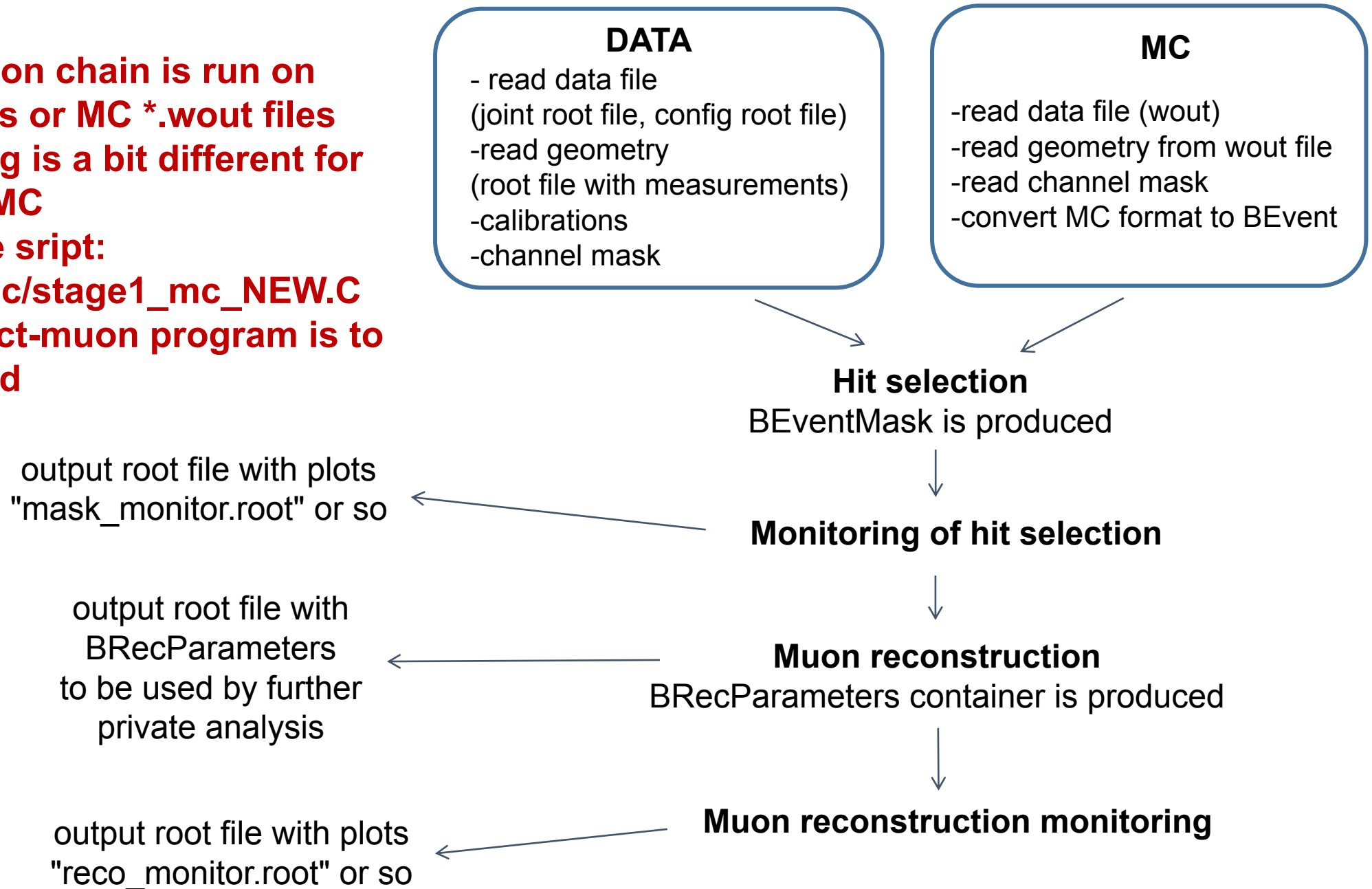


Overview

- New version of reconstruction software was committed to BARS
 - New methods for hit selection and track reconstruction
 - Track quality variables
 - More information in the output of the reconstruction
- First versions of reconstruction monitoring programs were committed
- Reconstruction script for MC is available:
macros/rec/stage1_mc_NEW.C
- Instructions and brief method description are available on twiki:
<https://gitlab-hybrilit.jinr.ru/baikal/bars/wikis/Muon%20Reconstruction>

