Status of PID

- PID in Release 18
  - Run 3 , Run 5
- Muon Identification
- Influence of G4-Bug on PID

The PID-Group:
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(*)moving on to other duties; we're getting short of manpower !

BABAR Collaboration Meeting, Oct 1st 2005

Overview : What happened since Elba ?

- Continued validation of Run3 / R18 processing
  - feedback to EMC ($\Rightarrow$ bugfixes)
  - validation of new dE/dx calibration constants
- Validation of Run5 / R18 processing
  - validation of dE/dx calibration for Run5
    - 1st round of processing / skimming had run4 constants
  - look at PID-performance before and after DCH-FEX bugfix
  - validate improvements in IFR reconstruction
    - alignments, bugfixes, software improvements ...
- Retrain NN based muon selectors (still ongoing)
- Look at consequences of Geant4 bug on PID

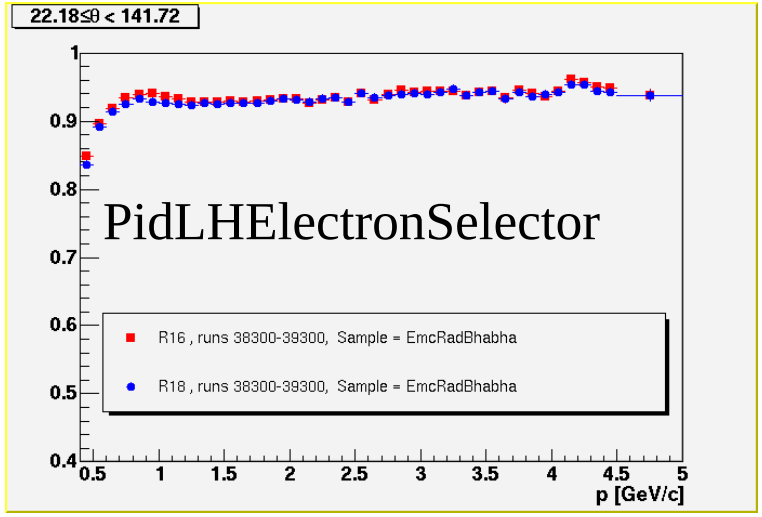
What means „Validation“ ?

- Produce a full set of PidTables for each selector and particle type
  - run BtaApp on data and produce ntuples *Sheila*
  - analyze ntuples and produce PidTables *Xuanzhong*
  - automatic production of comparison plots (eff./fake rate vs. p)
- Allows for very detailed checks *ALL*
  - even deviations on the few % - level located in small regions of phase space can be noticed
- Important ingredients:
  - capability to run in refit mode *thanks to CM2 !*
  - capability to run 100‘s of jobs simultaneously in batch farm *thanks to SCS !*
  - framework for automated production of PidTables & plots

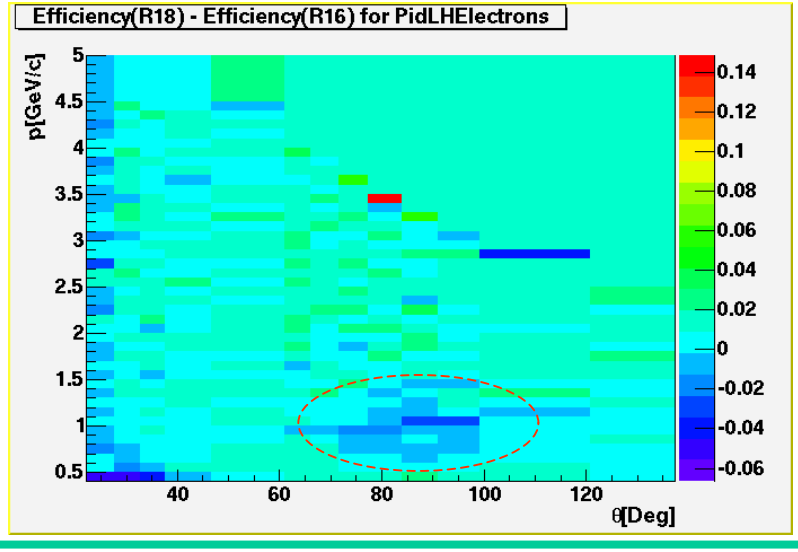
Electron Identification (Run3 / R18)

Thorste

- Slight discrepancy observed at low momentum
  - PidLHElectronSelector
  - eMicroVeryTight

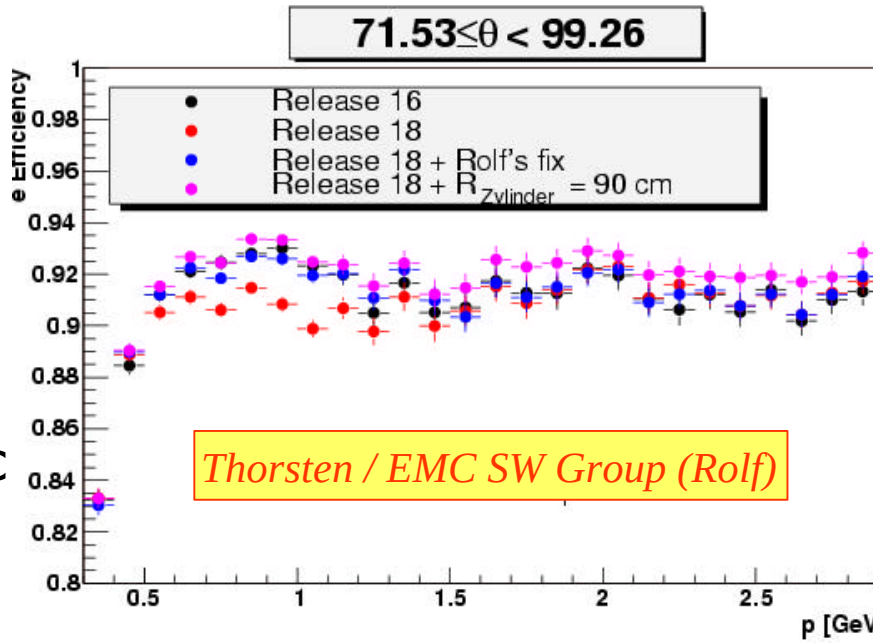


- Look at the difference in 2 dimensions
  - there is a problem near 90 degrees !



