

# **muon reco validation**

**- the DQMOffline monitoring -**

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DPG-PH Muon Meeting

- Preliminary remarks
- Main validation goal for the immediate future (incoming data taking period)
- Tests available for the muon monitoring
  - with some examples -
    - ✓ kinematics
    - ✓ residuals
    - ✓ muon identification
    - ✓ energy deposits
    - ✓ multiplicity
- Final validation goal (for future TIER data storage)
- To do & Conclusions

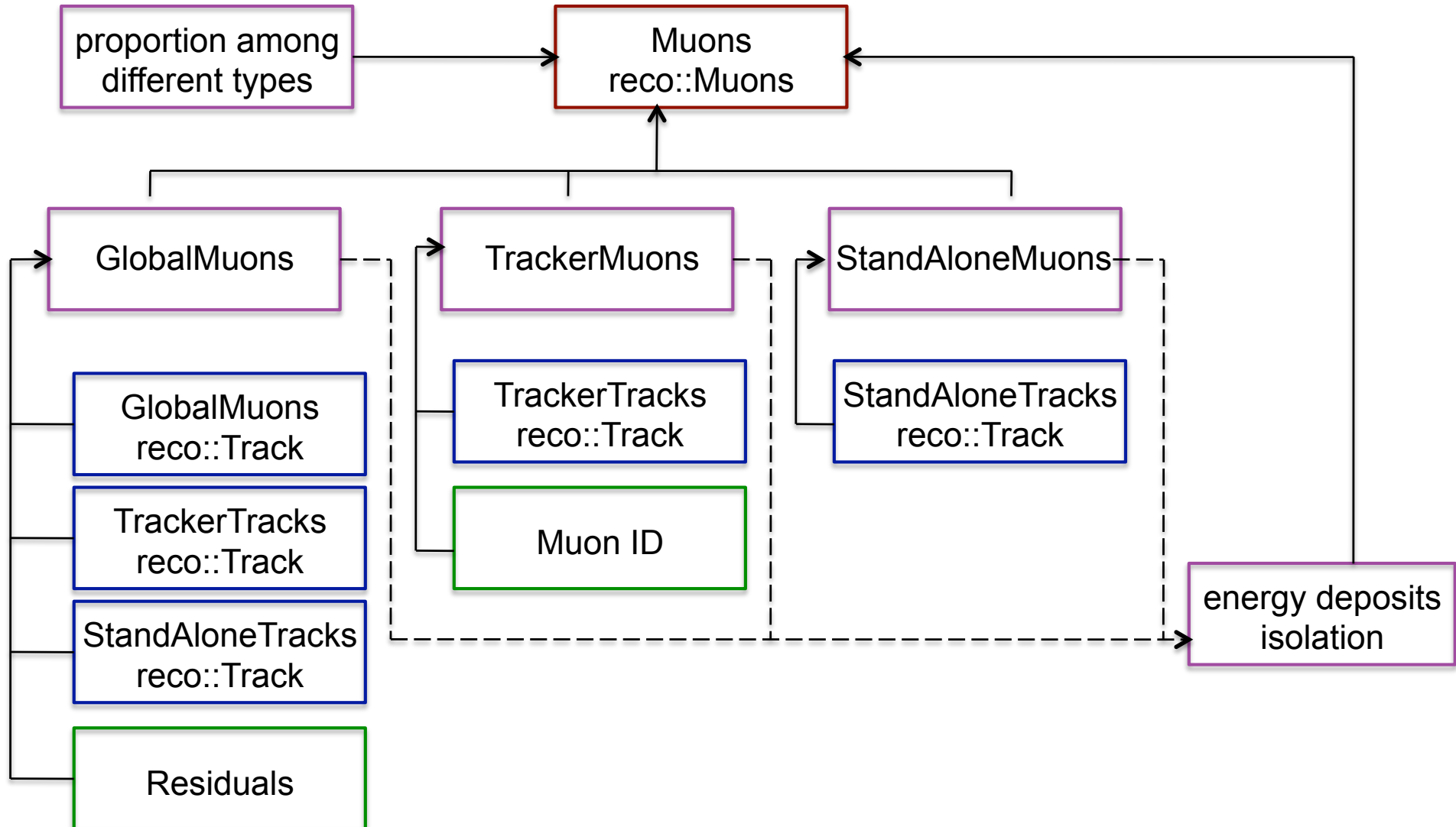


# Preliminary remarks : the muon object

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A RecoMuon it's a very complicated object to be validated because it's composed by different components, which have all to be tested and the results matched together !