Reconstruction chain is run on joint root files or MC *.wout files

- **processing is a bit different for data and MC**
- **up-to-date script: macros/rec/stage1_mc_NEW.C**
- **reconstruct-muon program is to be updated**



Component	Code location
Hit selection	
Causality and muon criterion	bfilter/BCausality.(h,cc), bfilter/BMuonCriterion.(h,cc)
Hotspot	bfilter/BStringHitGroup.(h,cc) bfilter/BHotspotHitGroupProducer.(h,cc)
Causality and residual cleaning	bfilter/BHitGroupProducer.(h,cc)
Reconstruction	
Methods for track reconstruction, trajectory parameters	bmutrajectory/BMuonTrajectory.(h,cc)
Module which reads event mask and calls the reconstruction methods	bmutrajectory/BMuonTrajectoryProducer.(h,cc)
Namespace with useful functions (geometric calculations, quantum efficiency curves, etc..)	butils/BHelperFunctions.(h,cc) NEW
Mask and reconstruction monitoring	bmonitoring/BMaskMonitor.(h,cc) NEW bmonitoring/BRecoMonitor.(h,cc) NEW
Container for reconstructed event	breconstruct/BRecParameters.(h,cc)

RED - updated or new modules

More details on reconstruction code

BMuonTrajectory class

- Contains references to selected hits
- Muon trajectory parameters
- Methods for trajectory reconstruction
 - Trajectory first approximation
 - Minimization with various functions
 - Exclusion of outliers
- Trajectory quality variables

BMuonTrajectory is used already at the hit selection stage for estimation of trajectory and exclusion of outliers

- Minimisation functions in BMuonTrajectory (defined in BMuonTrajectory::getModQuality(..) method) more details at

<https://gitlab-hybrilit.jinr.ru/baikal/bars/wikis/Muon%20Reconstruction>

1) **Quality = time chi2 + A*D**

2) Time chi2

3) Time chi2 + distance chi2

4) Likelyhood maximisation
(not ready)

5) M-estimator (ANTARES)

6) modified M-estimator

7) phit product maximisation

8) combined time chi2 and phit

9) robust distance chi2

More details on reconstruction code

BMuonTrajectoryProducer

- Is used in the reconstruction chain
- Reads event mask
- Creates BMuonTrajectory and fills it with hits
- Calls trajectory reconstruction methods
- Calls methods for quality calculation
- Fills BRecParameters container

Monitoring

Purpose of the monitoring:

- Fast feedback during the production and user runs
- Monitoring of the data quality
- Validation of the reconstruction code
- Validation of the MC production

New folder "bmonitoring" was added to BARS

- BMaskMonitor(h,cc) and BRecoMonitor.(h,cc) are available there
- Anything connected to monitoring could be placed into this folder