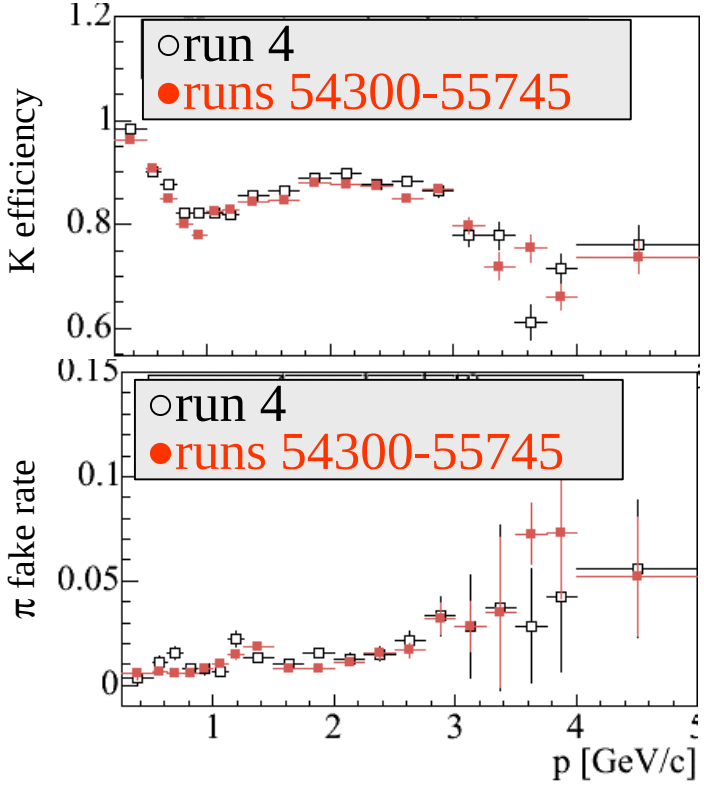
Electron Identification (Run3 / R18)

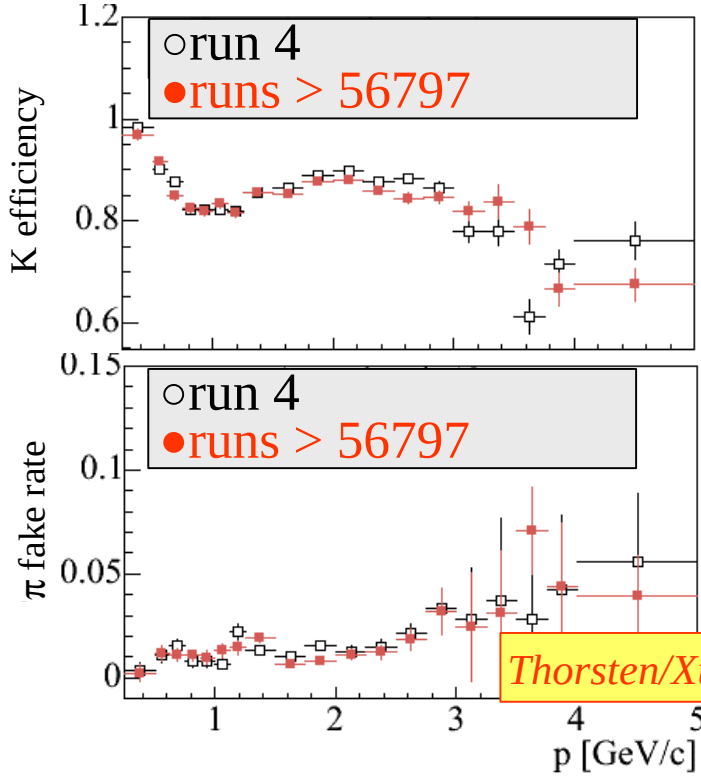
- Look at discriminating variables
  - find problems with point where track intersects the EMC
  - report to EMC group
- Source of problem found
  - intersection algorithm fooled by EMC alignment
- Bugfix by EMC-group
  - too late for already reprocessed data
  - for R18, additional AppModule which recomputes problematic intersection points
  - will run in Skims (R18b)



Kaon Identification (Run 5)

- Check performance with latest dE/dx validations
- Tight LH-based Kaon selector („KLHTight"):