# Preliminary remarks : the present talk

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## disclaims

- the figures present in this talk are "example plots" obtained running on few thousand of data just to show you how they appear  
→ do not fix your attention on the tests results values
- the ranges of all the tests have yet to be optimized studying the muon reconstruction on real and Monte Carlo data sample

## presentation's main aim

- discuss about the possible ways to optimize the analysis tests
- understand (from your suggestions) the validation metrics
- ....
- find people interested in becoming involved on this Data Quality Monitoring & Validation task [a lot of work and lack of man power!]



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# The final report plot - example

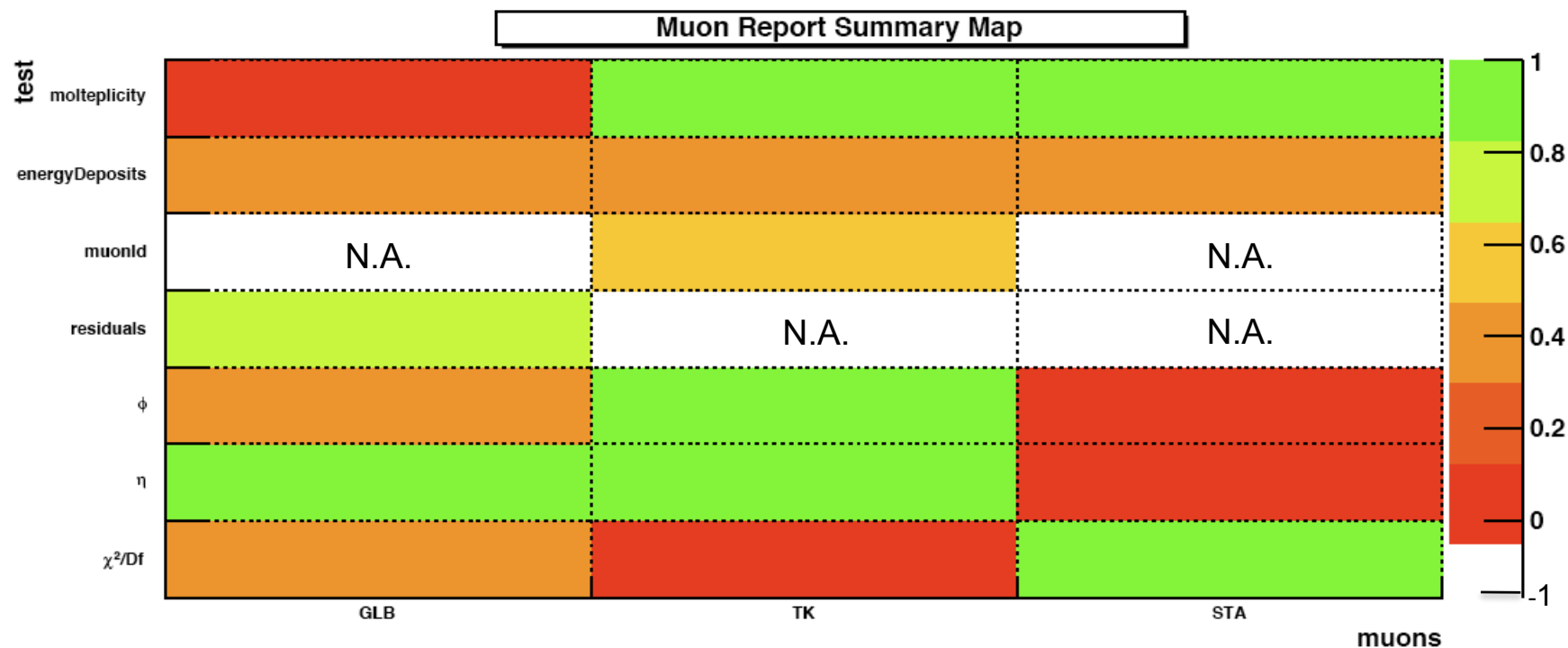
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main validation goal for the incoming data taking period:

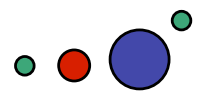
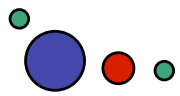
produce a 2D histograms which summarize the status of the Muon Reconstruction and which are easy readable also for a non-expert shifter

