MUPAGE tuning

- Starting with 6 ‘significant’ parameters: $\beta, \nu_{1b}, K_{1a}, d_{0b}, b_{1b}, \rho_{0b}$
- Scan parameter space for each parameter: for different values of the parameter, run
  MUPAGE - JSirene - JTE - Jpp track reconstruction
- Run *JDataPostfit* on the output to produce histograms of the observables & compare histograms using JCompareHistograms tools

```
/sps/km3net/users/bofearra/MUPAGE/ORCA4/test_params > root beta/datapostfit/beta_0.084.datapostfit.root -l
root [0]
Attaching file beta/datapostfit/beta_0.084.datapostfit.root as _file0...
(TFile *) 0x1c9b400
root [1] .ls
TFile**         beta/datapostfit/beta_0.084.datapostfit.root
 TFile*         beta/datapostfit/beta_0.084.datapostfit.root
  KEY: TH1D     job;1
  KEY: TH1D     hz;1
  KEY: TH1D     ho;1
  KEY: TH2D     hzo;1
  KEY: TH2D     hxy;1
  KEY: TH1D     hq;1
  KEY: TH1D     hb0;1
  KEY: TH1D     he;1
  KEY: TH2D     heo;1
  KEY: TH2D     hzq;1
  KEY: TH2D     hze;1
  KEY: TH2D     hzb0;1
root [2]
```

MUPAGE tuning

- Scanning [0.8, 1.0, 1.2, 1.6] x nominal value

```
('ni1b: ', array([ 0.376,  0.47 ,  0.564,  0.658]))
('beta: ', array([ 0.336,  0.42 ,  0.504,  0.588]))
('k1a: ', array([-0.465, -0.581, -0.697, -0.813]))
('d0b: ', array([ 3.164,  3.955,  4.746,  5.537]))
('b1b: ', array([ 4.899,  6.124,  7.349,  8.574]))
('rho0b: ', array([ 22.608,  28.26 ,  33.912,  39.564]))
```

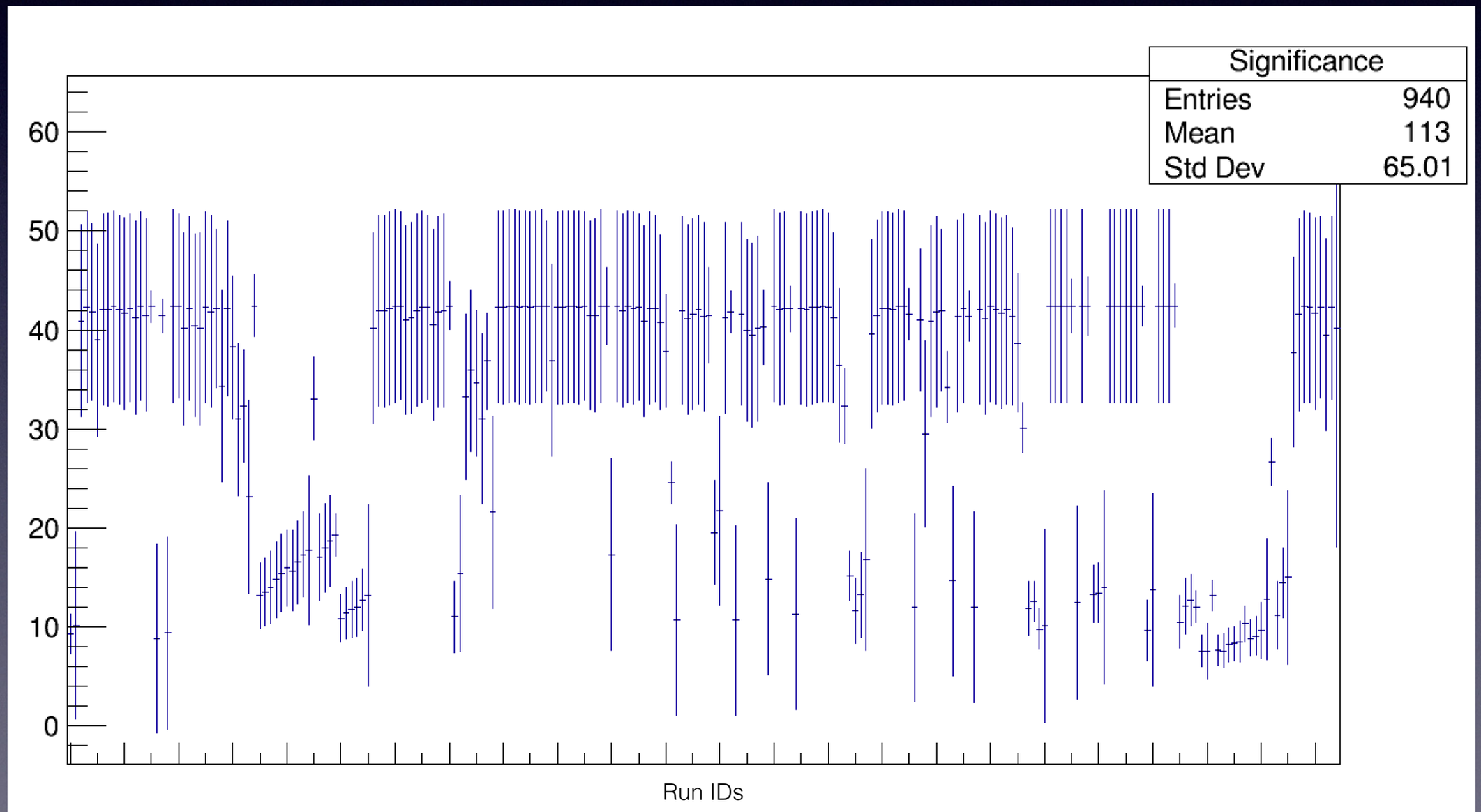
- Compare resulting histograms of observables with data - check using quality parameter (i.e. some test statistic)

- E.g. for the significance *S*, compare how the shape differs.

  Also the reduced chi-squared: $\frac{\chi^2}{NDF}$.

MUPAGE tuning

- Comparing output of 700 parameter combinations with one ORCA4 RBR data file
- Every point is the significance for a specific run (unique parameter combination) & associated error