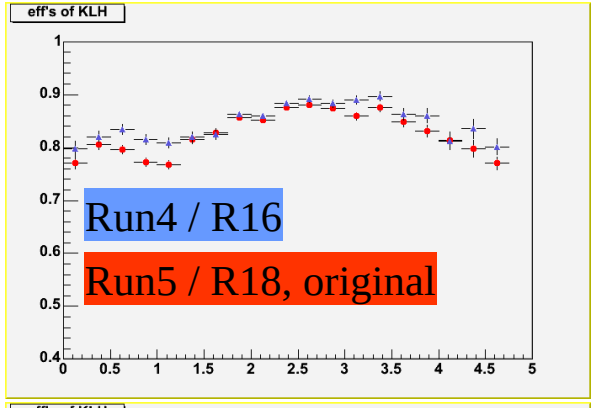


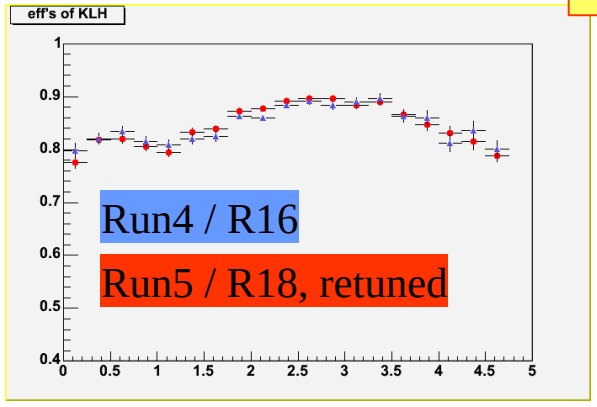
- slight problem with K efficiency at 1 GeV/c at beginning of Run5 (LH-selectors only)

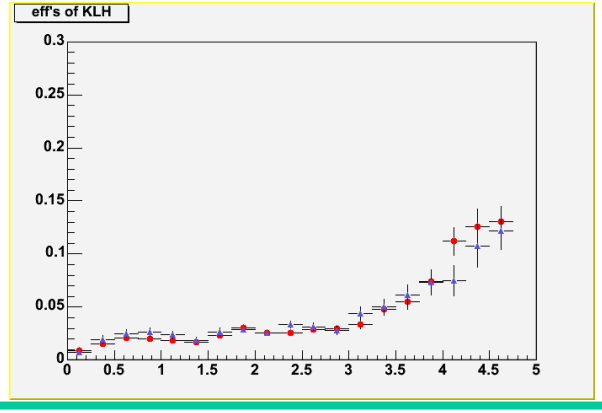
Kaon Identification (Run 5)

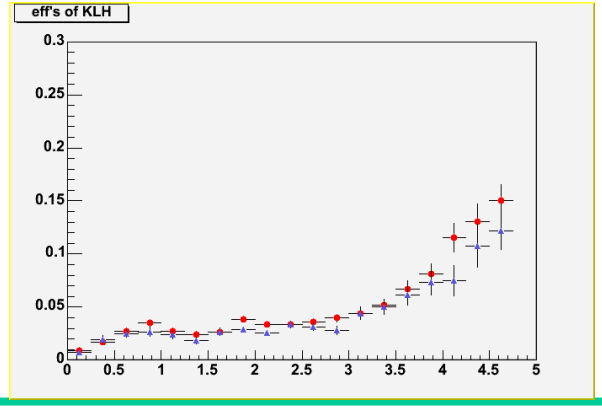
- Study to retune LH based K selector for first Run5 data
  - change cuts on likelihood ratios to regain old eff. at 1 GeV/c
  - following plots show „pseudo-efficiencies“ of KLHLoose
    - no corrections for control sample contaminations

Sep









Kaon Identification (Run 5)

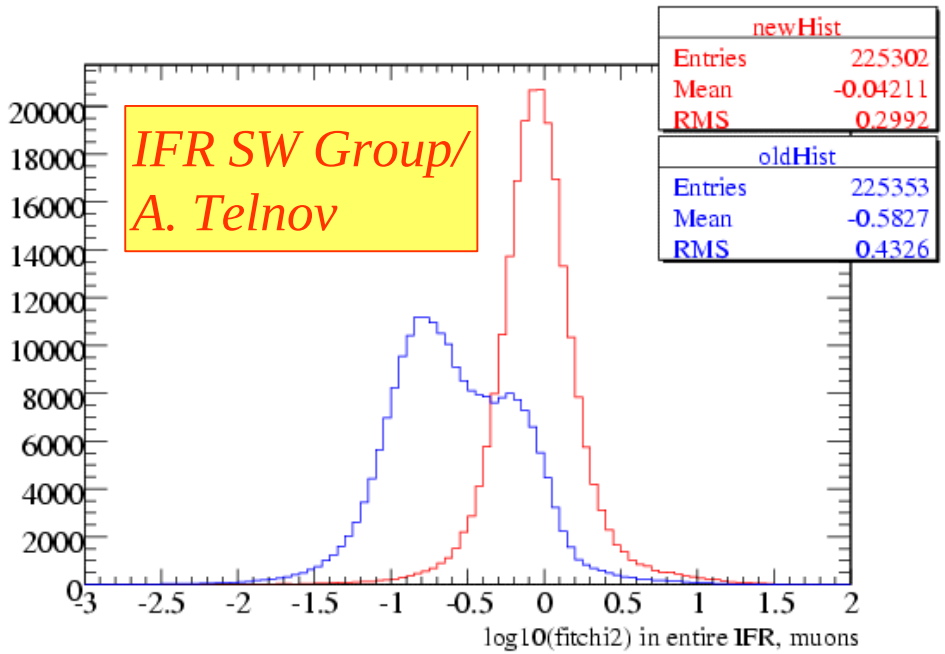
- Retuning of cuts can almost recover efficiency loss in first part of Run5
- New cuts also lead to a slightly higher fake rate
- So far, new cuts **not** implemented
  - would require to implement cuts as function of time
  - only the first part of run5 affected
  - would also need to work out new cuts for KLHTight and KLHVeryTight
  - would need to run this through PID validation cycle
  - after all, it is only a small effect

Muon Identification

- BIG improvement due to LST's
- Many improvements in IFR reconstruction, even for RPC's
  - new alignment constants for Run 5
    - forward & belt part aligned for the first time
    - barrel re-alignments for Runs 4 & 5
  - improved / fixed „clusterFitChi2“
  - improved Kalman χ^2
  - see Sasha's talk from Wednesday for details
- NN based muon selectors retuned
  - retuning based on re-aligned detector
  - NN kernels loaded into cond18boot
  - plan another retraining to benefit from improved χ^2's
    - will be available in time for R18b skimming

