PRS-μ, CMS week

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Energy loss study of TeV μ's

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Motivation

- Increasing interest in high p_t muons,
- Eg. Z' search,
- Large room for improvements and optimization in actual muon reconstruction,
- Major concern is energy loss (brem) along muon trajectory,
- How to recognize it?
- How to improve muon fit?

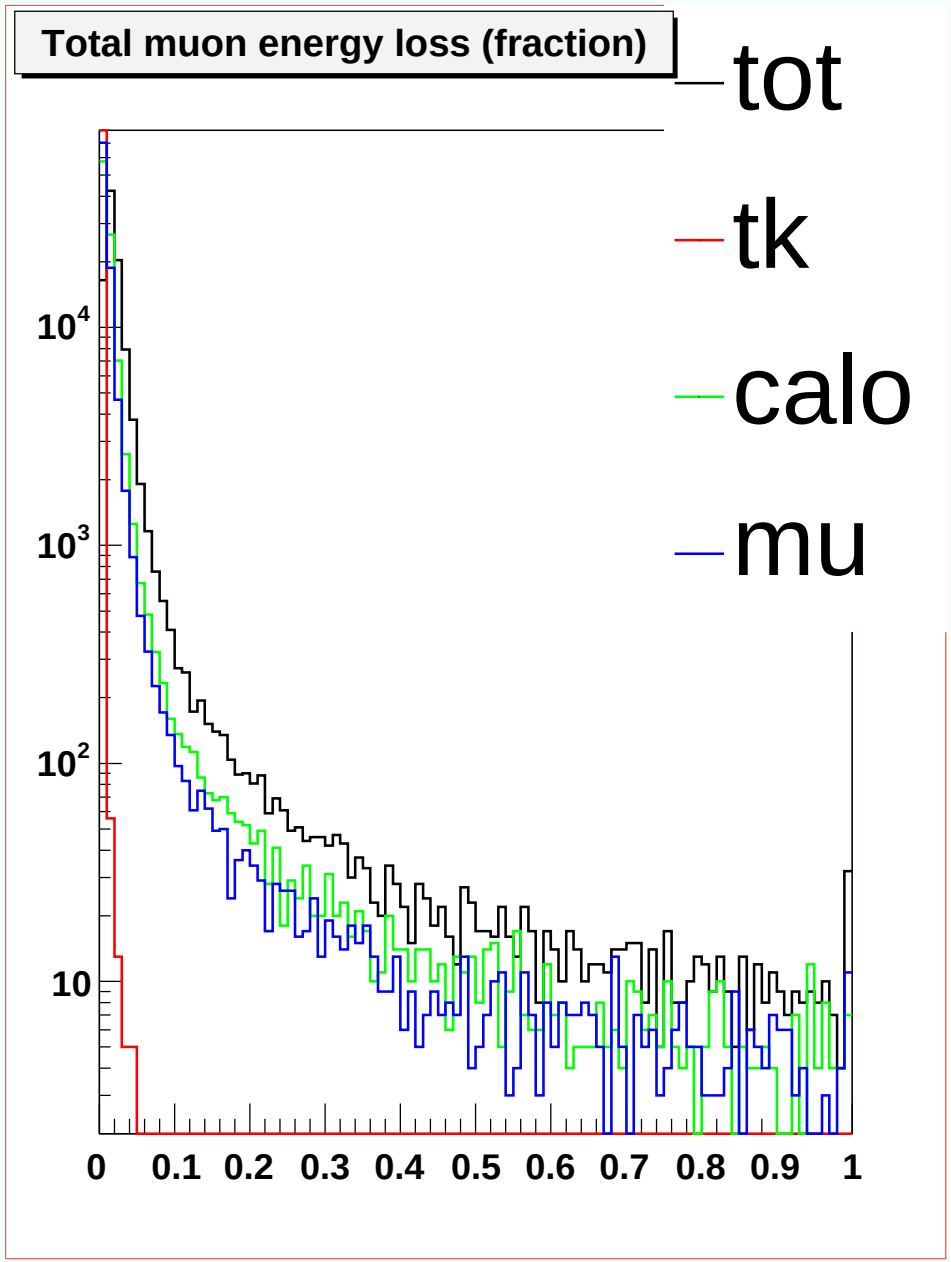
Approaches

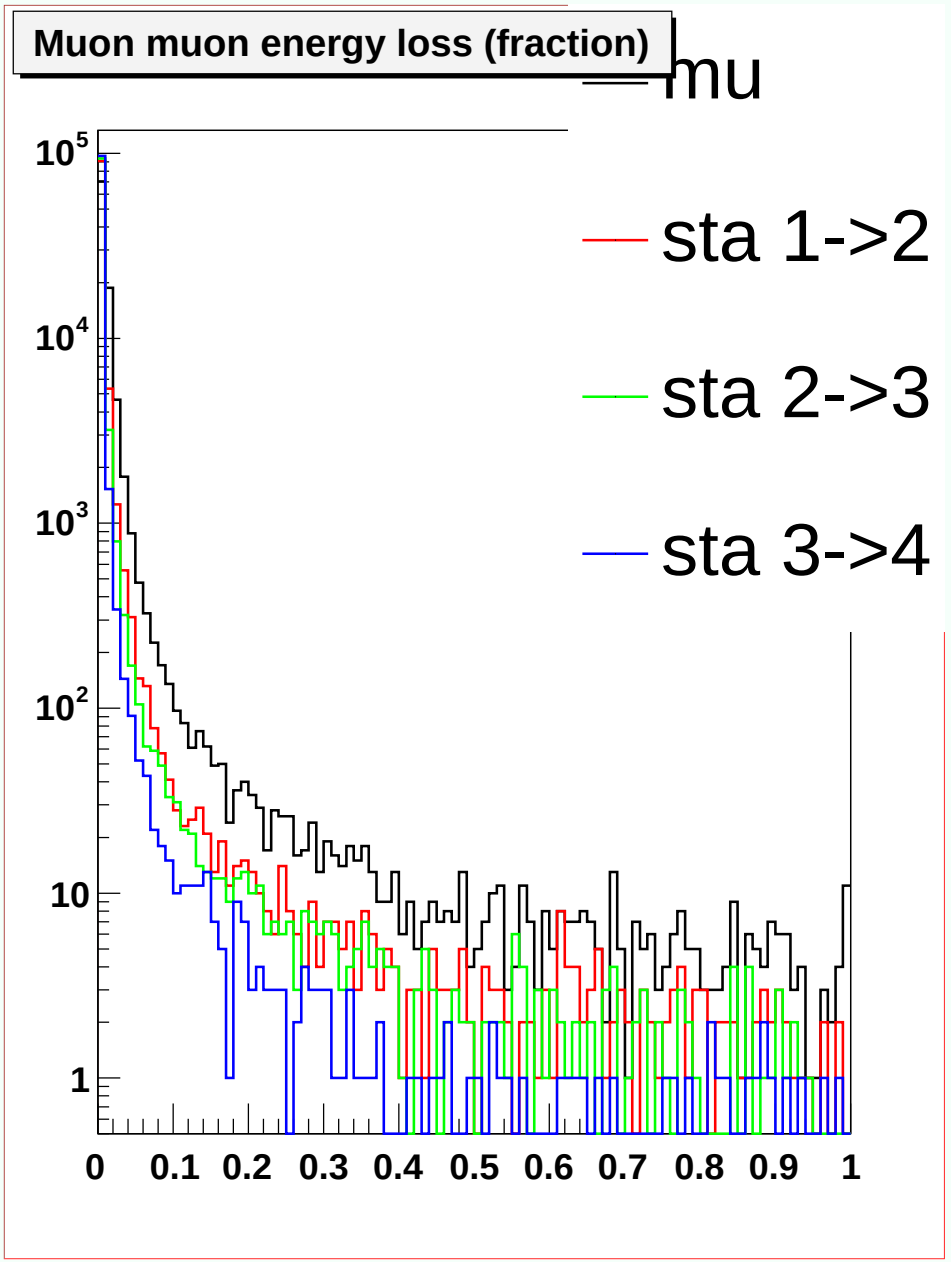
- So far a *"top-bottom"* approach
  - Look at high level reconstruction quantities (such as di-μ invariant mass) and see the effect of different reconstruction algorithms on it: eg Truncated Muon Reconstruction
  - Effect on $1/p_t$ resolution and pulls
  - Look at Kalman filter output (χ^2)
  - Found possible algorithm optimization
- Try *"Bottom-top"* approach
  - Look at MC to see how high p_t muons behaves in CMS
  - Look at energy deposit along muon trajectory
  - Look at hits multiplicity on muon chambers
  - Look at p_t, η reconstructed in Tracker and Muon systems alone

