Muon Momentum Scale

- Method
- Signal samples
- Backgrounds (bb mu 15)
- “Results”

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Method

2 steps:

1) Data correction **(Marianna)**:
Correction of the measured muon momenta using the Z peak constraint.
Based on a parametrization of the possible effects (misalignment, B field measurement errors, error on energy loss estimate).

2) "Momentum Scale"
Determine how the measured momentum in MC samples has to be affected (deteriorated) to provide a better description of (corrected) data samples.
Correct muon momentum as follows:

$$p_{corr} = p \cdot (r_{\alpha,\beta} + \delta_{\alpha}) + \Delta_{\alpha}$$

r: momentum scale
δ: rnd number extracted with mean 0 and sigma= σ_{α} (additional smearing $\sigma_{pcorr}^{2}=\sigma_{p}^{2}+\sigma_{\alpha}^{2}$)
Δ: constant term
α: barrel/endcap ; **β**: mu+/mu-

- the Z lineshape is computed using p_{corr};
- **r,δ,Δ** are determined fitting the obtained distribution to the data distribution;

- defined for Barrel & EndCap (further split with increasing statistics?)

Method (II)

Use 2 INDEPENDENT samples:

• 'MC' sample (simulated Z events from MC08)
Standard signal (+ background) events without distorsion.

• 'data' or 'signal' sample
Distorted signal (+background) events with known distorsions.
Take 100 m as reasonable guess for the knowledge of detector geometry @ start).

Process them as follows

• Compute a table(η,p) with Trigger and recostruction efficiency ratio between 'data' and 'MC' (Claudio)
• Use this table to reweight MC events and create a third 'modified MC' sample (1').
• Create invariant mass distribution with 'modified MC' sample and 'data' sample.
• Compute with a minimization procedures the parameters for the momentum scale which maps 1' into2.

NB: Background samples are not complete for the moment.
The determination of the momentum scale needs an event loop. If we want to introduce bkg in the calculation we have to wait for a reasonable statistics. Applying the bkg just rescaling the bkg shape to the total number of expected events would introduce correlations & wrong stat errors. (can be done as a test of the algorithms)

Signal samples

Base signal sample:

250k Z->μμ AODs from the dataset:

`mc08.106051.PythiaZmumu_1Lepton.recon.AOD.e347_s462_r541_tid028727`

Misaligned signal samples:

4 datasets produced for 4 different Muon Spectrometer misalignments

(respectively 30, 100, 200, 500 μm translations and 15, 50, 100, 250 μrad rotations)

Datasets available on the grid (~250k events each).

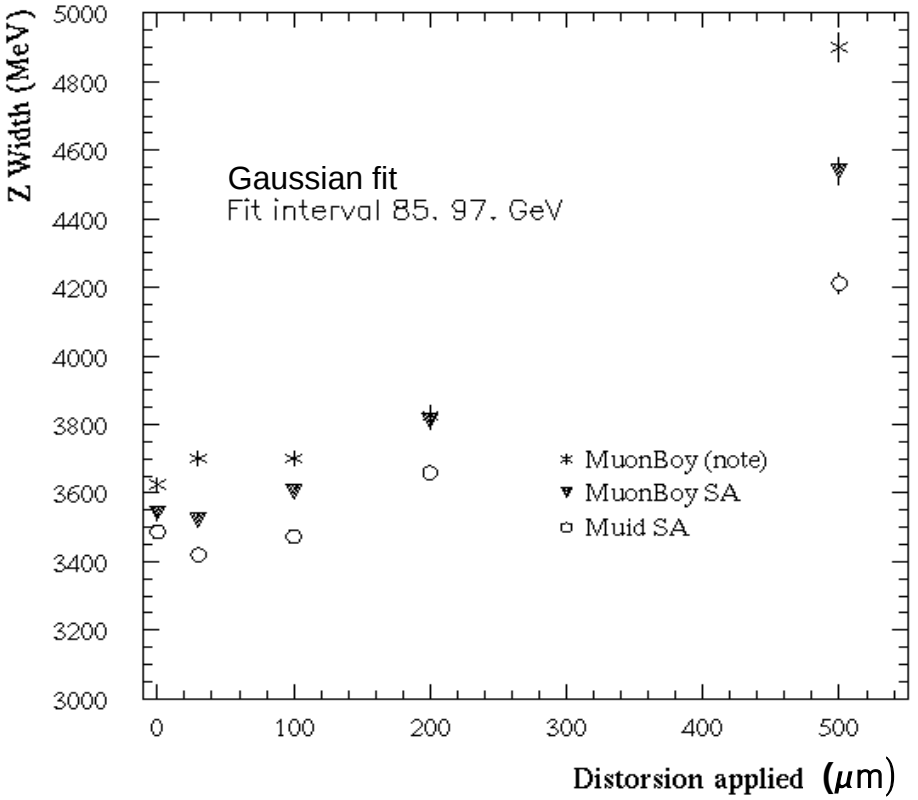
```
user09.FulvioGaleazzi.PythiaZmumu_1Lepton.mc08.106051_misal.recon.AOD.e347_s462_r541_tid028727_misal_30u
user09.FulvioGaleazzi.PythiaZmumu_1Lepton.mc08.106051_misal.recon.AOD.e347_s462_r541_tid028727_misal_100u
user09.FulvioGaleazzi.PythiaZmumu_1Lepton.mc08.106051_misal.recon.AOD.e347_s462_r541_tid028727_misal_200u
user09.FulvioGaleazzi.PythiaZmumu_1Lepton.mc08.106051_misal.recon.AOD.e347_s462_r541_tid028727_misal_500u
```