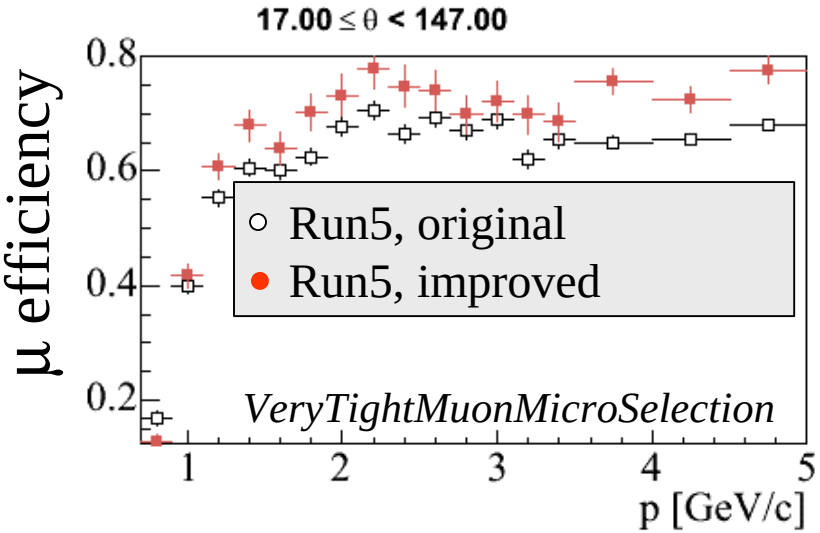
IFR Software Improvements

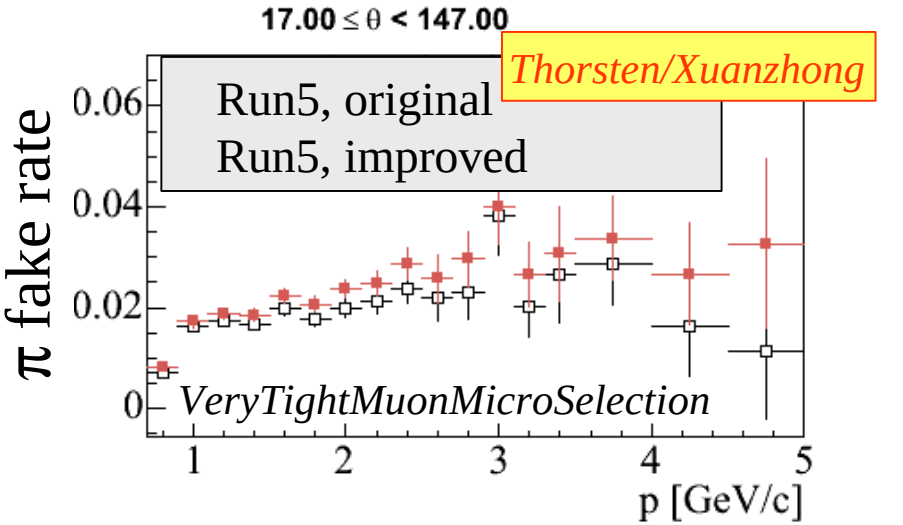
- A lot of work by IFR Group (A. Telnov)
- Improved calculation of „clusterFitChi2"
  - describes how good 1D-clusters fit together to build a 3D cluster
  - assumptions on spatial resolution were „non-optimal" for RPC
  - even worse for LST
  - fixed in latest version of IFR-Reco code
  - will be used in run5 reprocessing
  - neural nets will be re-trained in time



IFR Software Improvements

- New alignments and better Kalman-χ^2 already improve the „tight" cut based selectors a lot :





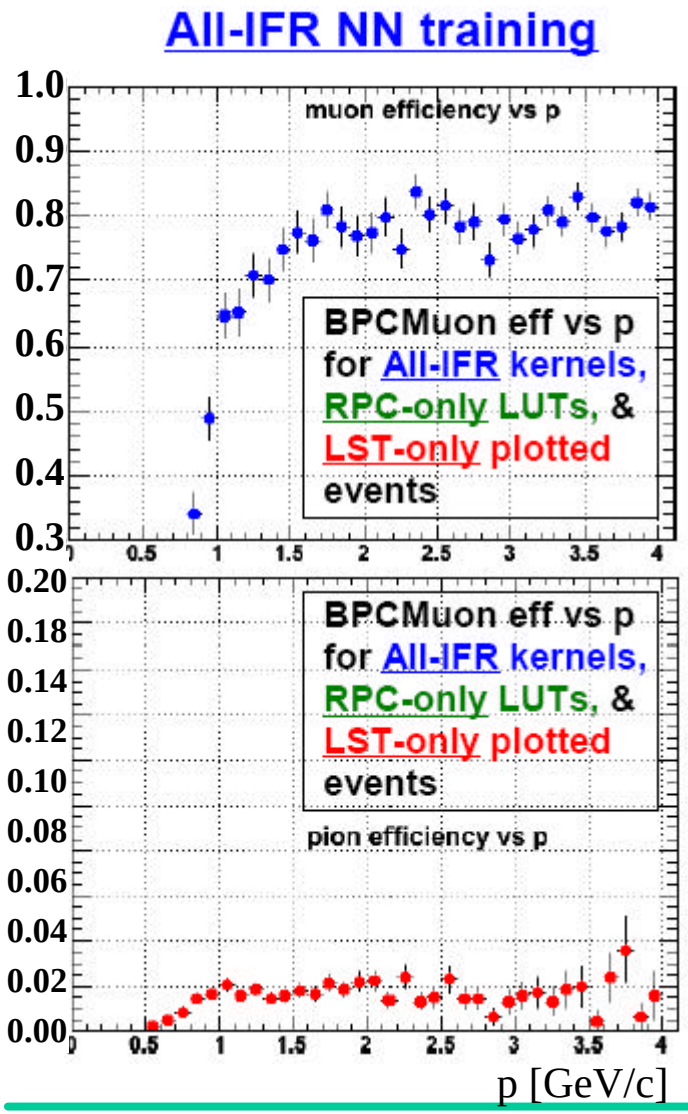
Selector : VeryTightMuonMicroSelection

Selector : VeryTightMuonMicroSelection

- same data used in both cases
- improvements also available for Run4
- plan to retune the cut based selectors

