Core Software
“Performance Review”
TkRecon
How do we know the Tracking is working?

GLAST Core Software
Wednesday, Oct 16, 2002

The TkRecon Group
Is the Tracking working?

YES!
How well is the Tracking is working?

- We know the tracking is working to a certain level:
  - The event display tells us we are not that far off most of the time
  - We can make basic distributions of TkrRecon output quantities
  - Output from merit doesn’t crash
  - More importantly, see Bill Atwood’s presentation from last week
    - Studies of track fits with muons
    - Studies of 100 MeV gammas
    - Some initial PSF plots
  - Gut feeling is that base performance already better than PDR

- Detailed studies of TkrRecon performance are in the early stages
  - Simulation/Digitization – See Leon’s talk
  - Track Finding/Fitting
    - Working towards details of “requirements” (using Monte Carlo information)
    - Developing tools to help understand the performance of different algorithms
  - Vertexing/gamma reconstruction
    - PDR inspired reconstruction working well
    - Working on developing new techniques
  - Algorithm timing
Event Display

1 GeV downward going muon

- Launch point at $z = 1000$
- Generated into a cone
  - $0.8 < \cos(\theta) < 1$. 
Event Display

100 MeV downward going gamma

- Launch point at \( z = 1000 \)
- Generated into a cone
  - \( 0.8 < \cos(\theta) < 1 \).
McHits from Default Muons
McHits, Energy Deposit

![Graphs showing energy deposition for charged particles and photons]
McHits, Fit to Landau Distribution

![Graph showing McHits fit to Landau distribution with labeled parameters]

- $e_5$
- $N_{ent} = 68085$
- $Mean = 0.14$
- $RMS = 0.05054$
- $Under = 0$
- $Over = 0$
- $Chi^2 / ndf = 231.2 / 38$
- $Constant = 9.204e+004 \pm 526.4$
- $MPV = 0.1156 \pm 8.141e-005$
- $Sigma = 0.007445 \pm 3.674e-005$
Clusters

Clusters (30 degree muons)

#Clusters/event

Input: 2000
Mean = 45.51
RMS = 5.205
Under = 0
Over = 0

#Clusters/fit

Input: 2000
Mean = 1.054
RMS = 9.146
Under = 0
Over = 0

#Cluster width

Input: 87827
Mean = 1.296
RMS = 6.5418
Under = 0
Over = 0

Position of cluster

Input: 87827
Mean = 97.3
RMS = 6.164
Under = 6.269e+003
Over = 3.275e+003
McHits from All_gamma
McHits, Energy Deposit

![Graph showing energy deposit for charged particles and photons with labels for "long" and "short" hits]
McHits, Fit to Landau Distribution

$e^5$

$N_{ent} = 16499$

$Mean = 0.1441$

$RMS = 0.04547$

$Under = 0$

$Over = 0$

$\chi^2 / ndf = 320.9 / 38$

$Constant = 2.1 \times 10^4 \pm 239.3$

$MPV = 0.1213 \pm 0.0001848$

$\Sigma = 0.007795 \pm 7.326 \times 10^{-5}$
Clusters

Clusters (all_gamma)

#Clusters vs #Jets
- Input: 48C
  - Mean = 36.07
  - RMS = 35.67
  - Under = 0
  - Over = 0

#Clusters vs #Bjets
- Input: 48C
  - Mean = 0.873
  - RMS = 0.391
  - Under = 10'
  - Over = 69

#Clusters vs #Width
- Input: 23224
  - Mean = 2.446
  - RMS = 1.176
  - Under = 0
  - Over = 712

Position of cluster
- Input: 23224
  - Mean = 98.46
  - RMS = 6.96
  - Under = 6861
  - Over = 5.699e+06
Energy deposited from McPositionHits
(100 MeV Gammas)
An Aside - Backsplash Clusters
(100 MeV Gammas)

Geant4 with default settings
100 MeV Downward going gammas

Clusters from backsplash <0.5%
Total Energy deposited in clusters
(100 MeV Gammas)
TkrRecon / Monte Carlo Comparisons
100 MeV Gammas

