Update on TOF performance at SPD

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SPD Physics Weekly meeting
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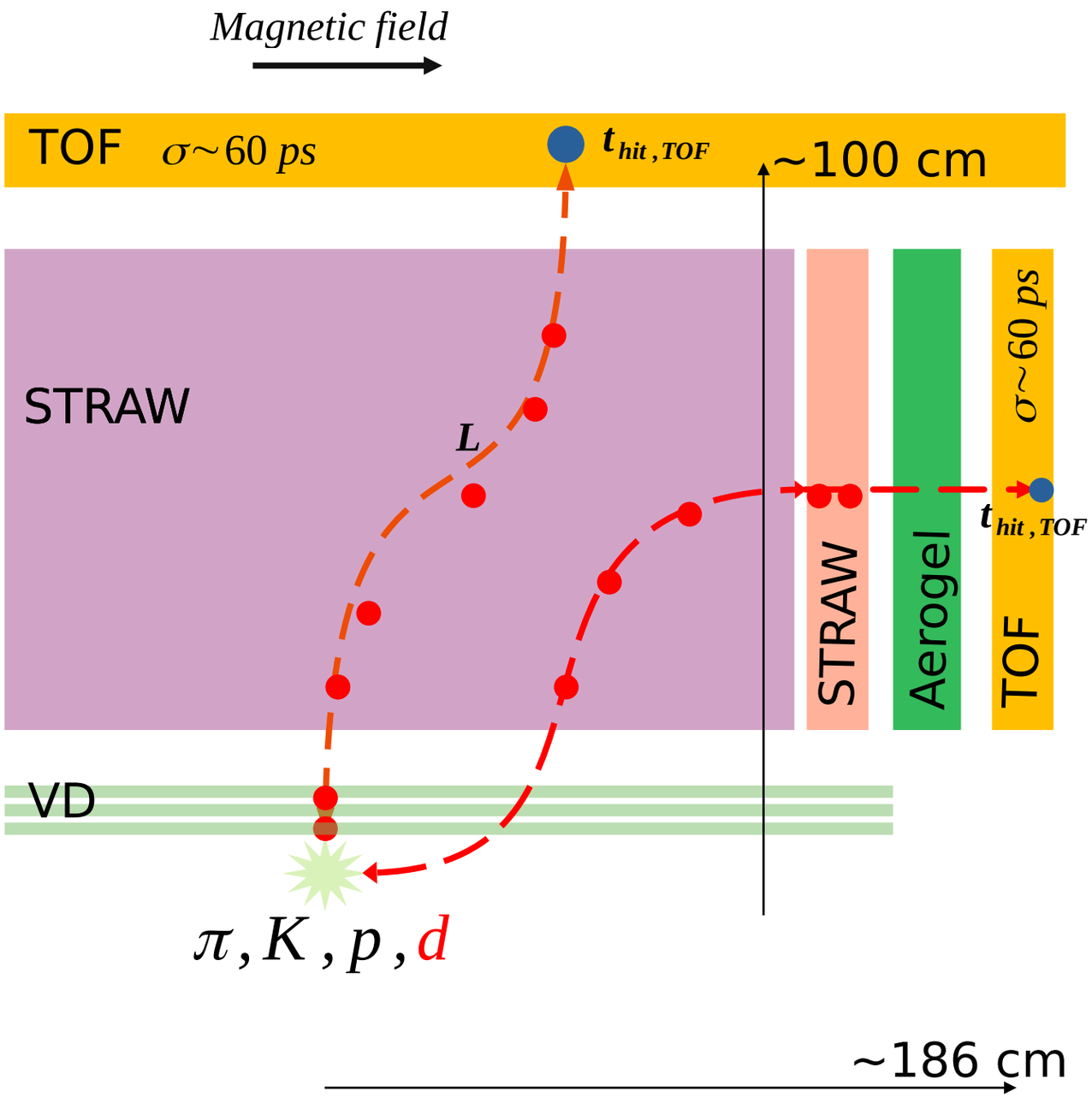
Time of Flight system



$$m^2 = \frac{p^2}{c^2}\left[\frac{t_{TOF}^2 c^2}{L^2} - 1\right]$$

$$\sigma_{m^2}^2 = 4m^4\left(\frac{\sigma_p}{p}\right)^2 + 4E^4\left(\frac{\sigma_t}{t}\right)^2 + 4E^4\left(\frac{\sigma_L}{L}\right)^2$$

