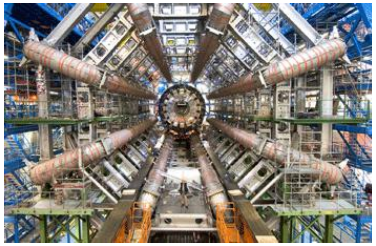


Combined Muon Performance:
muon momentum scale

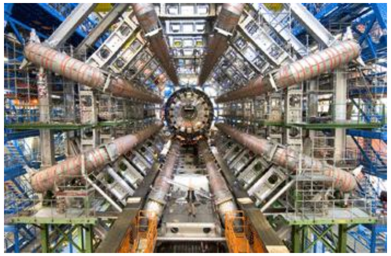
In Roma Tre, we started to have a look to the problem of determining the muon momentum scale.

Using the Z lineshape is our first attempt.

We are using the EWPA framework.

EWPA is a modular framework (developed by M.Bellomo and already used for some physics and trigger studies) that allows to:

- accessing information from AOD through StoreGate service
- pre-filter particles when reading
- remove overlap between objects
- make track-matching
- calculate general User Data information and attach it to the relevant objects
- save all of that on disk to iterate analysis over more steps
- easy the development of new analysis tools in Athena since many services are already in place



Combined Muon Performance: muon momentum scale

A new tool is beeing developed **(EWMuCP)** for the studies on muon momentum scale. The test of the algorithms done with root macros running on DPDs created with EWPA and then they are ported into the tool.
Using the dataset: trig1_misal1_csc11_V1.005145.PythiaZmumu.recon.AOD.v13003002

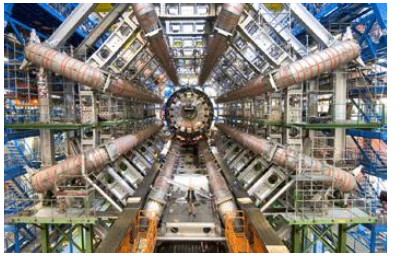
We use the proposed parametrization for the muon moment variation which takes into account the variations in the B field, in the alignment and in energy loss.

$$\delta p = p_{MS}\left(\delta\bar{B} + \frac{p_{MS}}{q\left|\int_P \vec{B}\times d\vec{l}\right|}\bullet\delta gr\right) + (1+\varepsilon)E_{loss}$$

B field variations

Misalignment

Energy loss variations



Two following steps as a startup procedure:

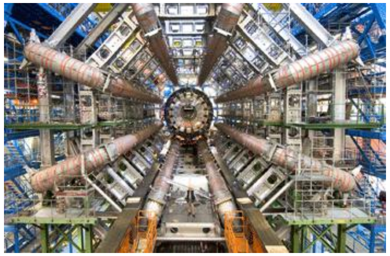
1. Study the effect of δB, δgr and ε variations on a set of quantities (Z mass, Z width, asymmetry, ...);
2. Determination of the variations using a constrained fit on an event by event base minimizing a X^2.

In the X^2, δB, δgr and ε are fit parameters:

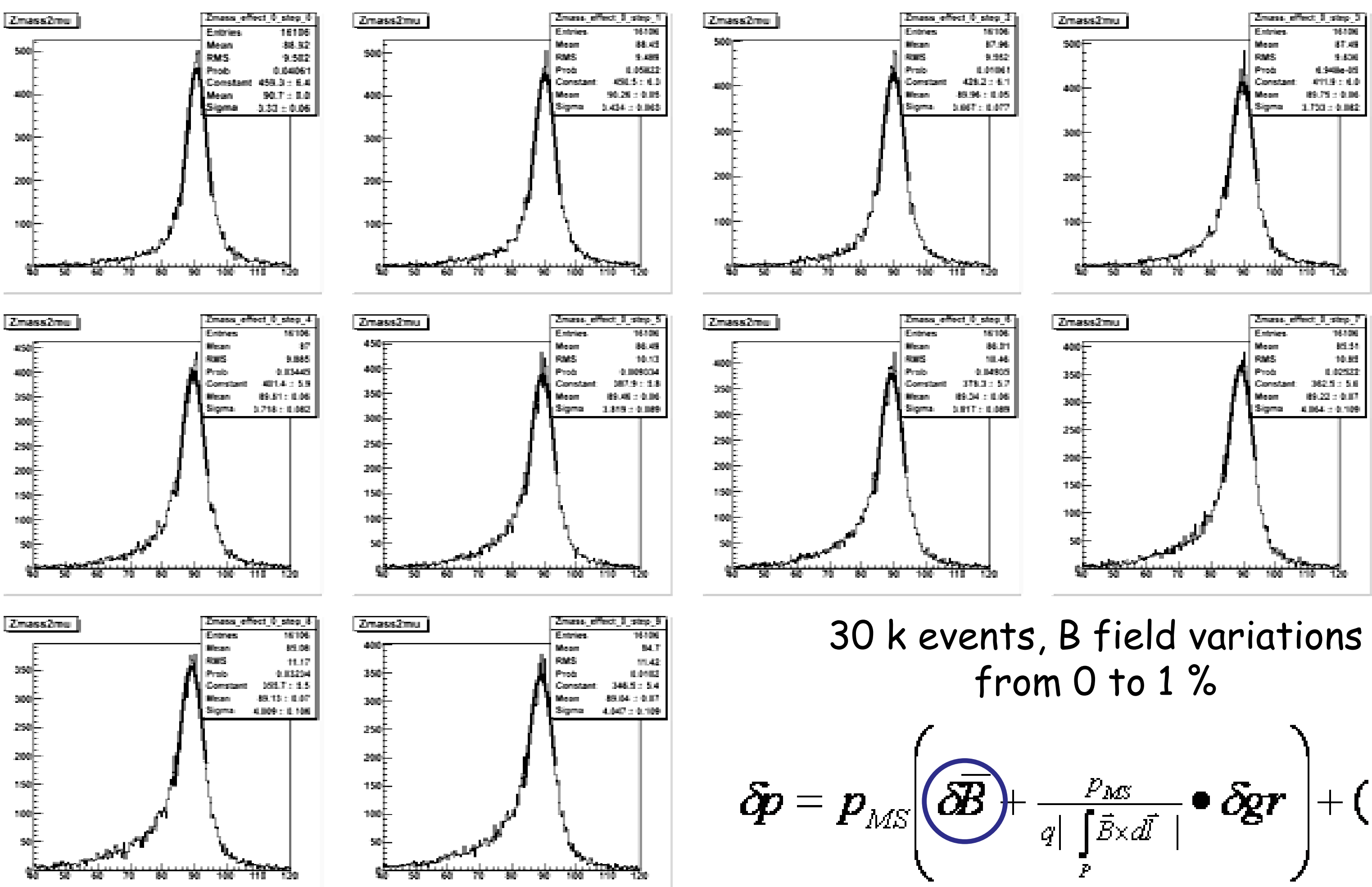
$$X^2 = \left(\frac{\delta \overline{B}}{1\%(?)}\right)^2 + \left(\frac{\delta gr}{500\,\mu m(?)}\right)^2 + \left(\frac{\varepsilon}{5\%(?)}\right)^2 + \frac{(M_{inv} - 91)^2}{\Gamma_Z^2} + ?$$

'?' indicates that the scales of the variations should be investigated and optimized and that other terms can be added (i.e. width, asymmetry, ...)

The values of δB, δgr and ε which minimize this X^2 are the corrections to apply to the data to obtain the proper momentum scale.