… etc

MUPAGE tuning

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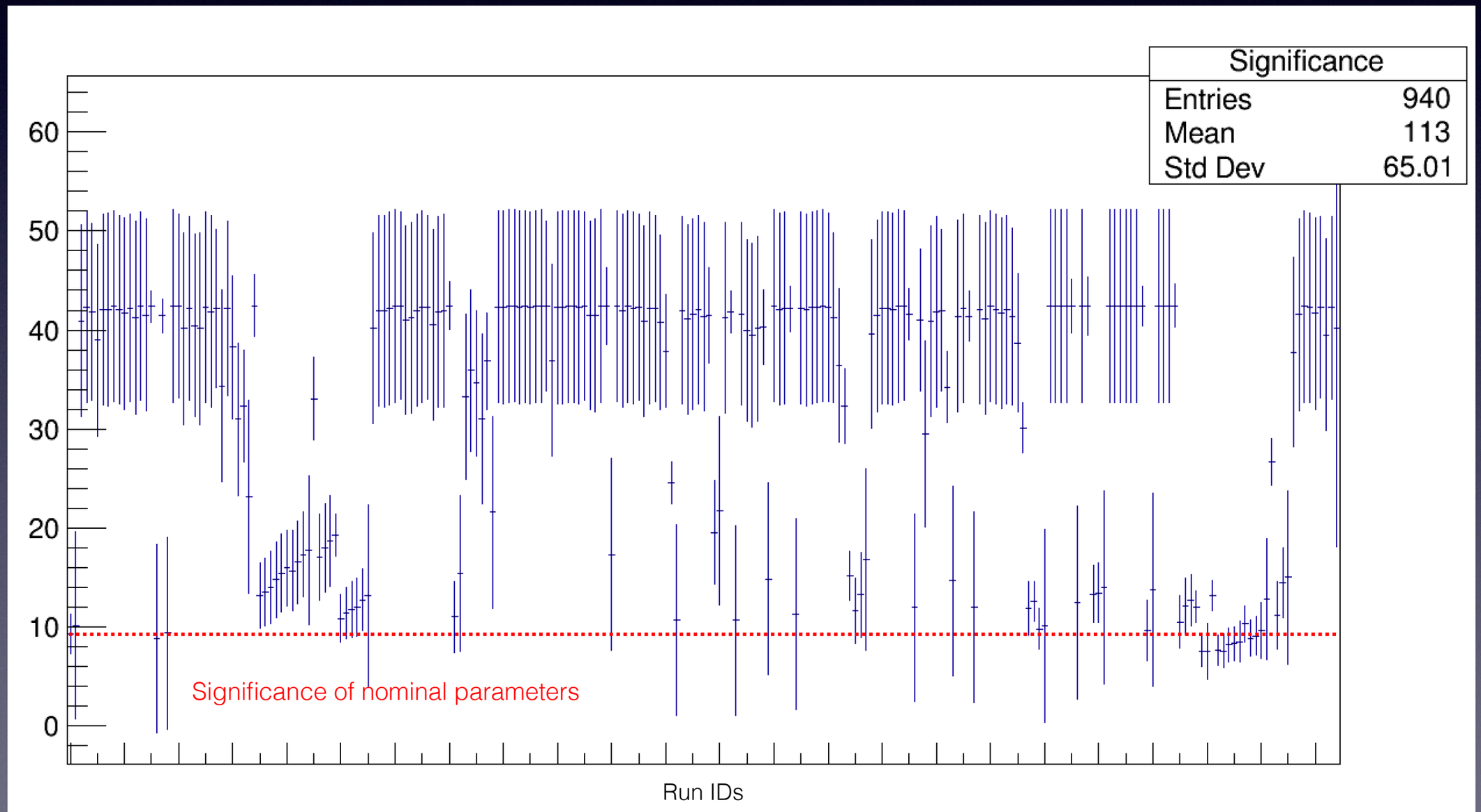
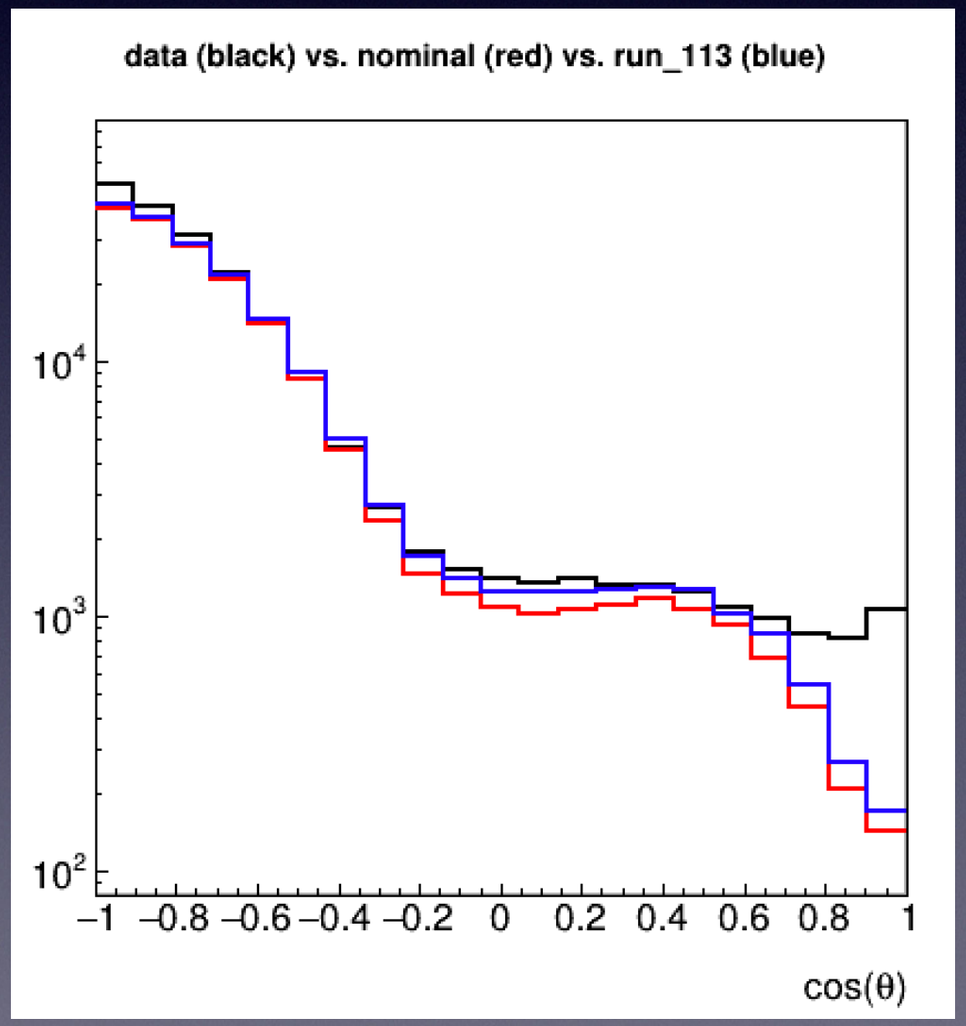
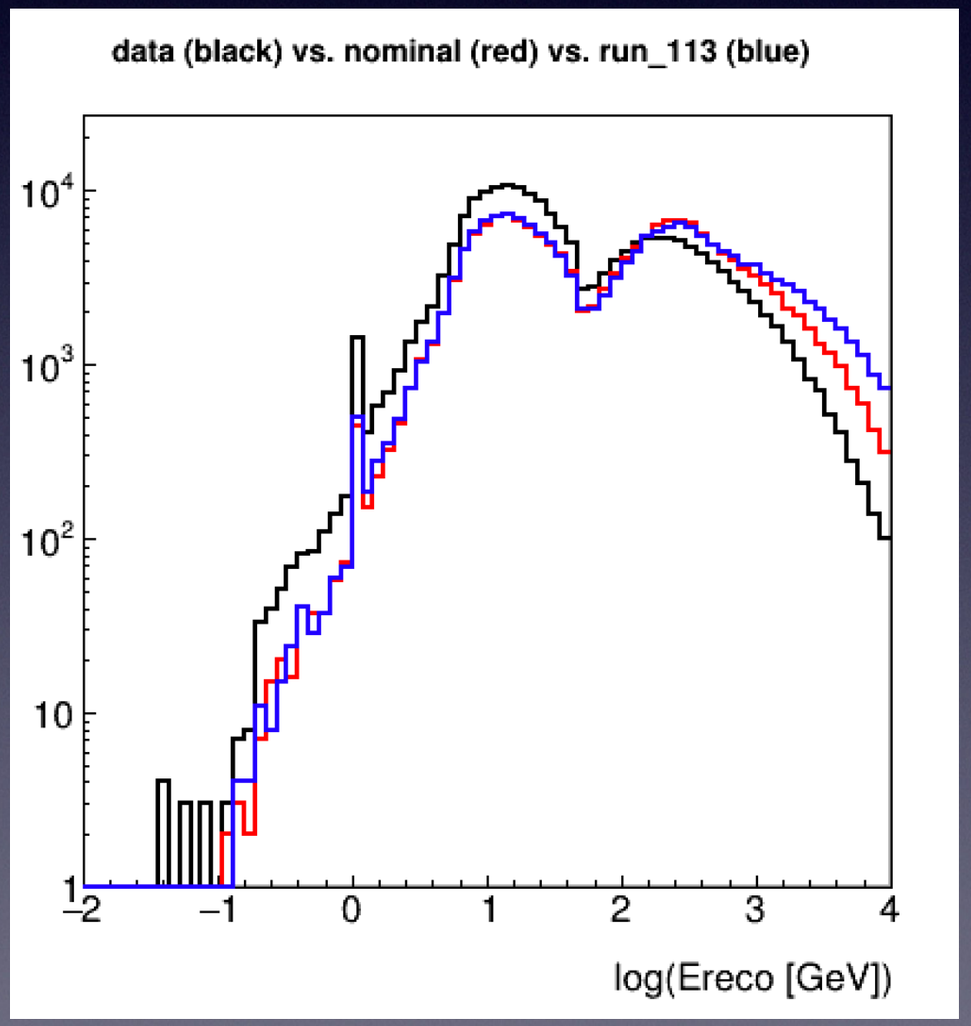


… etc

MUPAGE tuning

- Significance of nominal parameters: S = 9.3
- For runs with *S* < 9.3 ..