from reconstruction $\sigma\sim 150\,\mu m$

$\sigma_{TOF} = 60\ ps$

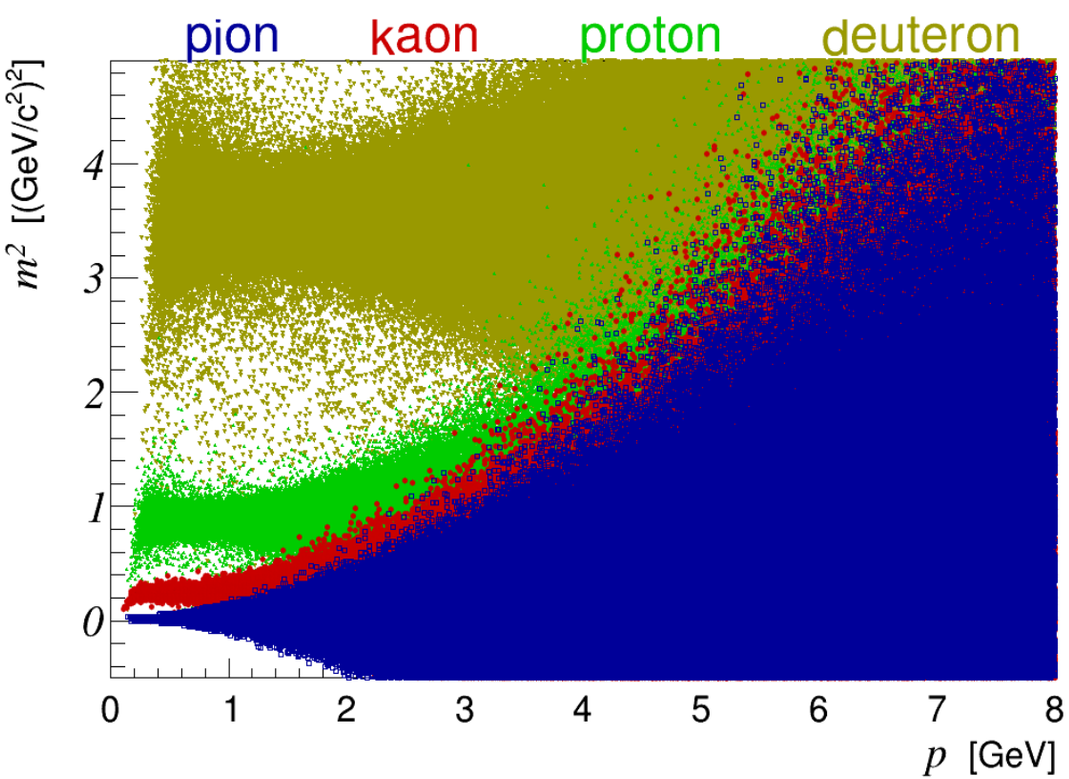
at the moment fixed 2

Artificial samples

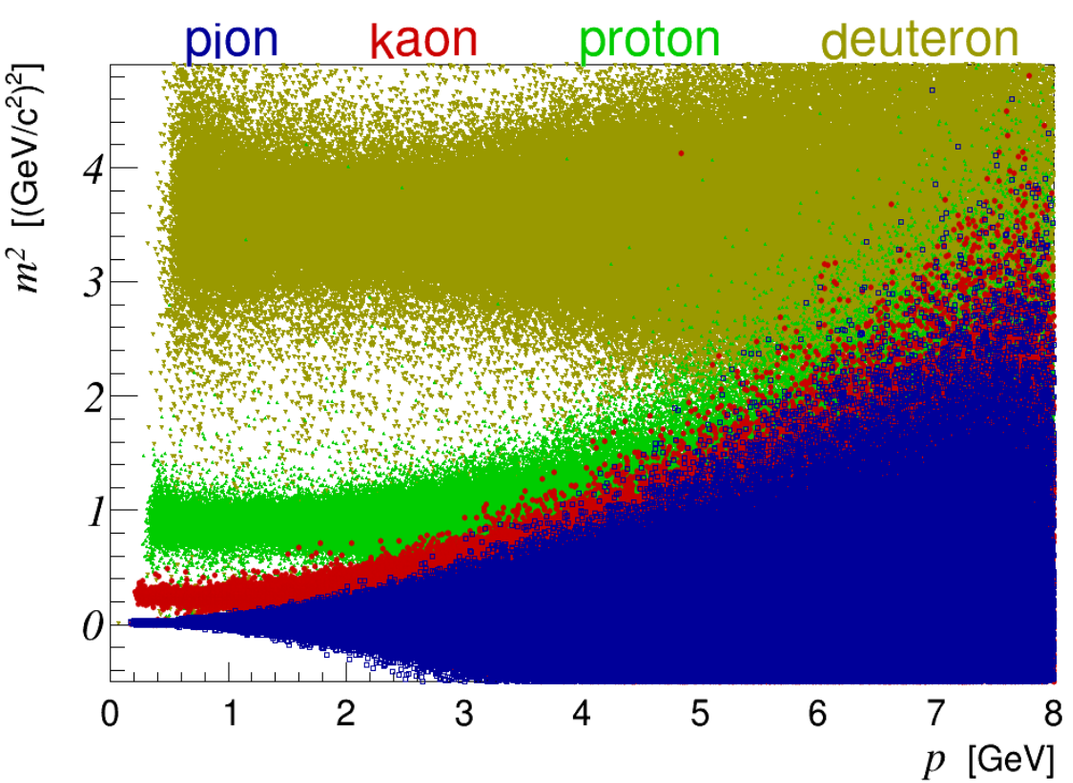
$p\in[0.2; 8.0, step = 0.01\,GeV]$

m^2 vs p

Barrel



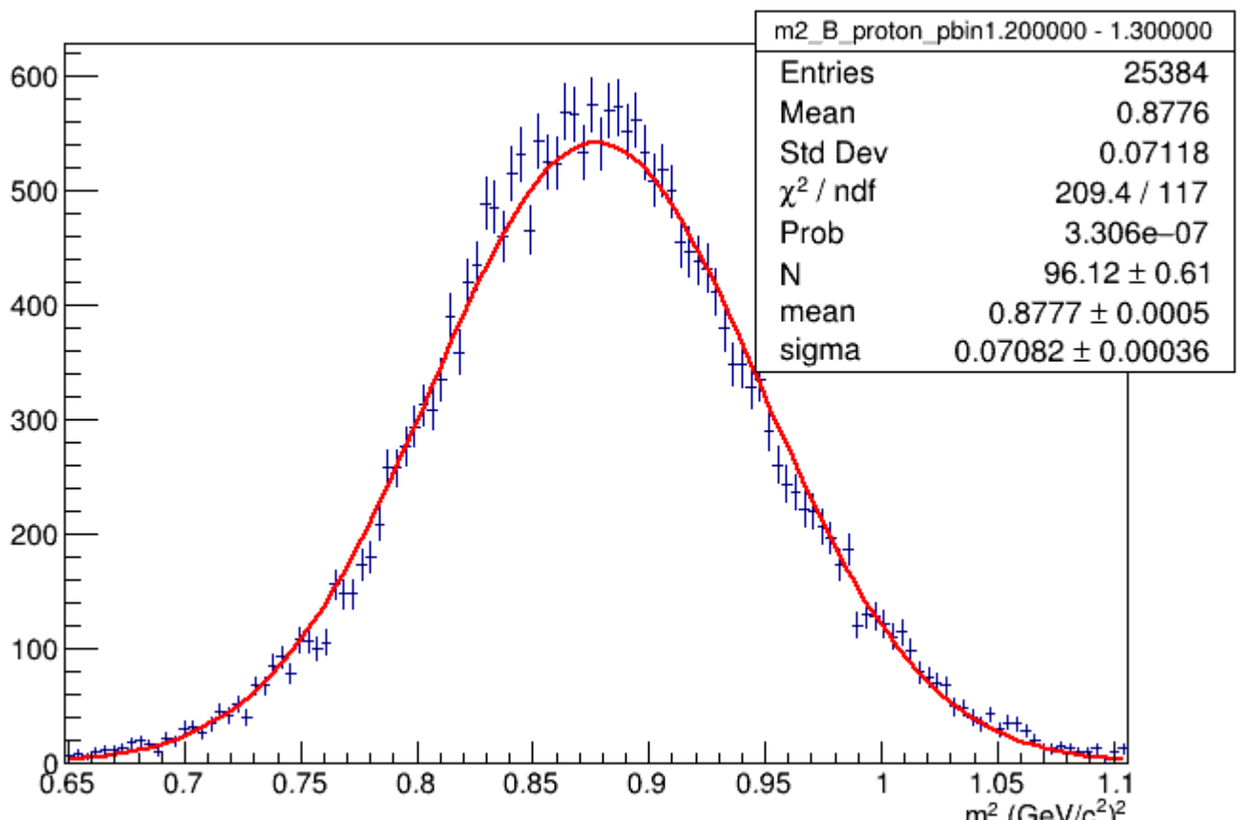