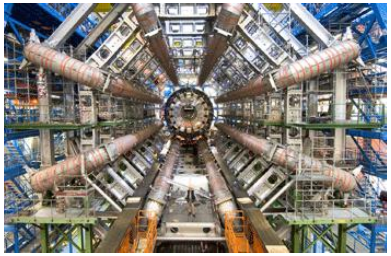


Step 1.: effects of B field uncertainty



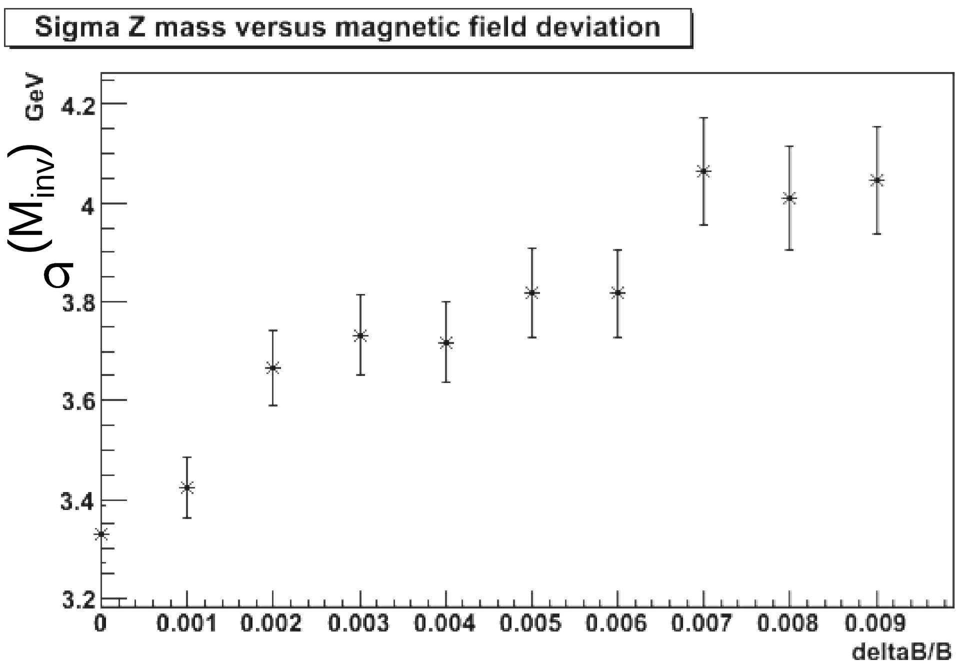
30 k events, B field variations from 0 to 1 %

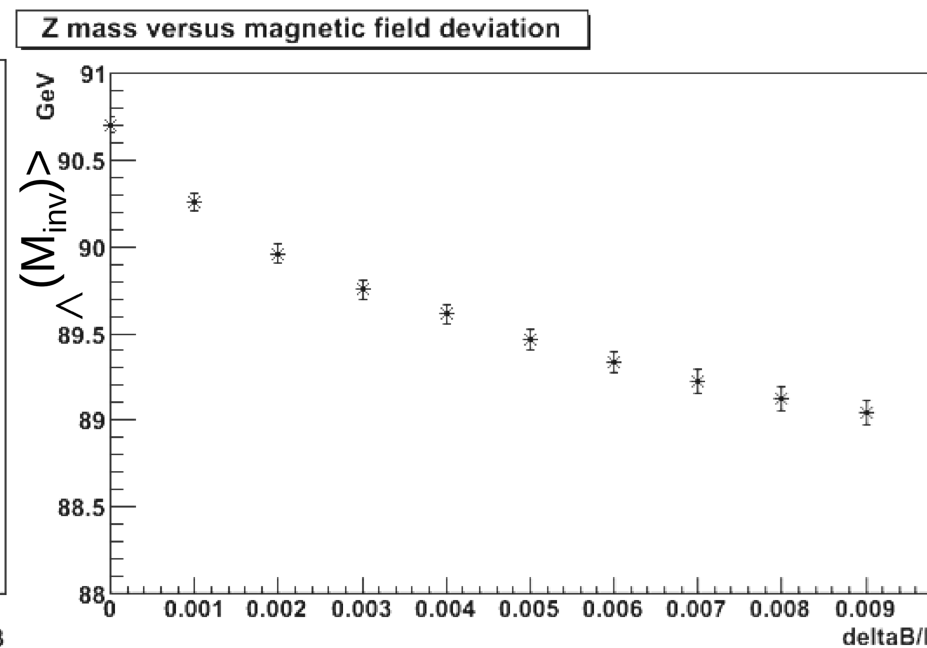
$$\delta p = p_{MS}\left(\overline{\delta B} + \frac{p_{MS}}{q\left|\int_{P} \vec{B}\times d\vec{l}\right|}\bullet \delta gr\right) + (1+\varepsilon)E_{loss}$$



