LDT simulation results

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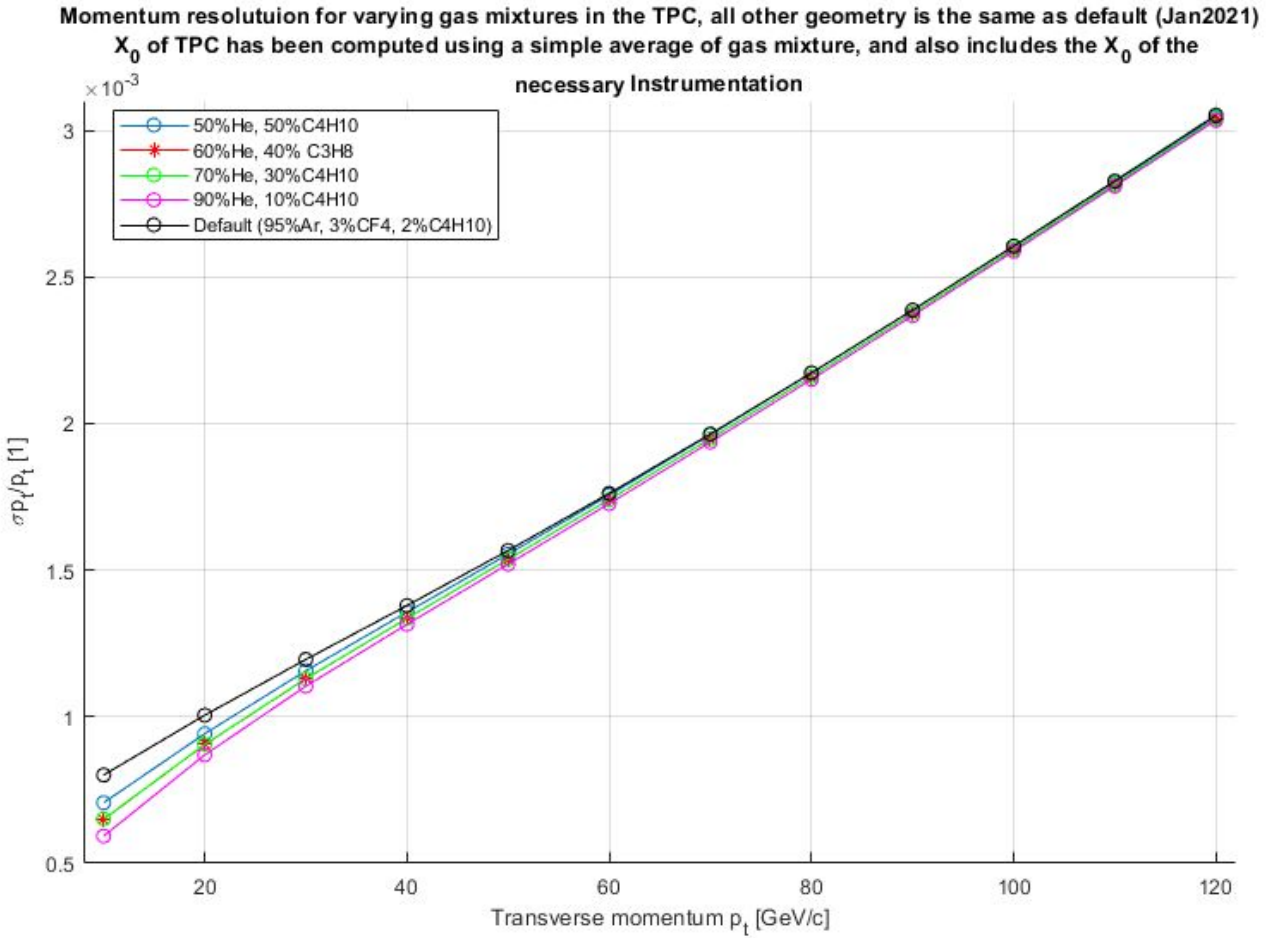
Question: How do the different gas mixtures affect the pT resolution?

Answer: When using a quenching gas of C4H10, a higher % of Helium is preferable for better momentum resolution. However, using 60%He and 40%C3H8 is directly comparable to 70%He and 30%C3H8. This is because C3H8 has a larger X0 than C3H8.

Notes:

- Basic simulation in LDT
- Only TPC X0 was changed in the simulation, but X0 due to wires/instrumentation was modelled.
- Very basic average method was used to simulate the X0 of the gas mixture. This needs to be confirmed by an expert.
- Effects of gas mixture on σ_0, σ_1, $C_{diff}(R\phi, z)$ and efficiency are not modelled here.
- Shows a vaguely proportional model between X0 and momentum resolution, so gas mixtures with low X0 are preferable.