End-Cap



Parametrization

One Gaussian function

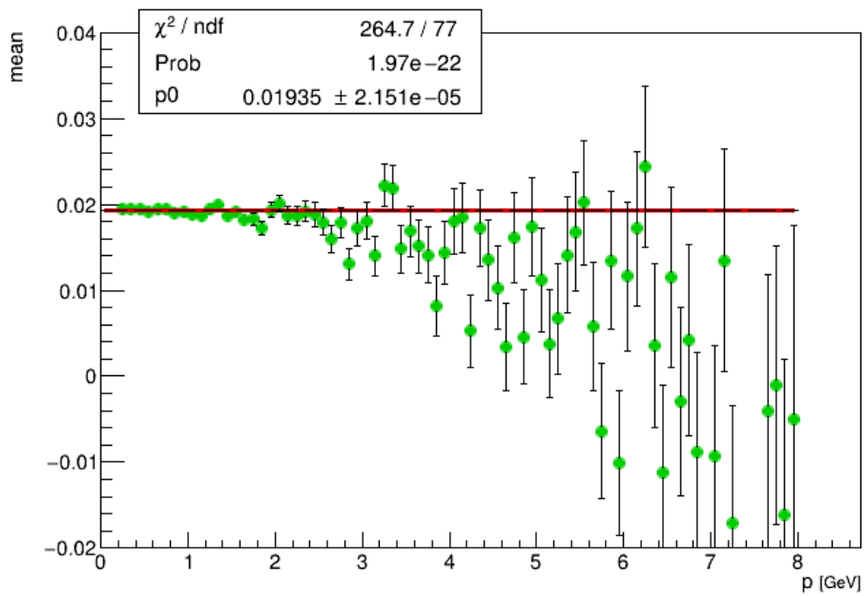
P_{bin}= 1.2 – 1.3 GeV, proton

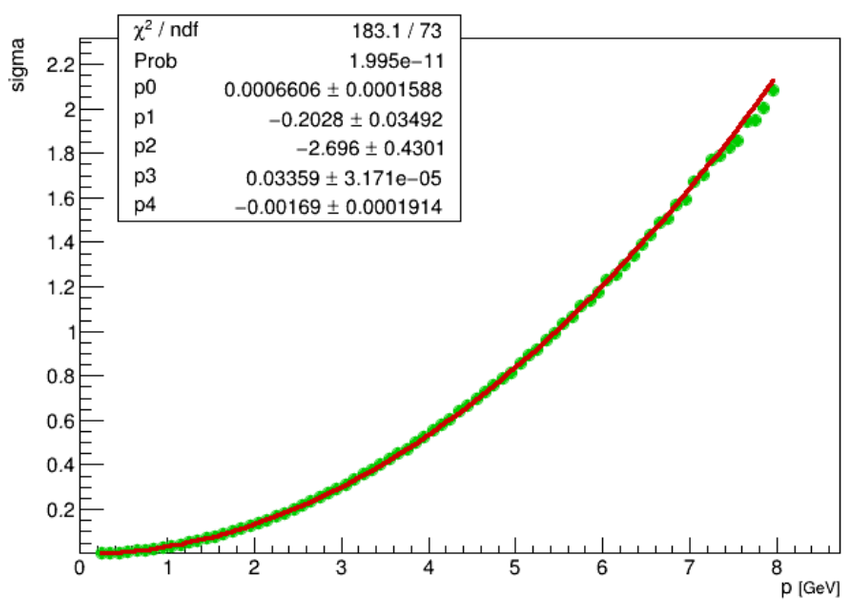


Pion parametrization

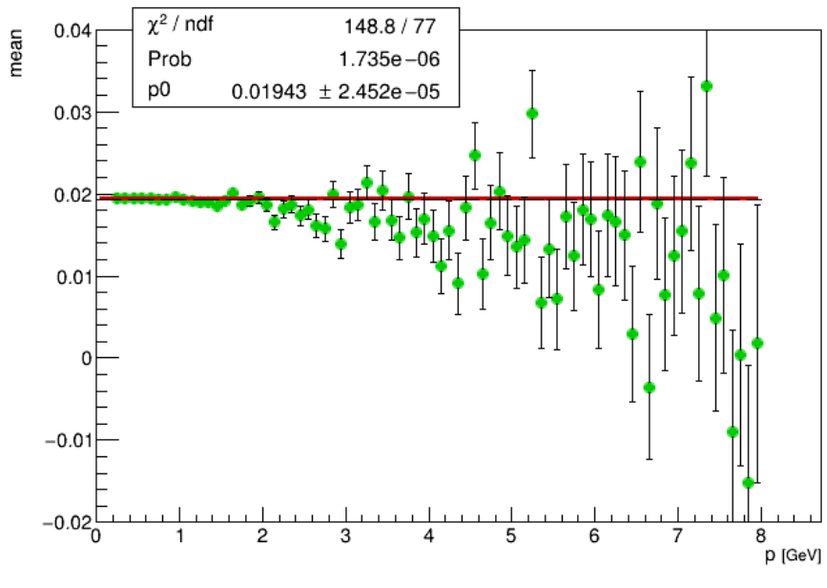
m^2_{pdg} = 0,019321 GeV

