The proposed Z scan will have three (main) points.

As displayed in Fig. 3.1, the statistical uncertainty of this measurement of QED(mZ) is optimised just below (ECM = 87.9 GeV) and just above (ECM = 94.3 GeV) the Z pole.
The half integer spin tune energy points

ECM = 87.7 GeV (v_spin = 99.5) or ECM = 88.5 GeV (v_spin=100.5)

and ECM = 93.9 GeV (spin = 106.5) or ECM= 94.7 (v_spin= 107.5)

are close enough in practice.

Together with the peak point at ECM = 91.2 GeV (v_spin = 103.5) they constitute the proposed Z-pole run plan; about half the luminosity will be taken at the peak point.
This scan will at the same time provide measurements of the Z mass and width with very adequate precision.

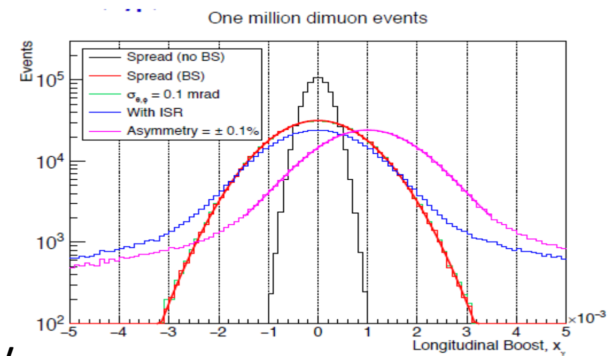
Point to point luminosity and energy errors will dominate the systematics in the measurements of the Z width, the Z pole asymmetry and perhaps alpha_QED.

Lets concentrate for today on energy errors.

We have several measurements sensitive to the center-of mass energy and beam energies
1. from the e+e- → mu+ mu- events:

$ECM = (E_b^+ + E_b^-) \cos(\alpha_{crossing}/2)$
Boost : $P_{\mu+} - P_{\mu-} = (E_b^+ - E_b^-)$
muon momentum $ECM \sim P_{\mu+} + P_{\mu-}$

we can monitor the boost from the mumu acollinearity
and the ECM from the muon momentum spectrum.
The precision on each 45 GeV muon is 50-100 MeV.
with 2000 /nb/s ($2 10^{36}$/cm2/s) and a cross section of
1.4 nb at the peak 0.14 nb at the peak-4 point



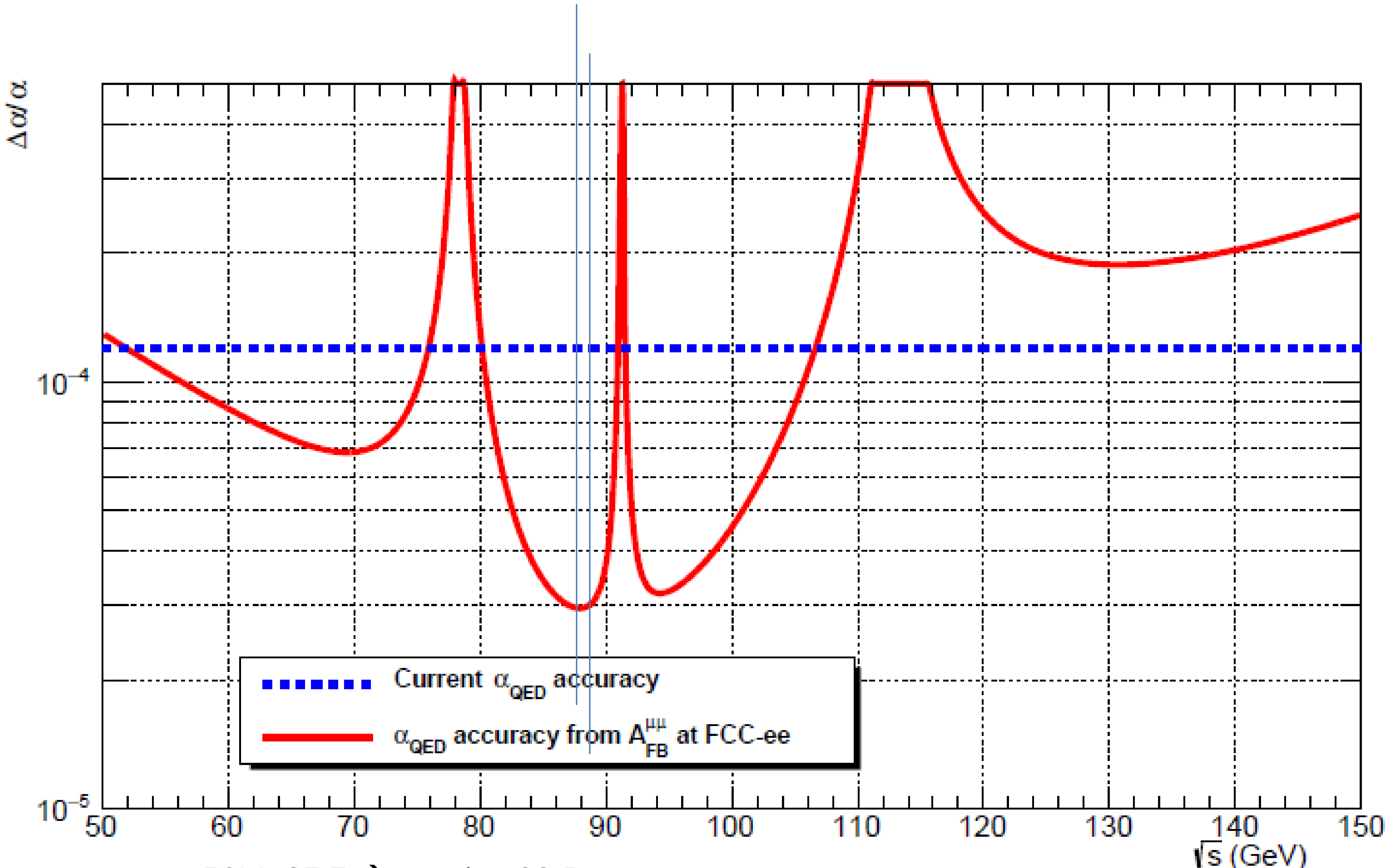
this is 280/s or 10^6/6min muon pairs at peak
this is 28/s or 10^6/hr muon pairs at «peak-4» ECM = 87.7 GeV point.

