - $\chi^2$ Probability: TMath::Prob( trajchisquared, ~ndf ). Slightly different from CERN cut.
- Likelihood functions to increase rejection of neutral currents:
  - MINOS uses: Muon candidate length (planes), visible energy fraction in candidate, mean deposit by candidate.

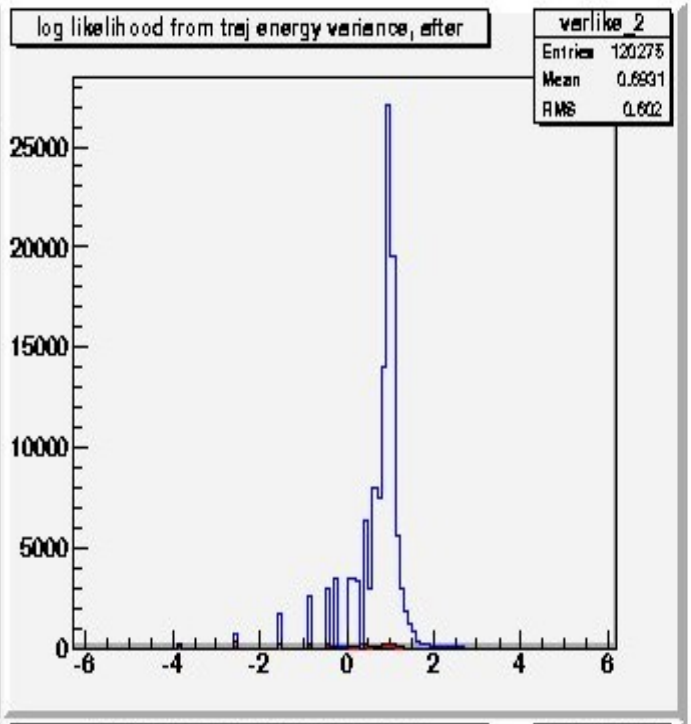
# Initial study

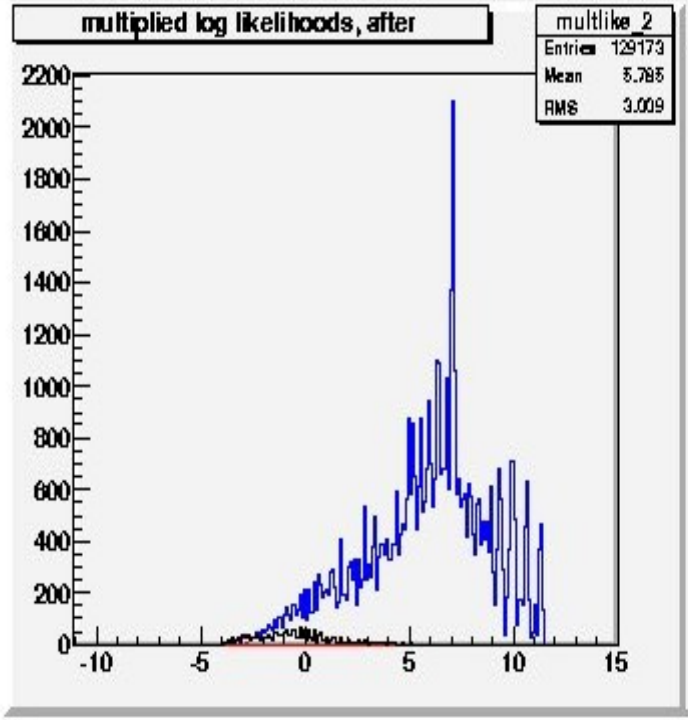
- Initially try to reproduce MINOS variables:
  - Third variable does not show separation for us:
    - Could be partially because of different iron thickness but likely because current (G3) simulation just has a hit with an associated energy
  - Looking at M1 and M2 and an additional variable: The variance of energy deposit along the candidate.
    Preliminary study of rejection:
    - For each event sample from the expected distributions and form the value log( fcc/fnc )