- each cell contain a test report number from 0 (worst) to 1 (best)  
[-1 means that the test not necessary for the mu reco monitoring: **N.A.** (not available)]
- if a test is wrong, it should be an other more detailed summary plot to understand where is located the problem



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# The kinematics tests



parameters:

chi square reduced

ranges:

$$0.2 < \frac{\int_0^{\max} \chi_2 \text{ov} DF}{\int_{-\infty}^{\max} \chi_2 \text{ov} DF} < 0.6$$

to be fixed  
analysis on going

pseudorapidity

$$x = \frac{\int_{-\pi}^0 \eta}{\int_0^{\pi} \eta}$$

$$t = \frac{|x - x_{\text{exp}}|}{\sigma_x} < 1.95$$

2σ conf. level

$$\left[ \begin{array}{l} x_{\text{exp}} = 1(ppColl) | 0.9(\cos m) \\ \sigma_x = x \sqrt{\frac{1}{\int_{-\pi}^0 \eta} + \frac{1}{\int_0^{\pi} \eta}} \end{array} \right]$$

radial direction

$$x = \frac{\int_0^{\pi} \phi}{\int_{-\pi}^0 \phi}$$

$$t = \frac{|x - x_{\text{exp}}|}{\sigma_x} < 1.95$$

2σ conf. level

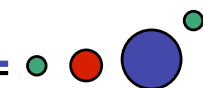
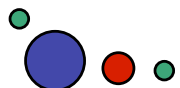
$$\left[ \begin{array}{l} x_{\text{exp}} = 1(ppColl) | 0.01(\cos m) \\ \sigma_x = x \sqrt{\frac{1}{\int_{-\pi}^0 \phi} + \frac{1}{\int_0^{\pi} \phi}} \end{array} \right]$$

results: 1-ok , 0-no

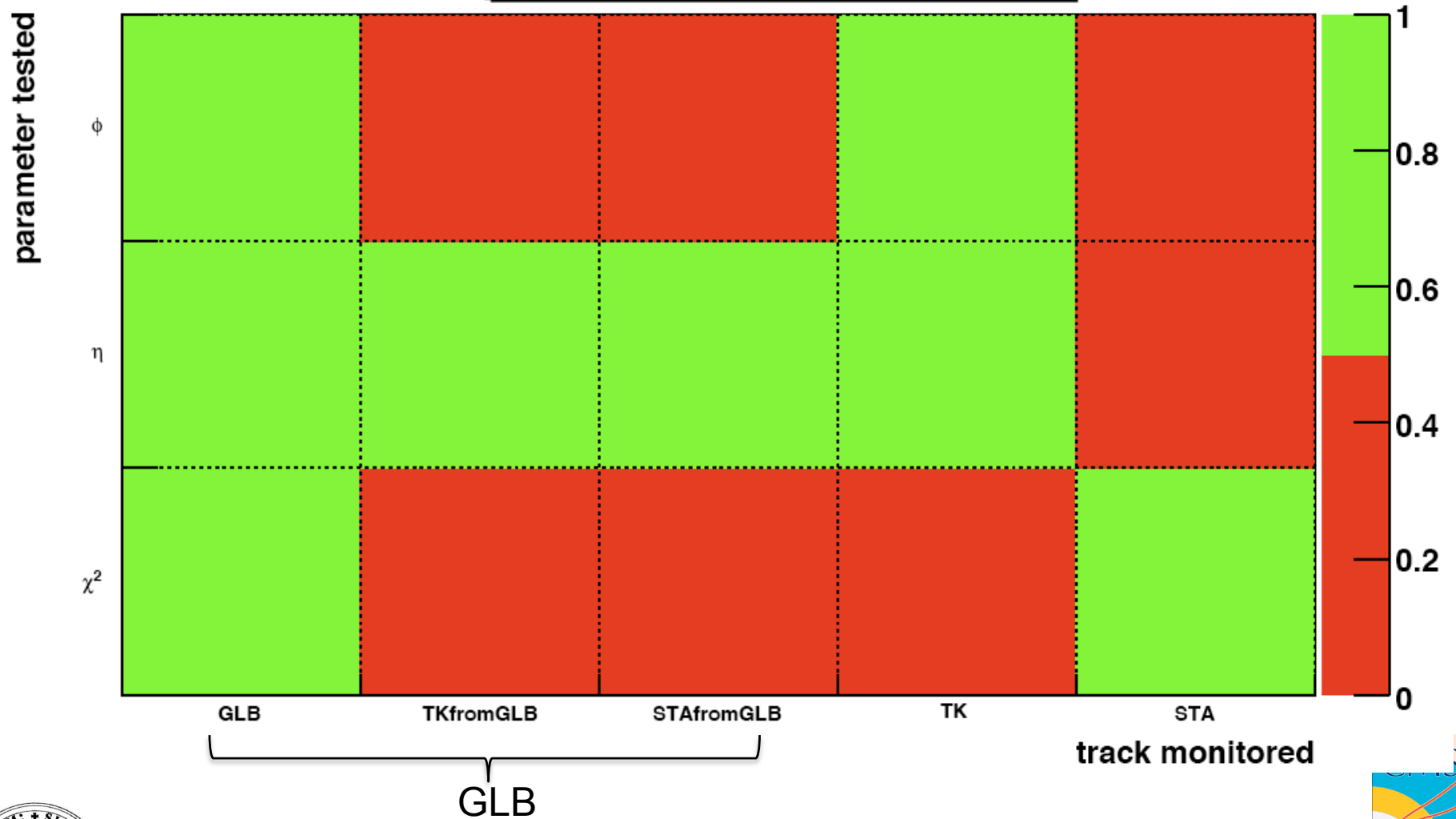
tracks involved: Glb, Tk\_Glb, Sta\_Glb, Tk, Sta



