Some calculations

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Assumptions

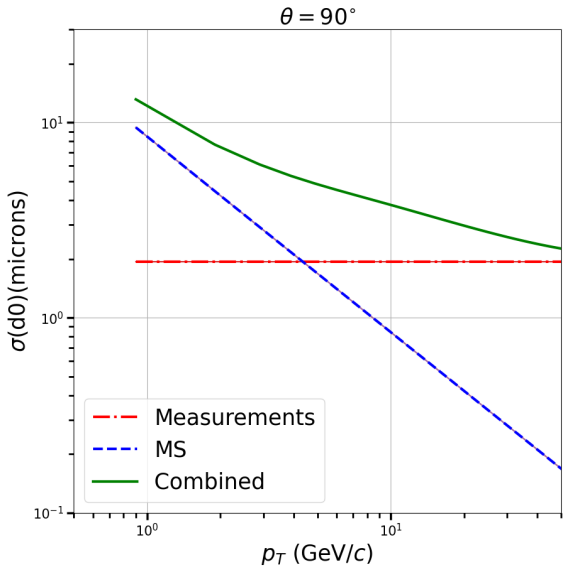
Only barrel, $\theta = 90^\circ$

Sub-detector	layer	+/-z(mm)	R(mm)	sigma_xy(mm)	sigma_z(mm)	X/X0(%)
BeamPipe	0	4225	14.5	---	---	0.15
vertex	1	62.5	16	0.0028	0.0028	0.15
vertex	2	62.5	18	0.006	0.006	0.15
vertex	3	125.	37	0.004	0.004	0.15
vertex	4	125.	39	0.004	0.004	0.15
vertex	5	125.	58	0.004	0.004	0.15
vertex	6	125.	60	0.004	0.004	0.15
VXTShell	7	145.	65	---	---	0.15
Si_pixel	8	371.	78	0.0072	0.0866	0.65
Si_pixel	9	665.	189	0.0072	0.0866	0.65
Si_pixel	10	2350	298	0.0072	0.0866	0.65
DC	11-160	2350	300-1800	0.1000	2/9999	1.20
Si_pixel	161	2350	1811	0.0072	0.0866	0.65