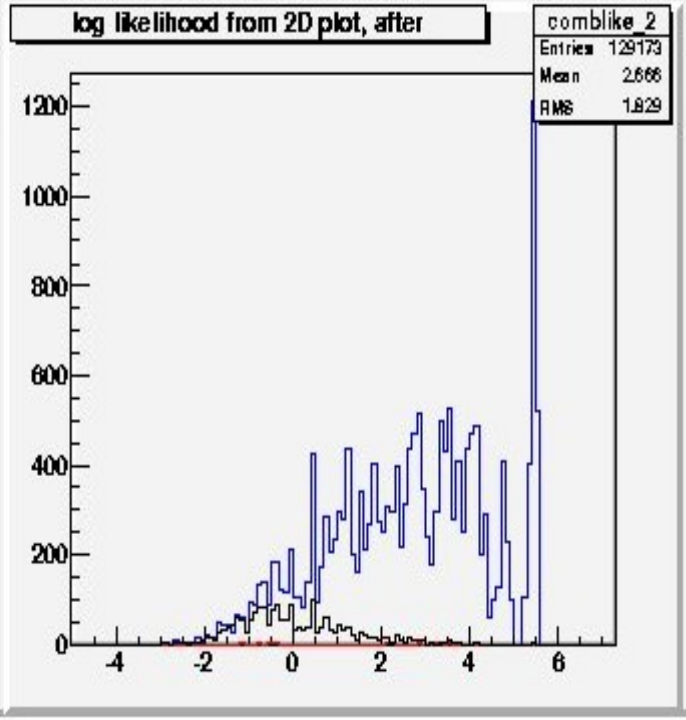
PRELIMINARY

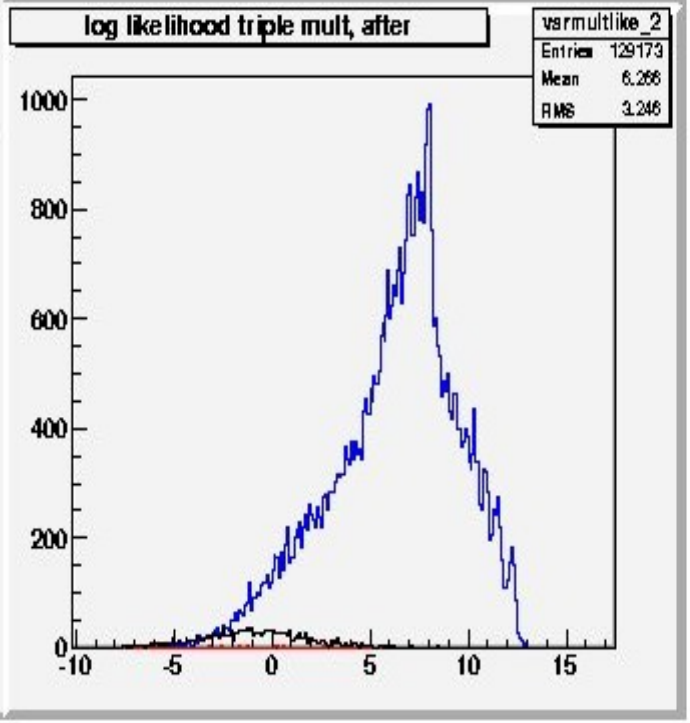