# The kinematics tests - example



**Kinematics test summary**



# The residuals tests

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Two main types :

1

tests on the sigma of residuals distributions:  $\sigma + err_{\sigma} < \sigma_{\max}$

parameters:  $\phi$  ,  $\eta$  ,  $1/p$

tracks: Tk\_Glb/Glb, Sta\_Glb/Glb, Tk\_Glb/Sta\_Glb

- 0.001 Tk\_Glb/Glb  
- 0.05 Sta\_Glb/Glb  
- 0.05 Tk\_glb/Sta\_Glb

2

test on the charge residuals:  $(tracks_{!q} / tracks_{tot}) < \%_{\max}$

tracks: Tk\_Glb/Glb, Sta\_Glb/Glb, Tk\_Glb/Sta\_Glb

- 0.10 Tk\_Glb/Glb  
- 0.14 Sta\_Glb/Glb  
- 0.18 Tk\_glb/Sta\_Glb

results: 1-ok , 0-no



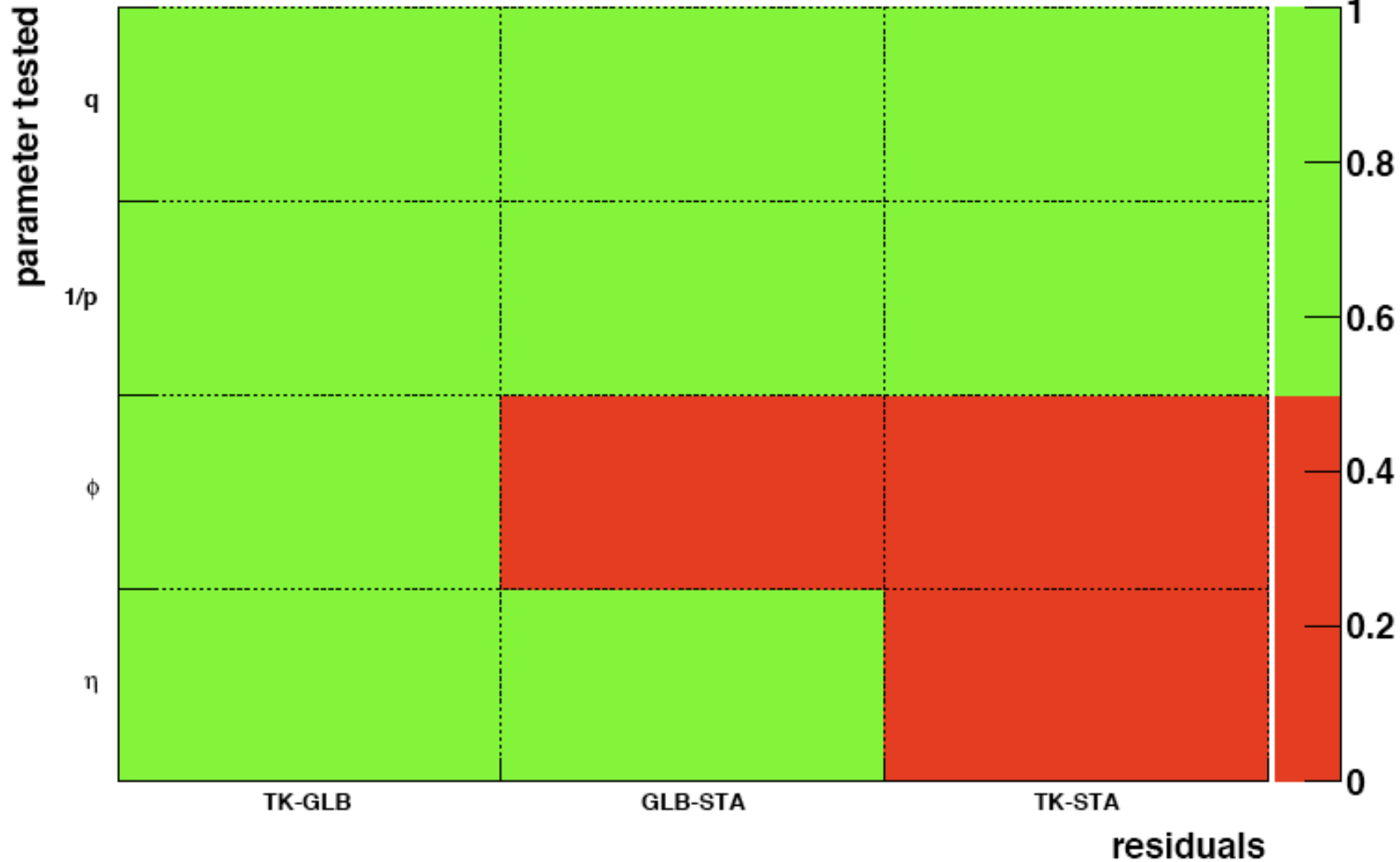
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# The residuals tests - example