Mask monitoring

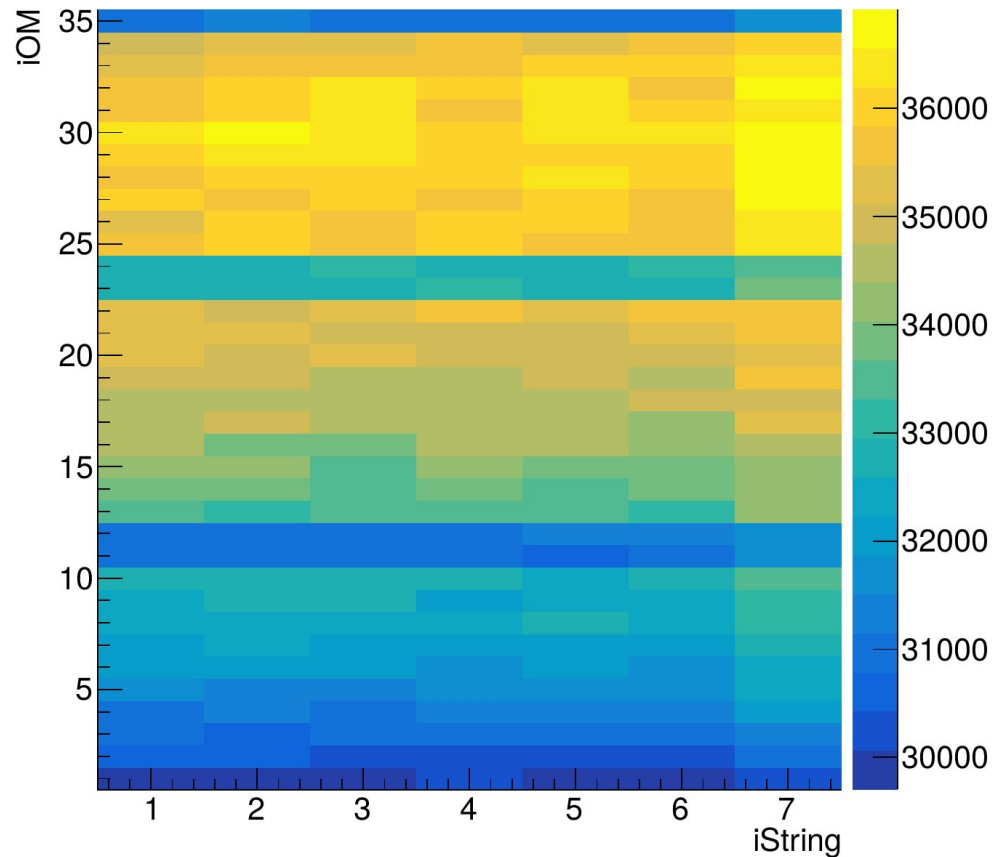
- Detector occupancy before/after noise suppression
- Average amplitude before/after noise suppression
- In case of MC matching with signal
 - Purity of selected hits
 - Efficiency for signal hit selection
- Number of hits after selection
- Etc..