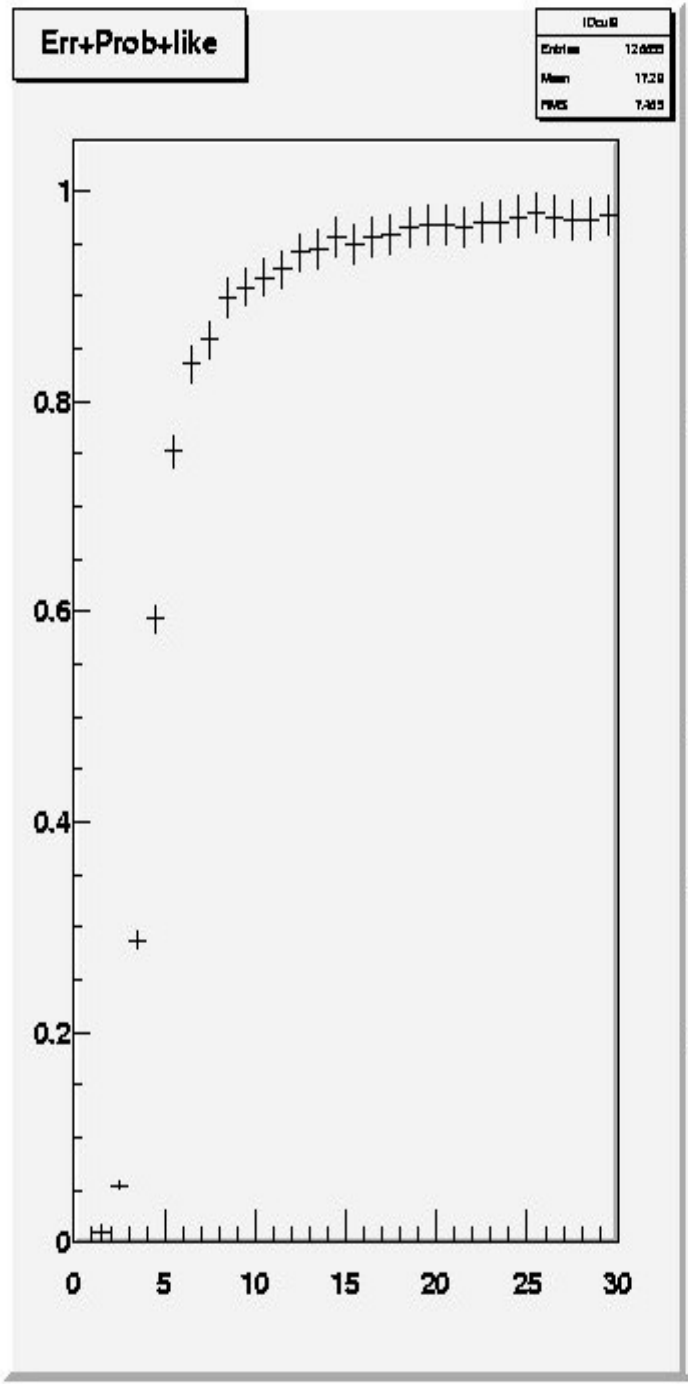



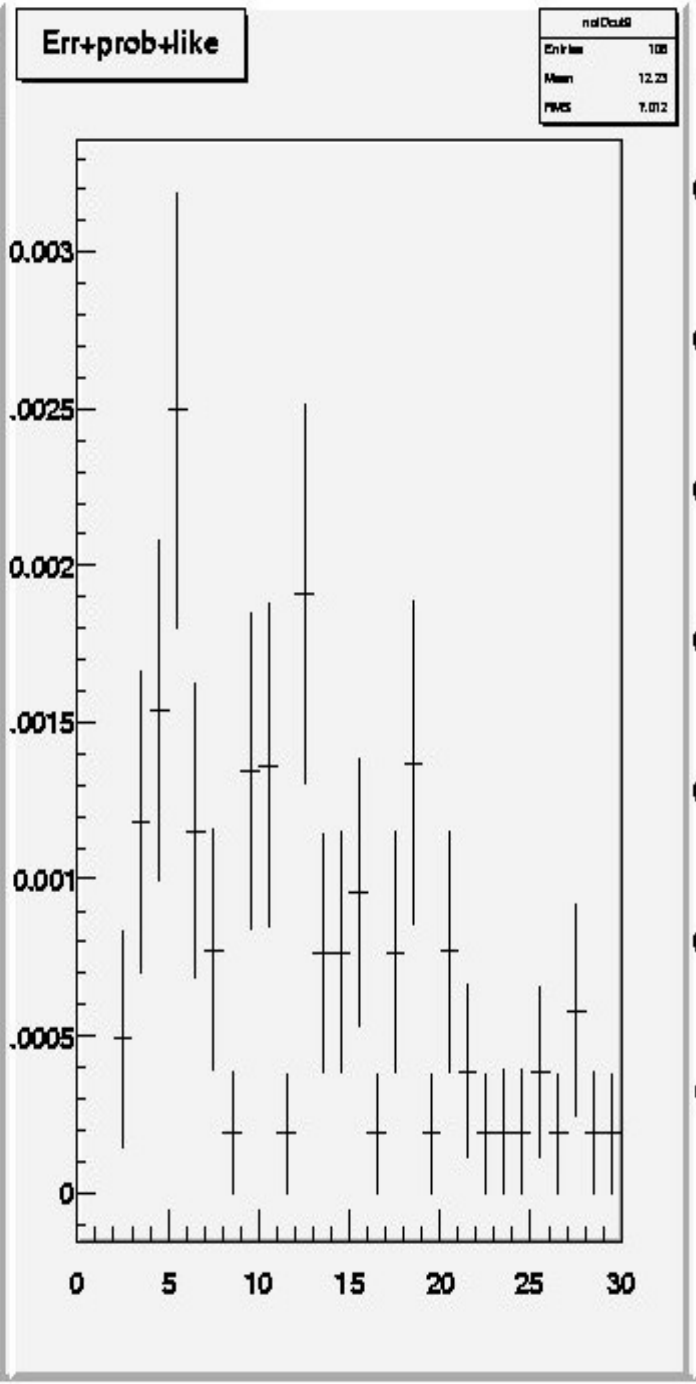