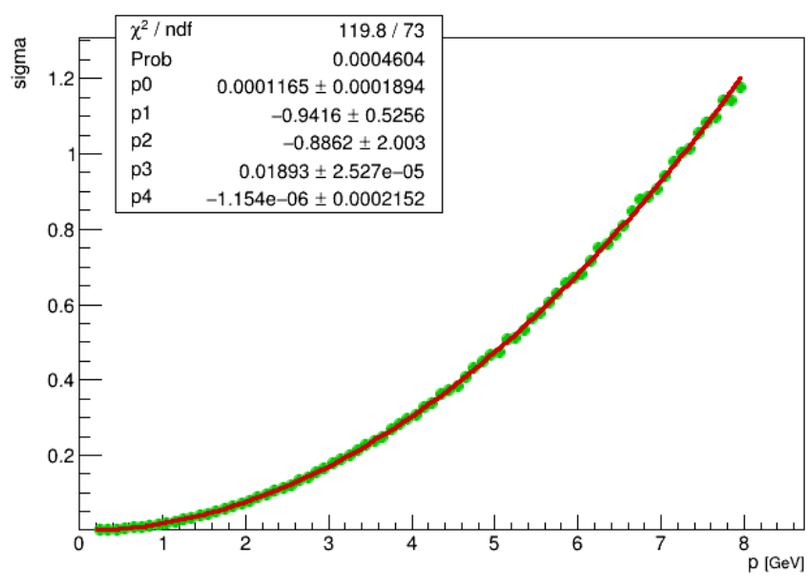
Barrel





End-Cap

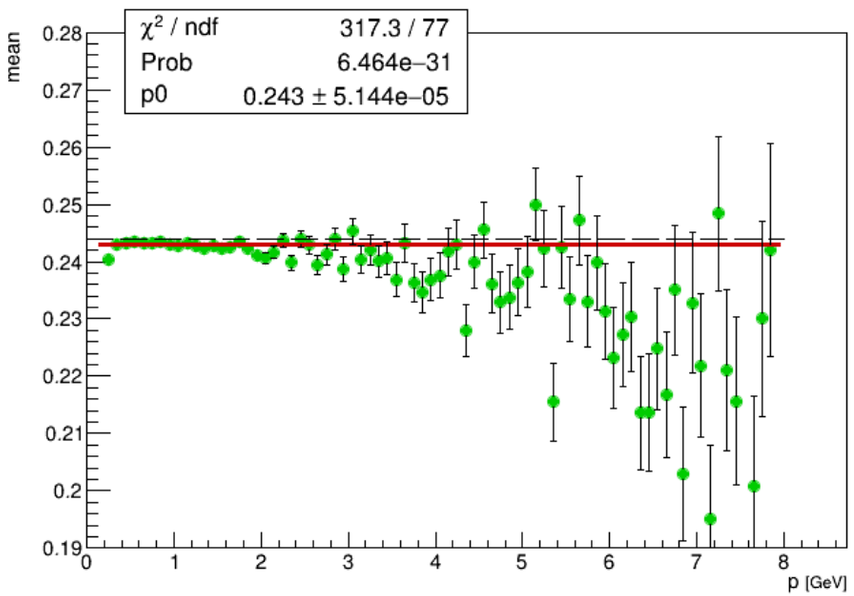


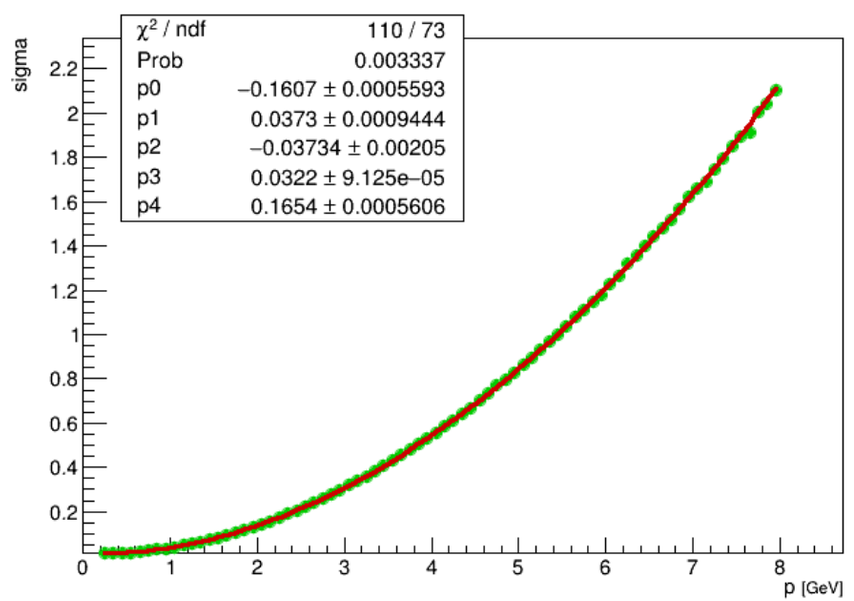


Kaon parametrization

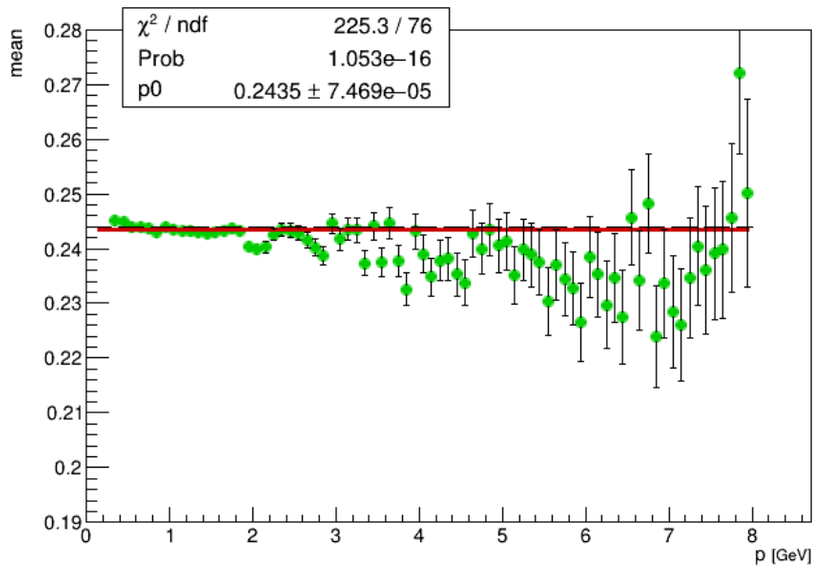
$m^2_{pdg} = 0{,}244036$ GeV

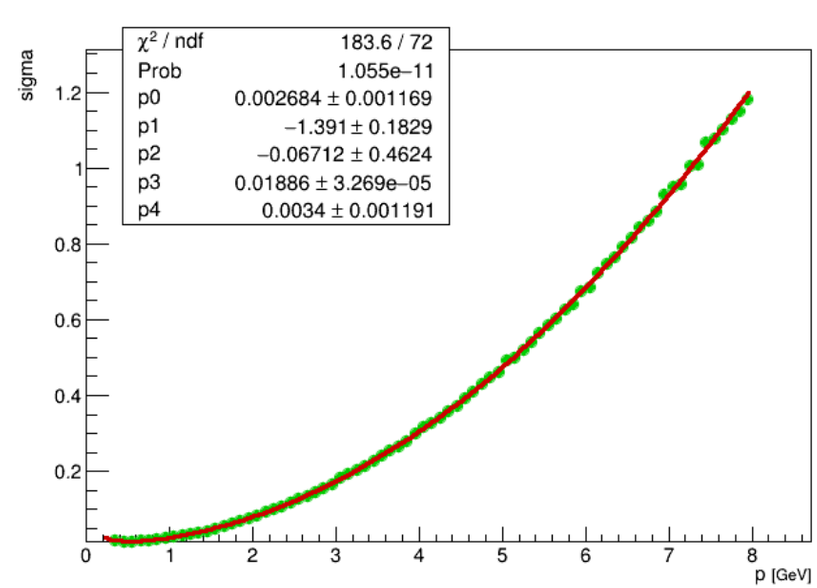
Barrel





End-Cap