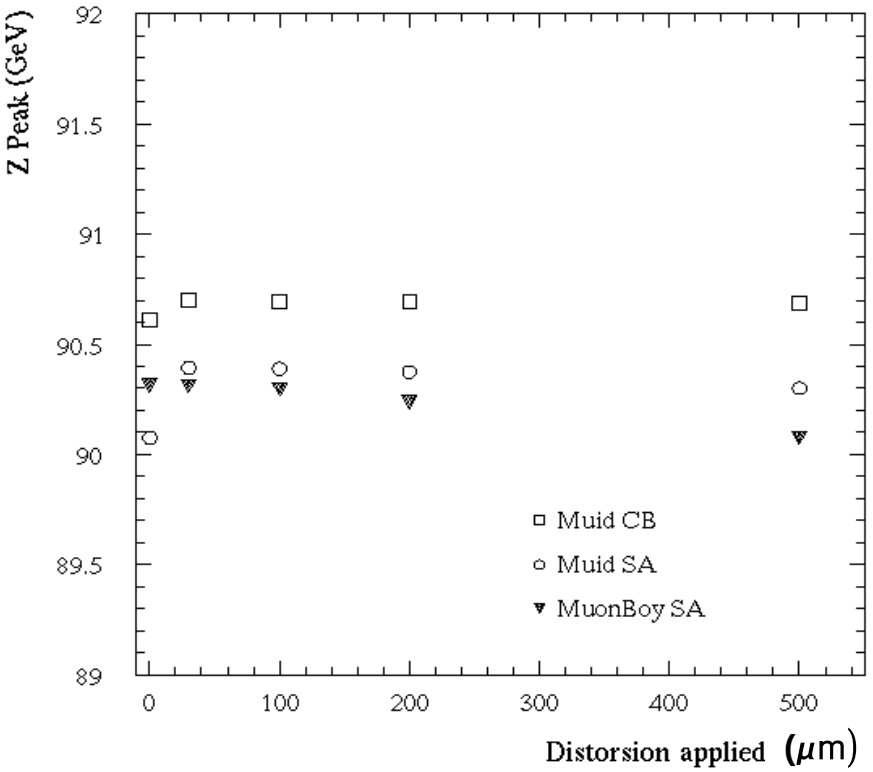
- Produced with RecExCommon (release 14.5.0) starting with centrally produced RDO.
- RDOs copied locally on the Tier3. GANGA used for the production (requiring to run on the Tier3).
- The JobOptions were modified (following S.Spagnolo prescription) to exploit the misaligned db tags produced by the Saclay group.

Signal samples (II)

Gaussian fit in the range 85-97 GeV
For comparison with the note
ATL-PHYS-COM-2008-053 (* in the plot)

Reconstructed Z mass vs. distorsion applied.





Different dataset used in (*)

athena 12.0.6

misal1_csc11.005145.PythiaZmumu.digit.RDO.v12003103_tid003850

Differences could arise from generation and simulation

bb backgrounds

On the GRID, 1784 files are available from the dataset
`mc08.108405.PythiaB_bbmu15X.evgen.EVNT.e388_tid042962`
for a total of ~9M events (5k events/file).

The fast simulation jobs for this dataset are not already submitted (as can be seen from "ATLAS Production":http://www-f9.ijs.si/atlpy/atlprod/)

We would like to start the production of 1M events (~10 pb^{-1}) on Roma Tre Tier3 using the fast simulation.

Each atlfast job produces an HITS file (simulation output) and an RDO file (digitizazion output)
(NOTE: HITS files can be deleted , reconstruction runs from RDOs.)

