

MUPAGE tuning

- Starting with 6 'significant' parameters: β , ν_{1b} , K_{1a} , d_{0b} , b_{1b} , ρ_{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 260 parameter combinations with one ORCA4 RBR data file
- Can run test on many histograms at once, and find the averaged value of the test results - **new** (thanks to Rodrigo)

Test result Average value error

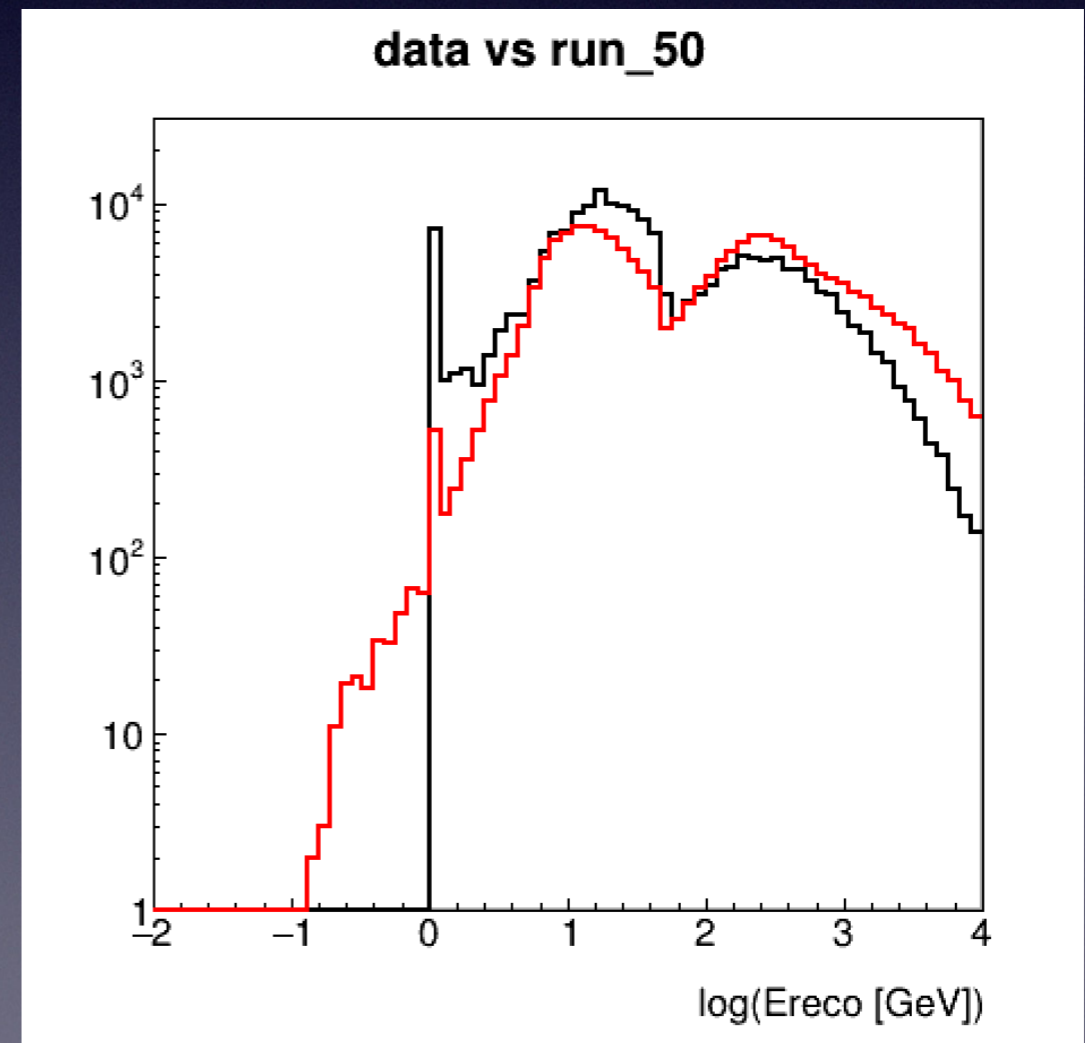
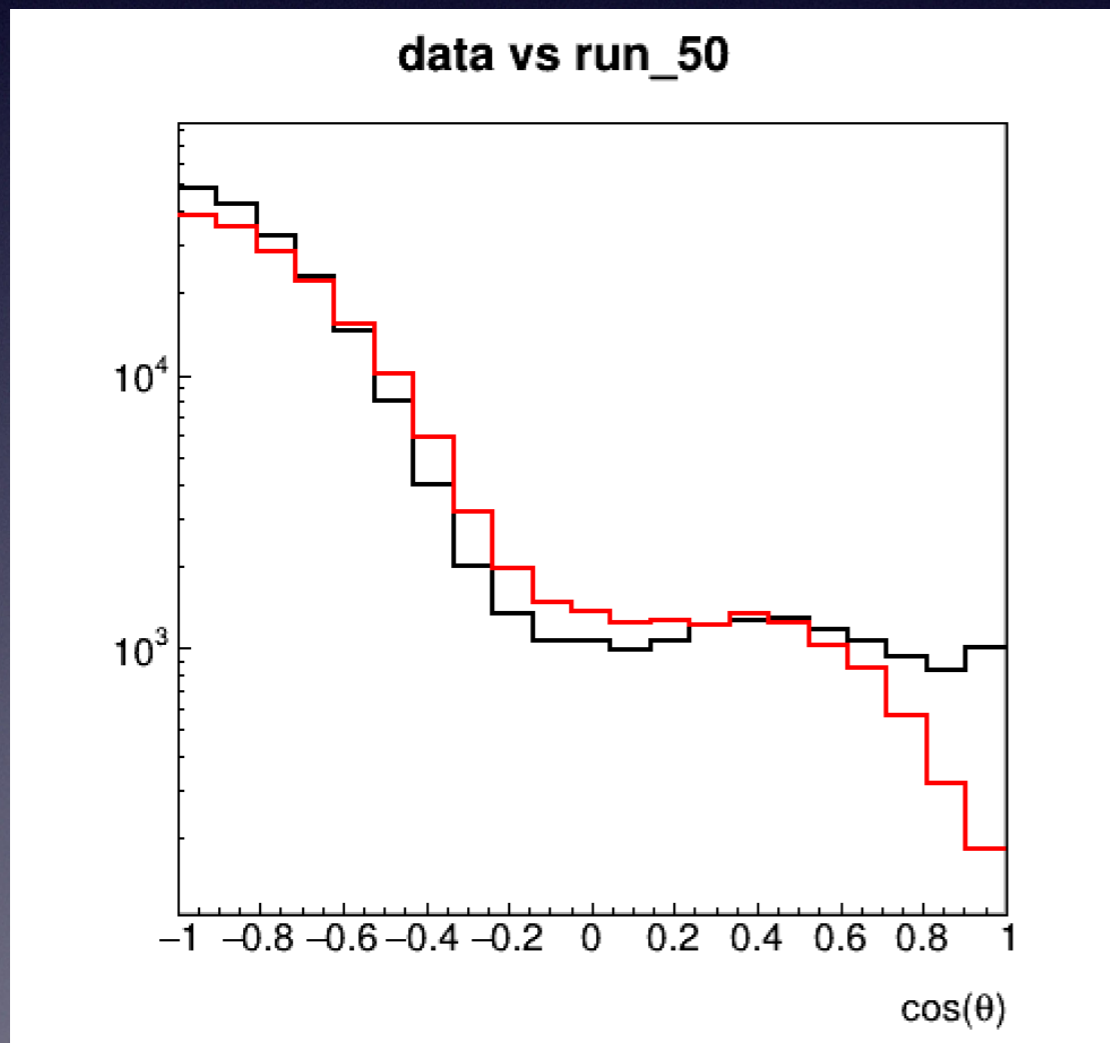
```
See also: http://common.pages.km3net.de/j...#JPlotZebraMantis
File_ID Significance Significance(ERROR)
0000 9.30266 1.99001
0 9.70942 9.14124
100 40.342 9.44473
101 41.6956 9.33785
102 41.255 8.69293
103 38.3827 9.38564
104 41.4494 9.39036
105 41.471 9.46651
106 41.7874 9.39232
107 41.4817 9.30235
108 41.0733 9.42401
109 41.6214 9.18734
110 40.7089 9.4802
111 41.8087 9.25486
112 40.9372 9.46313
113 41.7559 9.48479
114 41.8127 9.25842
115 40.8483 9.48479
116 41.8127 9.47906
117 41.8098 9.47789
118 41.8209 8.97795
119 39.6025 9.41741
120 41.5575 8.986
121 39.9081 8.97648
122 39.6075 9.45217
123 41.7255 9.34493
124 41.2892 9.42396
125 41.5916 7.68153
126 33.7881 9.42241
127 41.6177 8.52954
128 37.7328 6.86247
129 30.424 7.34866
```