MUPAGE tuning

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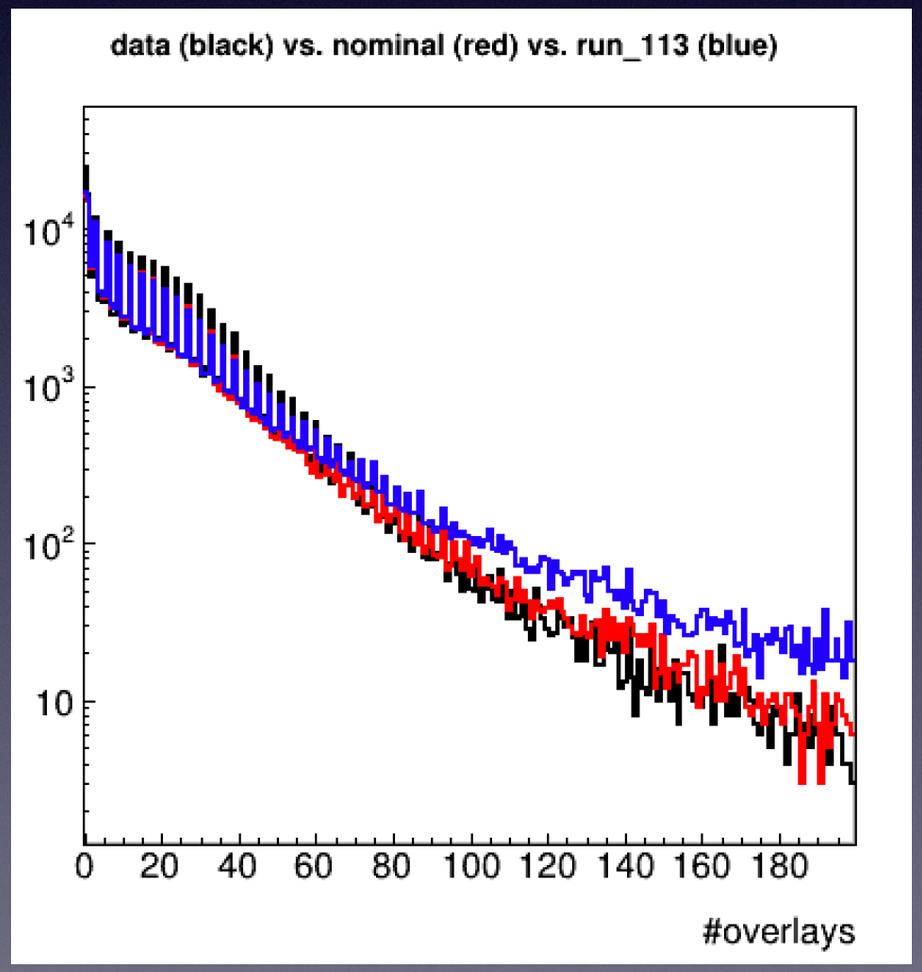

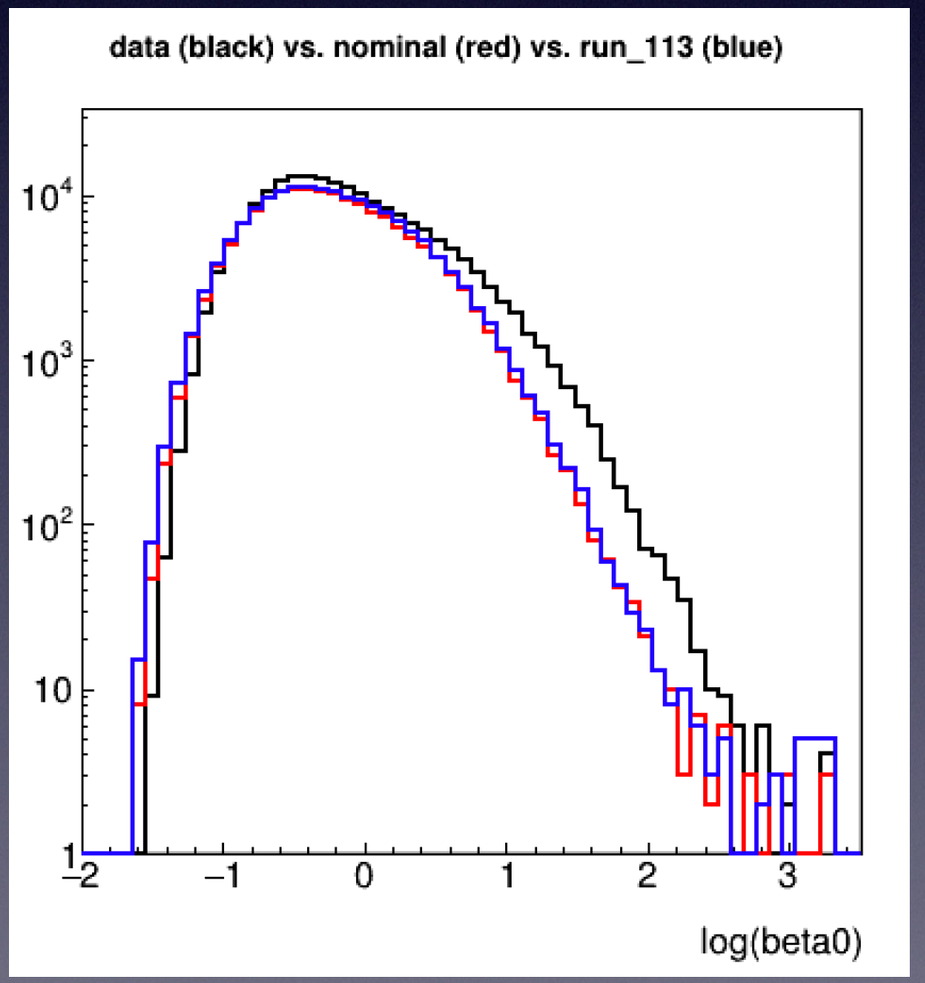

with 10+ examples like this

MUPAGE tuning

- The points currently investigated which fall below $S_{nominal\ value}$ behave similarly, with an improved zenith angle agreement but with a greater discrepancy for the reconstructed energy and # overlays

- The following plots indicated a better significance for the zenith angle distribution *in particular &* is clear by eye