Tools

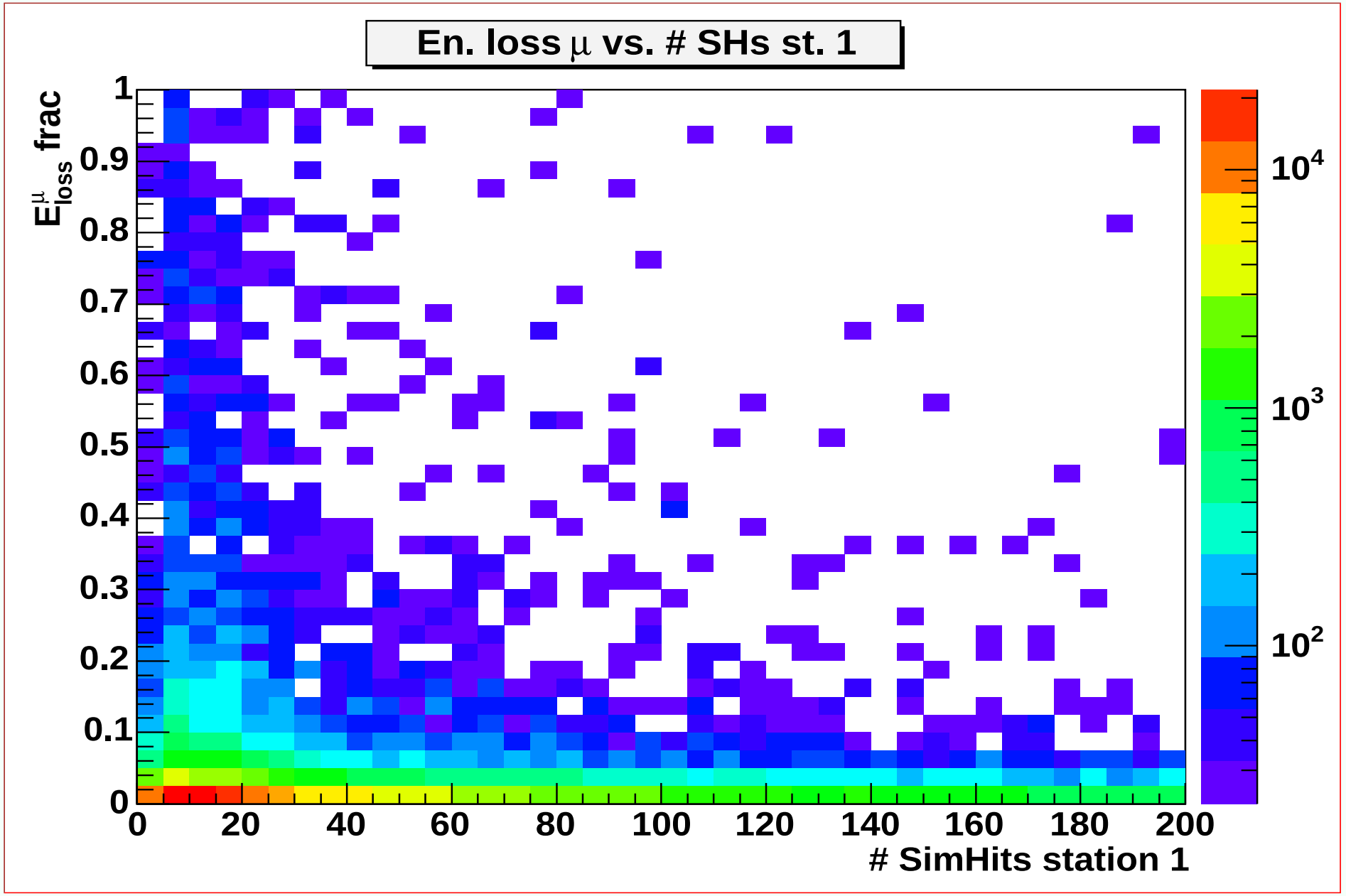
- Sample single μ, mixed charge, $p_t = 1$ TeV , $|\eta| < 2.5$, CMSIM 133
- Maybe not the best sample: at high η the p_t^{μ} is not relevant for CMS (e.g. $p \approx 3.5$ TeV). Will try $p = 1$ TeV
- Standard geometry (with wrong Al and DT gas density in DT system)
- Reconstruction with ORCA 813 (plus various bugs fix, to be released in 820 soon)
- Check μ energy loss in Tracker (from IP to outermost Tk layer), Calo's (outermost Tk – innermost Muon station), Muon (innermost – outside)
- Compare μ energy loss with SimHits multiplicity
- Ditto for RecHits (layer hits)
- η independent study

μ energy loss (fraction)