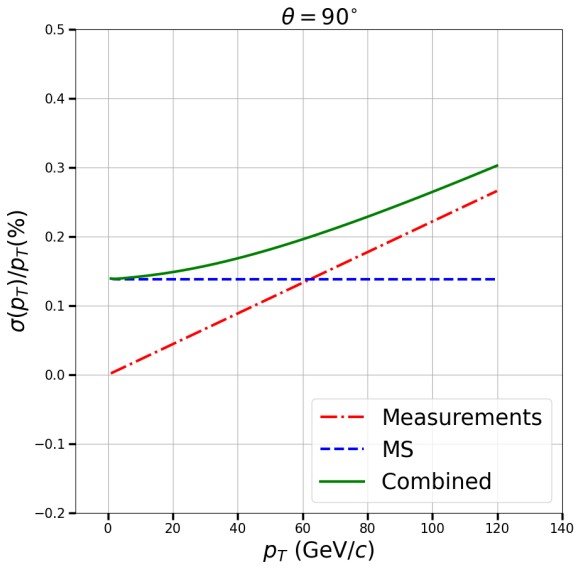
Sum: 5.0%

Analytical calculation

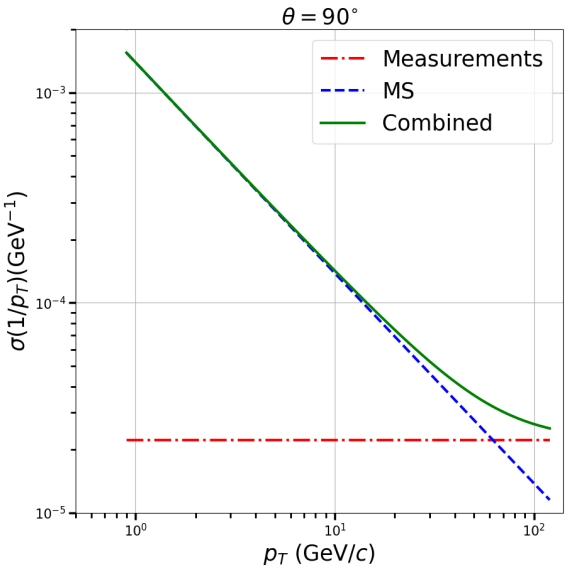
a = 2 μm
b = 12 μm*GeV



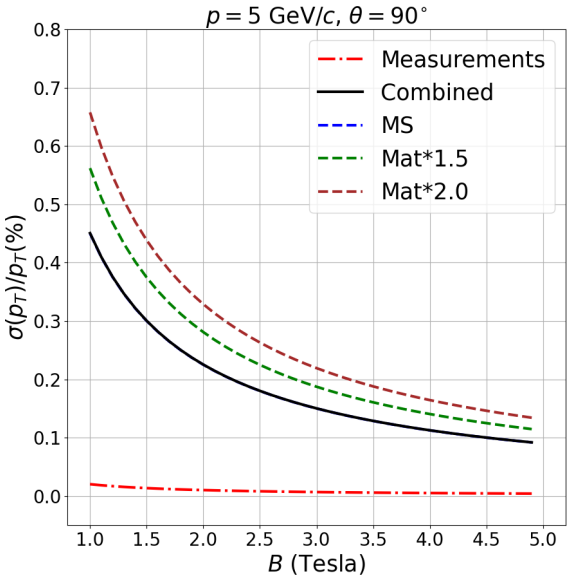
b = .0014

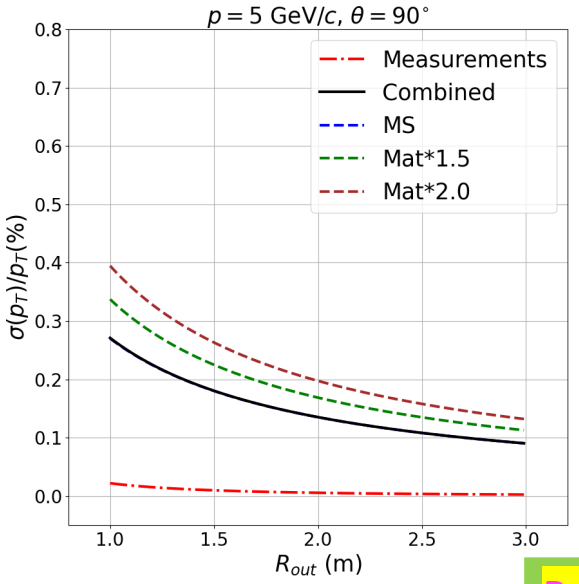


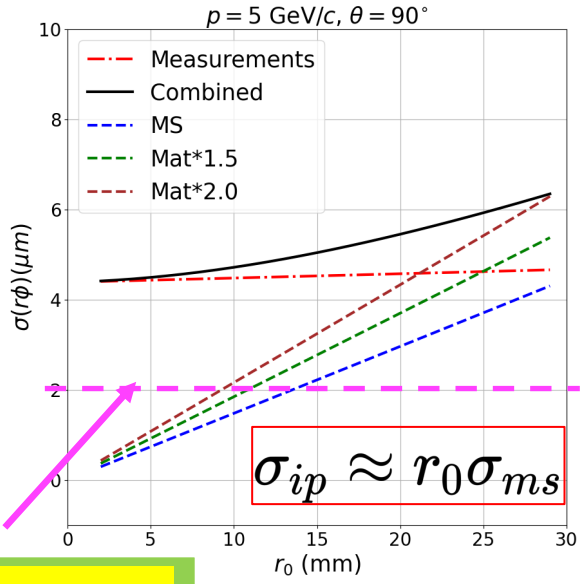
a = .000 023



Analytical calculation







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Additional ssumptions: Equal spacing, same resolution

Summary

- Based NIM, A 910 (2018) 127
- Some simple calculations performed
- And some straight conclusion
  - Material is more critical
  - R0 sensitive to impact parameter measurement

$$\sigma_{ip} \approx r_0 \sigma_{ms}$$

  - P and IP are weakly depend on # of measurement
  - P strongly depends on BL^2

$$\Delta d_0|_{res.} = \frac{3\sigma_{r\phi}}{\sqrt{(N-1)(N+1)(N+2)(N+3)}} \times$$

$$\sqrt{\left(N^3 - \frac{N}{3} - \frac{2}{3}\right) + \frac{4(2N^3 - N^2 - N)r_0}{L_0} + \frac{4(7N^3 - N^2 - N)r_0^2}{L_0^2} + \frac{40N^3 r_0^3}{L_0^3} + \frac{20N^3 r_0^4}{L_0^4}}$$

$$\approx \frac{3\sigma_{r\phi}}{\sqrt{N+5}} \sqrt{1 + \frac{8r_0}{L_0} + \frac{28r_0^2}{L_0^2} + \frac{40r_0^3}{L_0^3} + \frac{20r_0^4}{L_0^4}}$$

$$\Delta d_0|_{m.s.} = \frac{r_0}{\beta p_T} f\left(\frac{d}{X_0 \sin\theta}\right) \sqrt{\frac{N - 3/4}{N-1} + \frac{N}{2(N-1)}\left(\frac{r_0}{L_0}\right) + \frac{N^2}{4(N-1)}\left(\frac{r_0}{L_0}\right)^2}$$

$$\Delta d_0|^{opt}_{m.s.} = \frac{r_0}{\beta p_T} f\left(\frac{d}{X_0 \sin\theta}\right) \sqrt{1 + \left(\frac{r_0}{L_0}\right) + \left(\frac{r_0}{L_0}\right)^2} \qquad N_{opt} = 2 + \frac{L_0}{r_0}$$

$$\approx \frac{0.0136\,\mathrm{GeV/c}}{\beta p_T} r_0 \sqrt{\frac{d}{X_0 \sin\theta}} \sqrt{1 + \left(\frac{r_0}{L_0}\right) + \left(\frac{r_0}{L_0}\right)^2}$$

$$f(y) = 0.0136\,\mathrm{GeV/c}\sqrt{y}(1 + 0.038 \ln y).$$

$$\frac{\Delta p_T}{p_T}\Big|_{res.} = \frac{\sigma_{r\phi}\, p_T}{0.3\, B_0 L_0^2} \sqrt{\frac{720 N^3}{(N-1)(N+1)(N+2)(N+3)}}$$

$$\approx \frac{12\, \sigma_{r\phi}\, p_T}{0.3\, B_0 L_0^2} \sqrt{\frac{5}{N+5}}$$

$$\frac{\Delta p_T}{p_T}\Big|_{m.s.} = \frac{N}{\sqrt{(N+1)(N-1)}} \frac{0.0136\,\mathrm{GeV/c}}{0.3\beta\, B_0 L_0}$$

$$\times \sqrt{\frac{d_{tot}}{X_0\, \sin\theta}} \left(1 + 0.038 \ln \frac{d}{X_0\, \sin\theta}\right)$$

$$\approx \frac{0.0136\,\mathrm{GeV/c}}{0.3\beta\, B_0 L_0} \sqrt{\frac{d_{tot}}{X_0\, \sin\theta}}$$