- The only differing parameter between all 3 runs is ρ_{0b}

MUPAGE tuning

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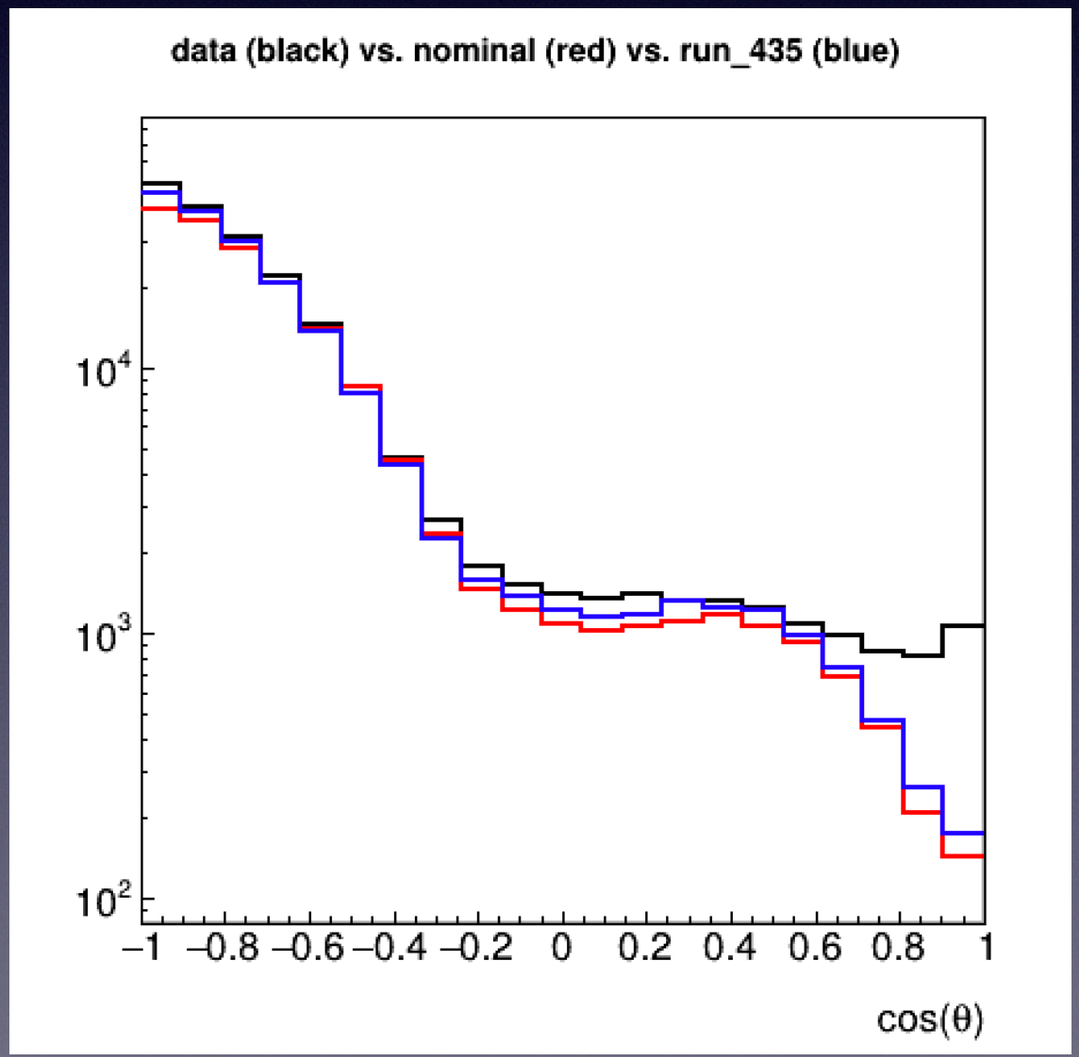

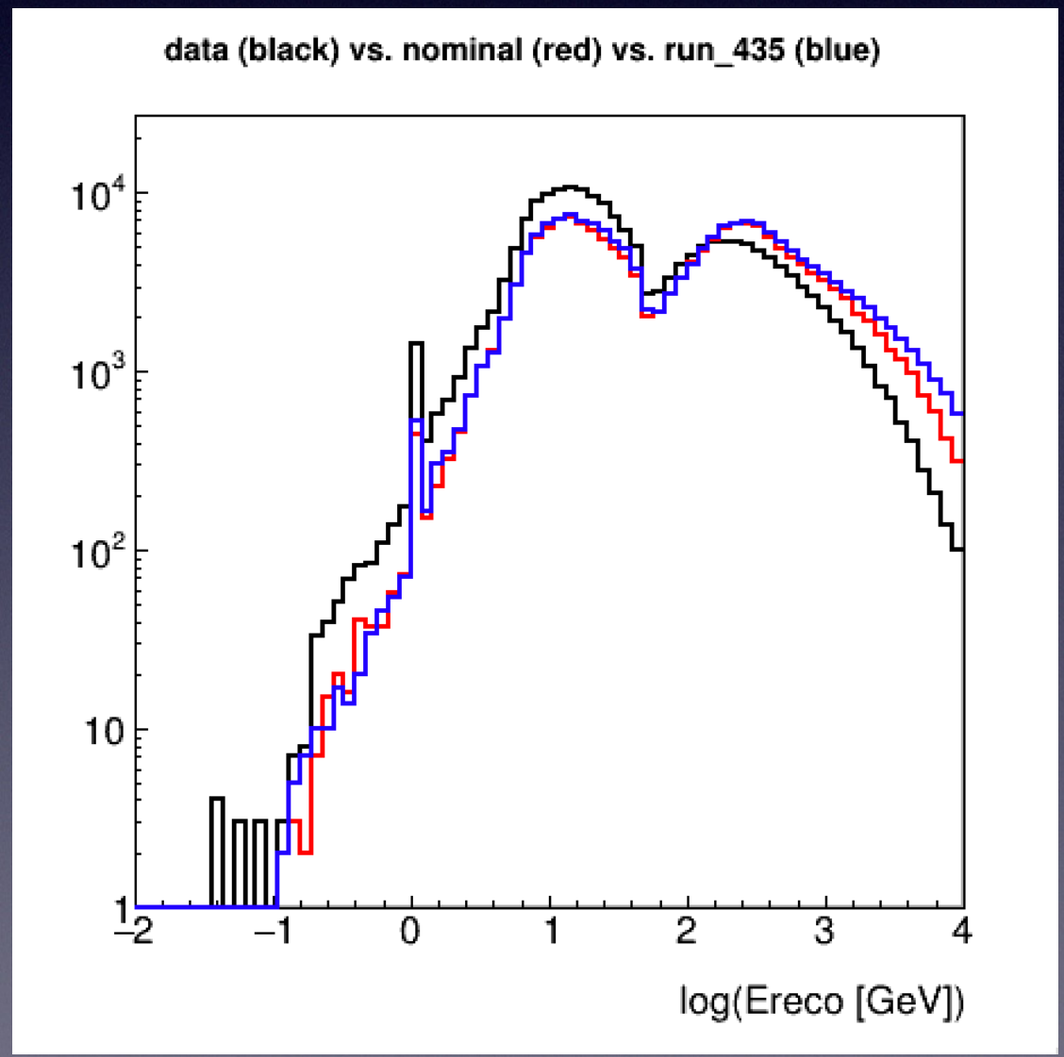

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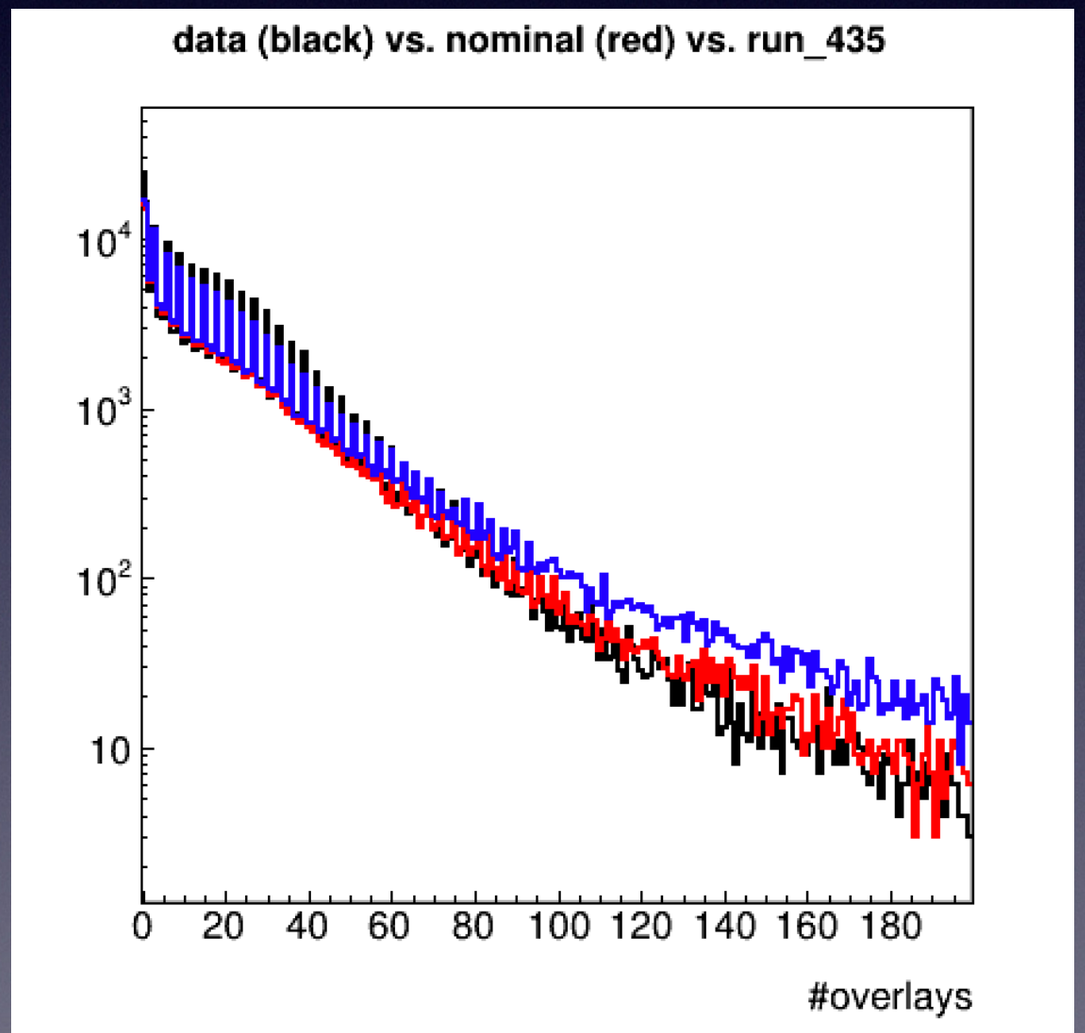