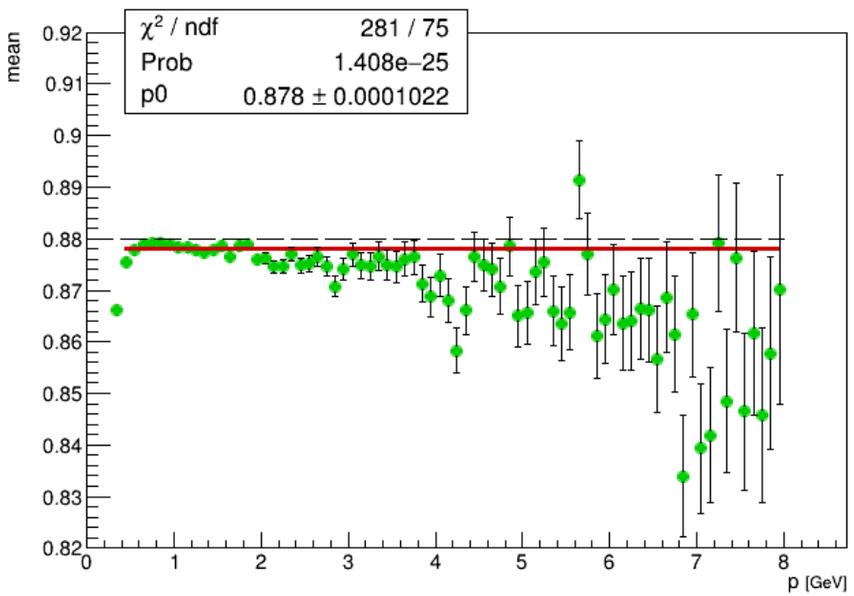


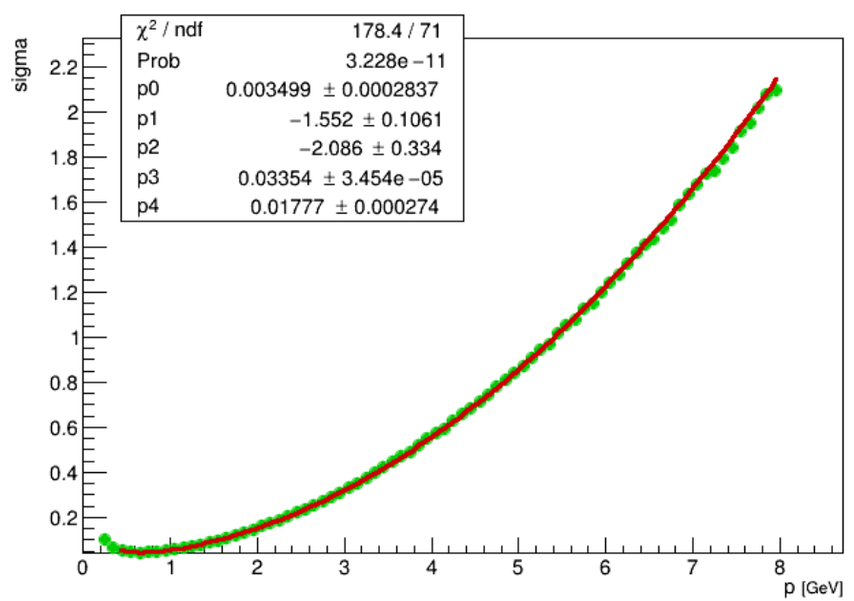


Proton parametrization

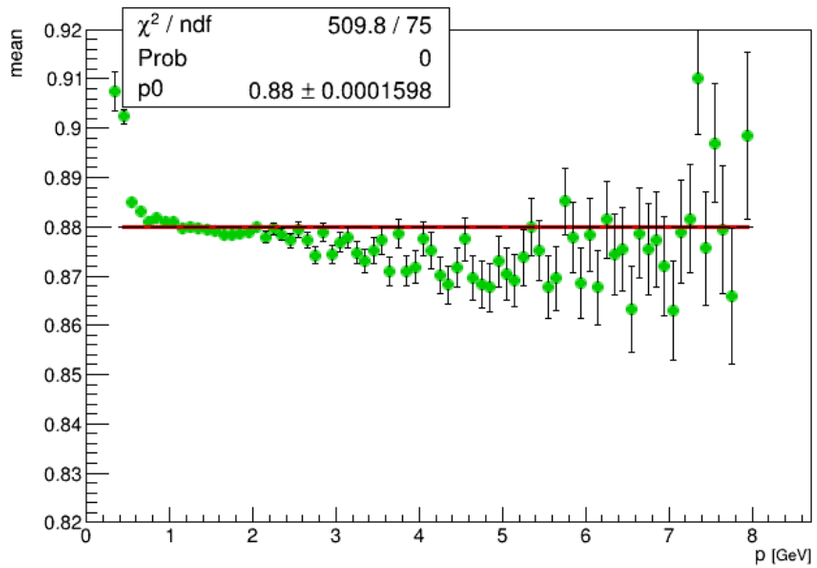
$m^2_{pdg} = 0{,}879844$ GeV

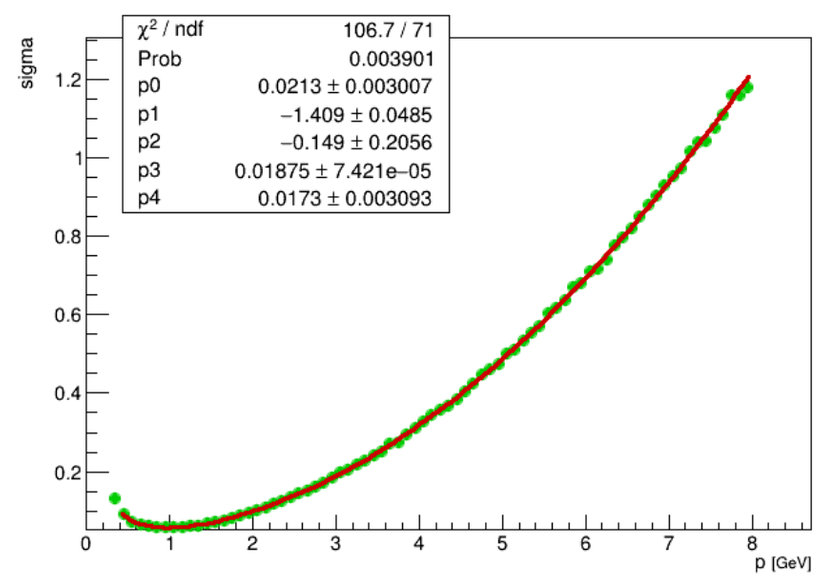
Barrel





End-Cap

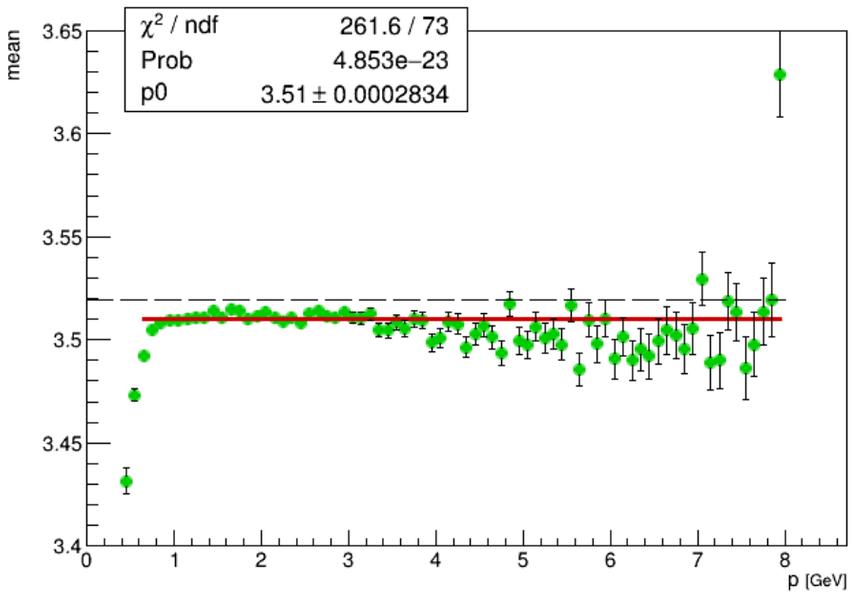