Run number (specific parameter combination)

... etc

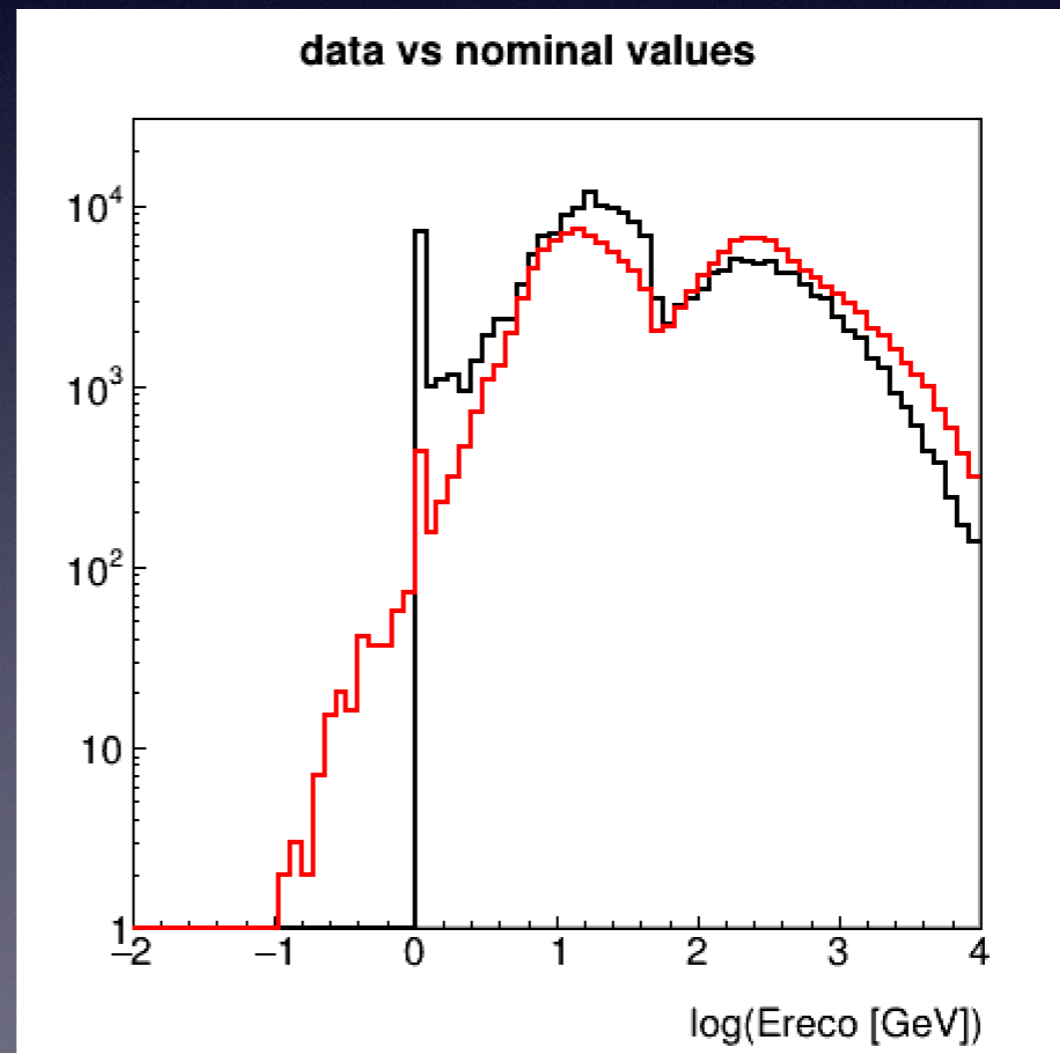
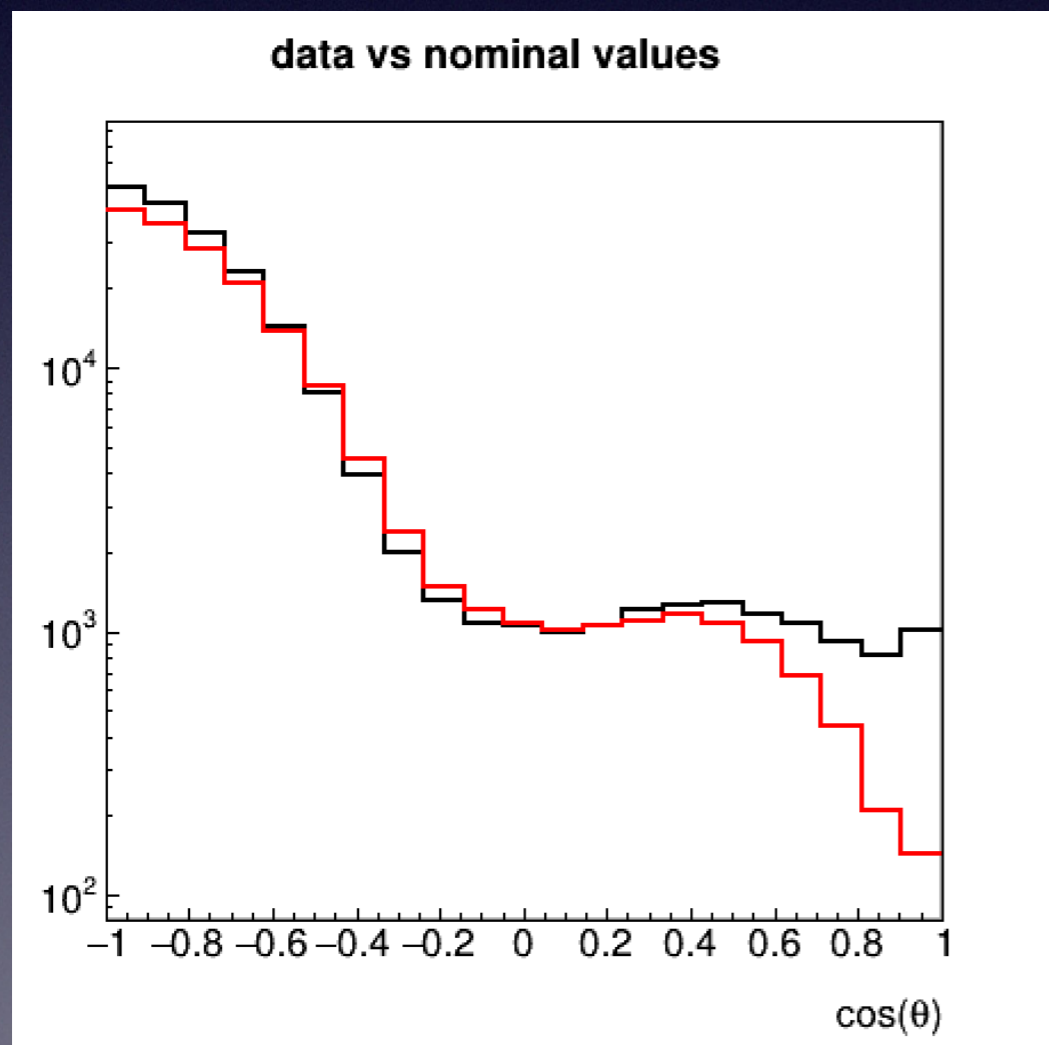
MUPAGE tuning