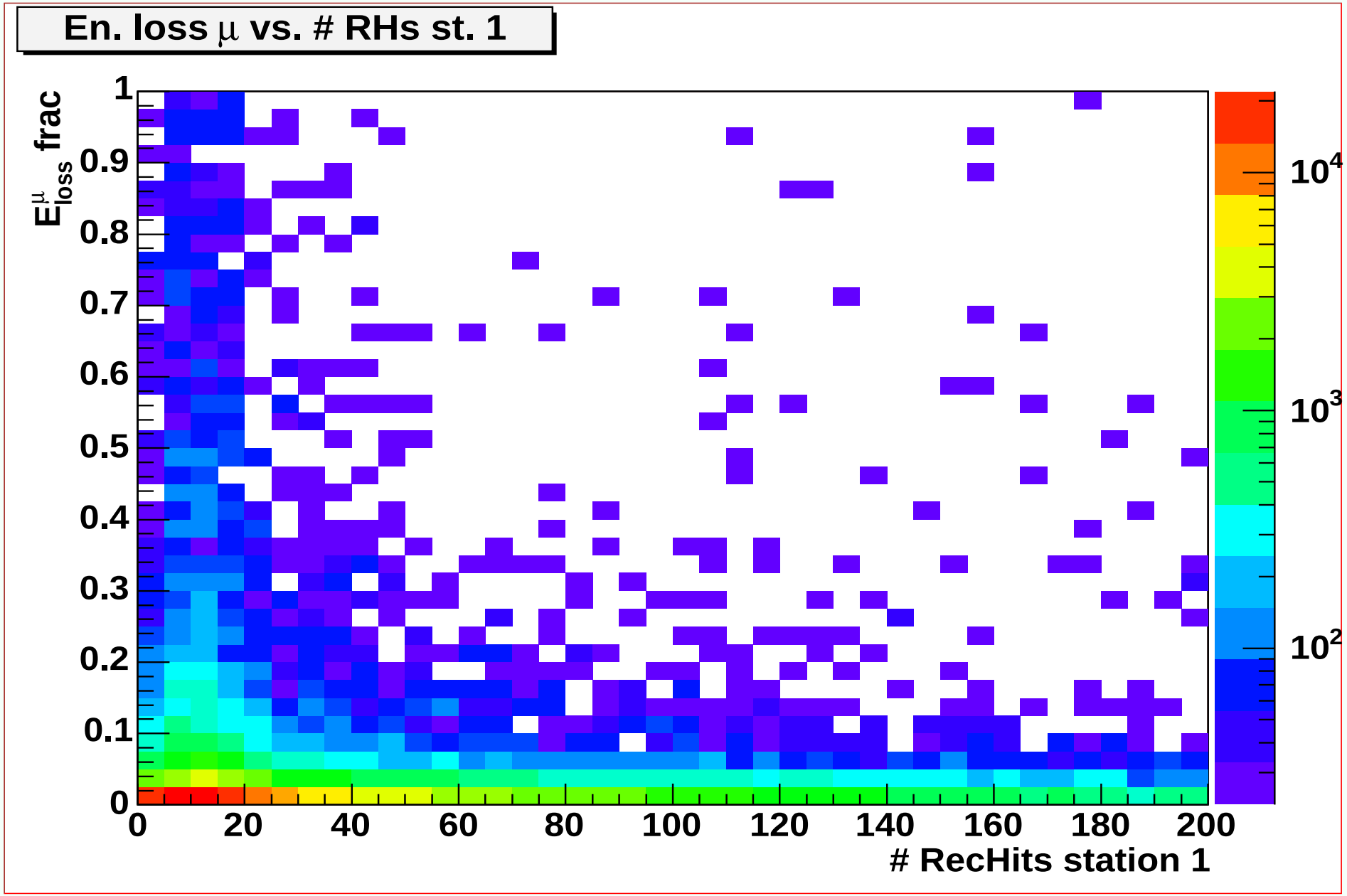




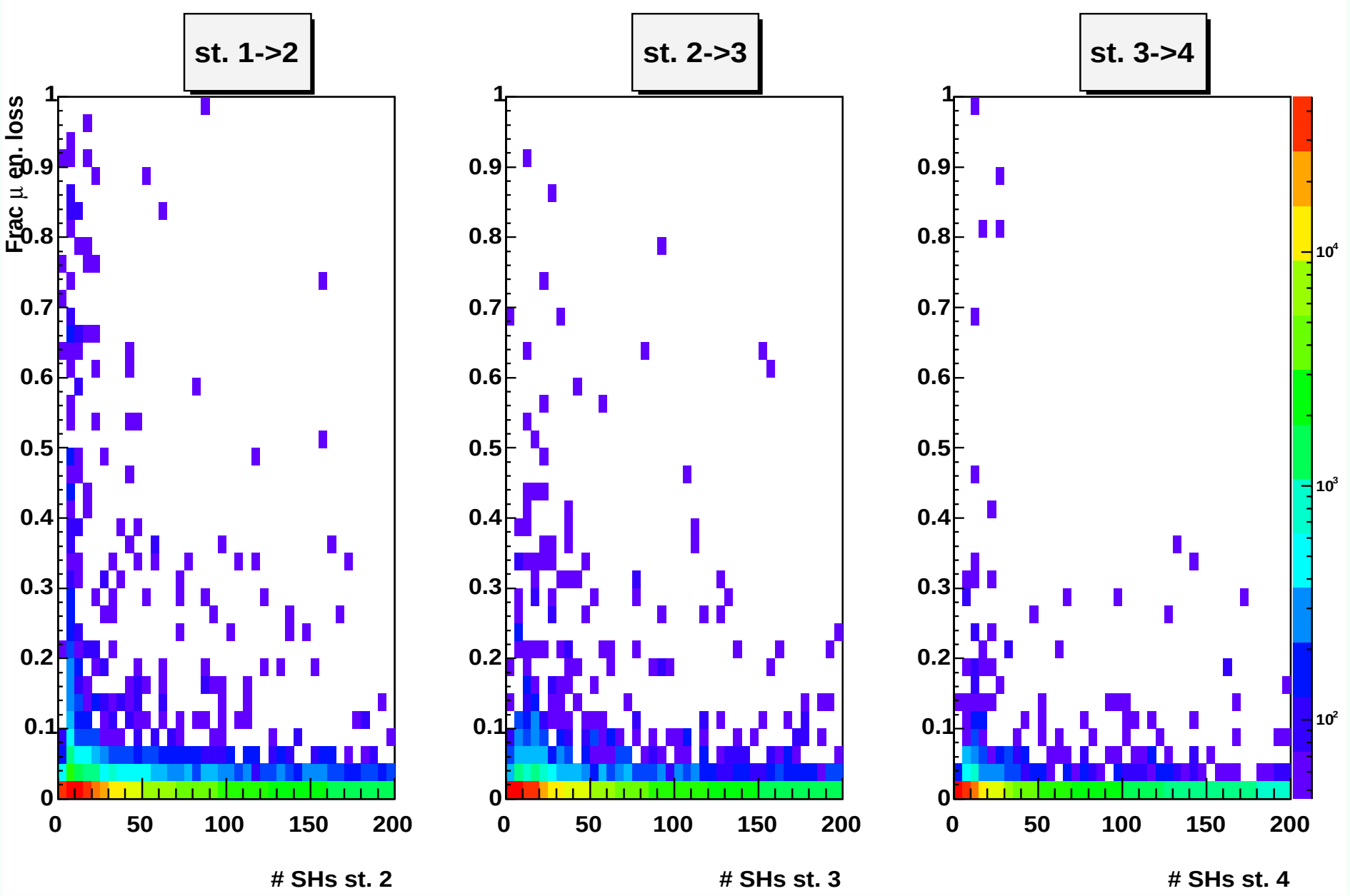
μ energy loss calo vs SimHit mult.