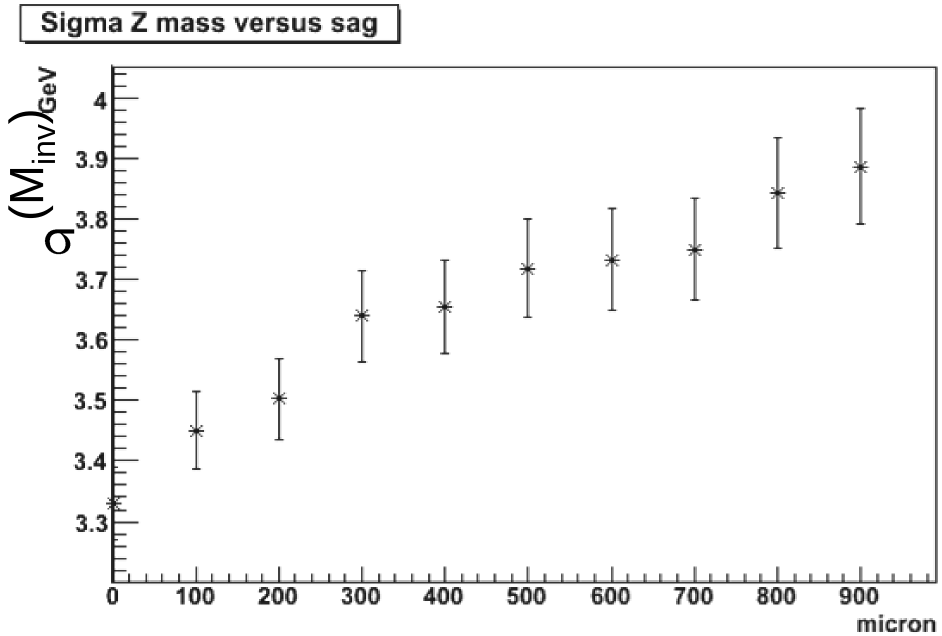
Step 1.: effects of B field uncertainty

$$\delta p = p_{MS}\left(\delta\bar{B} + \frac{p_{MS}}{q\left|\int_{P} \vec{B}\times d\vec{l}\,\right|}\bullet \delta gr\right) + (1+\varepsilon)E_{loss}$$