- e.g. for runID =50 (compared to data), where $S_{avg} = 8.7$



MUPAGE tuning

- Comparing to nominal values in MUPAGE, where $S_{avg} = 9.3$..



MUPAGE tuning

- e.g. for runID =50, where $S_{avg} = 8.7$, for individual histograms

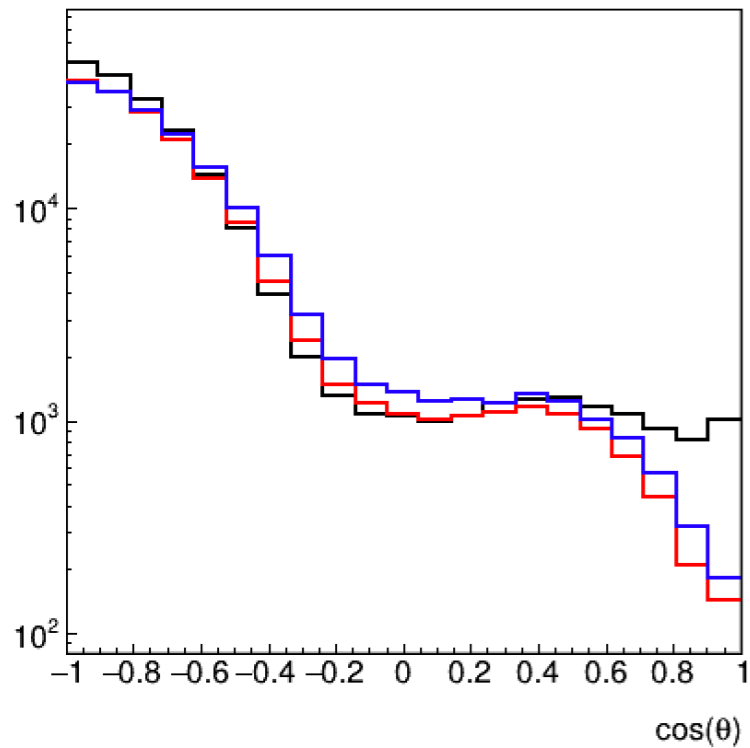
```
Significance_1D hz hz Significance 12.2105 0.001 PASSED  
Significance_1D ho ho Significance 3.39776 0.001 PASSED  
Significance_1D hb0 hb0 Significance 7.15721 0.001 PASSED  
Significance_1D he he Significance 11.9832 0.001 PASSED
```

- Compared to nominal values in MUPAGE

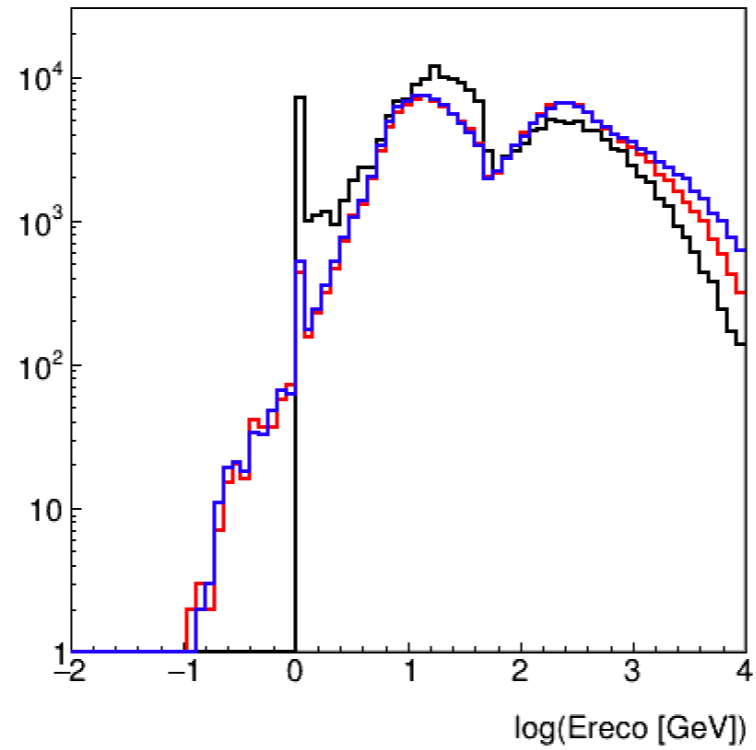
```
Significance_1D hz hz Significance 13.3484 0.001 PASSED  
Significance_1D ho ho Significance 3.17961 0.001 PASSED  
Significance_1D hb0 hb0 Significance 9.55865 0.001 PASSED  
Significance_1D he he Significance 11.124 0.001 PASSED
```