➔ 1. we can monitor the energy difference to 45 MeV every 6 minutes (hour) in each detector

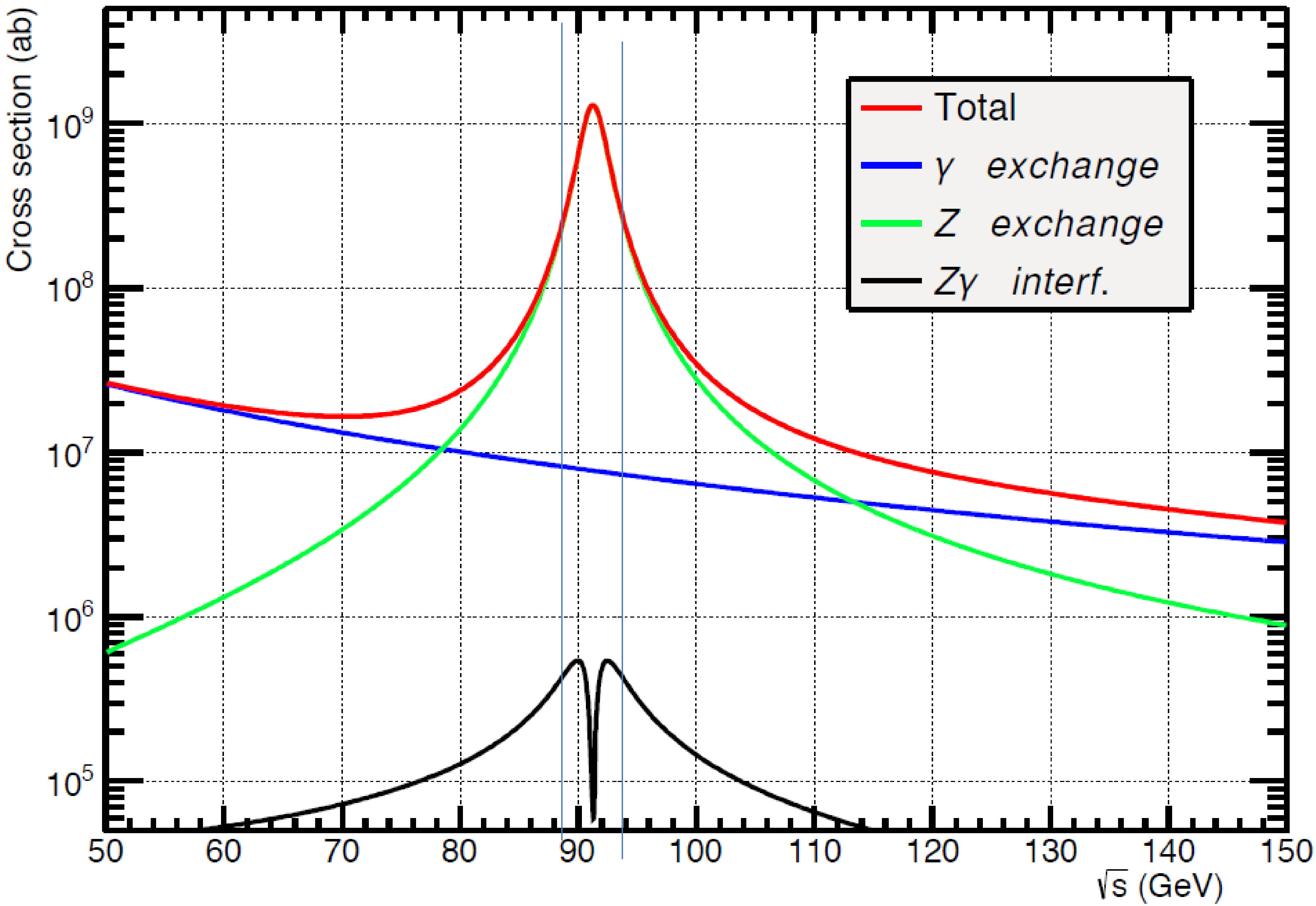
➔ 2. we can monitor the center of mass with this same precision
from the momentum of the muons themselves.