- **# Fit Tracks/Event - Front**
  - Nent = 1600
  - Mean = 1.761
  - RMS = 0.6557

- **# Fit Tracks/Event - Back**
  - Nent = 1129
  - Mean = 1.519
  - RMS = 0.6378

- **Number hits/track - Front**
  - Nent = 2062
  - Mean = 16.5
  - RMS = 7.106

- **Number hits/track - Back**
  - Nent = 1701
  - Mean = 8.354
  - RMS = 2.643

Blue is Recon
Red is MC
Tk.tracks / Monte Carlo Comparisons

100 MeV Gammas

- **MC Track angle - Front**
  - Blue is MC
  - Red is Recon
  - mcAaf
    - Nent = 1468
    - Mean = 0.05837
    - RMS = 0.06116

- **MC Track angle - Back**
  - mcAnb
    - Nent = 884
    - Mean = 0.09806
    - RMS = 0.07237
Tracker Reconstruction Software Performance Review, Oct 16, 2002

TkrRecon Algorithm Timing

Reconstruction time dominated by Track Finding (No surprise)
Tracker Reconstruction Software Performance Review, Oct 16, 2002

TkrRecon Algorithm Timing
(100 MeV Gammas)

****************************************************************************************************
*****Chrono***** INFO The Final CPU consumption (Chrono) Table (ordered)
*****Chrono***** INFO
****************************************************************************************************

TkrVertexTime INFO Time User : Tot= 0.51 [s] Ave/Min/Max= 173(+1.3e+03)/ 0/ 1e+04 [us] #=2946
TkrClusterTime INFO Time User : Tot= 7.2  [s] Ave/Min/Max= 2.44(+ 4.3)/ 0/ 10 [ms] #=2946
TkrSimpleDigiAlg INFO Time User : Tot= 15 [s] Ave/Min/Max= 3.01(+ 4.63)/ 0/ 40 [ms] #=5000
TkrFitTime INFO Time User : Tot= 23 [s] Ave/Min/Max= 7.8(+7.27)/ 0/ 50 [ms] #=2946
TkrFindTime INFO Time User : Tot= 19.2[min] Ave/Min/Max= 390(+665)/ 0/ 1.03e+04 [ms] #=2946
TkrReconTime INFO Time User : Tot= 19.7[min] Ave/Min/Max= 401(+670)/ 0/ 1.04e+04 [ms] #=2946
TkrReconAlg:exe INFO Time User : Tot= 19.7[min] Ave/Min/Max= 401(+670)/ 0/ 1.04e+04 [ms] #=2946
Tkr:execute INFO Time User : Tot= 19.7[min] Ave/Min/Max= 401(+670)/ 0/ 1.04e+04 [ms] #=2946
ChronoStatSvc INFO Time User : Tot= 23.3[min]

#= 1
*****Chrono***** INFO
****************************************************************************************************
Output from Merit
(100 MeV Gammas)

Layers 0-11
Events used : 1566
  eff. proj. sigma : nan deg = nan arc-min
  68% contained : 4.65 deg = nan*(1.51*sigma)
  95% contained : 19.3 deg = nan*(2.45*sigma)
  Energy: meas/gen : 0.26
    std : 0.161
  events w/ no data : 9
  effective area : 9396 cm^2
  Figure of merit : -2147483648 cm

Found in tuple : 2946
Generated energy--mean : 0.1
  rms : 2.22321e-08
  min : 0.1
  max : 0.1
  Elapsed time (sec) : 663.216
  TKR_No_Tracks>0 : 2822
  Accepted for analysis : 2822

Layers 12-15
Events used : 1256
  eff. proj. sigma : 4.7 deg = 282 arc-min
  68% contained : 8.54 deg = 1.2*(1.51*sigma)
  95% contained : 24.7 deg = 2.15*(2.45*sigma)
  Energy: meas/gen : 0.478
    std : 0.201
  events w/ no data : 14
  effective area : 7536 cm^2
  Figure of merit : 1058 cm

total effective area : 16932 cm^2
Combined FOM : -2147483648 cm