Reconstruction monitoring

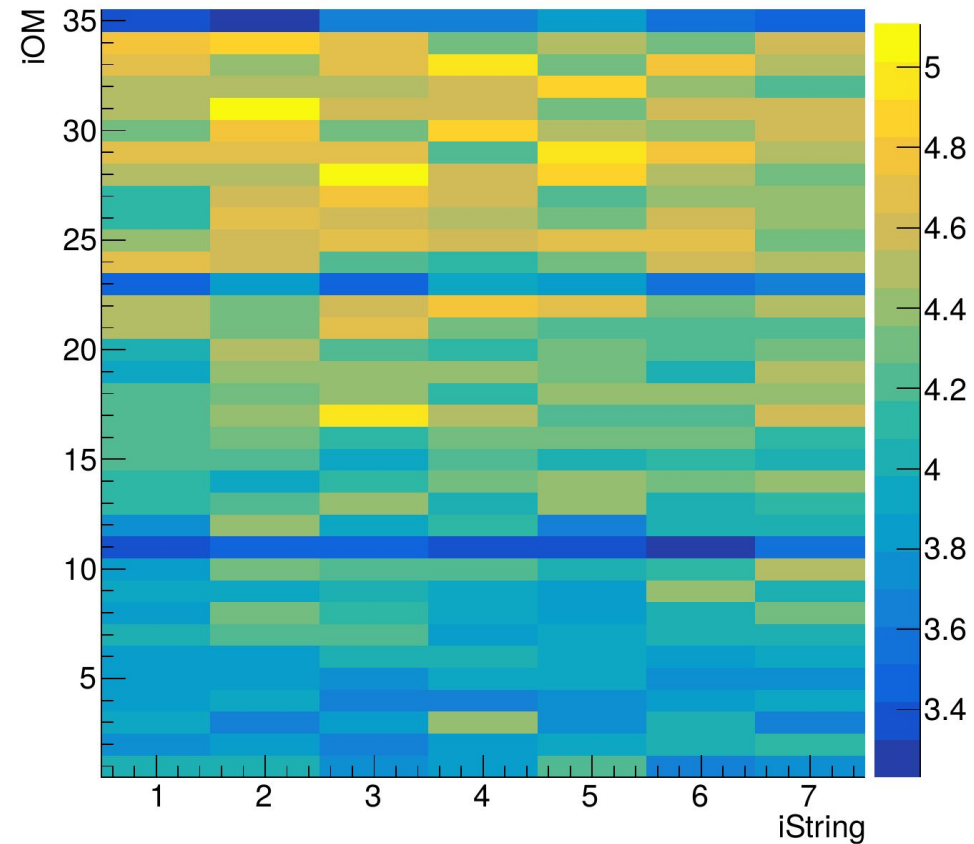
- Reconstructed angles
- Reconstructed coordinates
- MC track angles and coordinate
- Matching of MC truth and reco
 - Mismatch angle for initial approximation
 - Mismatch angle for reco
 - Efficiency vs. angles and energy
- Quality variables
- Etc...