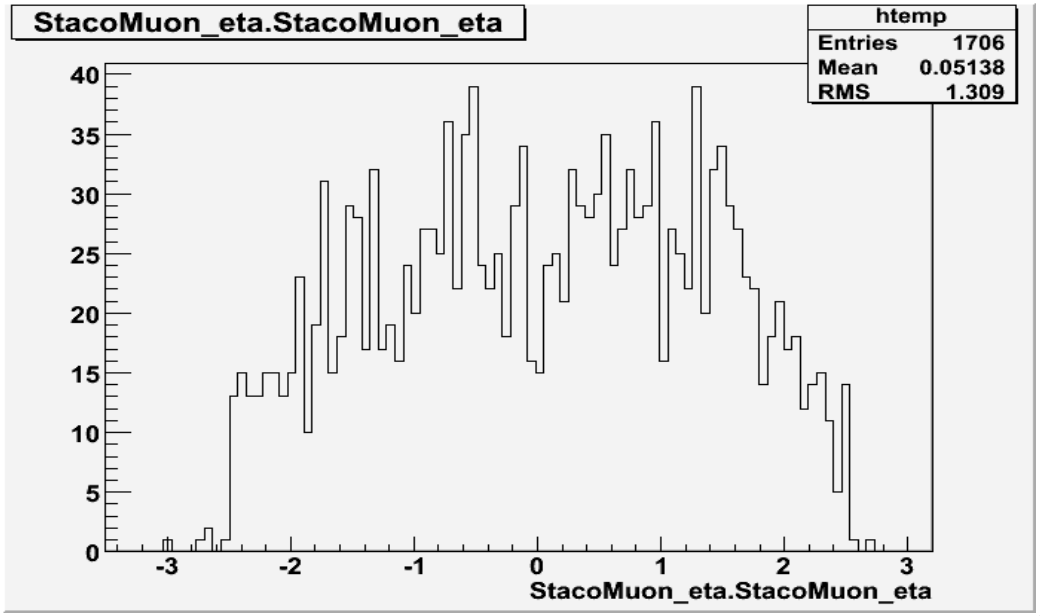
Production test performed with release 14.5.0 (1500 events):

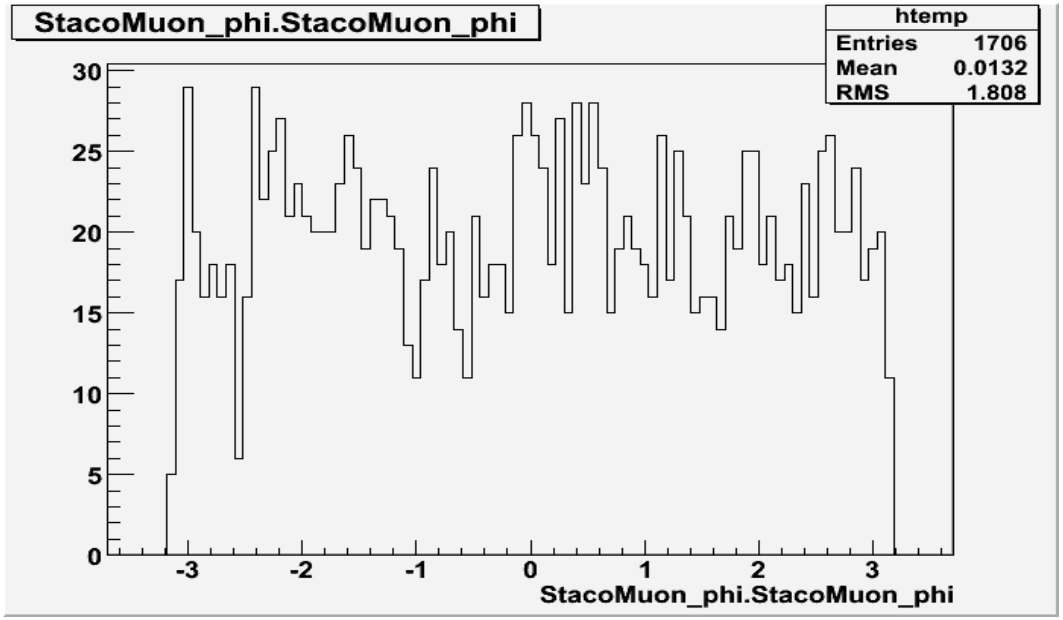
Production chain: EVNT-> HITS -> RDO -> AOD -> D3PD

HITS and RDOs have been produced with the official script (csc_simul_trf.py).
AODs produced with RecExCommon
D3PDs with EWPA (to start basic consistency checks)

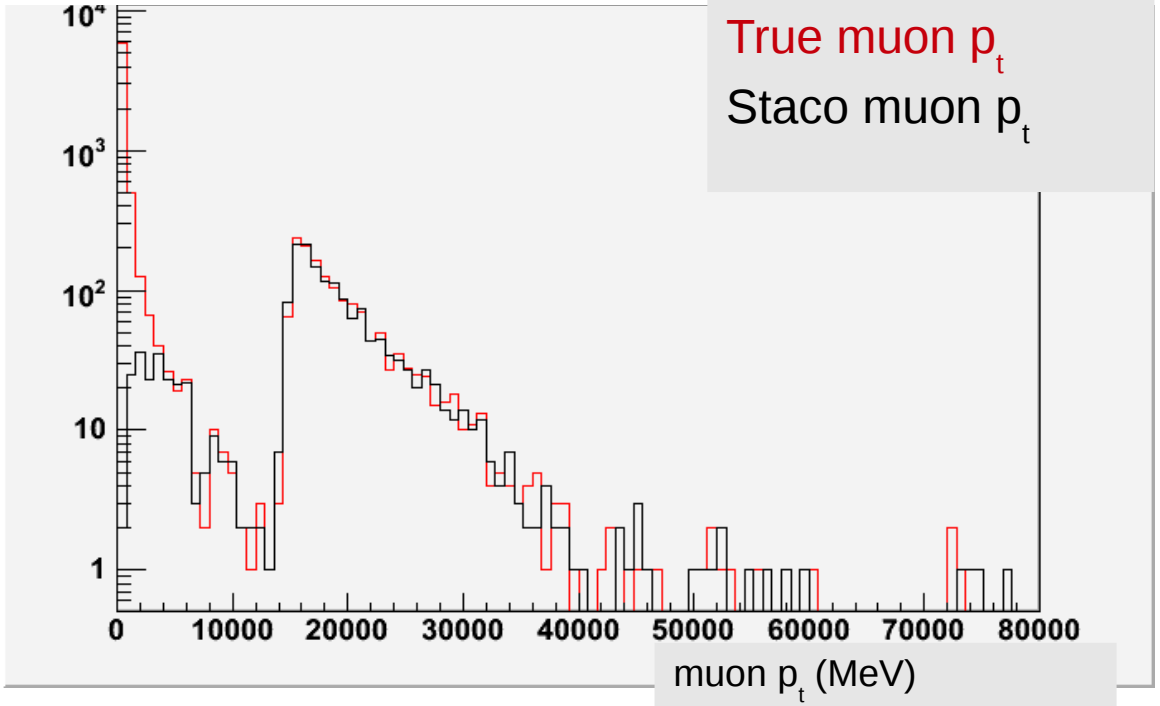
Results seem reasonable.