over the full exposure of 10^7s at each scan point this represents a measurement of the average with a precision of 1keV at the peak and 2.7 keV at the off-peak point.

Of importance is the monitoring of the stability of the magnetic field in the detector.



ECM=87.7 → v_spin= 99.5



Cross section (ab)
10^9
10^8
10^7
10^6
10^5
50
60
70
80
90
100
110
120
130
140
150
$\sqrt{s}$ (GeV)
Total
γ exchange
Z exchange
$Z\gamma$ interf.

The polarimeters are also equipped to spectrometers, which measures each of the beam energies with a precision of **+- 4 MeV every second.**

This is an independent monitoring of the stability of the beam which over 10^7 seconds of each scan will average to +- 1.5 keV. (here all scan points are equal)

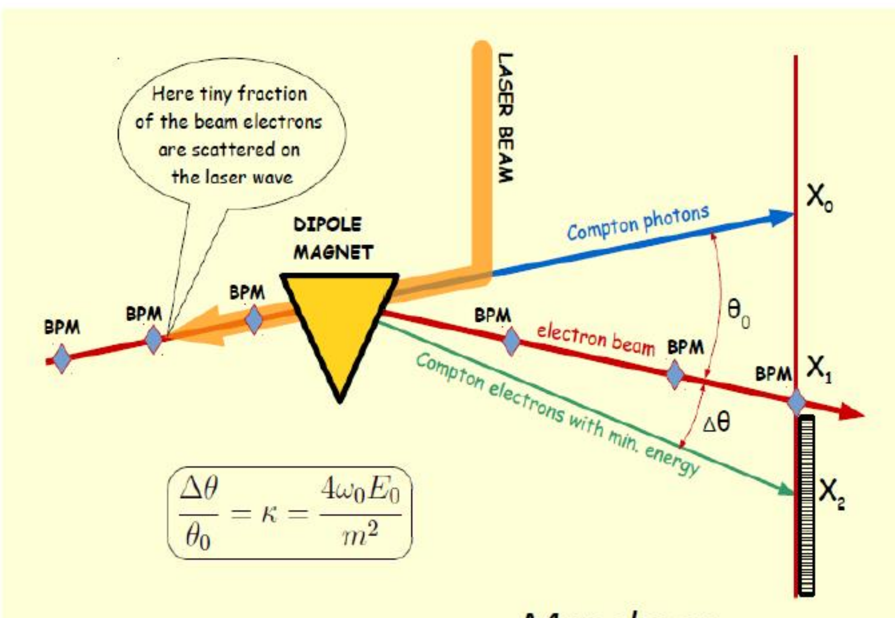
Hardware requirements: polarimeters

2 Polarimeters, one for each beam

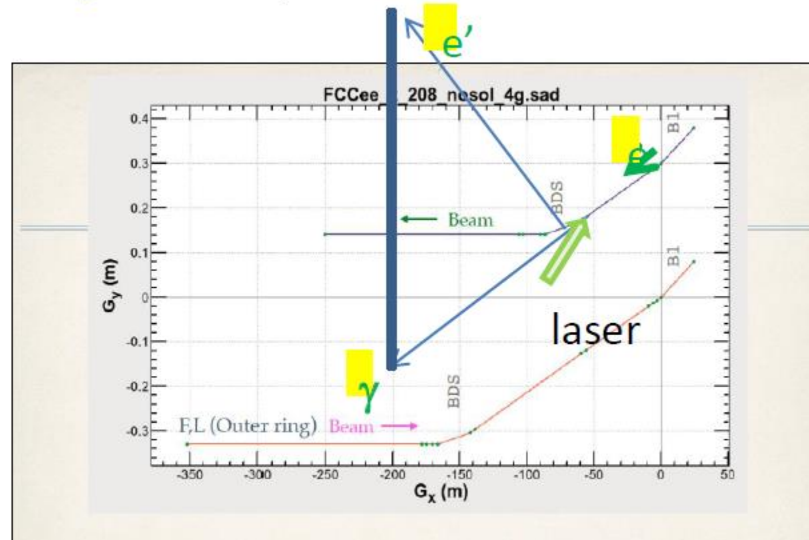
Backscattered Compton γ +e $\rightarrow \gamma$ + e **532 nm (2.33 eV) laser; detection of photon and electron.**