Mask monitoring

atm. neutrino sample: nuatm_thr500GeV_n10m.noise.wout



occupancy
for hits $A > 1.5$ p.e.



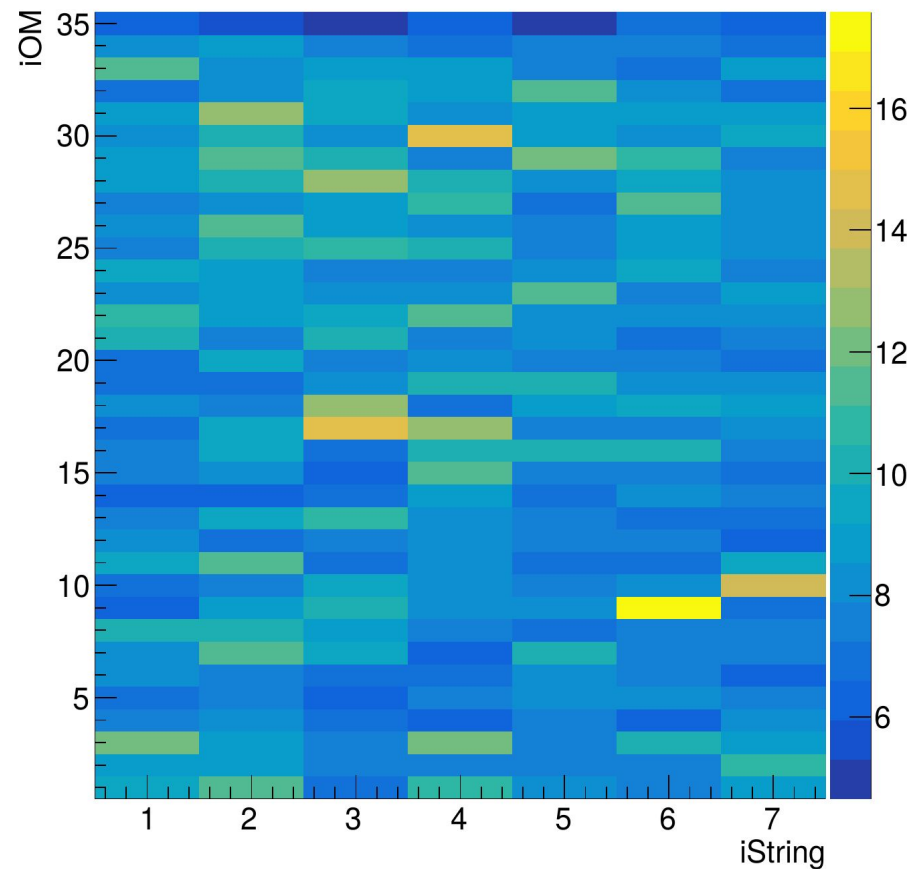
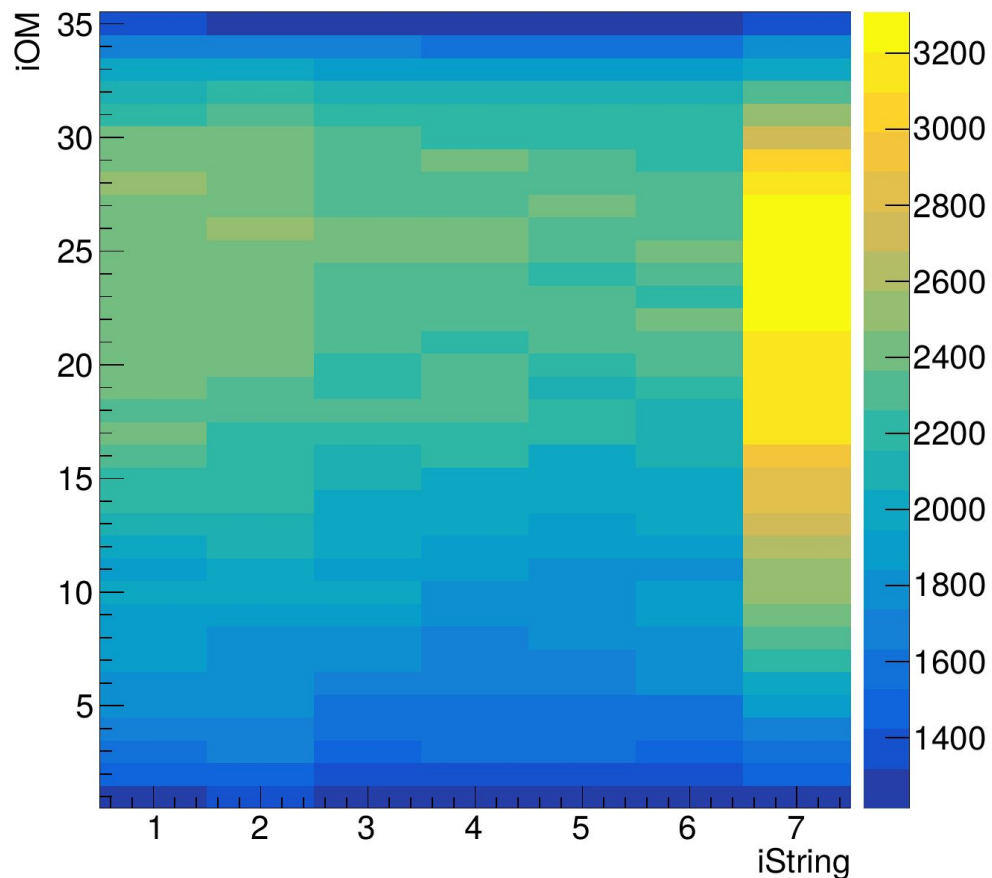
average amplitude
for hits $A > 1.5$ p.e.