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Residuals test summary



# The muonId tests

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**parameters:** (check on **Tk tracks**)

- **number of matching segments**
  - ✓  $4 < n < 5$
  - ✓ ok:1 , no:0
- **number of associated segments / tot(associated segments)**
  - ✓ dt:  $0.7 < n < 0.8$
  - ✓ csc:  $0.57 < n < 0.67$
  - ✓ okDTnoCSC:1/2 , noDTokCSC:1/2 , noDTnoCSC:0 , okDTokCSC:1
- **sigma of residuals between segments/track** (on x&y projection)
  - ✓  $0.95 < \text{meanSigma} < 1.05$
  - okDTnoCSC:1/2 , noDTokCSC:1/2 , noDTnoCSC:0 , okDTokCSC:1

**Note:** all these test expected values come from studies on simulated data ([Jacob](#))

1- [[http://jribnik.web.cern.ch/jribnik/tmp/DQM\\_V0001\\_R000000001\\_\\_Muons\\_\\_MuonIdVal\\_\\_TEST.ps](http://jribnik.web.cern.ch/jribnik/tmp/DQM_V0001_R000000001__Muons__MuonIdVal__TEST.ps)]

**NEW FEATURE: monitoring of muonId for Glb tracks** – tests still to be implemented from simulated data results ([Jacob](#))

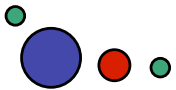
2- [<http://cmsdoc.cern.ch/cms/Physics/muon/CMSSW/Performance>

/RecoMuonMuonIdentification/CMSSW\_3\_1\_0\_pre4/ReValSingleMuPt10/GlobalMuons/]