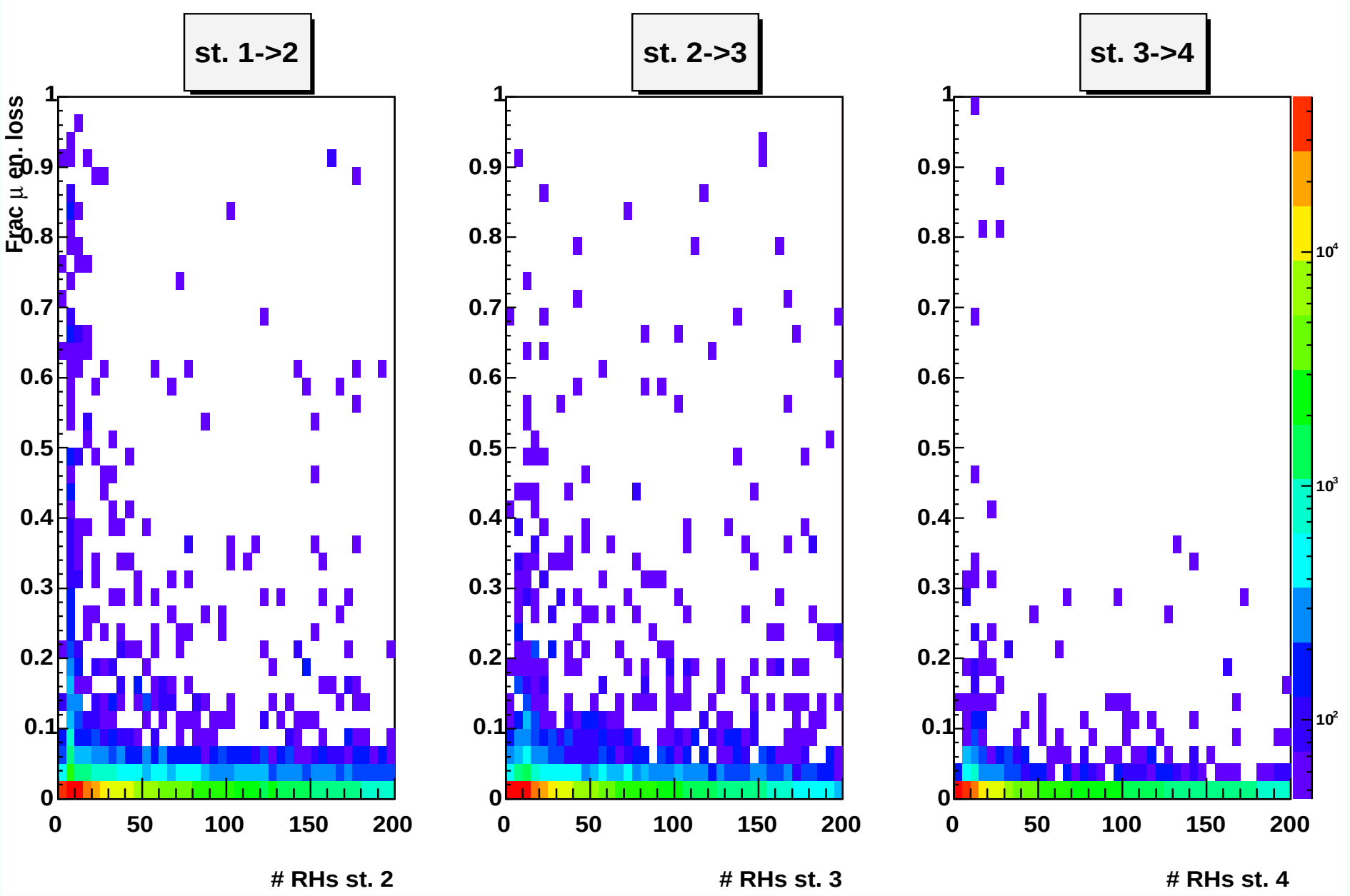
μ energy loss calo vs RecHit mult.



μ energy loss Muon vs SimHit mult.

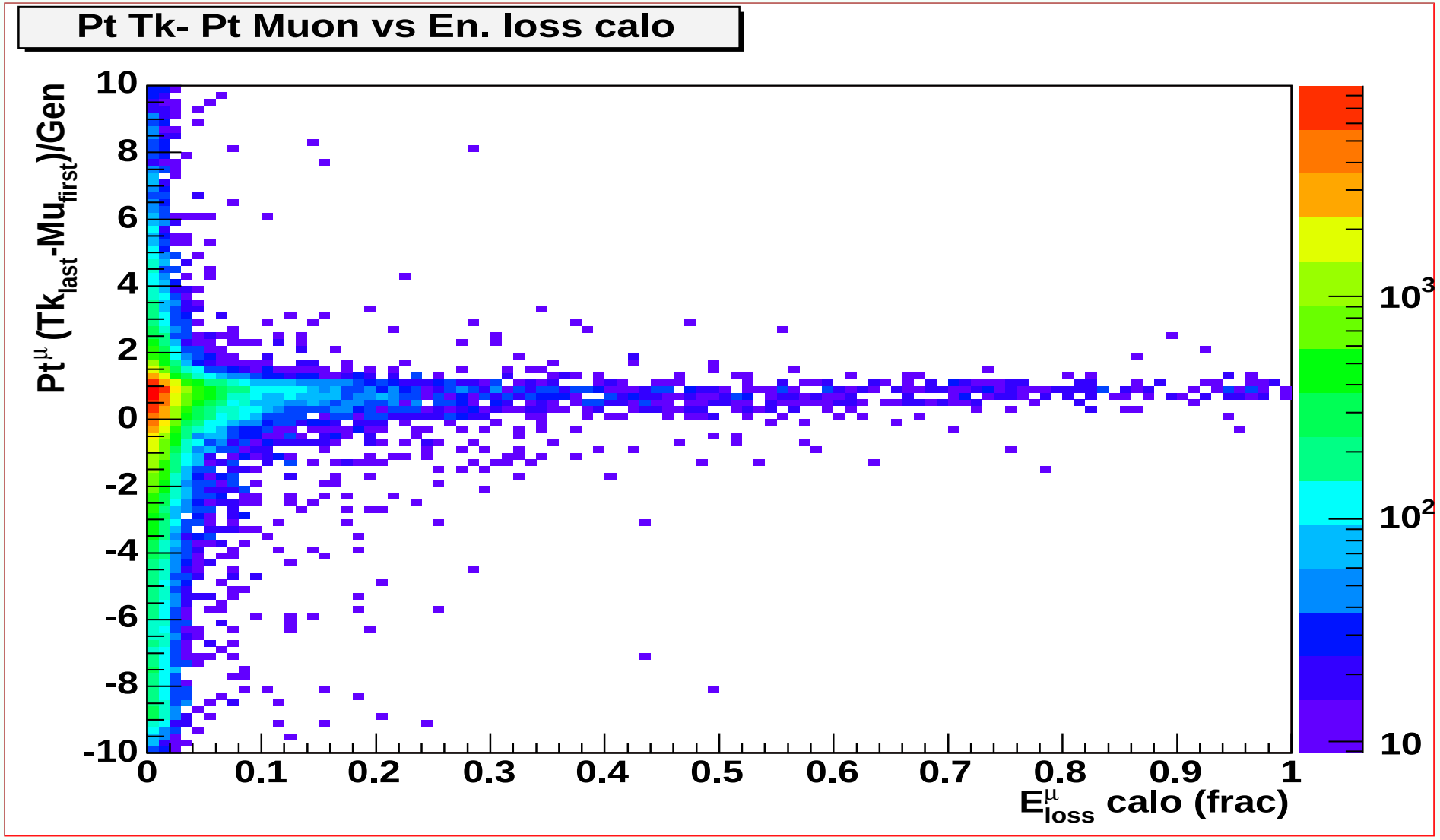


μ energy loss Muon vs RecHit mult.