MUPAGE tuning

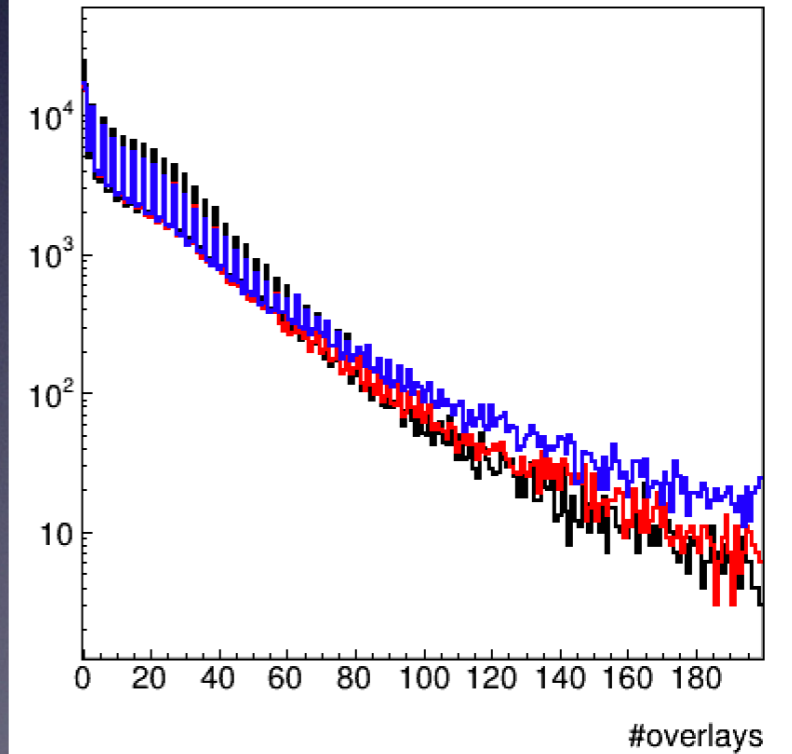
data (black) vs. nominal (red) vs. run50 (blue)



data (black) vs. nominal (red) vs. run50 (blue)



data (black) vs. nominal (red) vs. run50 (blue)