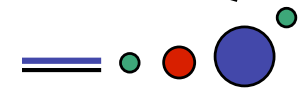


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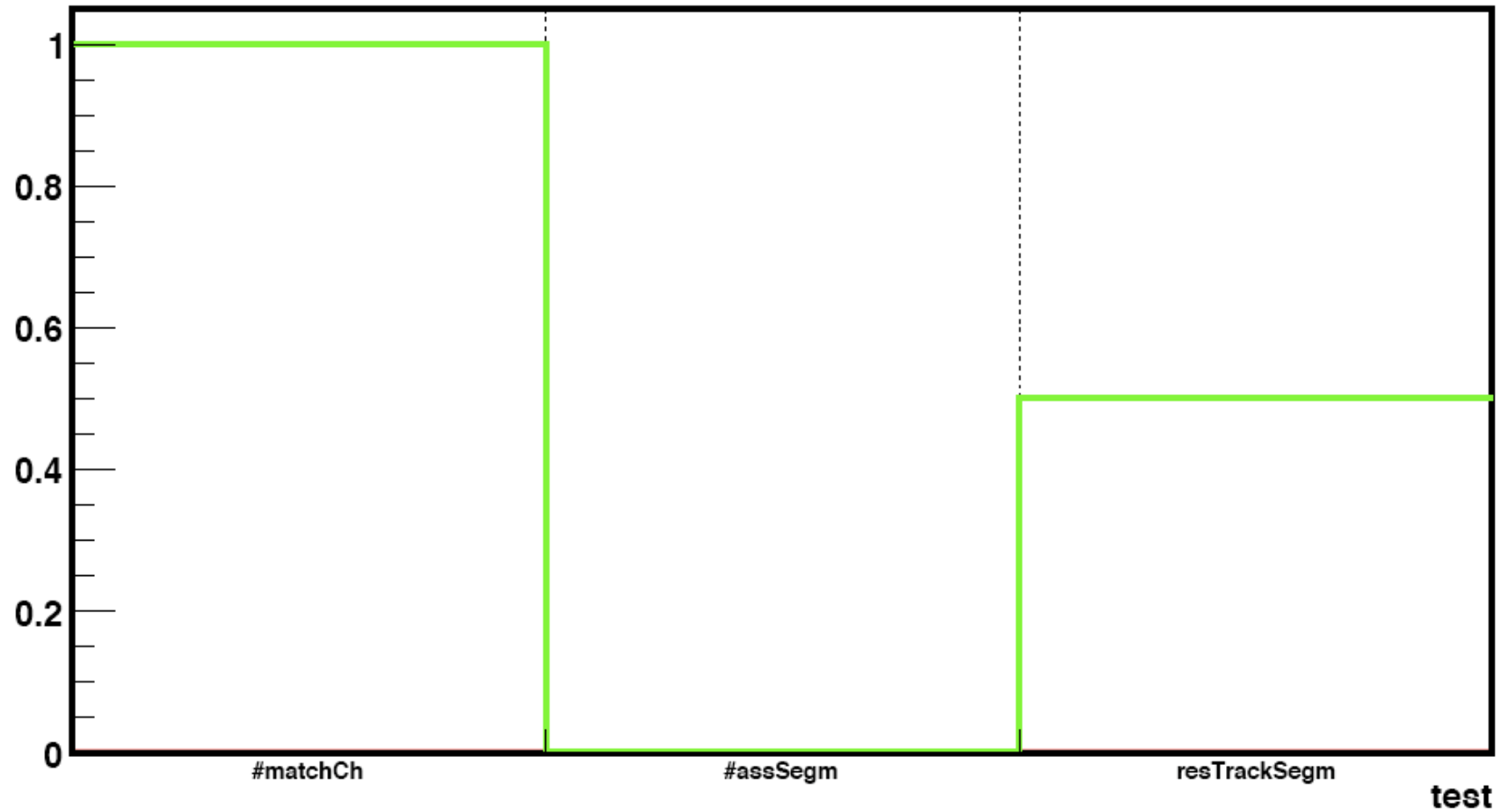
# The muonId tests - example



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muonId test summary



# The energy tests

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## parameter & method :

energy deposits of pointing muons fitted with the convolution of a gaussian and a landau functions and check on the most probable value (MPV)

ECAL :  $0.2 \text{ GeV} < \text{MVP} < 0.3 \text{ GeV}$

HCAL :  $2.0 \text{ GeV} < \text{MPV} < 3.5 \text{ GeV}$

## fit parameter :

### ECAL

startValues[0]=0.036; startValues[1]=0.193; startValues[2]=110.0; startValues[3]=0.06;  
parlimitslo[0]=0.0; parlimitslo[1]=0.; parlimitslo[2]=1.0; parlimitslo[3]=0.; parlimitshi[0]=0.05;  
parlimitshi[1]=0.5; parlimitshi[2]=80000.0; parlimitshi[3]=0.1;