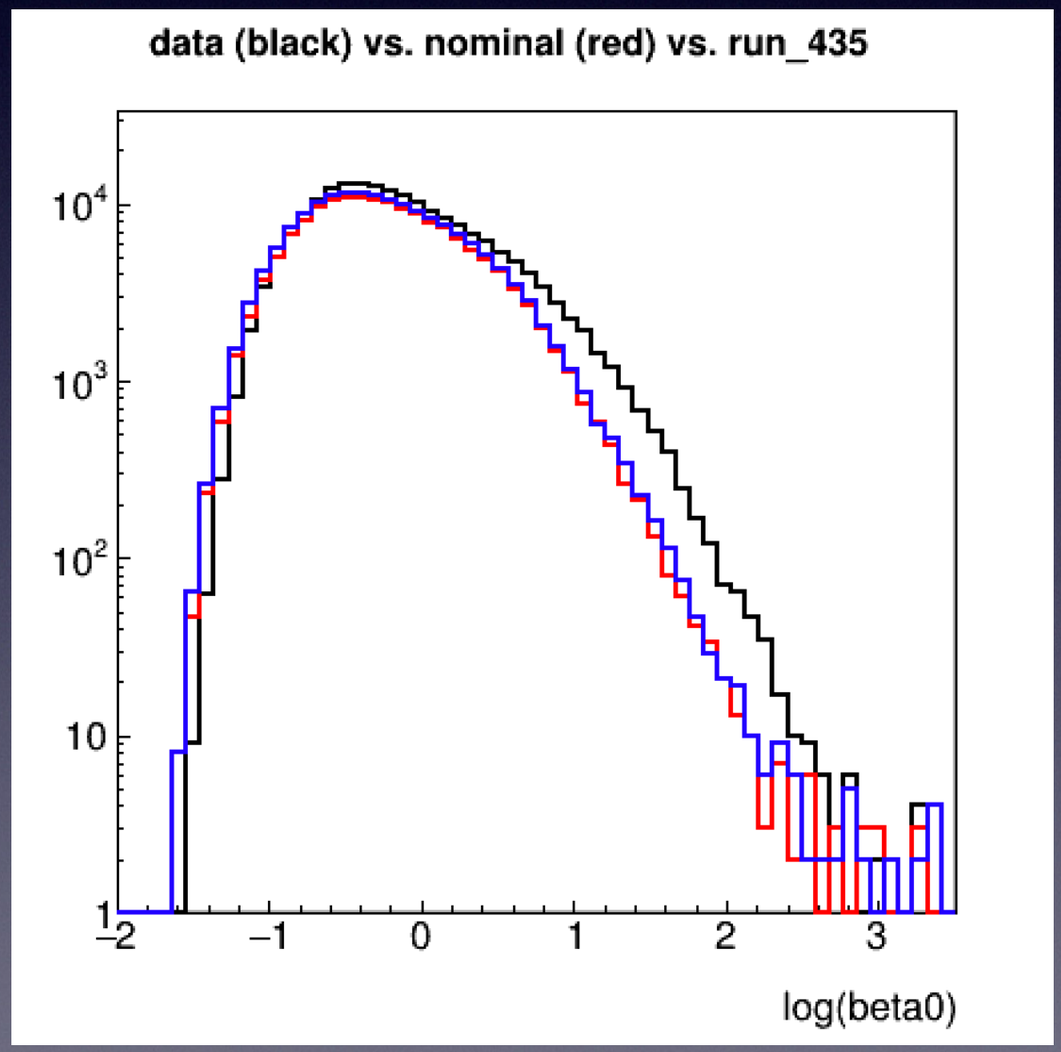

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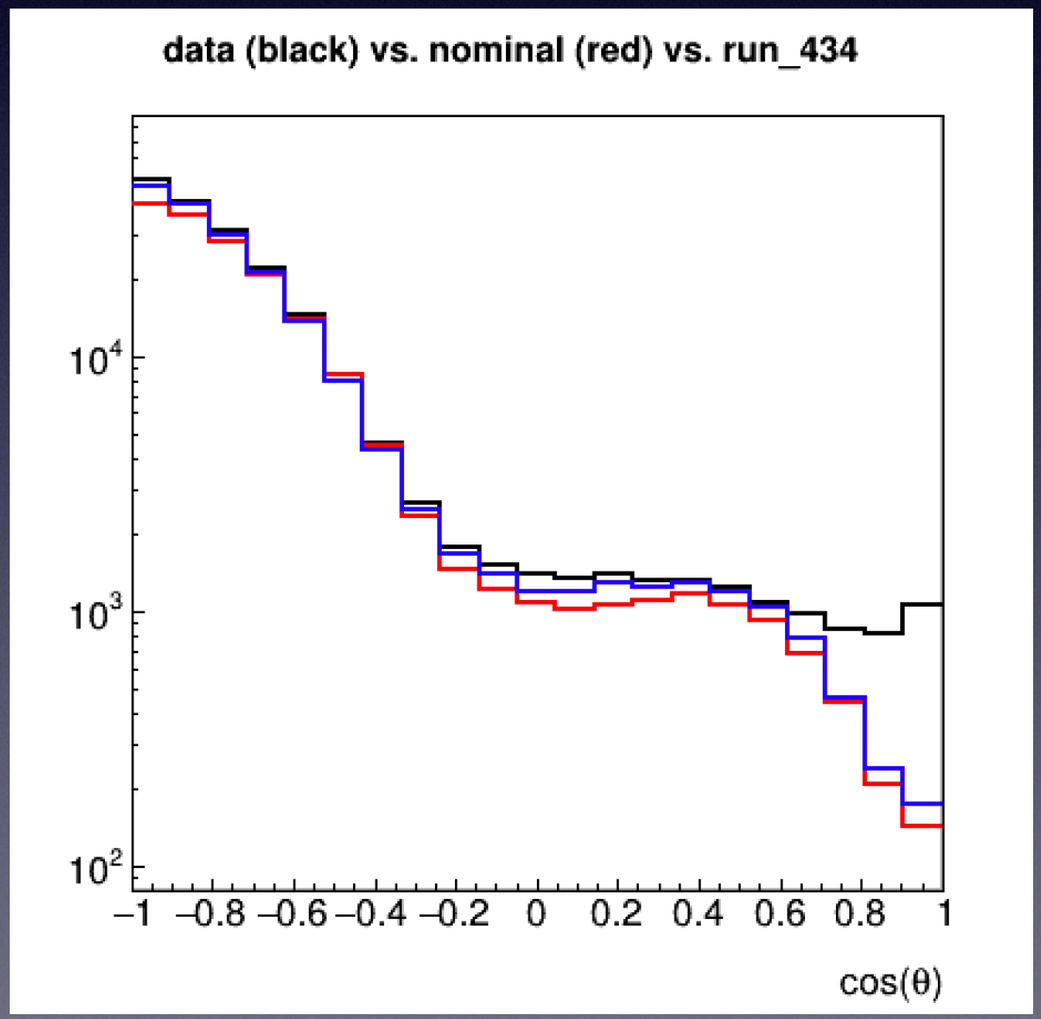