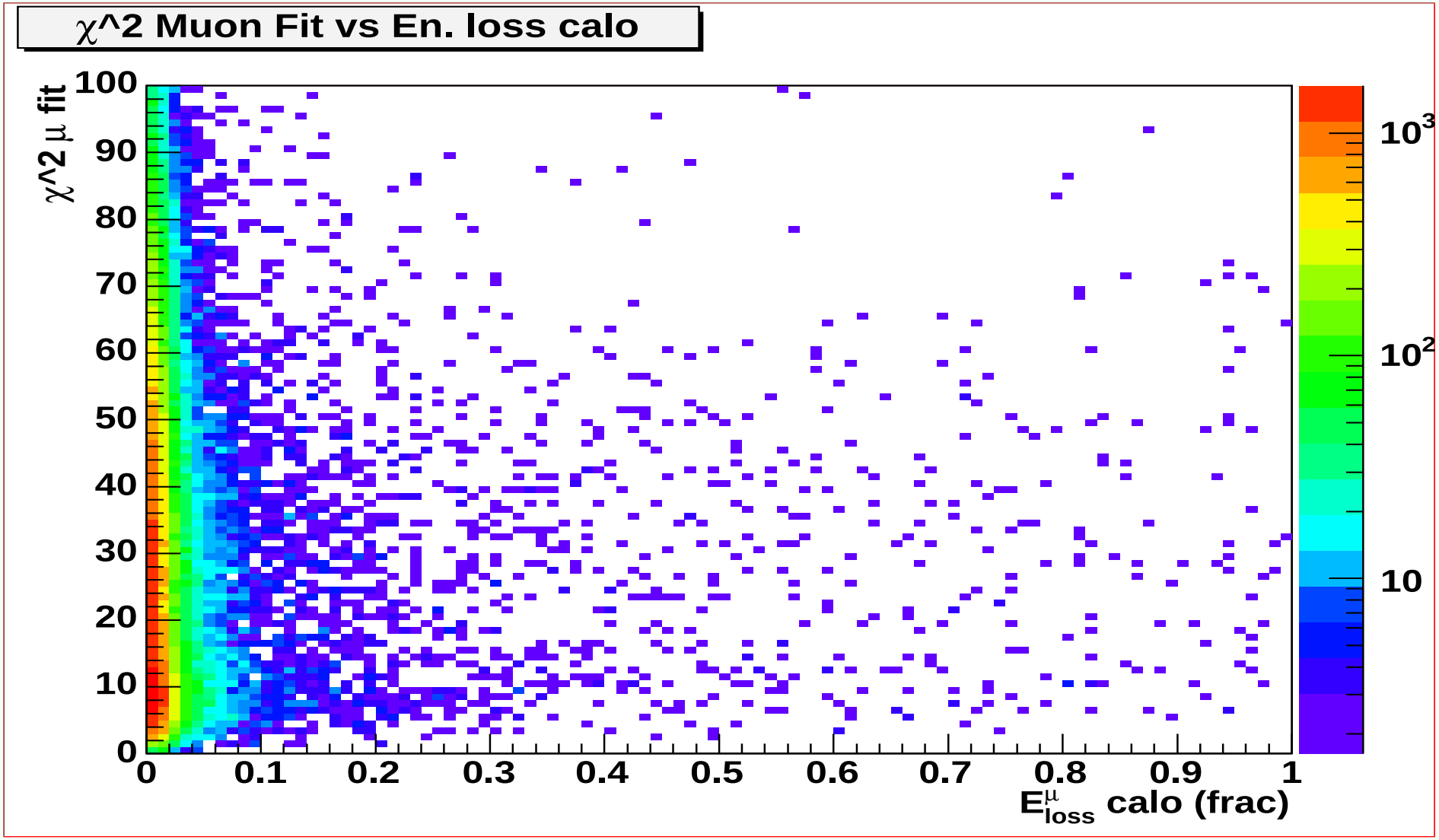


P_t^{μ} Tk-Muon vs Calo En. loss

(p_t outermost Tk st. - p_t innermost Mu st.)/Gen. p_t

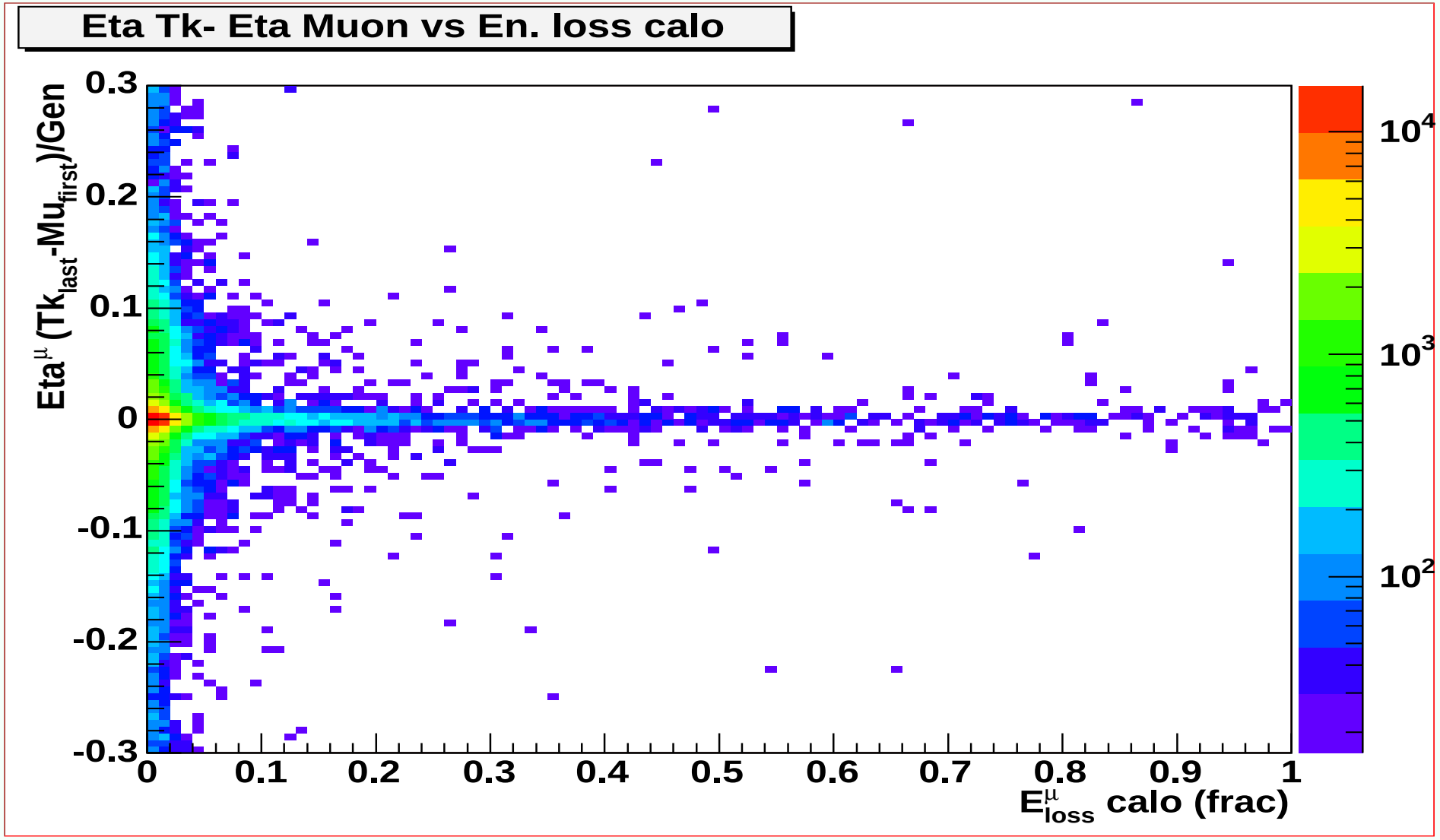


χ^2 Muon Fit vs Calo En. loss



η^{μ} Tk-Muon vs Calo En. loss

(η at outermost Tk station - η innermost Muon station)