Change upon flip of laser circular polarization → beam Polarization ±0.01 per second

End point of recoil electron → beam energy monitoring ± 4 MeV per second



Munchnoy



install photon-electron IP on inner ring in points H and F *(Oide)*

polarimeter-spectrometer situated 100m from end of dipole.

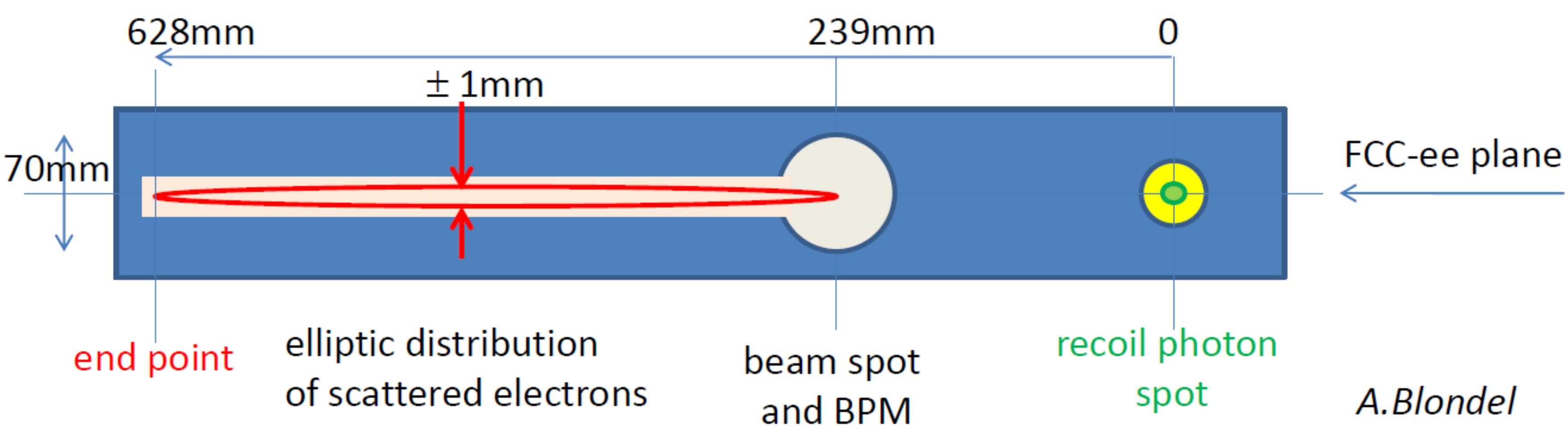
Using the dispersion suppressor dipole with a lever-arm of **100m** from the end of the dipole, one finds

-- minimum compton scattering energy at 45.6 GeV is 17.354 GeV

-- distance from photon recoil to Emin electron is 0.628m

	laser (eV)	beam (GeV)	mc2(MeV)	B field	R	LM	theta	L	true beam
	2.33	45.6	0.511	0.013451	11300	24.119	0.002134	100	45.60005
nominal kappa = 4. E_laser.Ebeam_nom/mc2	1.627567296								
true kappa = 4. E_laser.Ebeam_true/mc2	1.627568924								
nominal Emin	17.35445561								
true Emin	17.35446221								
position of photons	0								
nominal position of beam (m)	0.239182573								
true position of beam (m)	0.239182334	2.39182E-07							
nominal position of min (m)	0.628468308								
true position of min (m)	0.628468069	2.39182E-07							

mouvement of beam and end point are the same:
0.24microns for $\delta Eb/Eb=10^{-6}$ ($\delta Eb=45keV$)



A.Blondel

conclusions

-- we should be able to reduce the point-to-point energy errors to below the 8 keV level of the Z width statistical uncertainty both from the muon momentum and beam spectrometer.

-- same is true for the muon AFB and the determination of alpha_QED.

-- this will require devices to monitor the stability of the magnetic fields

-- also the scan points should be interleaved.