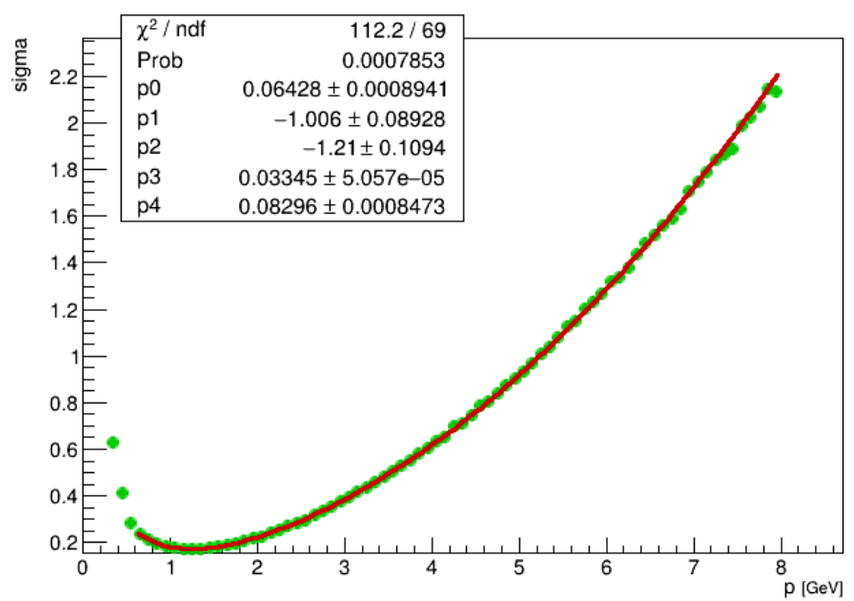


Deuteron parametrization

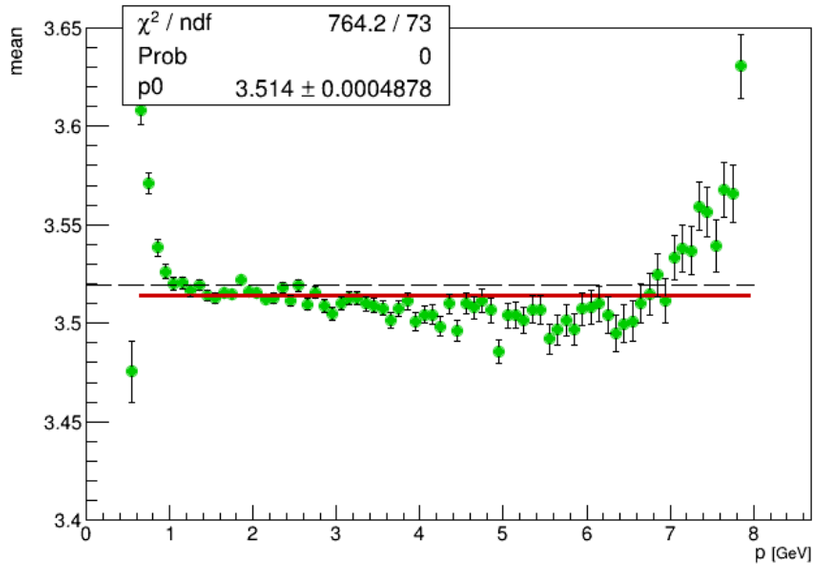
m^2_{pdg} = 3,519376 GeV

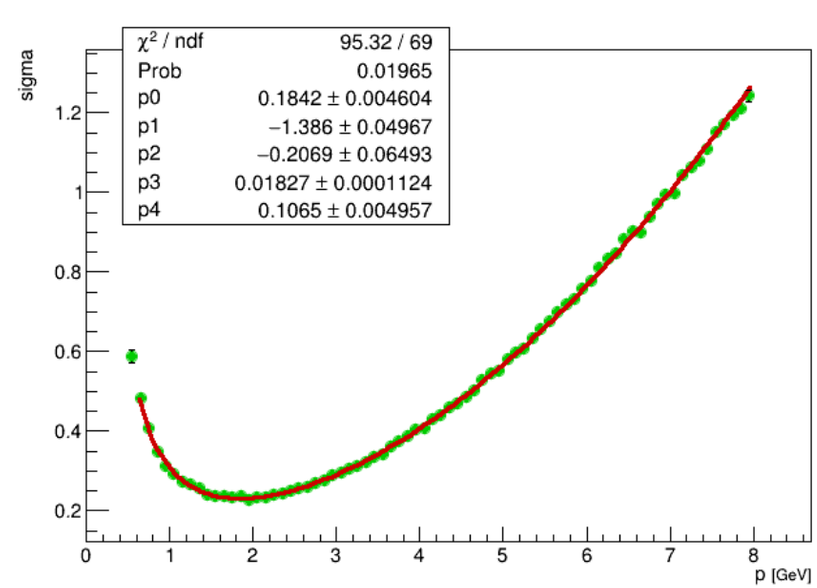
Barrel





End-Cap



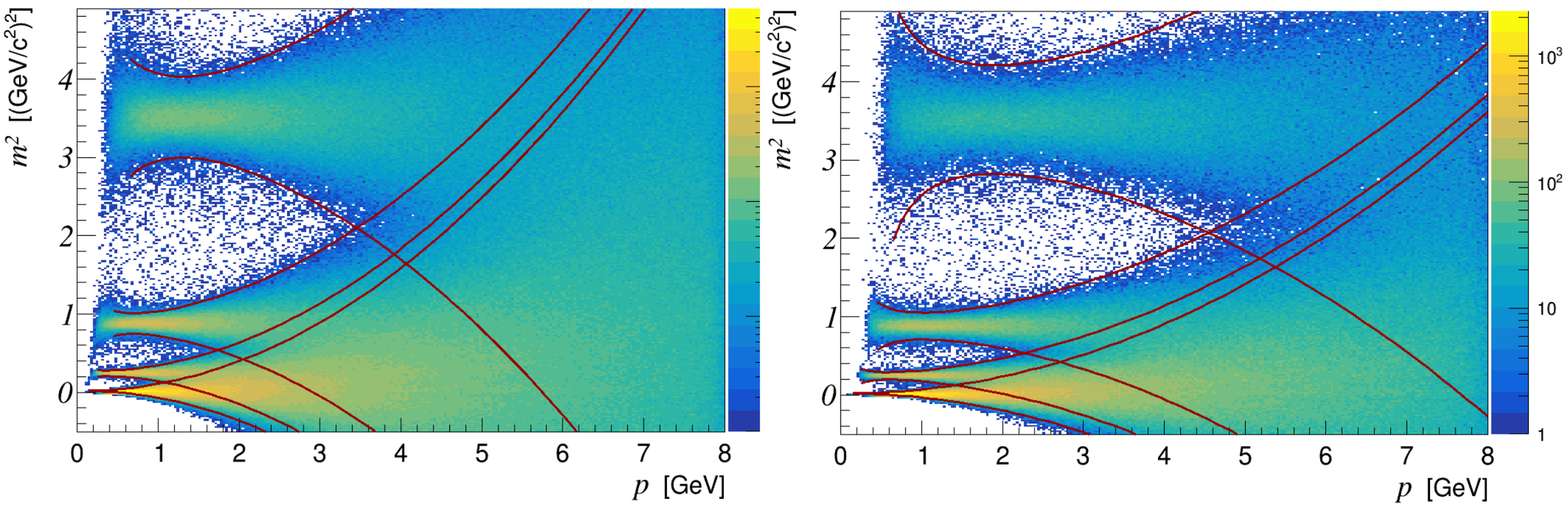


m^2 vs p

Barrel

End-Cap

curves with $3\,\sigma$



Typical PID approaches

For a detector with a Gaussian response

Observed signal from a detector

What we expect for a given *m* hypothesis

PID discrimination variable

$$n_{\sigma_\alpha^i} = \frac{S_\alpha - \hat{S}\left(H_i\right)_\alpha}{\sigma_\alpha^i}$$