NN based Muon Id. with LSTs

Kevin

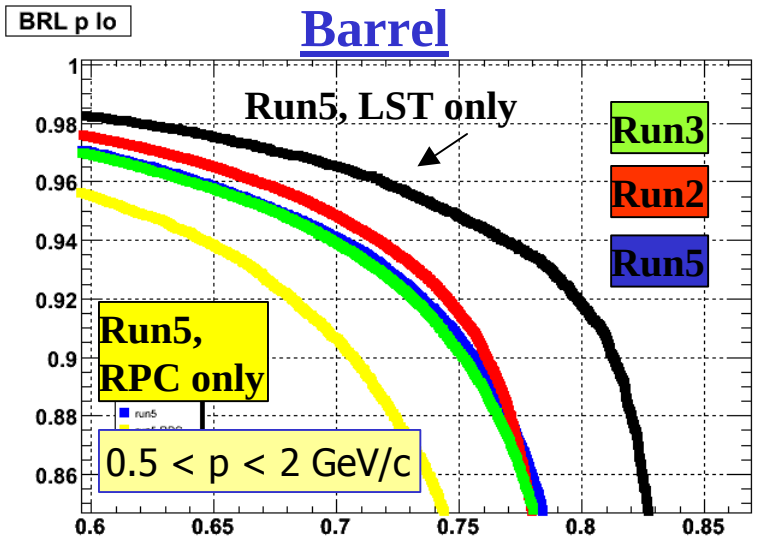


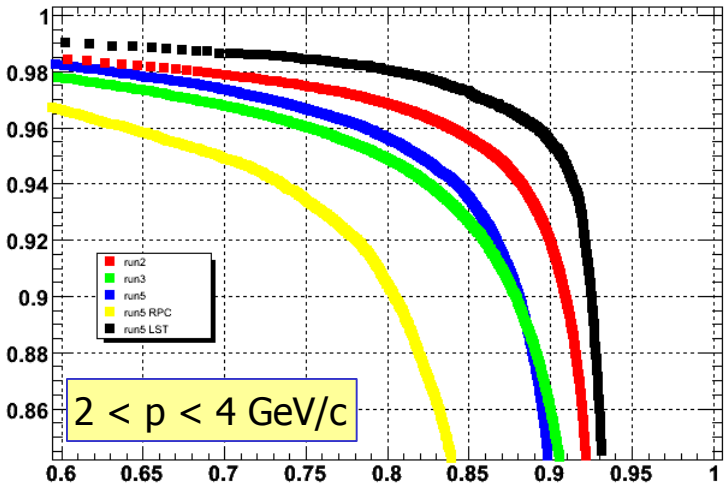
- In Run4/R16:
  π fake rate of 2% $\Rightarrow$
  μ efficiency of ~65%
- But: Further degradation of RPCs in Run 5