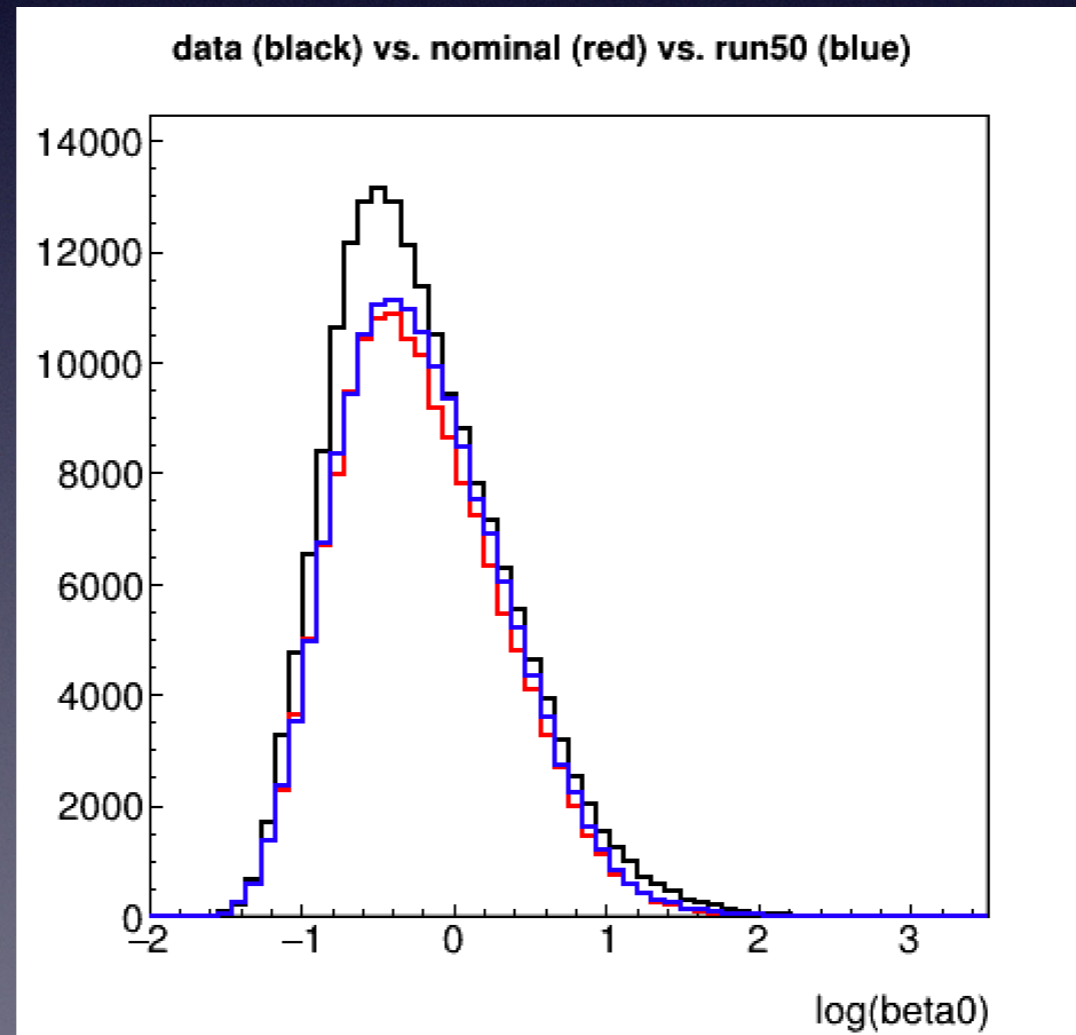
MUPAGE tuning

- e.g. for runID =50, for individual histograms

```
Significance_1D hb0 hb0 Significance 7.15721 0.001 PASSED
```