bb backgrounds (II)





Plots from the test production



bb backgrounds (III)

Requirements for 1M events production.

EVNT files already downoaded
(200 files for a total of 20 GB).

File sizes (per event):
- EVNT 0,02 MB
- HITS 1 MB
- RDO 0.5 MB
- AOD 0.13 MB
- D3PD 0.05 MB

Total size for 1M events : ~ 2 TB

CPU time (per event):
- atlfast ~60 sec
- RecExCommon ~15 sec
- EWPA ~100 msec

CPU time for 1M events:
atlfast:
17.000 h => 708 days/CPU
with 50 CPUs => 14 days
with 80 CPUs => 9 days

RecExCommon:
2.000 h => 83 days/CPU
with 50 CPUs => 2 days

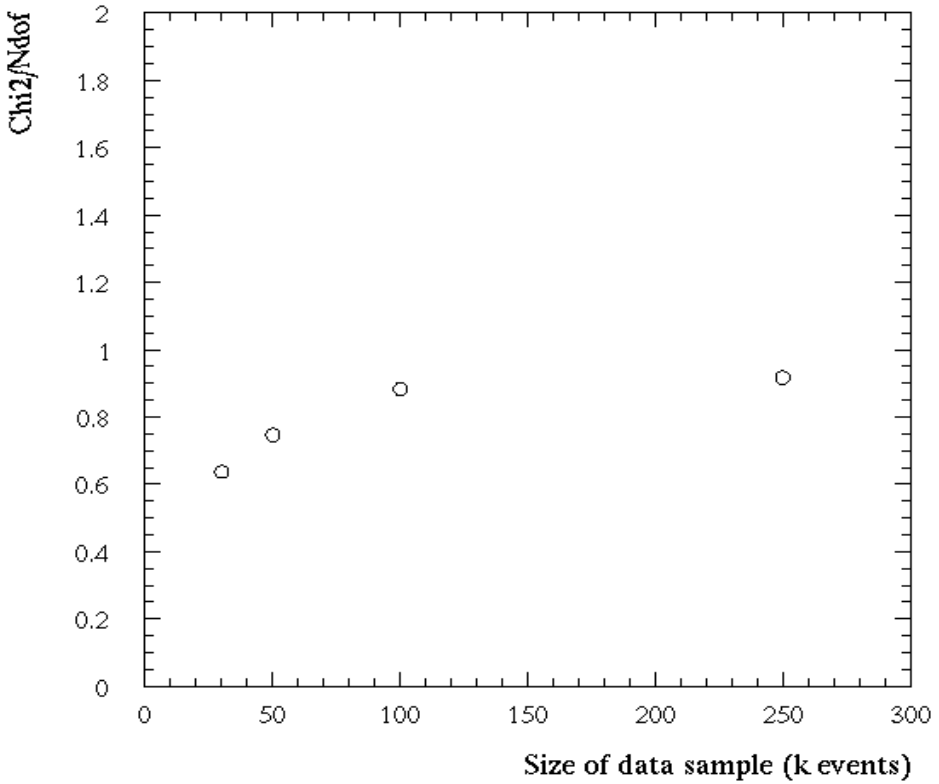
EWPA:
28 h (negligible)