p Rejection vs. *m* Efficiency

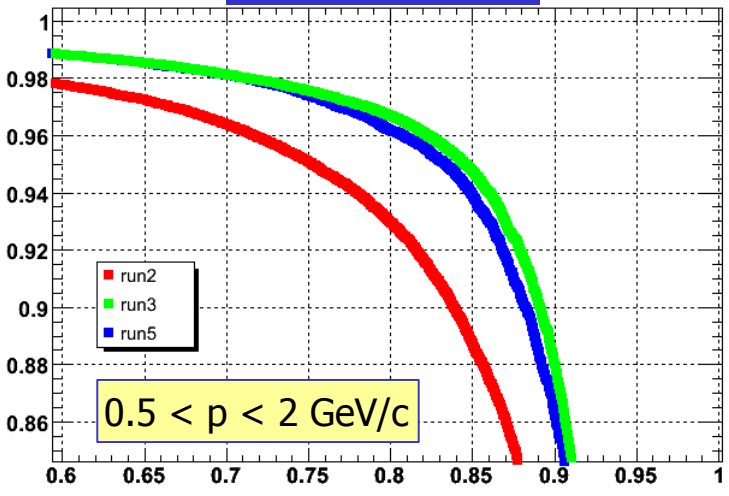
Kevin

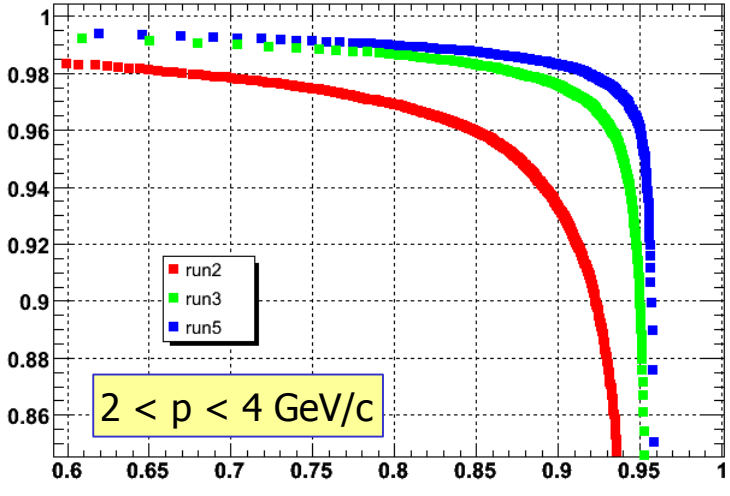
Barrel





FWD Endcap



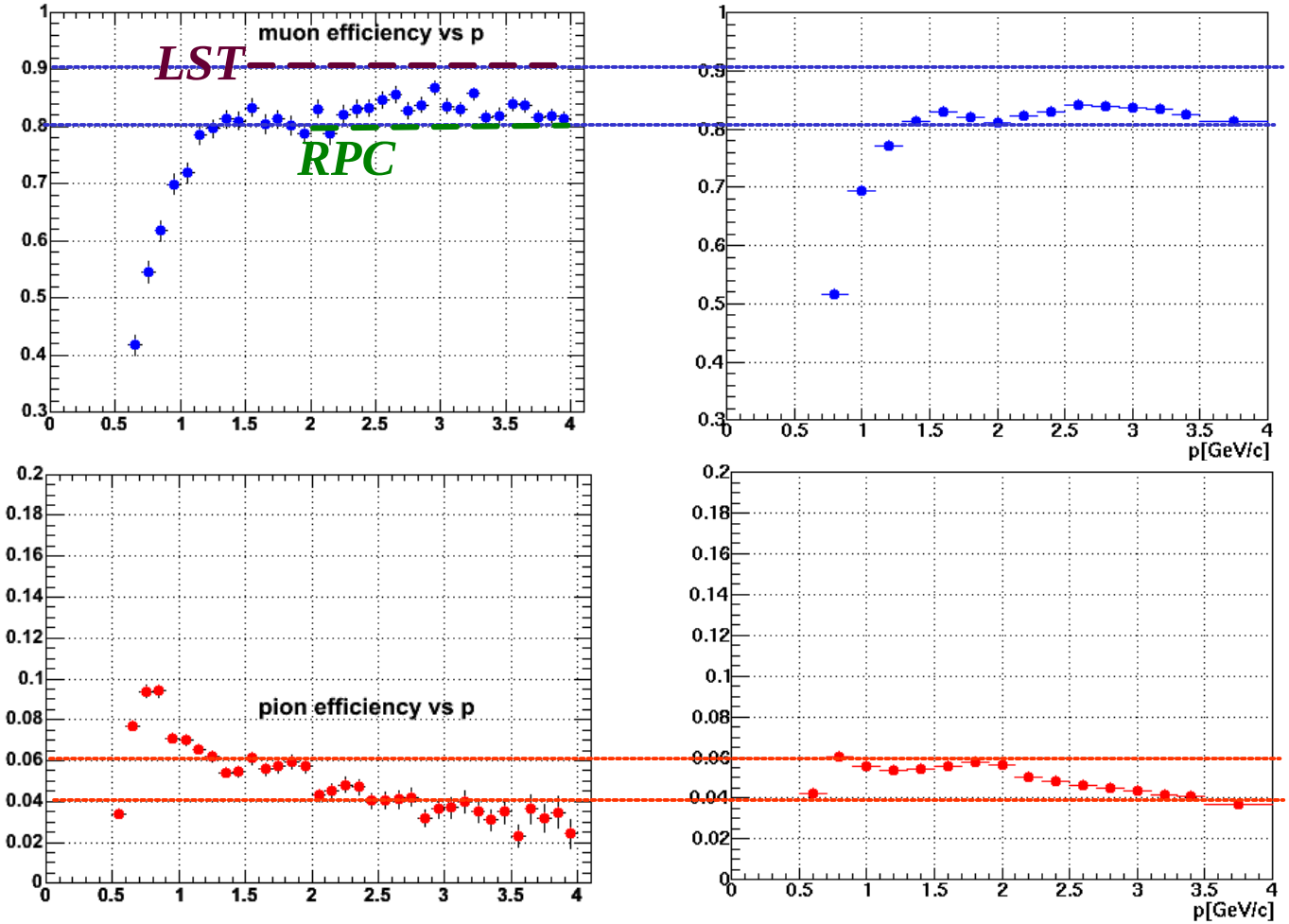


Loose NN-based Muon Identification

Run 5 / R18

Run 4 / R16

Kevin

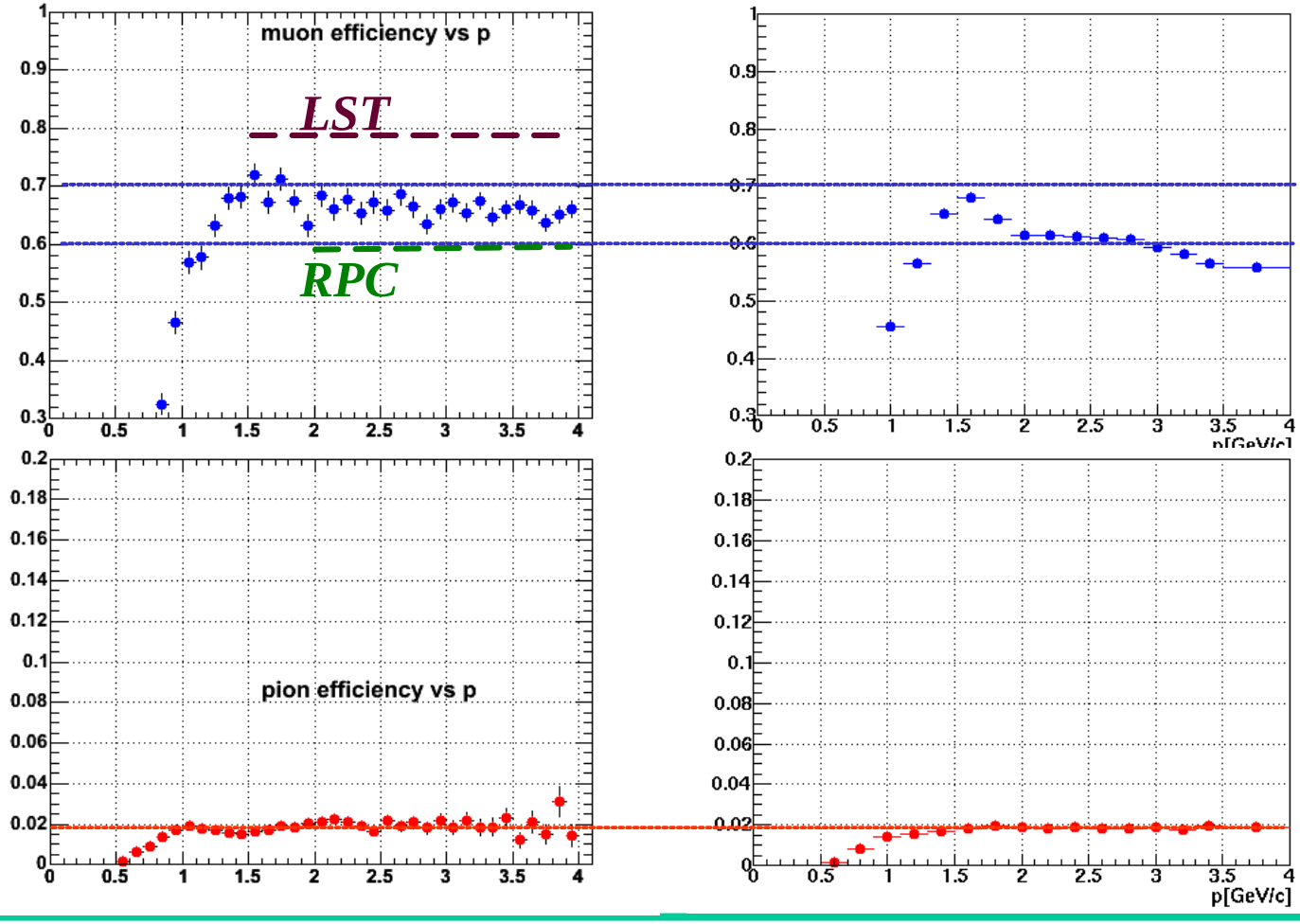