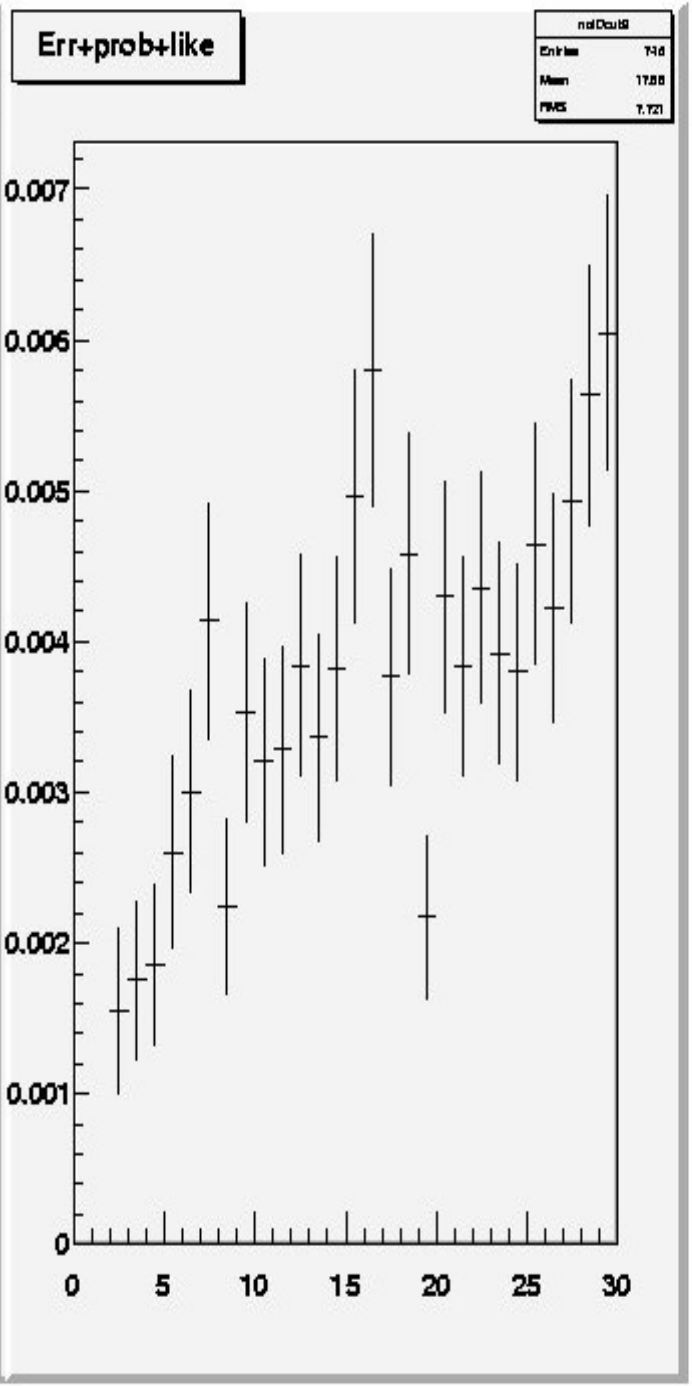



PRELIMINARY



VERY PRELIMINARY