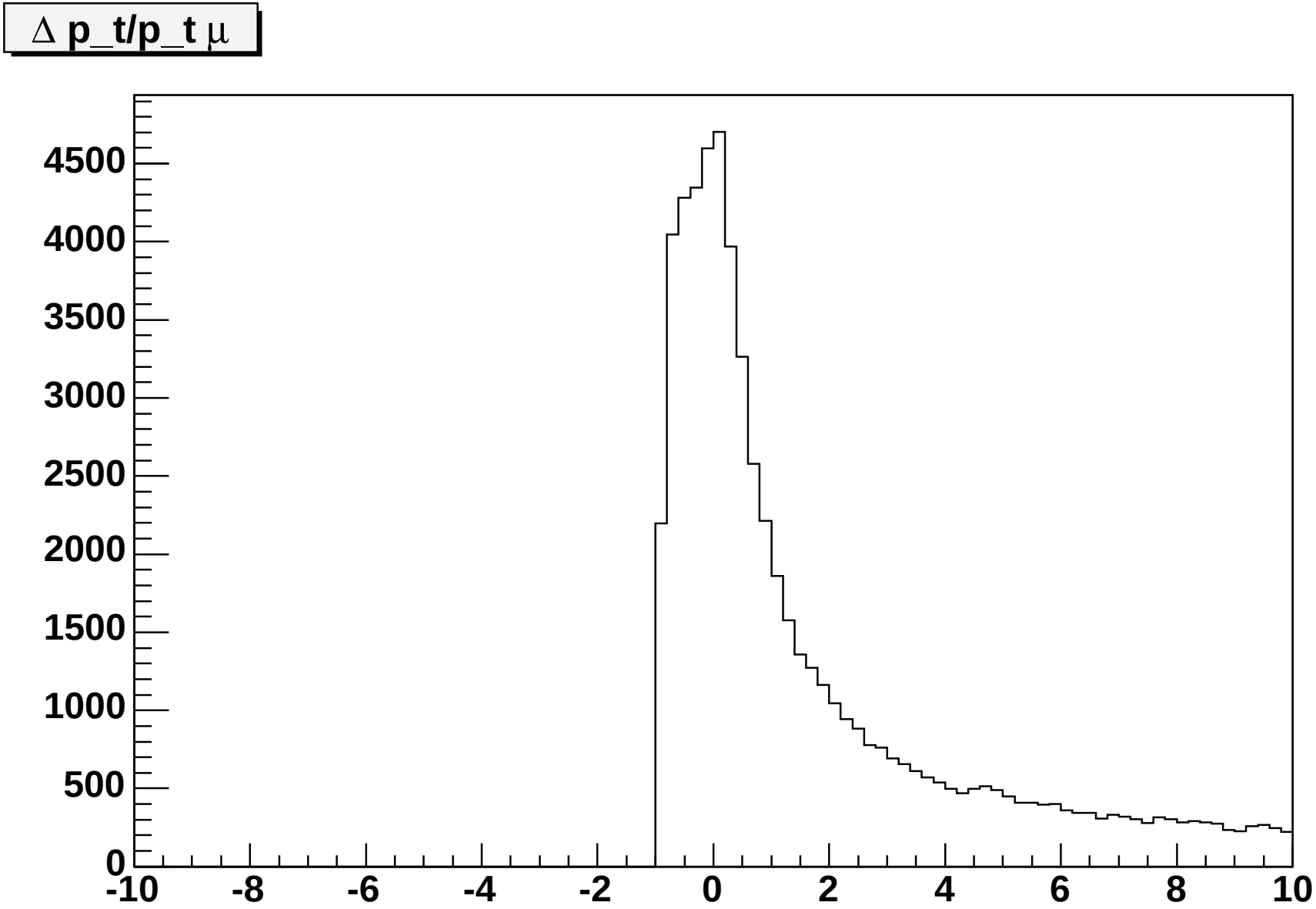
Conclusion and future

- Very preliminary study,
- Preliminary conclusion: hits multiplicity is not correlated with energy loss! Cannot use Muon station as calorimeter!
- Not correct to rely on hit multiplicity to stop fit of muon tracjectory,
- Need to use also station with very high multiplicity in the fit
- First test (not shown here) to “clusterize hits” in crowded chambers (DT), without pattern recongition looks not too bad,
- Naïve test of p_t, $\Delta\eta$, chi^2 Tk vs Mu not very promising
- Must repeat with OSCAR (also for cross check),
- More appropriate sample ($p = 1$ TeV ?)
- Must check energy measured by calo’s
- ...