NNVeryTightFakeRate

Run 5 / R18

Run 4 / R16

Kevin

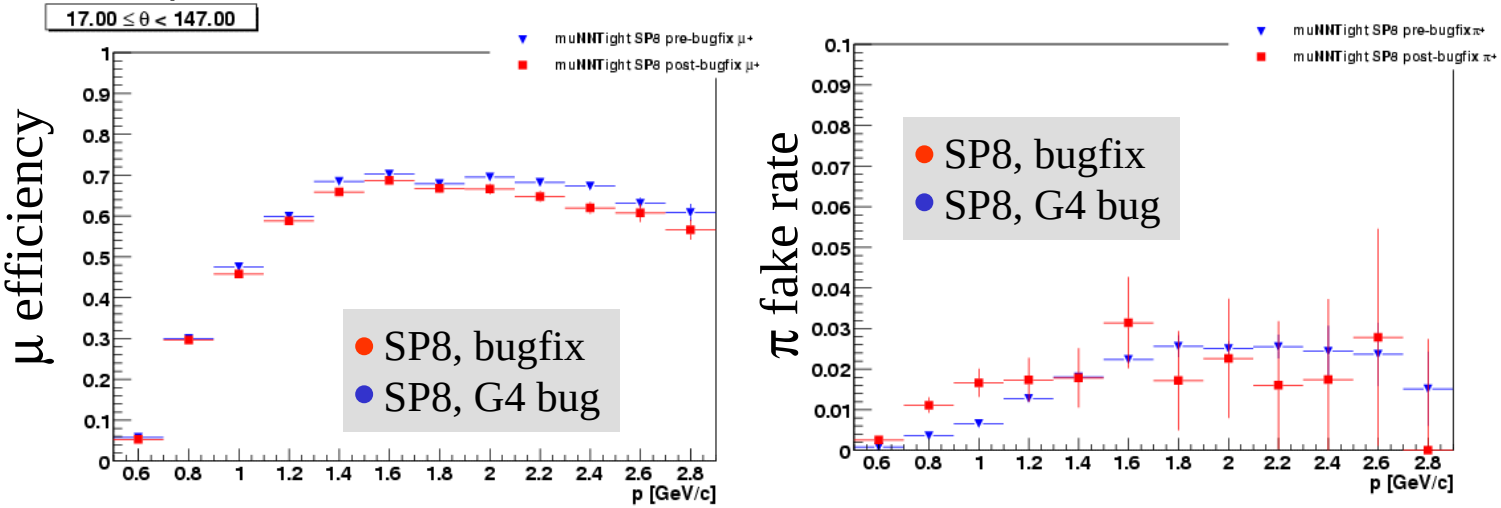


PID & Geant4 Bug

Jonathan

- Geant4 - bug causes some pions to stop too early
  - effect should be most drastic in pion fake rate of μ-selectors
    - some pions which would have passed the IFR might be stopped instead