Application of the method

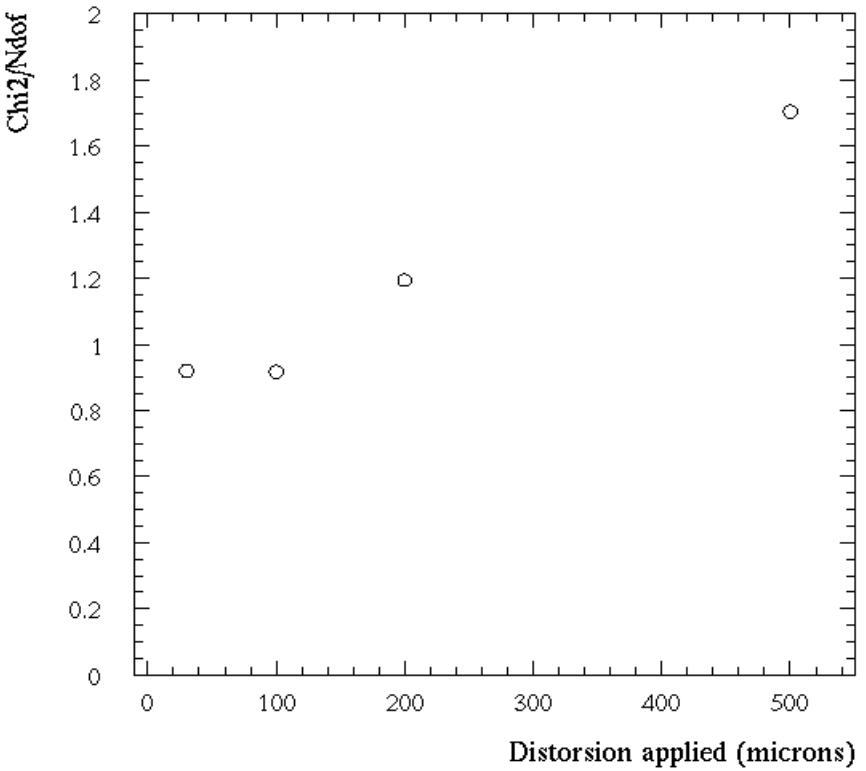
Signal only is considered in “data” and “MC” samples. No background considered for the moment.

Look at the χ^2 first

chi2/ndof vs size of the “data” samples (for a distorsion of 100 microns)