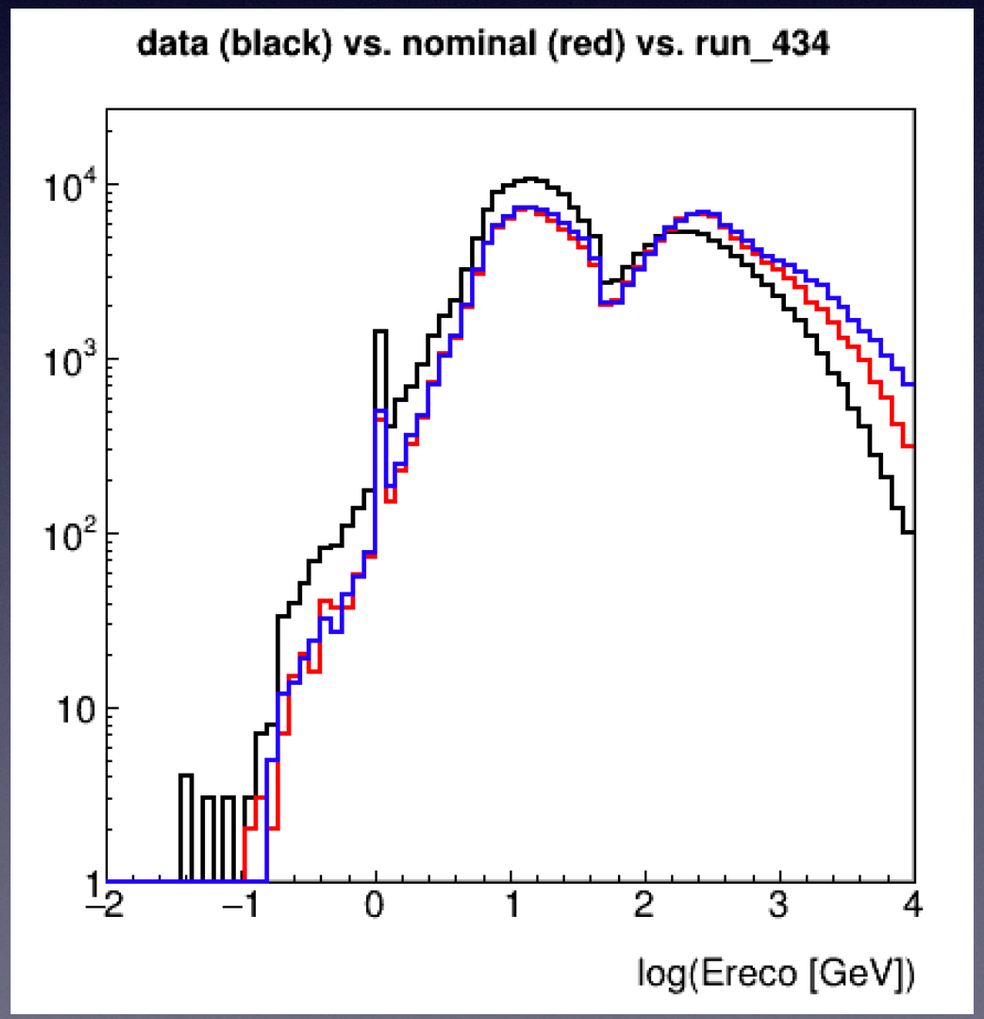

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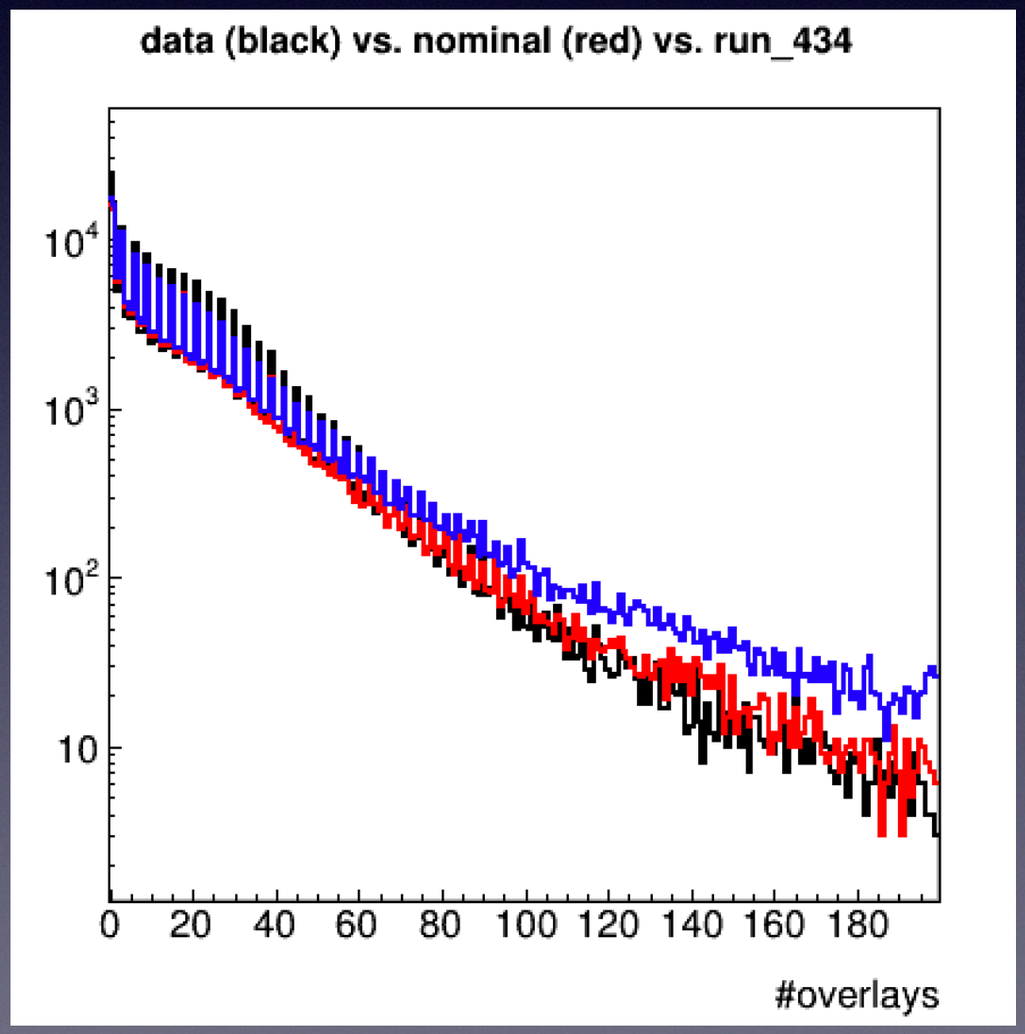