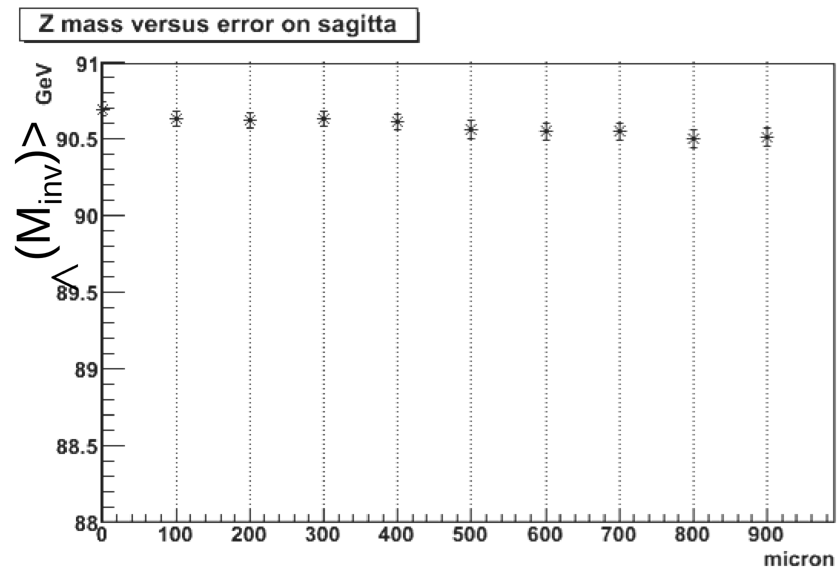


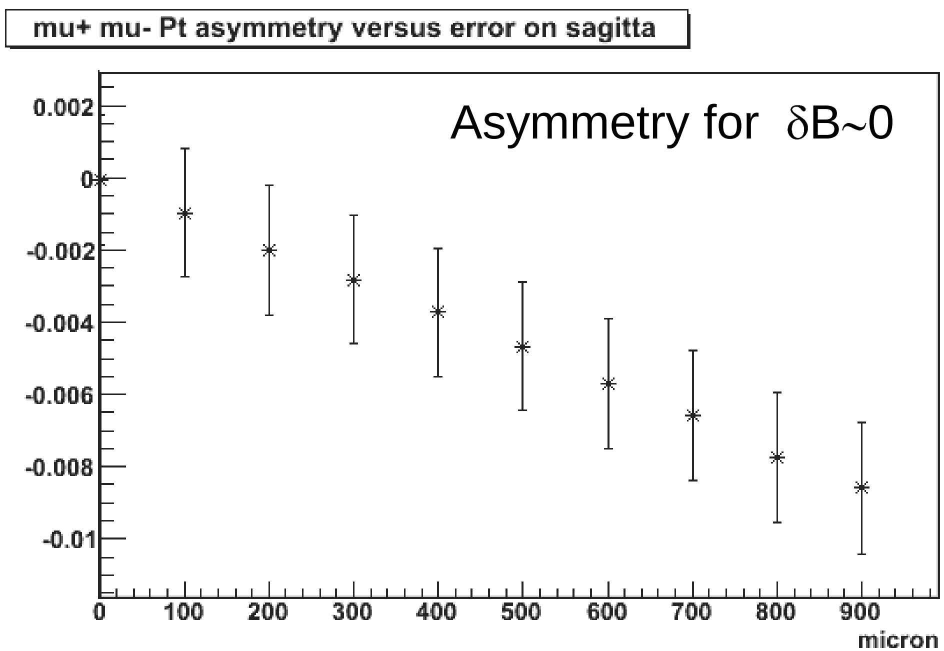


Step 1.: effects of misalignment



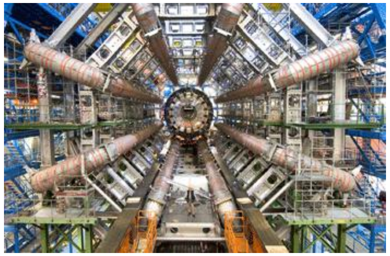
$$\delta p = p_{MS}\left(\delta\overline{B} + \frac{p_{MS}}{q\left|\int_{P}\vec{B}\times d\vec{l}\right|}\bullet\delta gr\right) + (1+\varepsilon)E_{loss}$$