    ⇒ pion fake rate too low

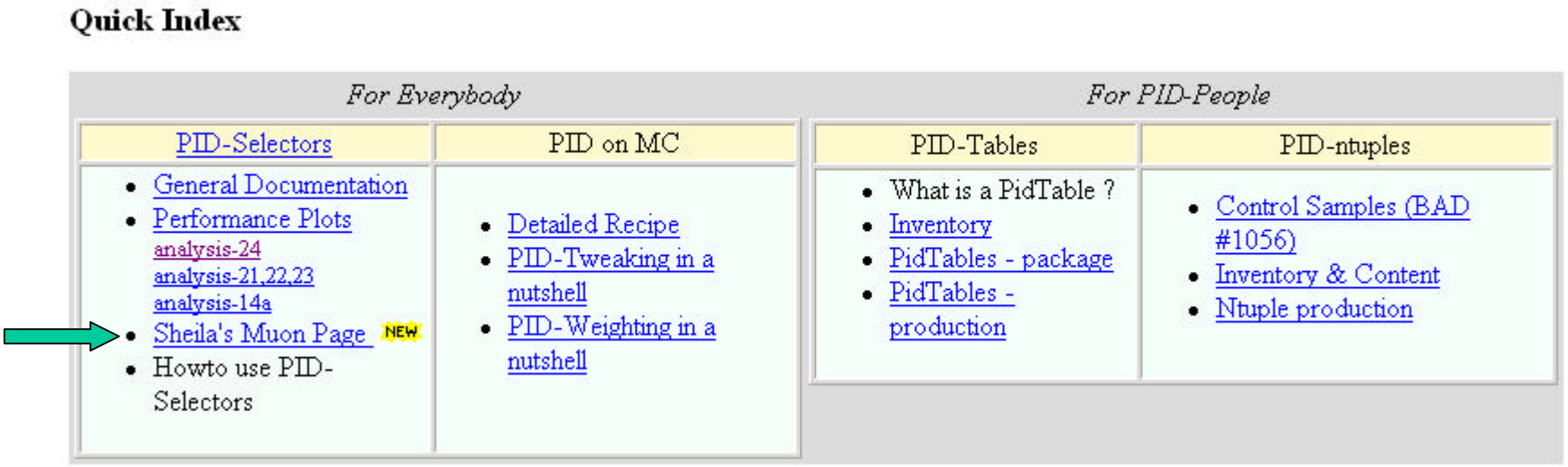


- Difference for p<1.1 GeV/c
  - muon id rarely applied below 1 GeV/c anyway
  - even below 1 GeV/c, your analysis won't be screwed up if you use PID-weighting/tweaking

Decision to keep buggy SP8

Sheila's Muon Page

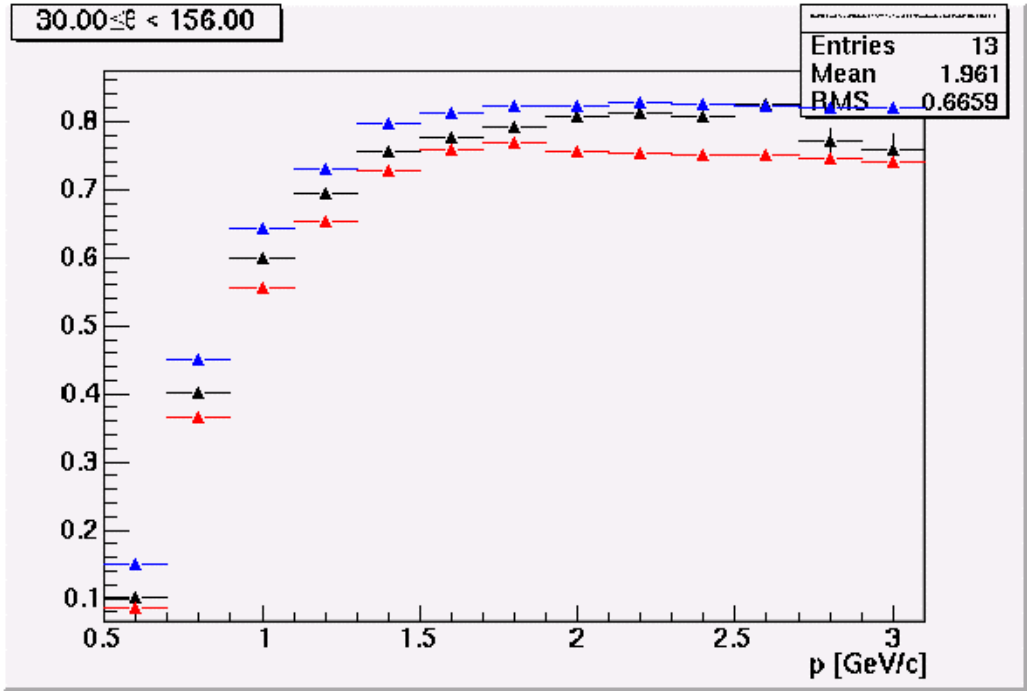
- Go to the PID-homepage and follow this link:



- Here you will find a lot of useful information
  - basic things about muon identification
  - which variables are used for muon identification
  - how distributions of these variables look like for μ and π
  - how muon efficiencies in data and MC look like

From Sheila's Muon Page

- Efficiency of muNNTight



also available for other muon selectors !

- red = efficiency measured from μμγ events in real data
- blue = efficiency measured from simulated μμγ events
- **black** = actual muon efficiency in BBar events (MCtruth, GTL)
- difference between black and blue ⇒ **systematics**

Summary

- Electron identification OK
  - additional module running in PIDSequence
- Kaon identification as good as OK
  - LH Selectors show small drop in efficiency around 1 GeV/c for runs 54300-56797
- Muon identification spectacular in LST region
  - almost eaten up by degraded RPC's , though
- Expect further performance increase with „clusterFit χ^2"
  - new neural nets will be available in time for skimming
- Small effect of G4-Bug on μ-id in „typical" p-range
  - modeling of too low π fake rate compensated by PID-weighting / tweaking anyway