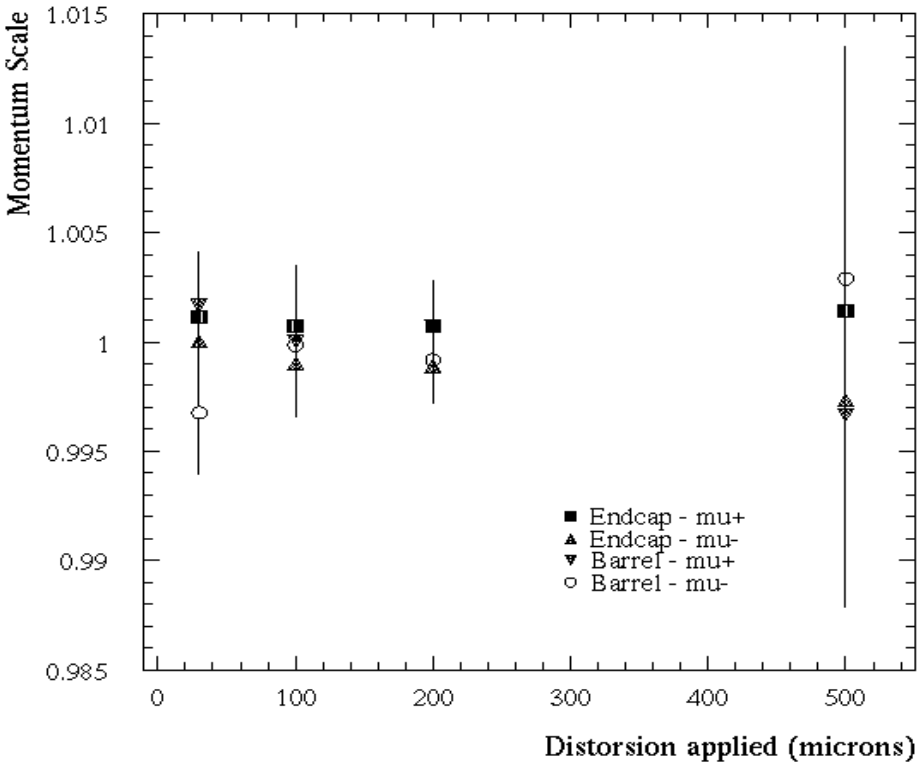


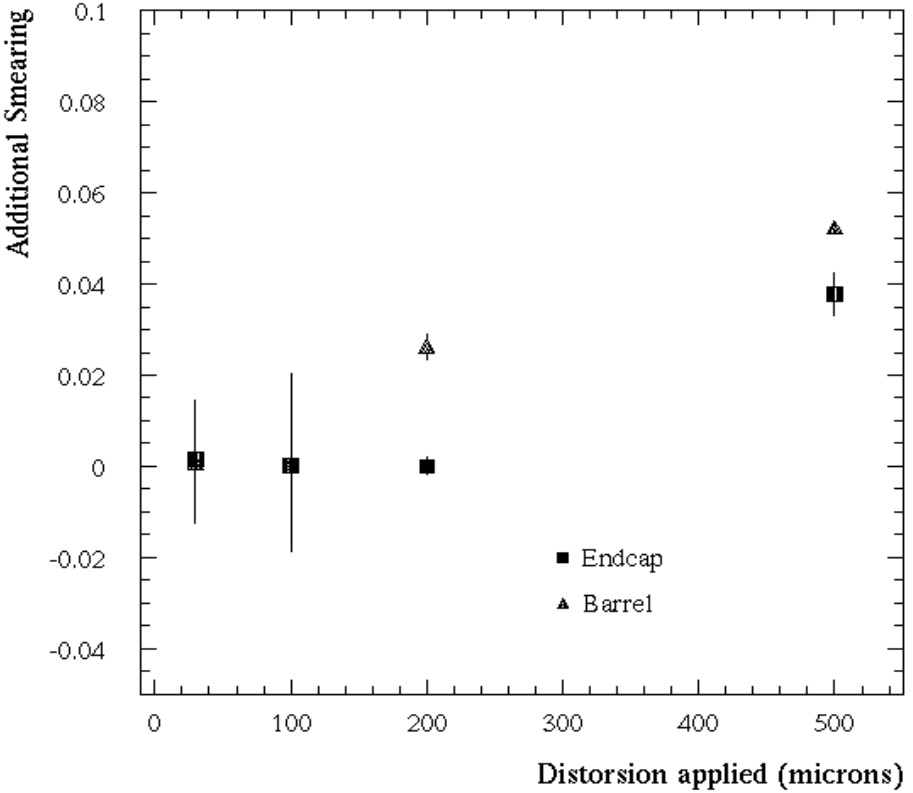
chi2/ndof vs distorsion for “data” samples of ~250k events



Application of the method

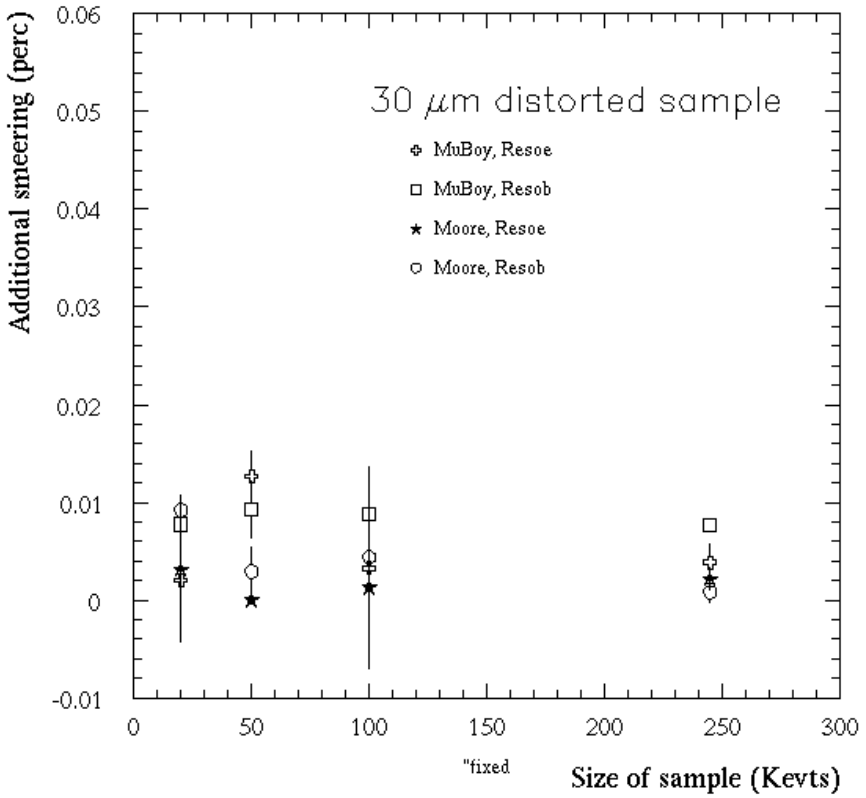
Variations of the parameters as a function of the distorsion in the “data”