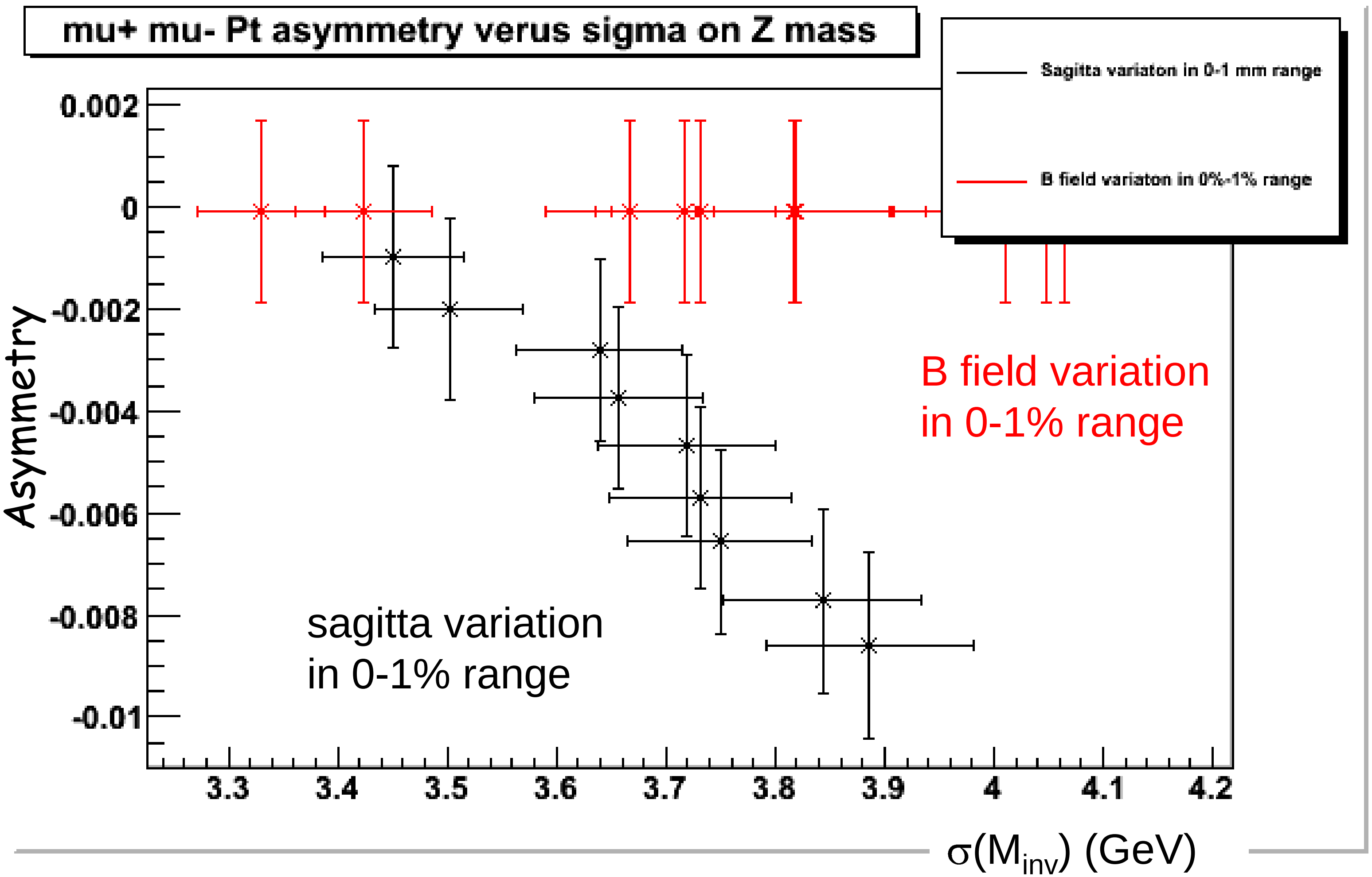


RE

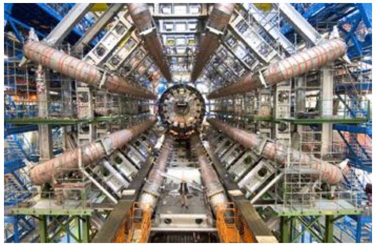
$$Asymmetry = \frac{p_t^+ - p_t^-}{p_t^+ + p_t^-}$$



$$\delta p = p_{MS}\left(\delta B + \frac{p_{MS}}{q\left|\int_P \vec{B}\times d\vec{l}\right|}\bullet \delta gr\right) + (1+\varepsilon)E_{loss}$$