### HCAL

startValues[0]=2.0; startValues[1]=2.4; startValues[2]=110.0; startValues[3]=4.0;  
parlimitslo[0]=0.0; parlimitslo[1]=0.; parlimitslo[2]=1.0; parlimitslo[3]=0.; parlimitshi[0]=4.0;  
parlimitshi[1]=4.0; parlimitshi[2]=80000.0; parlimitshi[3]=8.0;

tracks: Glb,Tk,Sta

results : 1-ok , 0-no

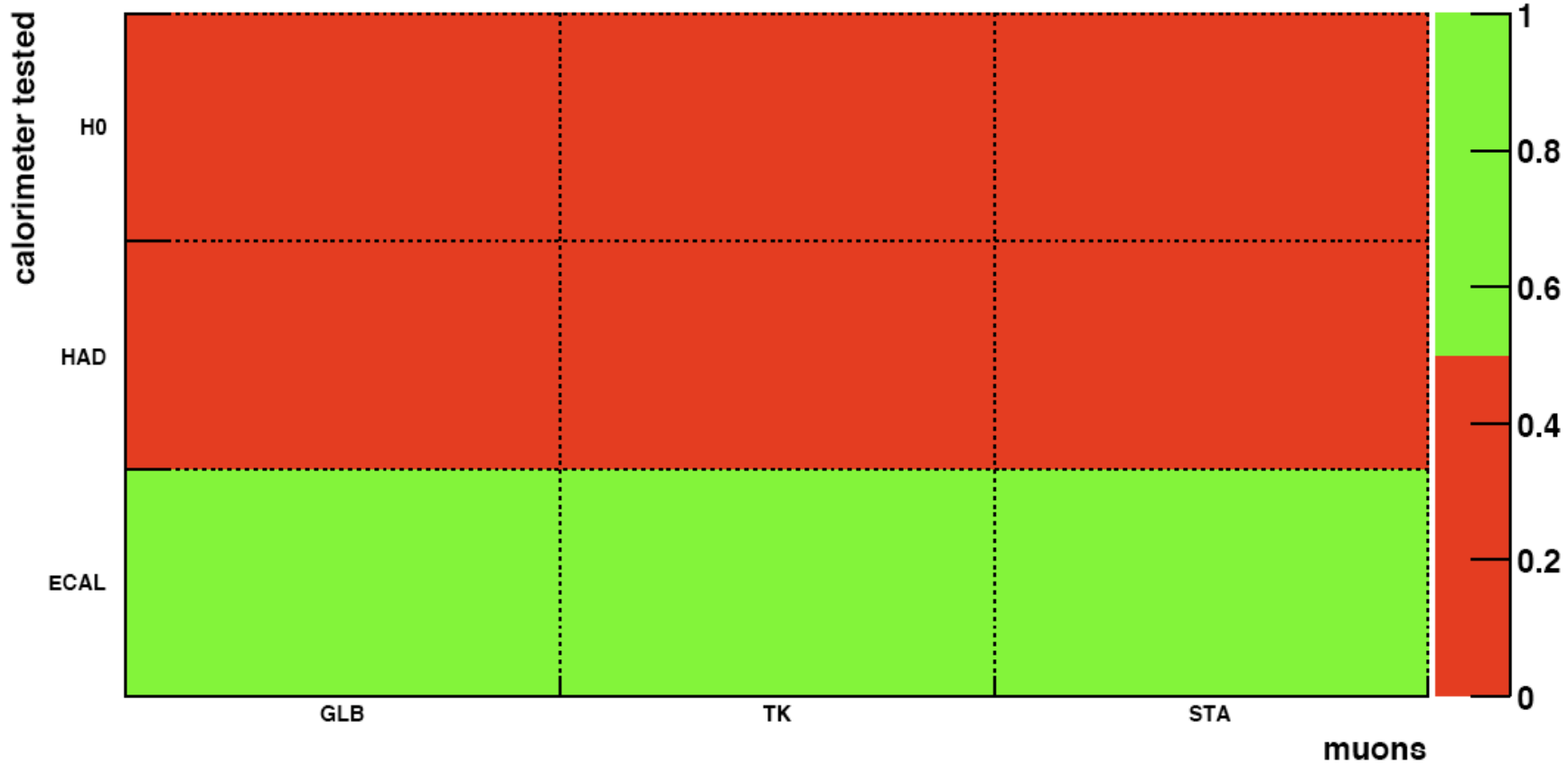
NOTE: HO still missing



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# The energy tests - example

Energy deposits test summary



# The multiplicity tests

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test of:  $(\%exp)_{min} < \%GLB\_mu < (\%exp)_{max}$