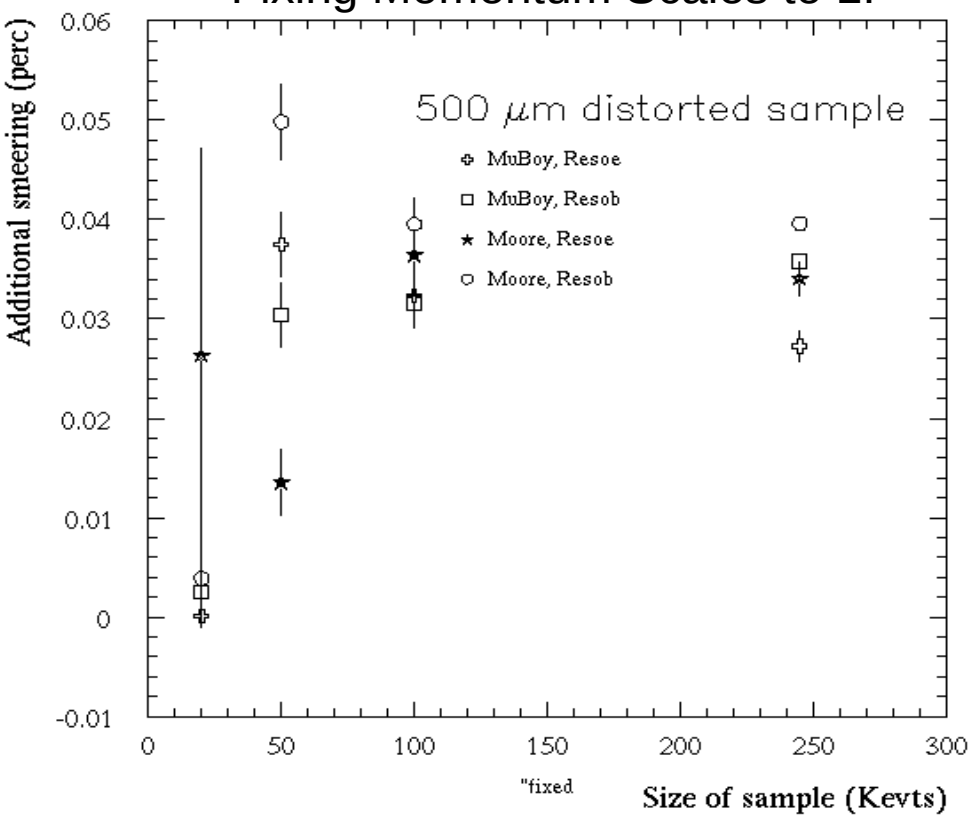


Application of the method

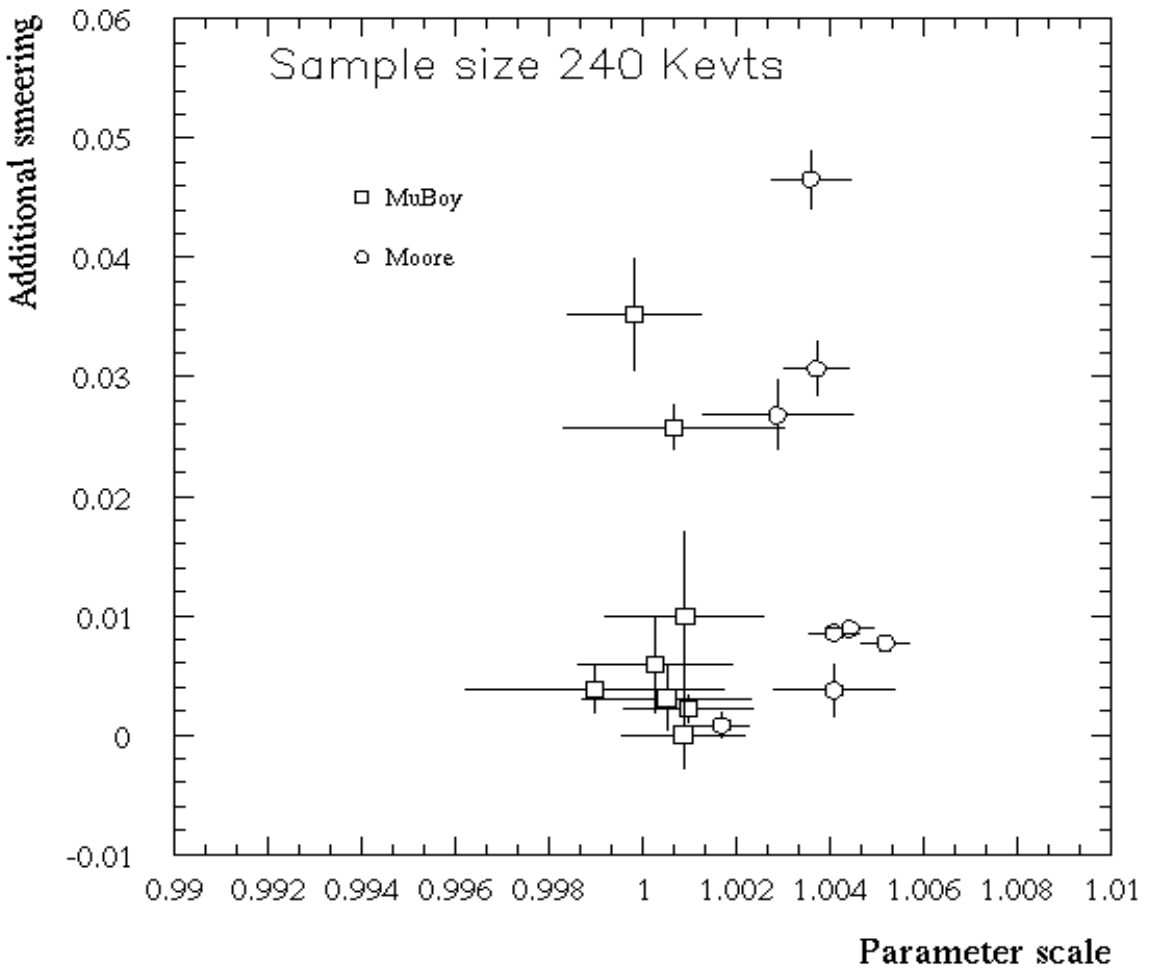
Variations of the parameters as a function of the “data” samples size



Fixing Momentum Scales to 1.