Step 2.: X^2 minimization

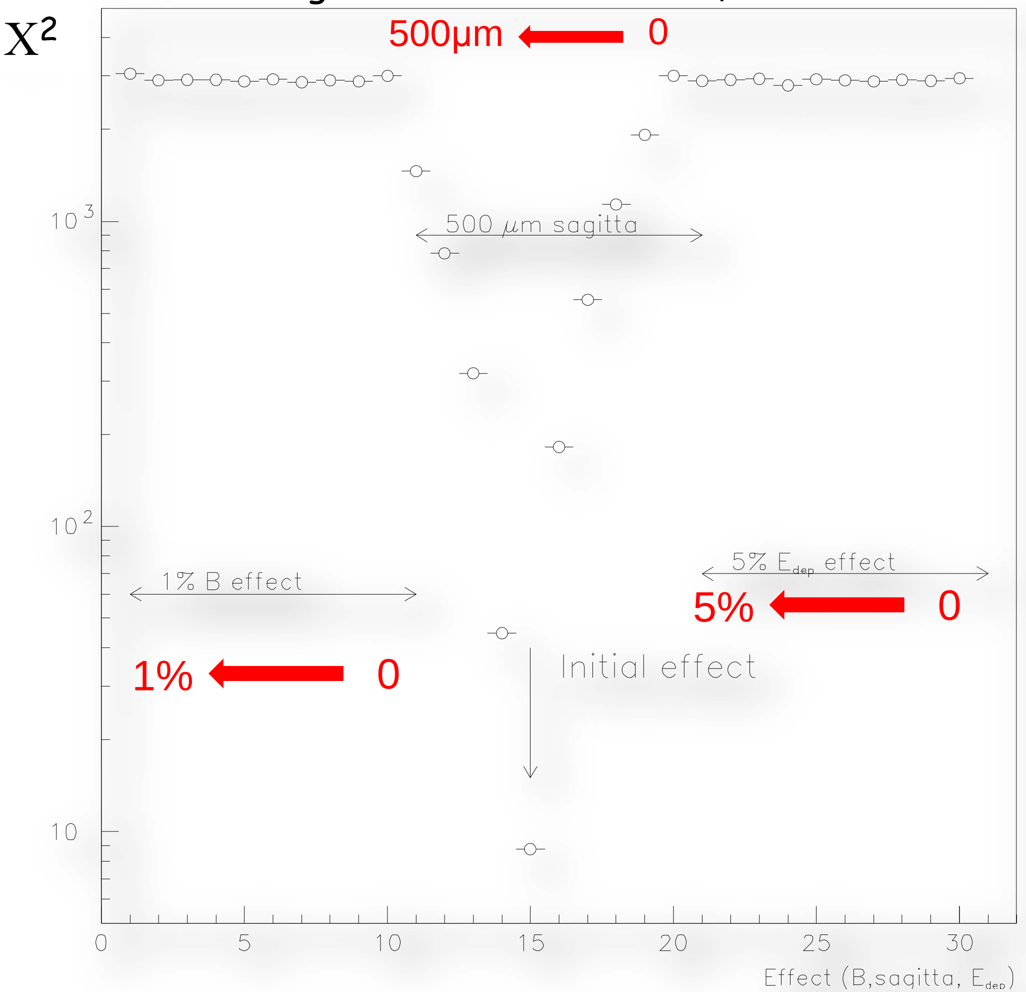


As a first test, only one initial effect is taken into account at a time.

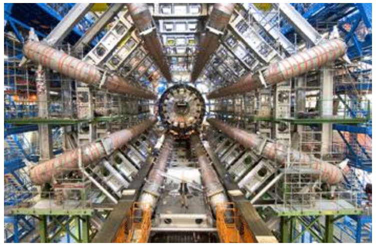
The X^2 minimization is done with a scan over the possible δB, δgr and ε values.
The scan is done on one parameter fixing the other to 0.

The minimum is found in good agreement with the "simulated" distorsion.