$\alpha = TOF$

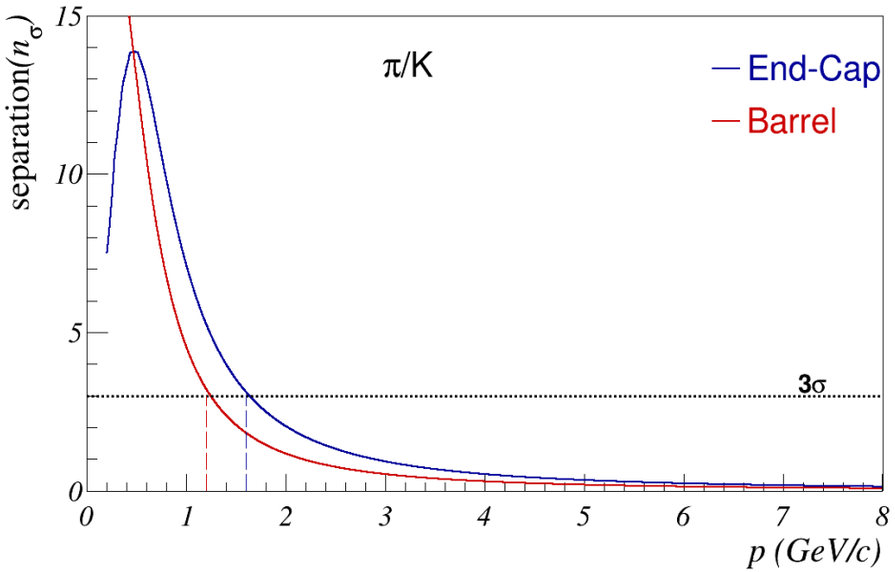
$i = \pi, K, p, d$

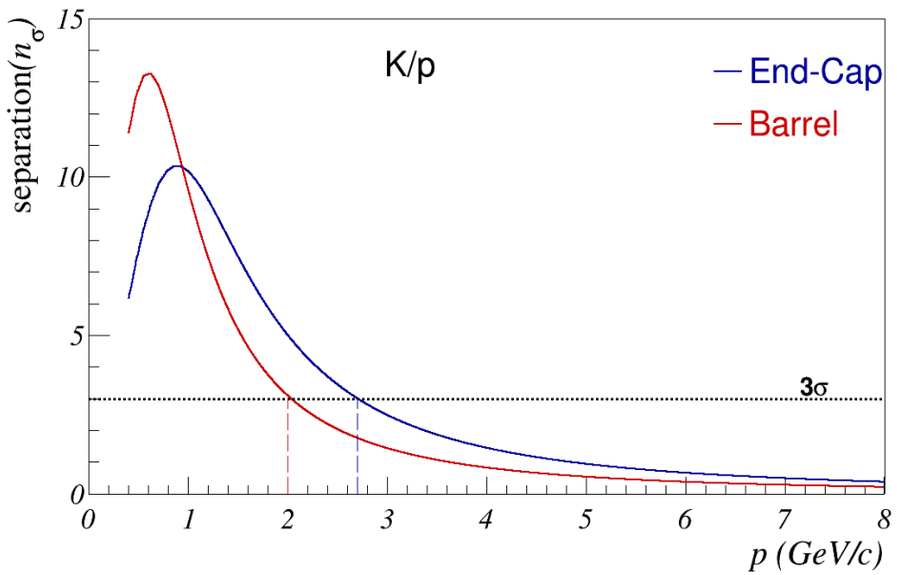
detector resolution

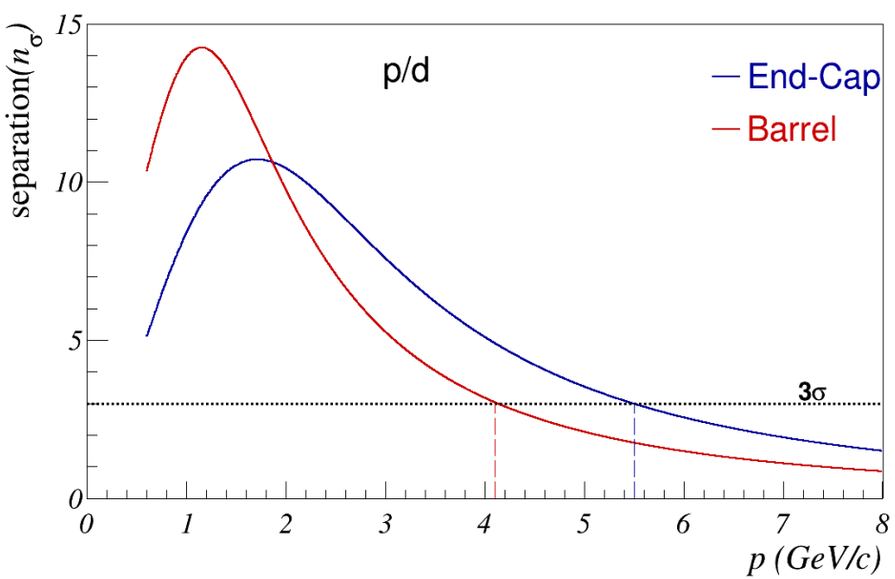
Separation power

$$n_{sigma} = \frac{\mu_i - \mu_j}{\sqrt{\sigma_i^2 + \sigma_j^2}}$$

$$i = \pi, K, p \; ; \; j = K, p, d$$





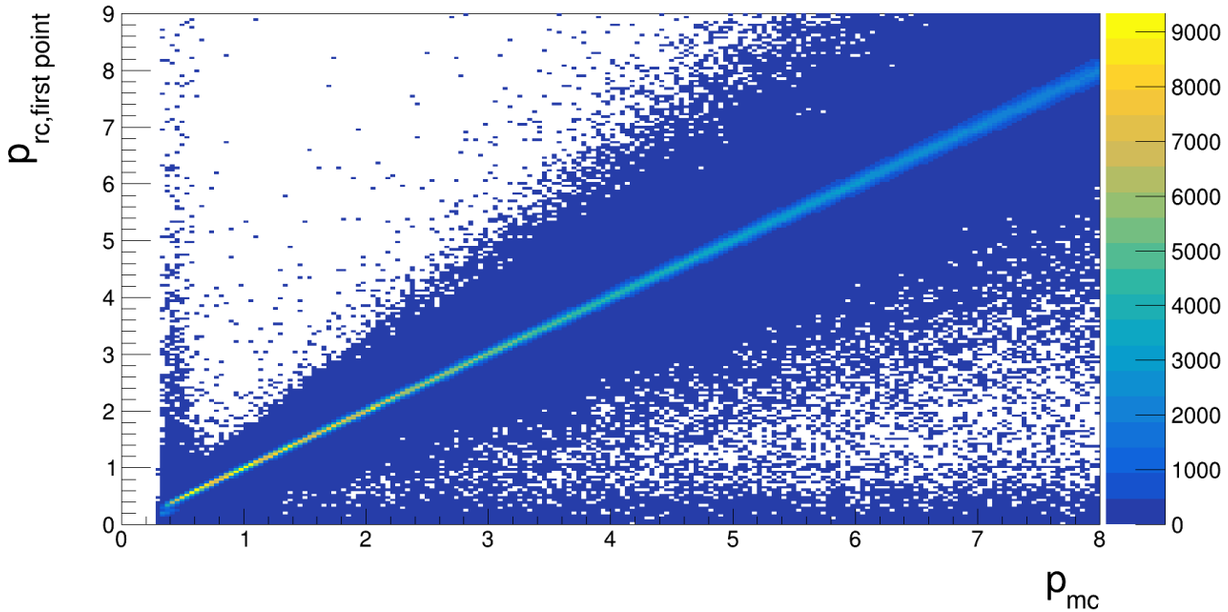


Conclusion

n_{sigma}=3	p_{max}(pion/kaon), GeV	p_{max}(kaon/proton), GeV	p_{max}(deuteron/proton),GeV
Barrel	1.2	2.0	4.1
End-Cap	1.6	2.7	5.5

Backup

deuteron



proton