Mask monitoring

atm. neutrino sample
6 hits at 3 strings selection

occupancy
for hits $A > 1.5$ p.e.
and suppressed noise

average amplitude
for hits $A > 1.5$ p.e.
and suppressed noise

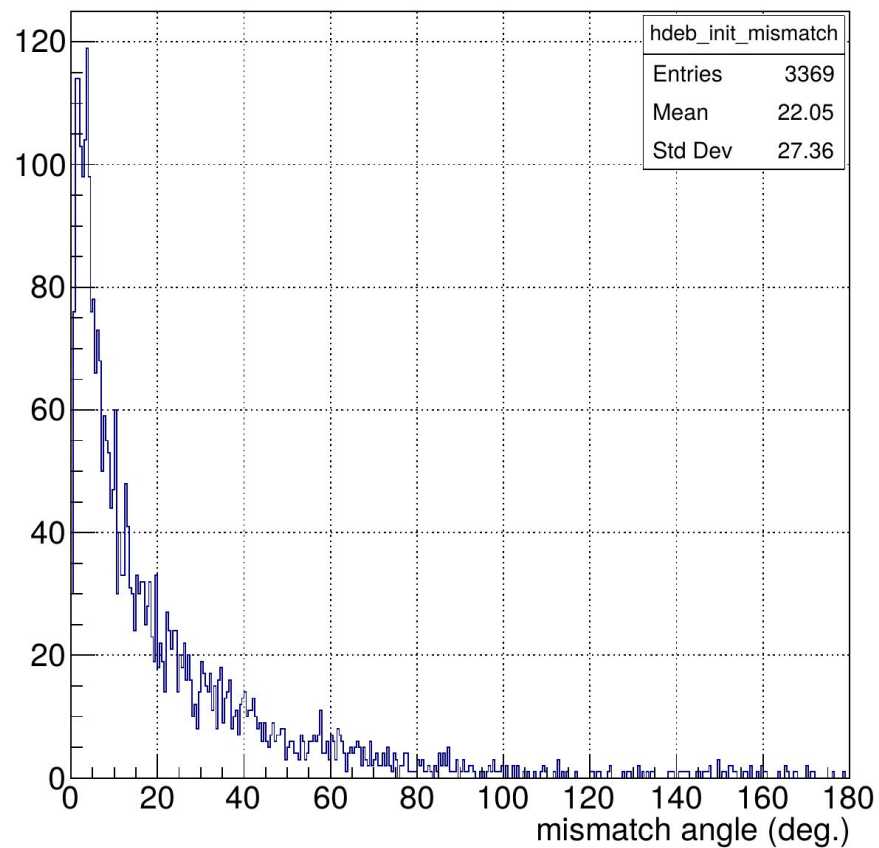


not more than 10% of noise hits contribute to these plots

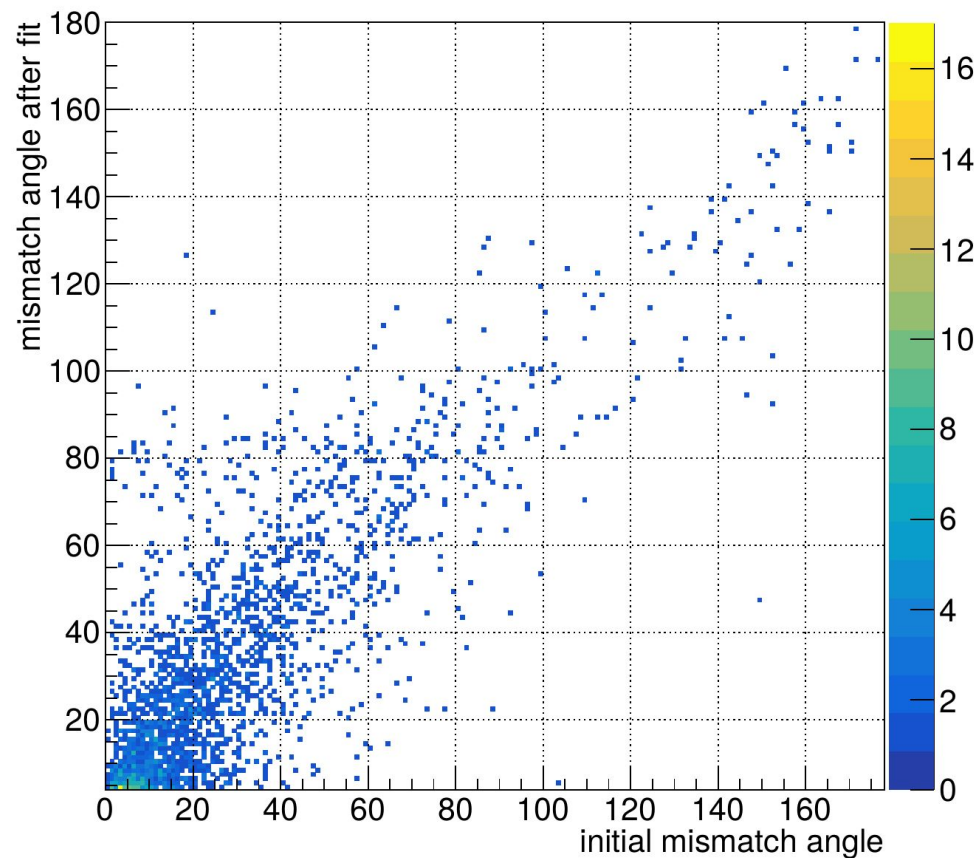
Reconstruction monitoring

atm. neutrino sample; 6 hits at 3 strings selection

Initial approximation mismatch angle



Initial approximation mismatch angle vs. final mismatch angle



Conclusion

- Reconstruction software has become a bit more user-friendly
- Everyone is welcome to use new software and give feedback concerning bugs, problems, etc..