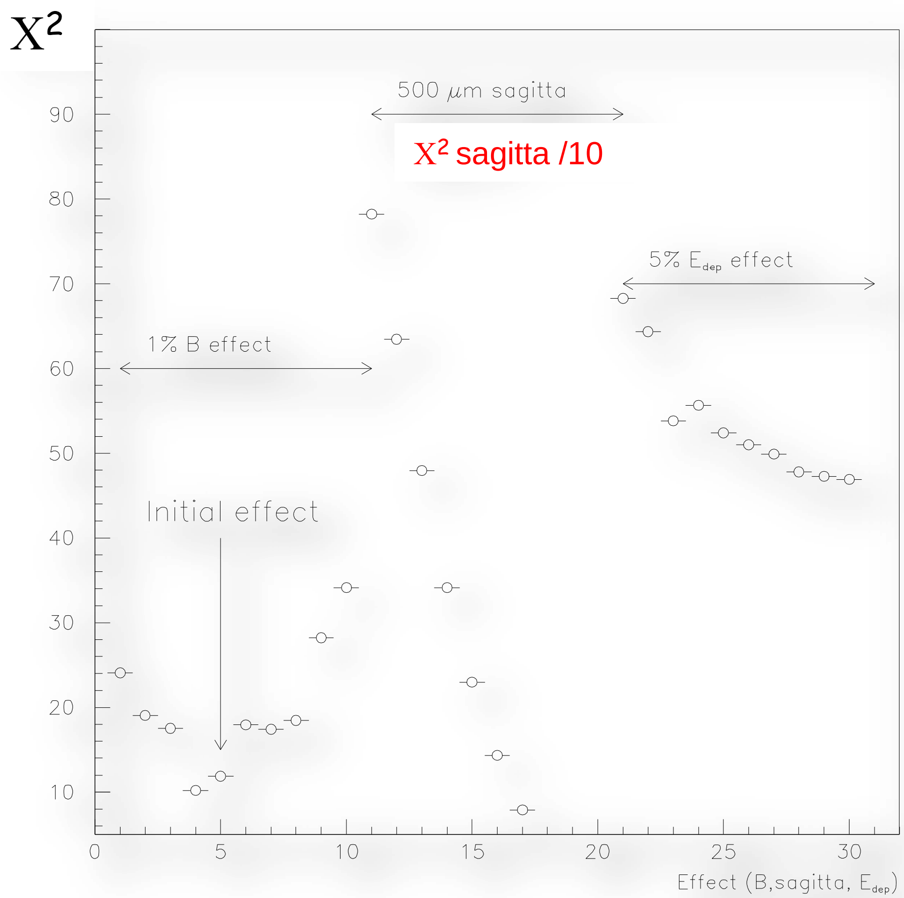
Initial sagitta distorsion of 250 μm



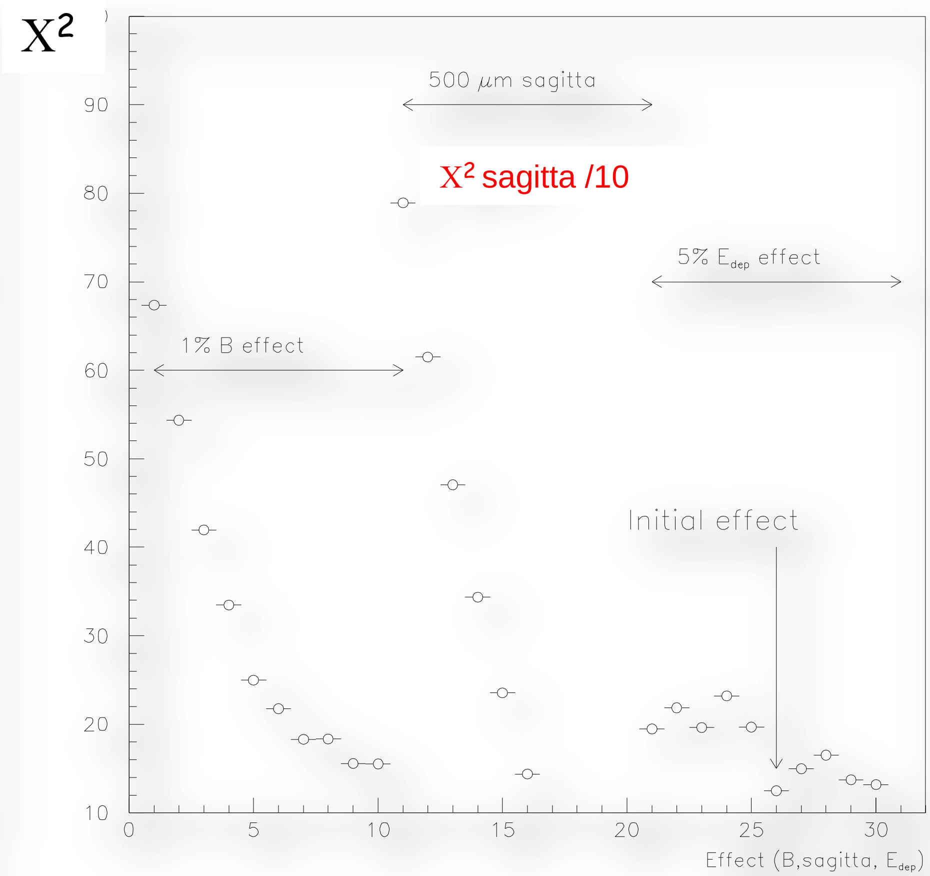
Step 2.: χ^2 minimization

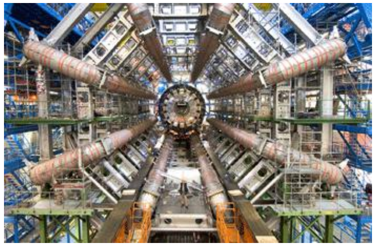


Initial bfield variation of 0.5 %



Initial eloss variation of 2.5 %





Conclusions

- The first tests are incouraging.

- We should introduce a momentum distorsion which is dependent on the position in the detector.

- The X^2 minimization should be done varying together the 3 parameters.