Correlations

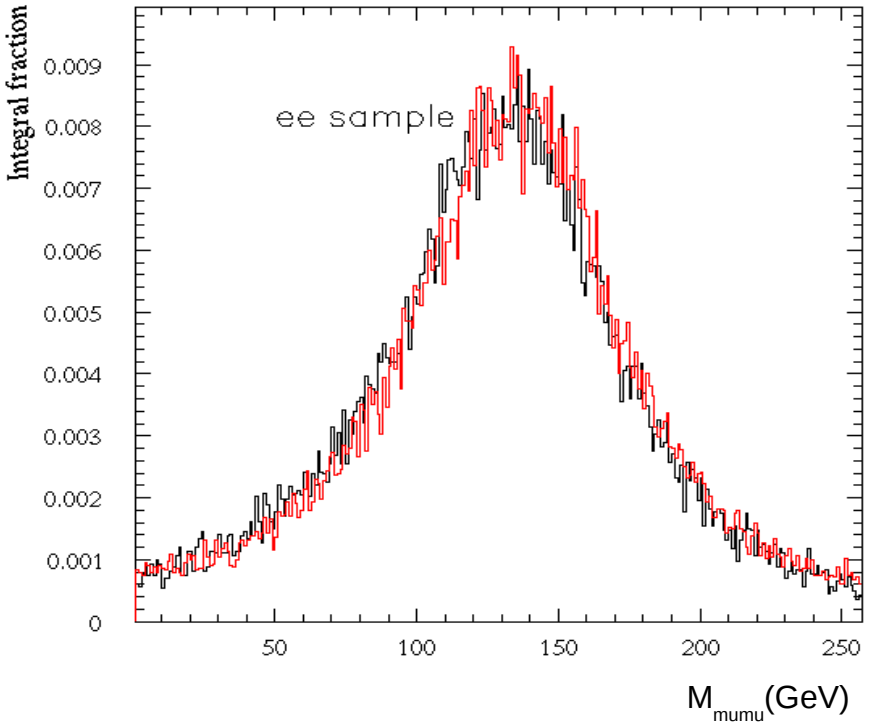


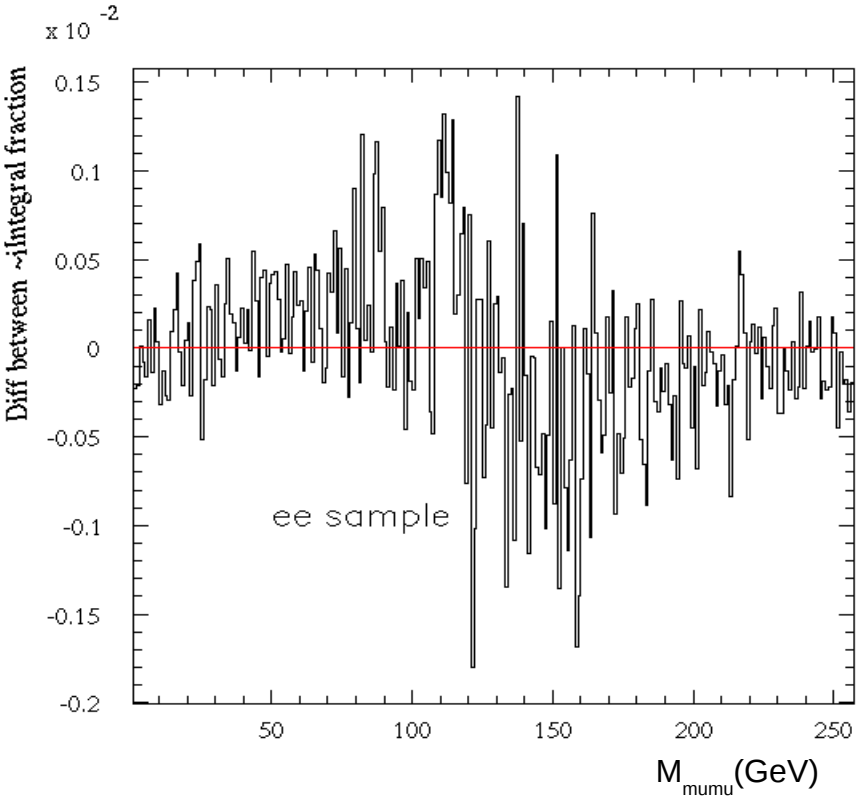
Additional smering
vs
scale parameter

(4 distorsion, MuonBoy & Moore, Barrel and Endcap)

A constant term?

Trying to improve the quality of the fit.
Comparison between M_{mumu} distribution in the “data” (black) and in the corrected MC (red).
A shift of the peak is observed. Is the constant term needed? (testing...)





Conclusions and plans

- Finalize the parametrization and the algorithm;
- How to test other effects than misalignment?
- Start to introduce background (a parametrization of W->munu, then bbmu...);
- Work on D3PDs for the moment, then merge into EWPA and benchmark analysis.