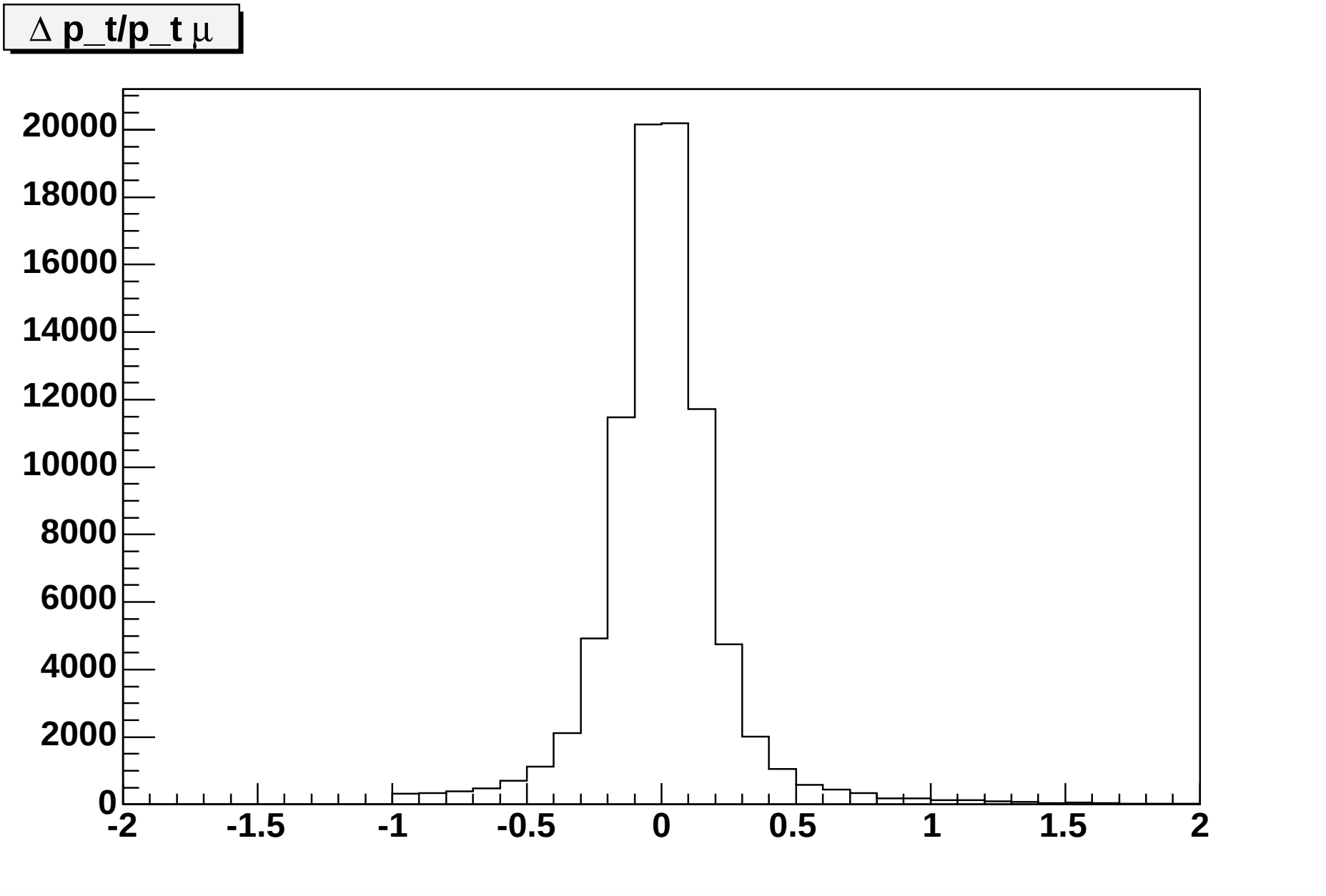
Backup

Backup slides

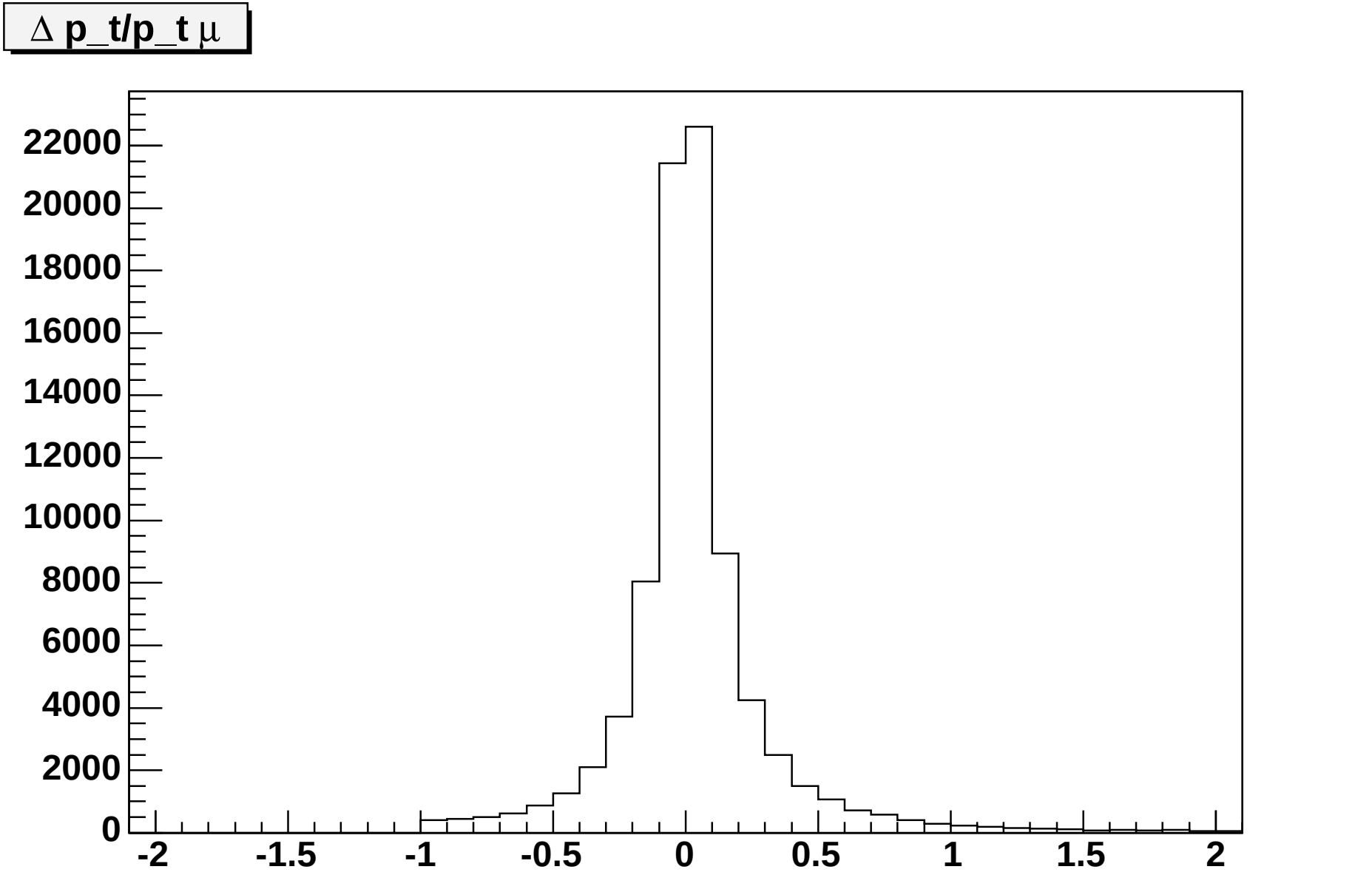
$\Delta P_t/P_t$ μ Muon only



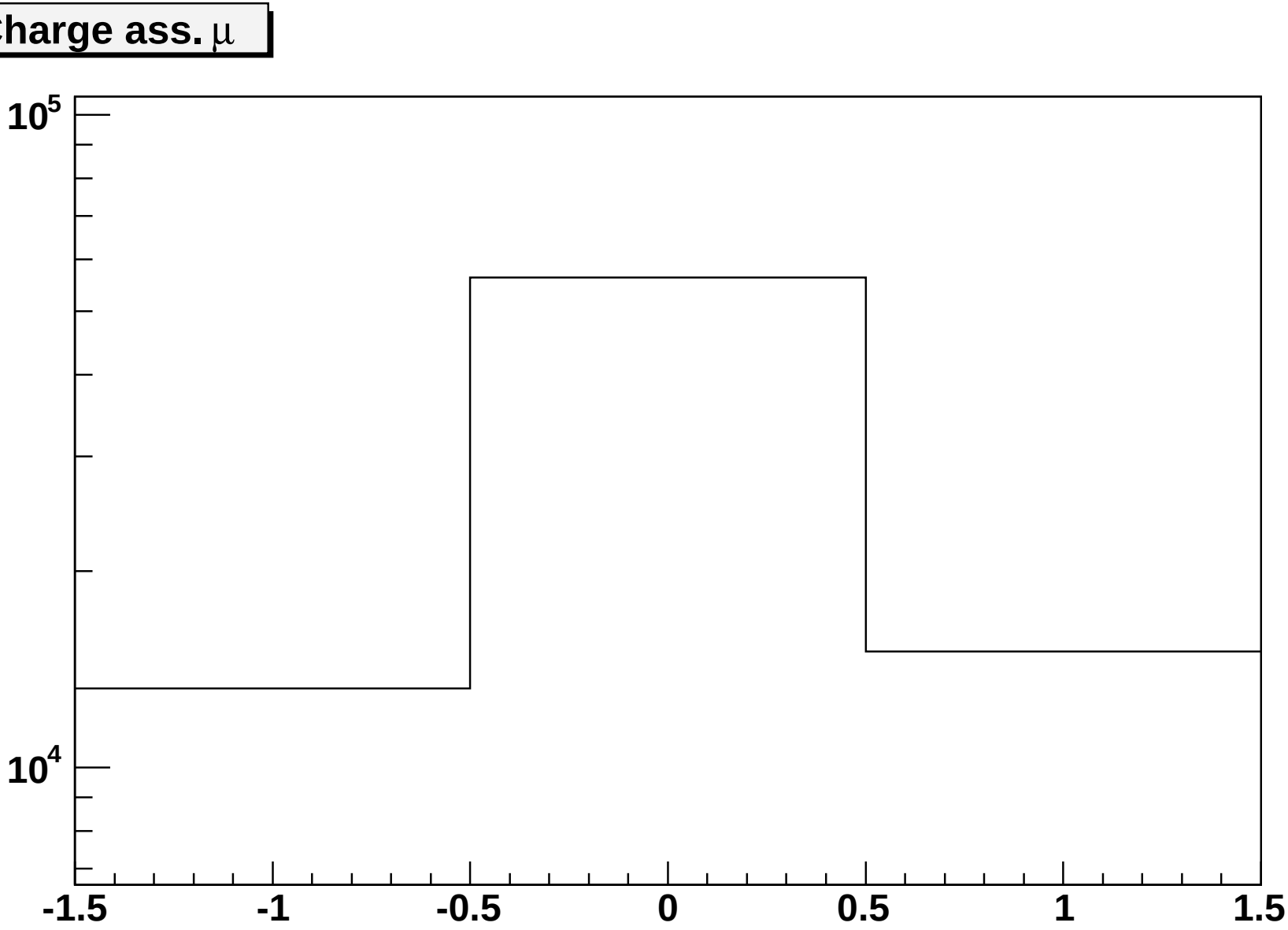
$\Delta P_t/P_t\ \mu$ Tk only