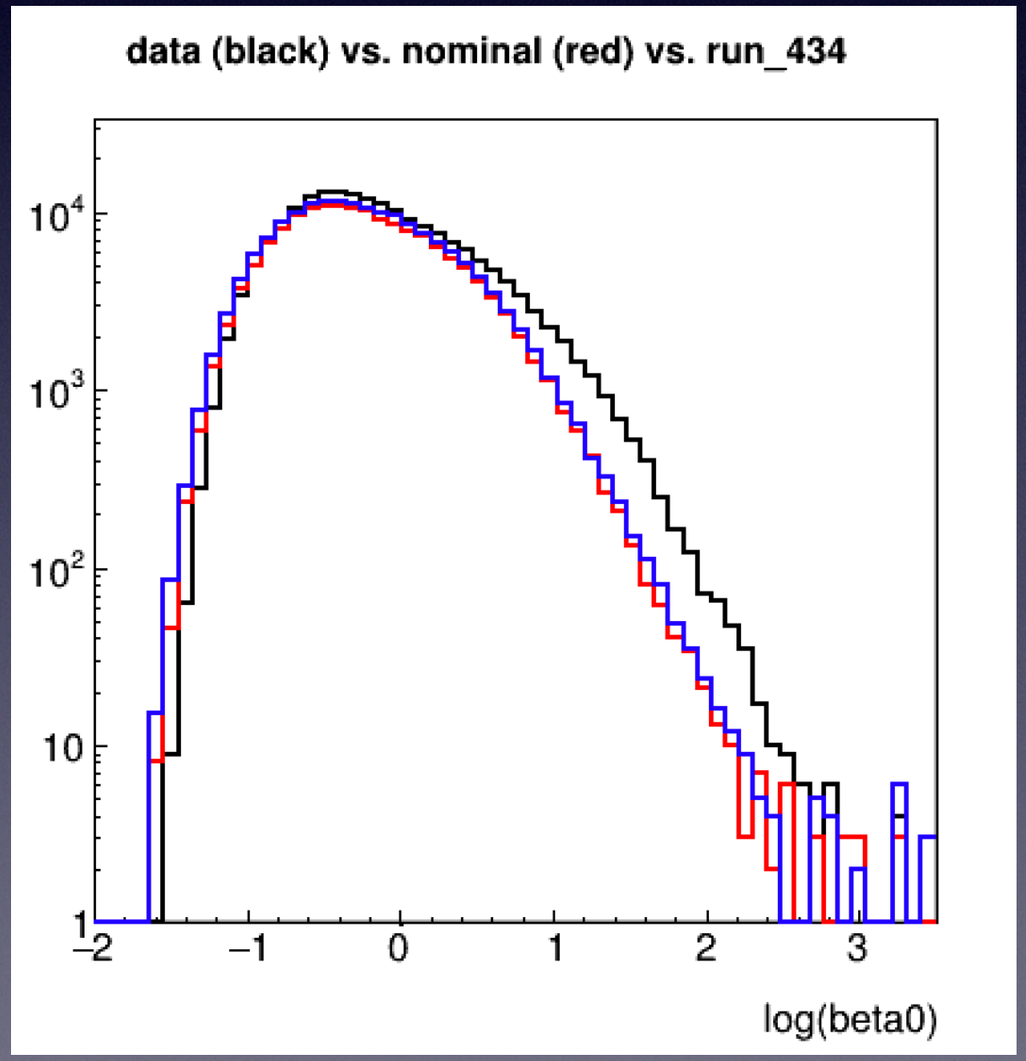

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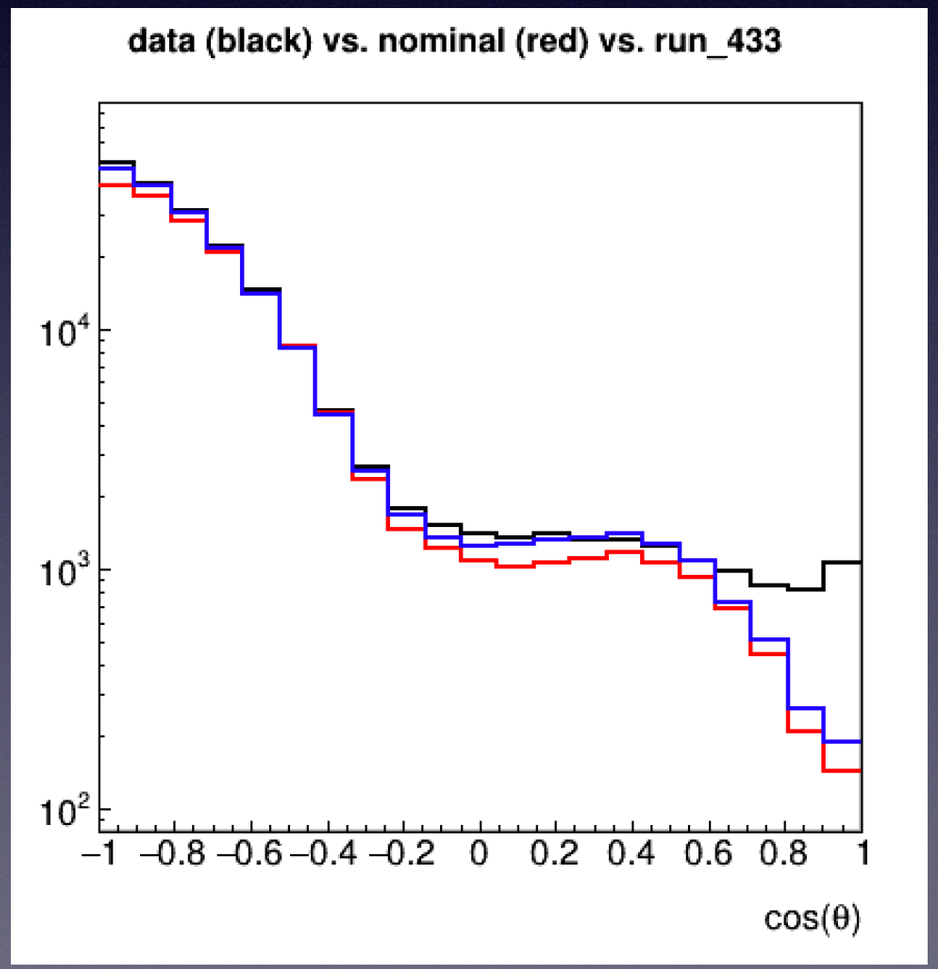