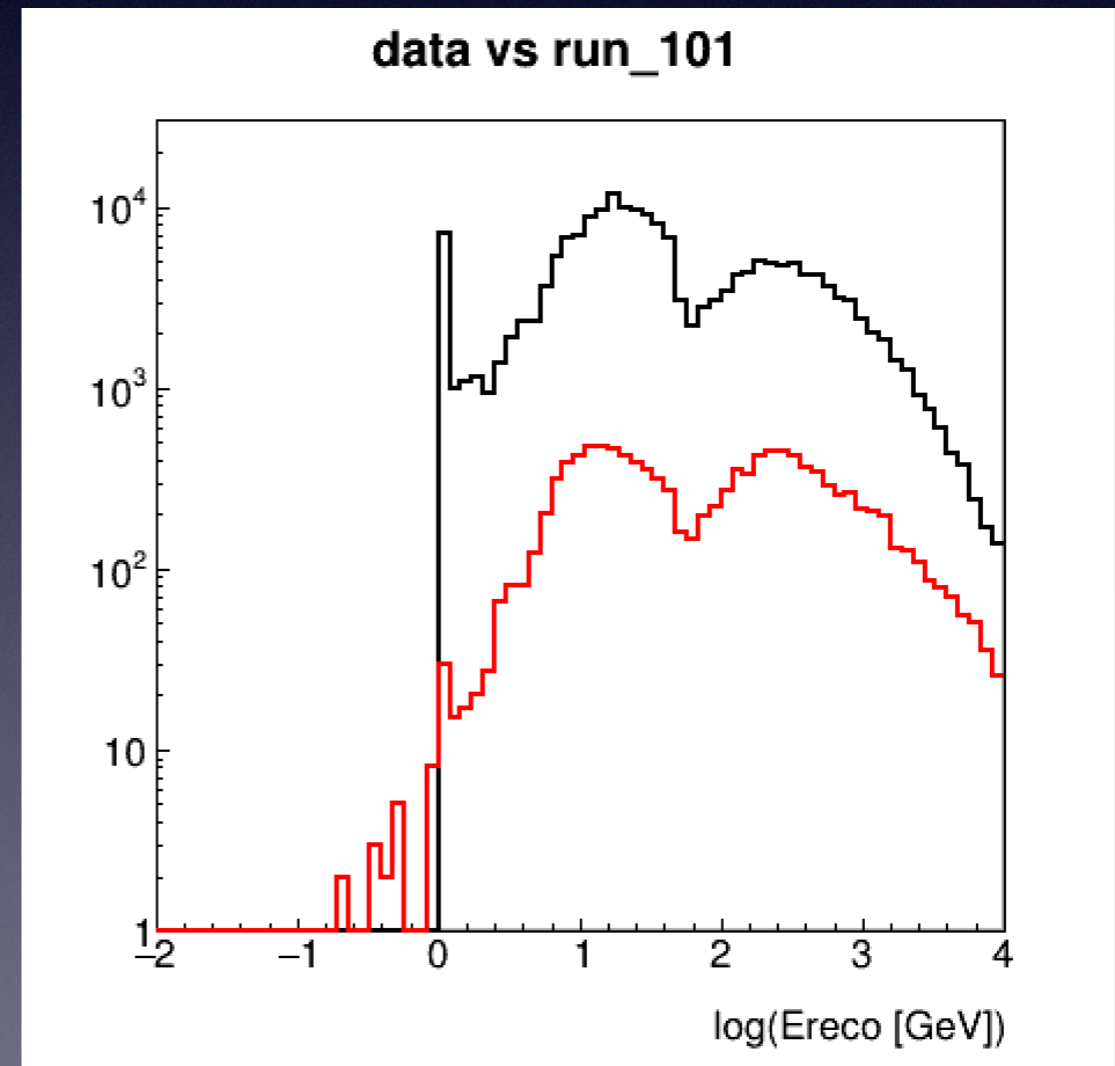
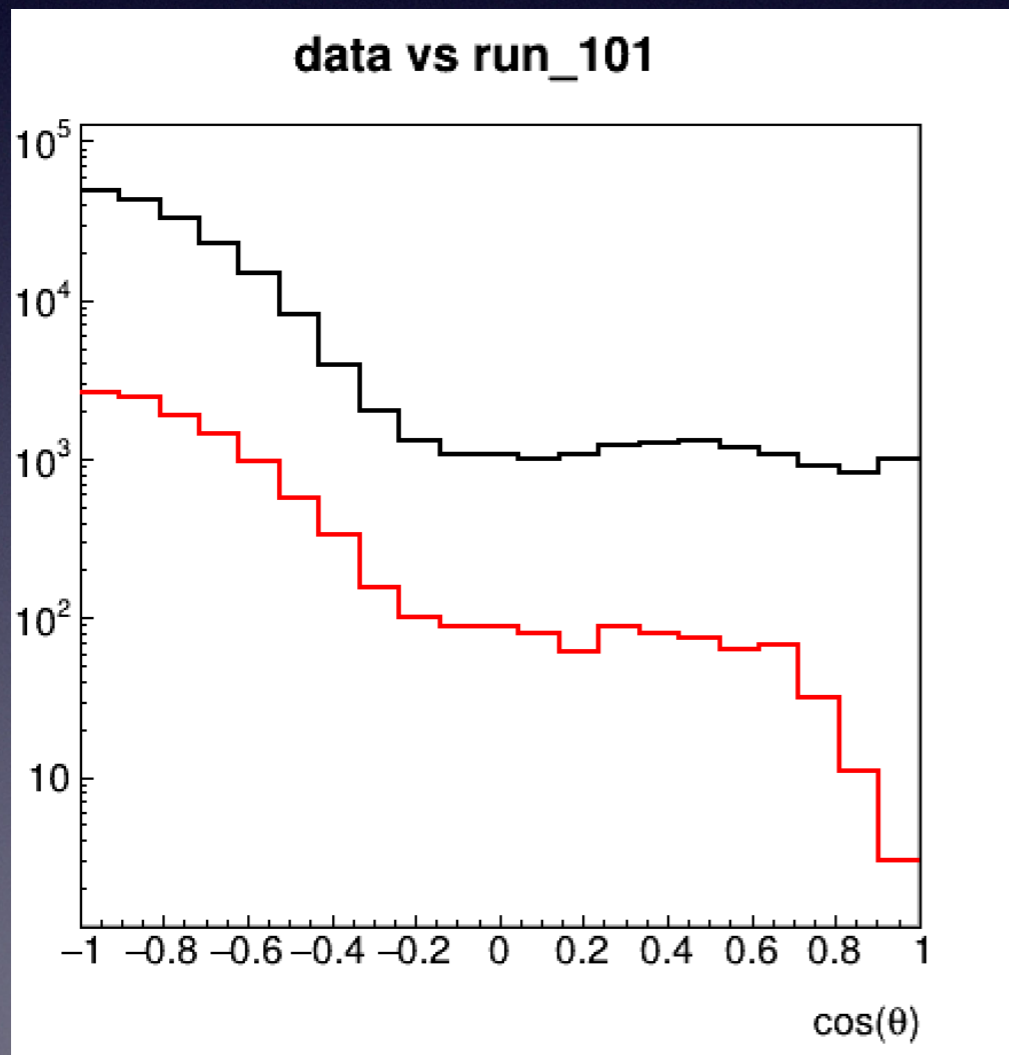
- Compared to nominal values in MUPAGE

```
Significance_1D hb0 hb0 Significance 9.55865 0.001 PASSED
```