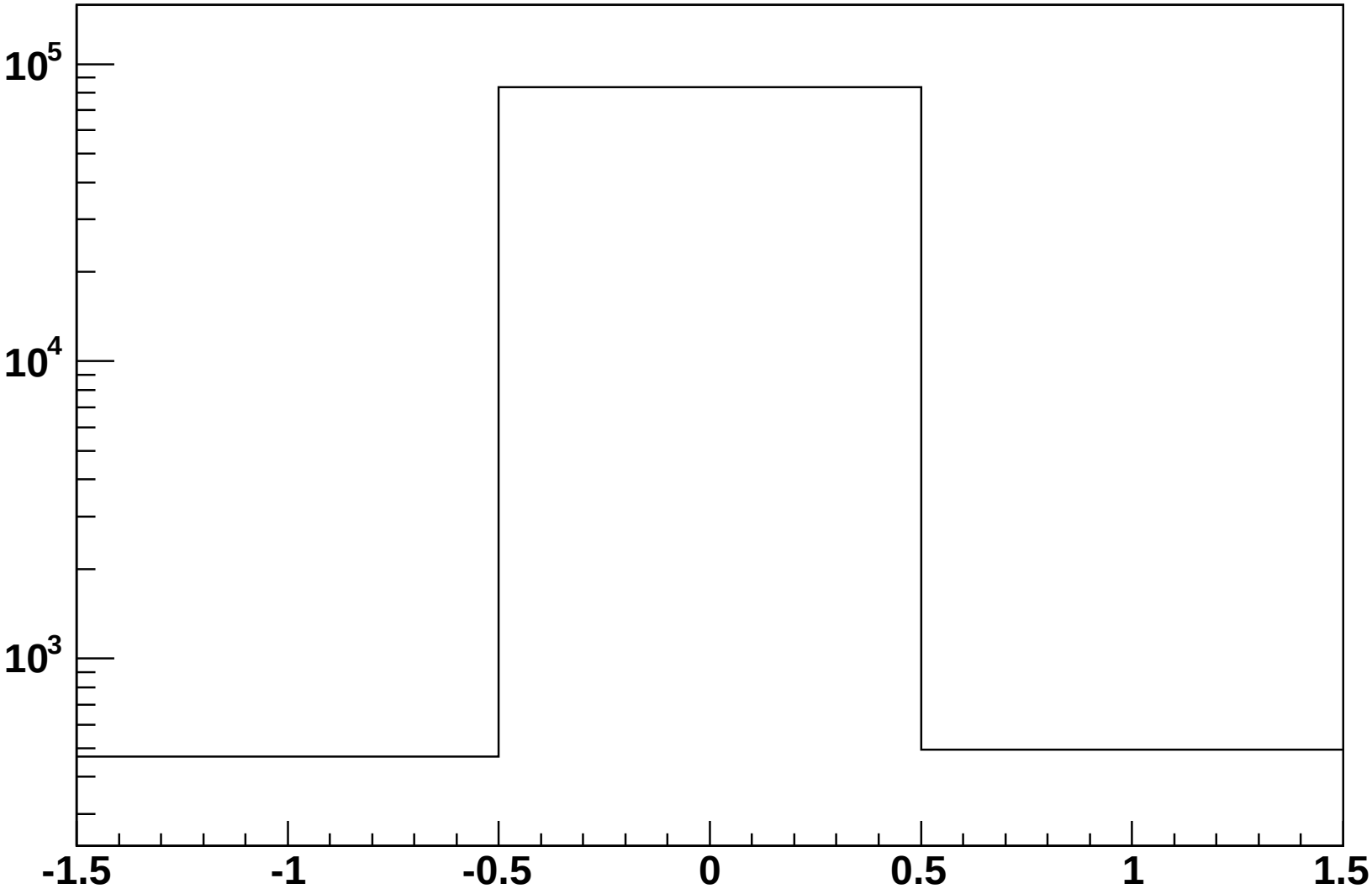
$\Delta P_t/P_t\ \mu$ Tk+Mu



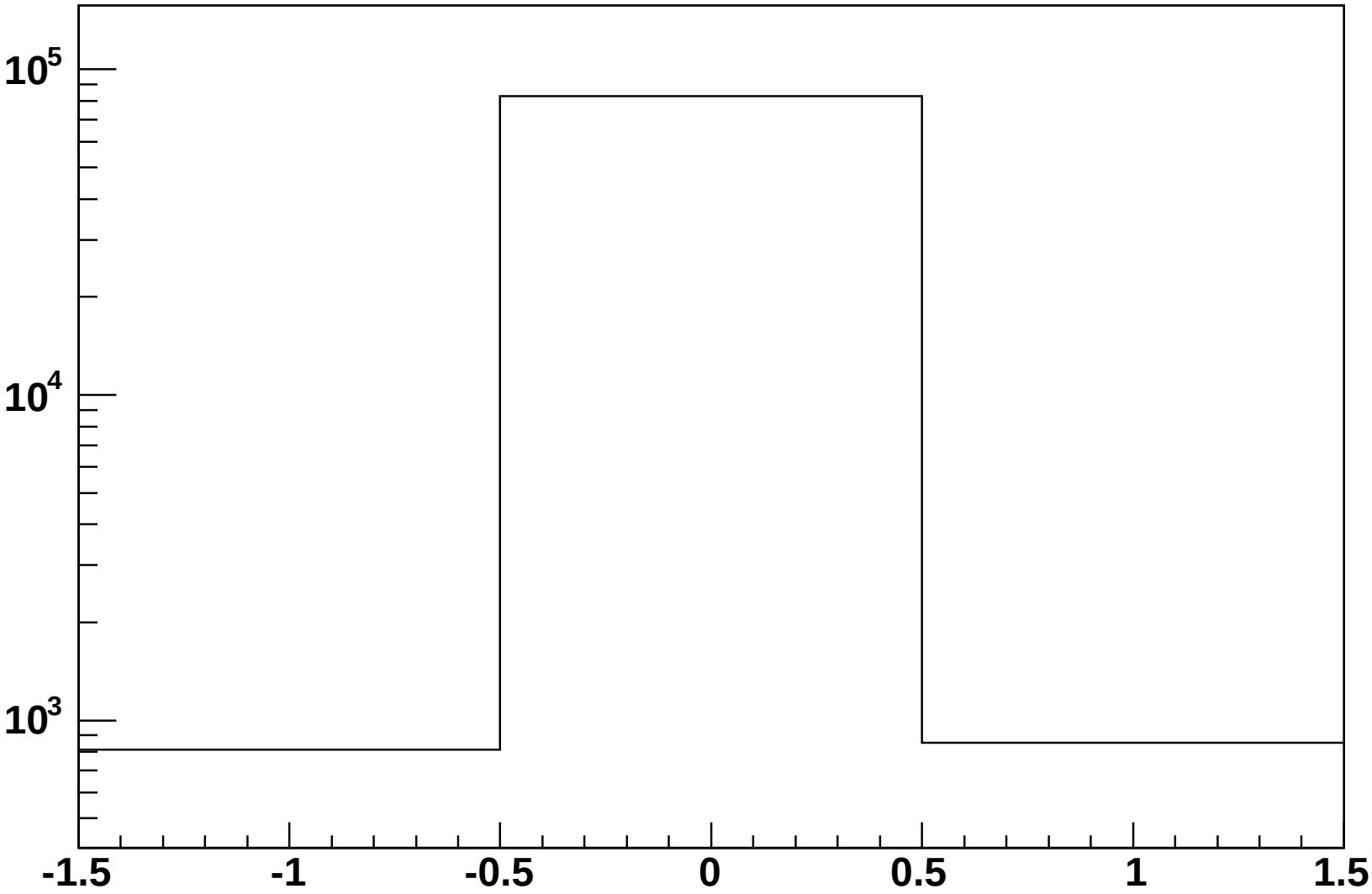
μ Charge assignment Mu only



μ Charge assignment Tk only



μ Charge assignment Tk+Mu



Charge assignment Tk+Mu Vs EnLoss Ca