Momentum considerations

RECAP:

- A maximum miscalibration of $4.5\mathrm{x}10^{-5}$*Ebeam (=6 MeV) can be tolered (to have 10^{-5} on σ)
- The energy is reconstructed by solving the relation $E\mu=2me/\theta^2$. For E=150 GeV this equation gives θ= 2.5 mrad for which $E_e=E\mu'$ =75 GeV.
- $\sigma_E/E=4.5\mathrm{x}10^{-5} \rightarrow \sigma_\theta/\theta \sim 2\mathrm{x}10^{-5}$ which at θ= 2.5 mrad gives $5\mathrm{x}10^{-5}$ mrad
- At these energies on 1 cm Be $\sigma_\theta=0.02_{MS} \oplus 0.02_{Det}$ ~0.035 mrad. To reach $5\mathrm{x}10^{-5}$ mrad on $\sigma_{<\theta>}$ we need to improve a factor 1000 i.e. collect 10^6 events ($\sigma_{<\theta>} \sim \sigma_\theta/\sqrt{N}$)
- ds/dθ(2mrad)~1μb/mrad. By assuming a bin width=0.1 mrad$\rightarrow$~100nb. By multypling for the flux expected with 1 cm Be f = $0.4/60\mathrm{nb}^{-1}\mathrm{s}^{-1}$ [passera] the number of expected rate is $0.7\mathrm{s}^{-1}$. Therefore a measurement of the average beam momentum at the required statistical accuracy of 10^6 can be obtained in ~10^6 sec=2 weeks

Momentum considerations II

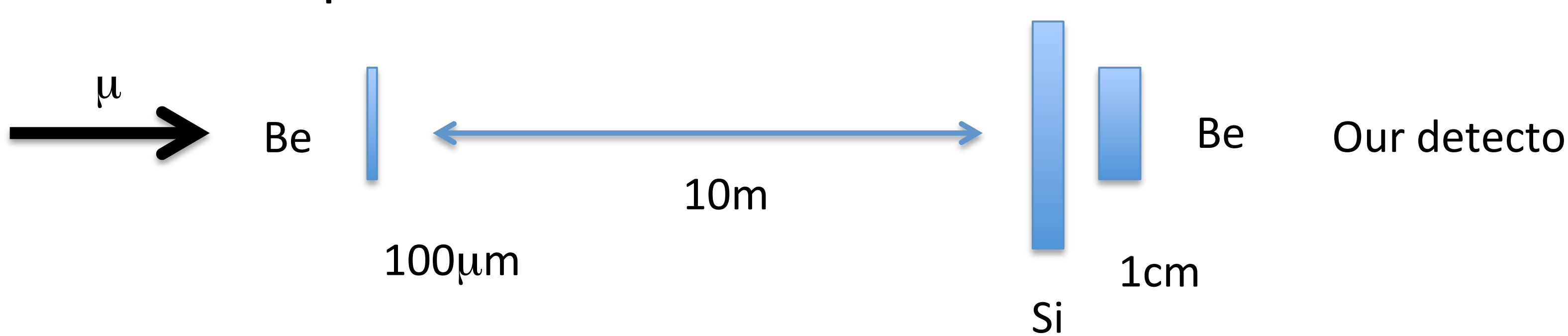
Of course the systematics are the major point. We need to control the angle at $5x10^{-5}$ mrad which needs a precise alignment using muons of the beams and other methods…

Here I discuss a possible way to intercalibrate the different units.:

- The energy loss in 1 cm Be is: 1.6 [MeV/g*cm2]*1.85[g/cm3]*1cm=3 MeV. Let's add 2mm Si (=6 layers)=0.8 MeV→ 4 MeV.
- If we assume to know this accuracy at 10% level it it gives a negligible error. Two adiacent modules should see the same energy! In this way we can intercalibrate the modules amongt them (of course we cannot correct for global misalignment/miscalibration/mistakes).
- It becames a math problem where we have n (60) measurements of E and (n-1) constraints

Momentum measurement

- The measurement of the momentum at 4.5×10^{-5} is not trivial. As I said this means to reach an accuracy $\sigma_\theta/\theta \sim 2\times10^{-5}$ which must compare with $\sigma_{\theta/\theta} \sim 10^{-2}$ (0.035 mrad) at 2 mrad.
- The following setup could help to improve the measurement of the angle: essentially we can think to put a thin Be target of 100μm separated by 10 m from the Si detector before our apparatus. In this way we can improve 10x the resolution ($\sigma_{\theta/\theta} \sim 10^{-3}$ (0.0035 mrad) or 10^4 events to reach $\sigma_\theta/\theta \sim 2\times10^{-5}$. Of course the cross section becomes 1/100 lower but we can avoid the non gaussian MS effects. In particular in one year we could have a very precise measurement. The separation in the transverse plane after 10m will be 2 cm



2018 Work plan: a feasibility study on a_μ^{HLO} at 10-20%?

- With 60cm Be and $4x10^7$ s we will get an accuracy of 0.3%.
- Let's assume 1 week with 2 modules and 0.5 duty cycle:
  - 2 cm Be
  - 7 days*0.5 duty cycle=3.5 days=$3x10^5$ sec
- So the stat accuracy would be:

$0.003*sqrt(60x4x10^7/(2x3x10^5))=0.003*63=0.2$

→Measurement with 20% stat error seems possible

- 1 Month would give us 10%!

2018 Work plan: Test Beam for MS study?

- We should demostrate to control MS at 1% level
- TB with e- at few GeV (at CERN/SLAC)?
- TB in Frascati with 0.5 GeV (possibility to study the tail)?
- Possible? When?