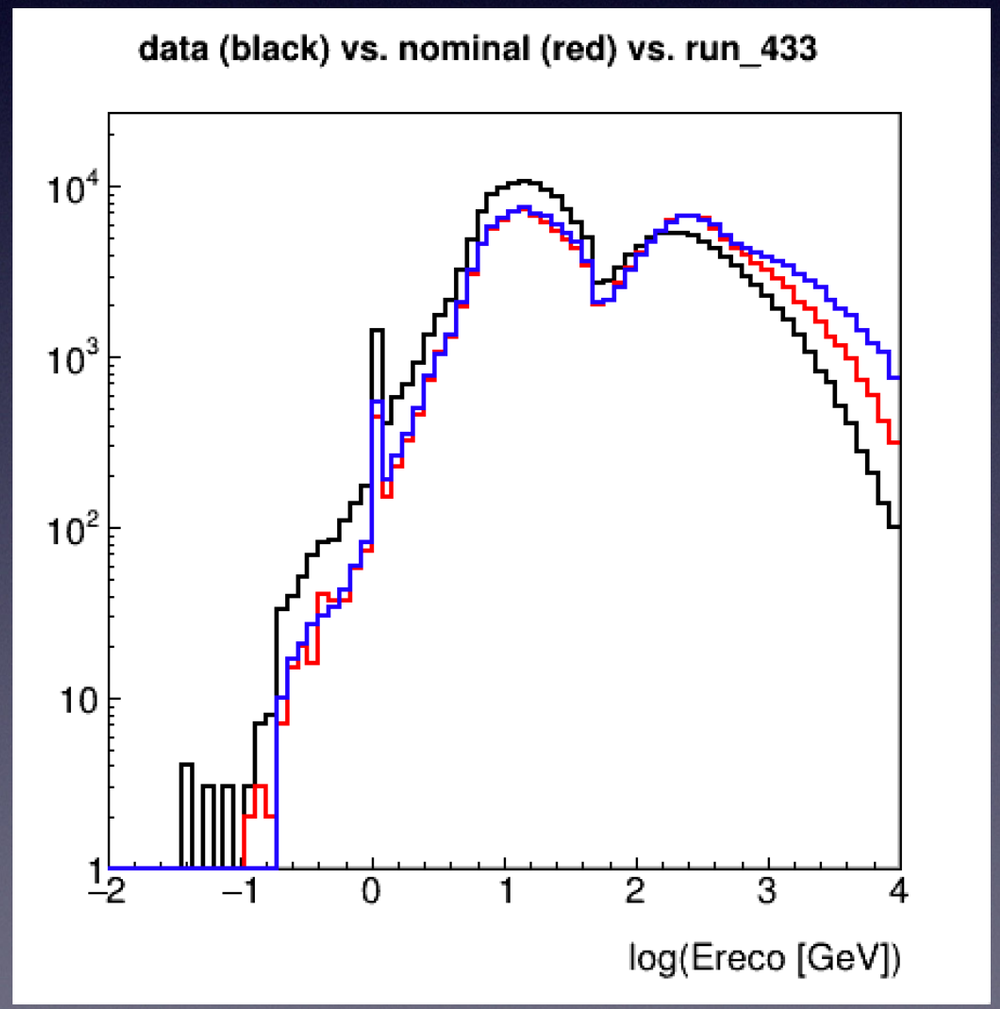

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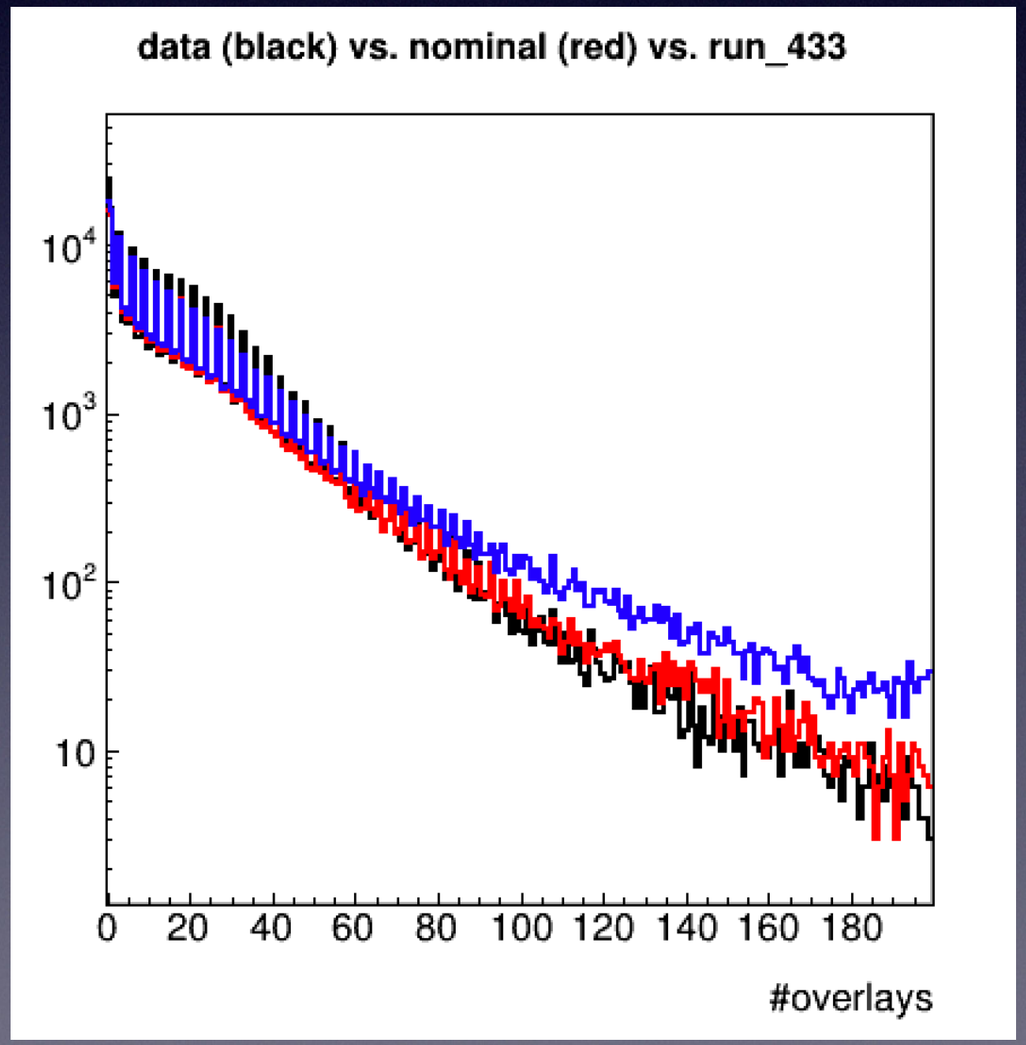

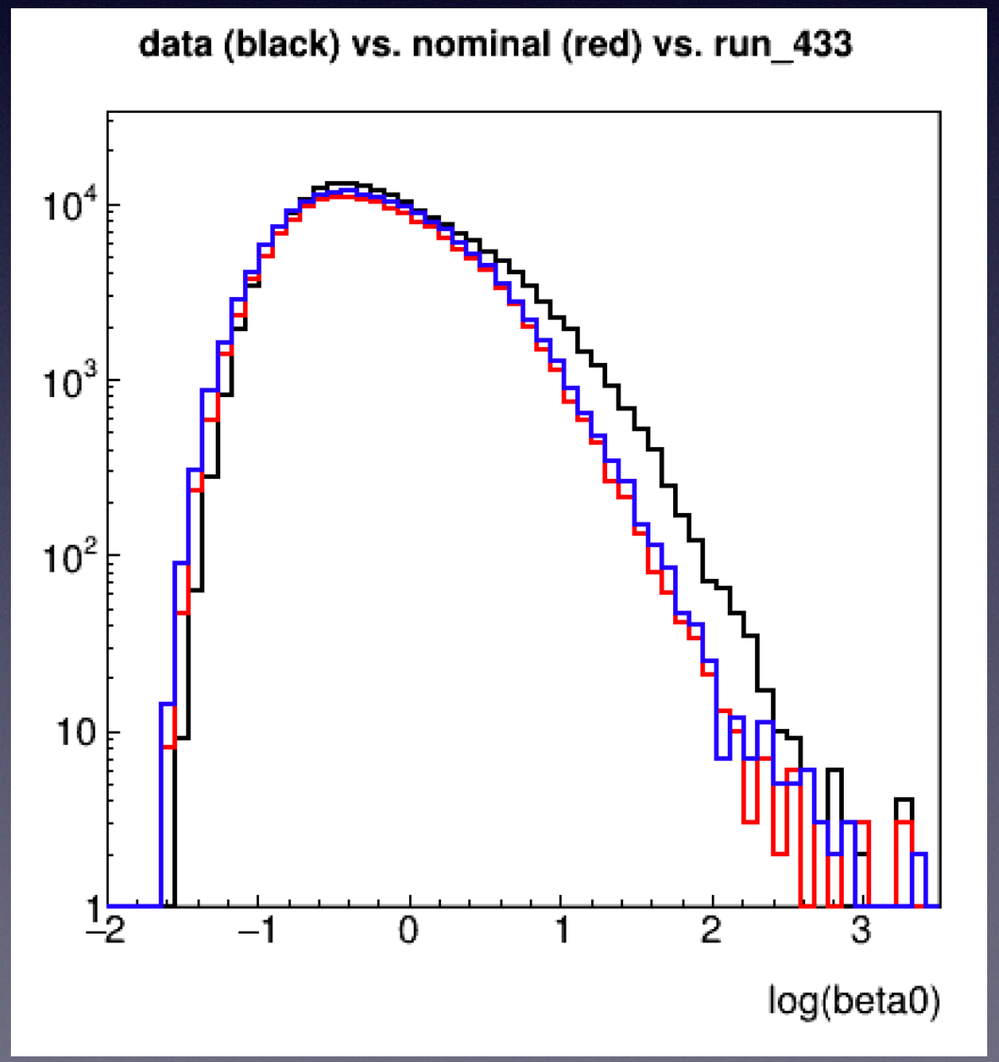

MUPAGE tuning

- At least one of the 5 parameters gives a better agreement with data for the zenith angle distribution
- The combination of parameters which improves *not only* this distribution is not clear yet
- Many more runs to go, however the procedure has been optimised

MUPAGE tuning

- When not comparing the distribution of beta0 (angular error), more points appear in the phase space with an “improved” significance compared to the nominal values — so more histograms add more constraints?
- The same comparison will be carried out with some simple cuts on the zenith and or energy distribution
- Note that parameters < 0.8*nominal values take much longer to run
- Must keep an eye on the MC-MC comparisons for “good values” to check

  https://drive.google.com/file/d/1yLy7cIfPPKJKLKQidGFr441nbpA_PNAD/view