MUPAGE tuning

- Choosing 'bad' values of significance
- e.g. for runID = 101, where $S_{avg} = 41.7$



MUPAGE tuning

- Very large values of S indicate parameter combinations where data/MC **do not agree**.
- As with the above example, when the test statistics are similar in value it can be more difficult to tell.
- Also, perhaps $[0.8, 1.0, 1.2, 1.6]$ x nominal value is not the right 'direction' — $0.2, 0.6$ x nominal value instead

MUPAGE tuning

- Lyon is slow, since for sufficient amount of muons launches 40 jobs per parameter combination run. Can fill disk space very quickly with too many jobs..
- Also trying to get jobs working at Nikhef cluster
- A lot more jobs to run
- Specify the same number of events between data and MC - this makes sure it is just the shape being compared

MUPAGE tuning

- Check that the significance and reduced-chi squared test give similar results — can then choose one
- Different values, some with zero entries.. this is because the ROOT chi2 function returns zero if any bin entry is zero.

File_ID	chi2/NDF	chi2/NDF(ERROR)
0000	102.074	66.8059
0	136.98	23.097
100	39.1721	8.11986
101	14.8188	13.5311
102	24.4307	24.0338
103	44.3392	13.1927
104	23.405	10.8534
105	20.2759	5.11072
106	9.14863	9.6918
107	17.4253	14.5963
108	24.9503	8.36473
109	16.0857	15.6777
10	36.101	3.0001
110	5.81344	13.5847
111	25.8623	12.4681
112	20.0795	0
113	0	20.014
114	34.0074	0
115	0	5.33211
116	8.75049	5.23908
117	8.84269	22.5995
118	41.5752	9.80484
119	17.49	18.4795
11	43.5387	26.04
120	44.7087	7.59384
121	13.2134	12.6859
122	23.0285	8.14349
123	14.7057	37.1994
124	67.0739	9.1998
125	16.3587	23.8557
126	44.2851	35.0284
127	65.7814	45.3203
128	71.6501	47.5374

MUPAGE tuning

- With respect to stbc, a single chain of RBR MC takes 73 hours..
- split up the runs on stbc

```
wn-sate-061.nikhef.nl wn-sate-061.nikhef.nl
Linux wn-sate-061.nikhef.nl 3.10.0-1127.19.1.el7.x86_64 #1 SMP Tue Aug 25 17:23:54 UTC 2020 x86_64 x86_64 x86_64 GNU/Linux
PBS ID 1
MINMAX 1 to 1
TMPDIR /data/antares/users/ofearrab/prod/temp
MASTER_DIR = /project/antares/public_student_software/data_processing/data_processing_nikhef
Mon Nov 16 11:11:27 CET 2020 DEBUG Sourcing config file: /project/antares/public_student_software/data_processing/data_processing_nikhef/configs/config_run_mupage_ORCA4_RBR_allparams_0.zsh
Mon Nov 16 11:11:27 CET 2020 NOTICE Creating temporary directory /data/antares/users/bofearraigh/MUPAGE/mc/ORCA4/check_run//temp/config_run_mupage_ORCA4_RBR_allparams_0.zsh_1.
Mon Nov 16 11:11:27 CET 2020 NOTICE Copying scripts from /project/antares/public_student_software/data_processing/data_processing_nikhef to /data/antares/users/bofearraigh/MUPAGE/mc/ORCA4/check_run//temp/config_run_mupage_ORCA4_RBR_allparams_0.zsh_1 .
MASTER_DIR = /data/antares/users/bofearraigh/MUPAGE/mc/ORCA4/check_run/temp/config_run_mupage_ORCA4_RBR_allparams_0.zsh_1
IRODS_MODULE_NAME =
Mon Nov 16 11:11:32 CET 2020 NOTICE Enter the main master loop
Mon Nov 16 11:11:32 CET 2020 NOTICE Starting task 1.
MASTER_DIR = /data/antares/users/bofearraigh/MUPAGE/mc/ORCA4/check_run/temp/config_run_mupage_ORCA4_RBR_allparams_0.zsh_1
Mon Nov 16 11:11:32 CET 2020 WARNING DETECTORB is not set, using the same as the DETECTOR
Mon Nov 16 11:11:32 CET 2020 NOTICE DETECTORA is /data/antares/users/ljnauta/detectors/ORCA4.detx
Mon Nov 16 11:11:32 CET 2020 NOTICE DETECTORB is /data/antares/users/bofearraigh/MUPAGE/data/44/detector/KM3NeT_0000044_00006118.detx
Mon Nov 16 11:11:32 CET 2020 NOTICE Parameters of /data/antares/users/ljnauta/detectors/ORCA4.detx detector:
CAN_MARGIN_M = 280
CAN_CENTER_X_M = 447.6
CAN_CENTER_Y_M = 575.7
CAN_ZMIN = 0
CAN_ZMAX = 476.4
CAN_RADIUS = 299.7
CAN_DEPTH_M = 2440
CAN_CENTER_DEPTH_M = 2201.80000
CAN_DEPTH_KM = 2.44000
Mon Nov 16 11:11:32 CET 2020 NOTICE File seeds/seeds_ORCA4.nikhef-0.1.mupage_10G.csv exists.
Mon Nov 16 11:11:32 CET 2020 NOTICE Seed is <1998836295>.
Mon Nov 16 11:11:32 CET 2020 NOTICE Running MUPAGE with 42727230 events.
Elapsed time 12328 s.
I am here: /data/antares/users/bofearraigh/MUPAGE/mc/ORCA4/check_run/temp/config_run_mupage_ORCA4_RBR_allparams_0.zsh_1
Mon Nov 16 14:40:21 CET 2020 NOTICE Starting JSirene
Mon Nov 16 14:40:21 CET 2020 NOTICE File seeds/seeds_ORCA4.nikhef-0.1.mupage_10G.sirene.csv exists.
Mon Nov 16 14:40:21 CET 2020 NOTICE Seed is <3940870176>.
Elapsed time 55126 s.
Tue Nov 17 06:02:19 CET 2020 NOTICE Starting JTE RBR
Tue Nov 17 06:02:19 CET 2020 NOTICE File seeds/seeds_ORCA4.nikhef-0.1.mupage_10G.sirene.jterbr.csv exists.
Tue Nov 17 06:02:19 CET 2020 NOTICE Seed is <2572173647>.
Elapsed time 19924 s.
Tue Nov 17 11:35:11 CET 2020 NOTICE Starting JGandalf reconstruction chain.
Elapsed time 175455 s.
Cleaning workdir!
```