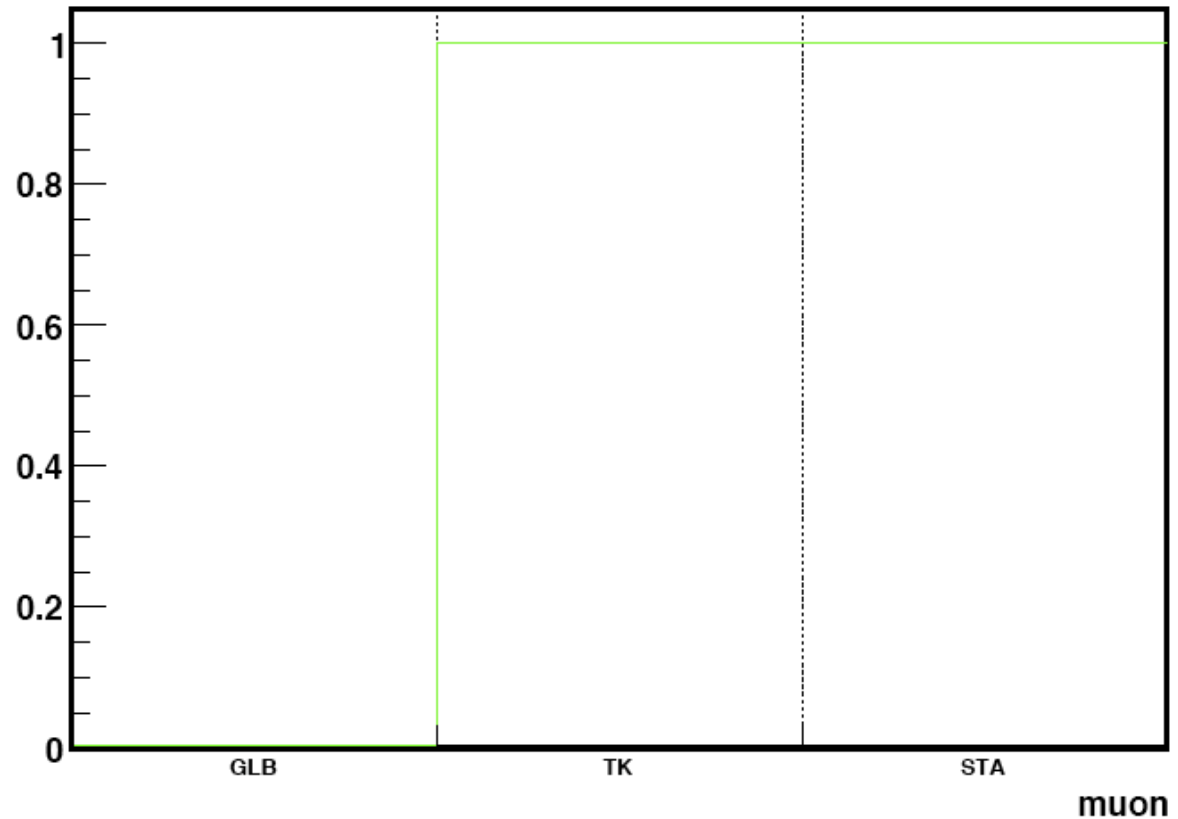
results : 1-ok , 0-no

$(\%exp)_{min} < \%TK\_mu < (\%exp)_{max}$

$(\%exp)_{min} < \%STA\_mu < (\%exp)_{max}$

percentual values to understand  
(from real MC data comparison)  
work on going !!

muon multiplicity test summary



# The final report number

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really final goal of the muonReco validation:

for each run provide a **float number from 0 to 1** which represent the status of the muon reconstruction and which can be considered as a flag before the data storage

This final decision on the mu reconstruction should come from all the test results [float numbers from 0 to 1] mentioned in the previous slides:

- kinematics\_GLB
- residuals\_GLB
- kinematics\_TK
- muonID\_TK
- kinematics\_STA
- energyDeposits
- multiplicity
- isolation (still missing)

**but it's yet to understand the metrics!**

[i.e. the way to match all the single test report]



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# To do & contents summary

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## to do :

- tune the test ranges
- add the missing analysis part  
[ex. mu isolation studies, HO energy deposits tests, ...]
- match together all these so different information



## summary:

- the muon reconstruction monitoring & validation structure is almost ready for the incoming data taking period but the contents have to be optimized
- need of people who not only work for the analysis improvements but also look to the DQM plots in order to improve their legibility, debug the already present code and tune the test ranges from data results



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