P = 1 atm

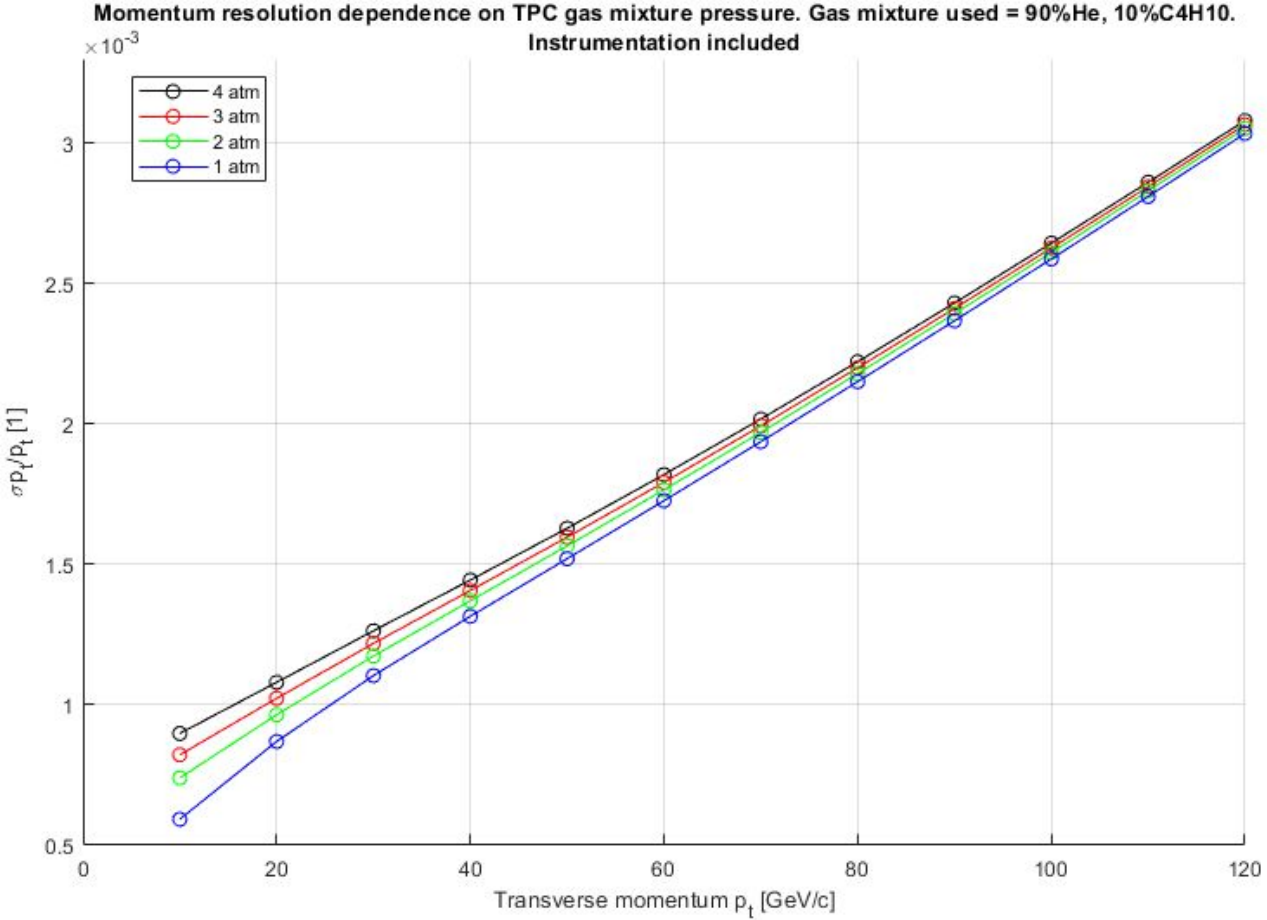


Question: How does the TPC gas mixture pressure affect the pT resolution?

Answer: Using the ideal gas law, we assume that if pressure is increased by a factor of x, the density does also. Thus, X0 decreases by 1/x, and the thickness in the .bgeom files increases by x (since we take the reciprocal).

Notes:

- Shows a proportional model between pressure and momentum resolution. Therefore lower pressure is preferable.
- This effect is larger with gas mixtures that have a larger X0, for example, the default setting of 95%Ar would see a larger increase at higher pressures.
- This effect is also larger at lower momenta.

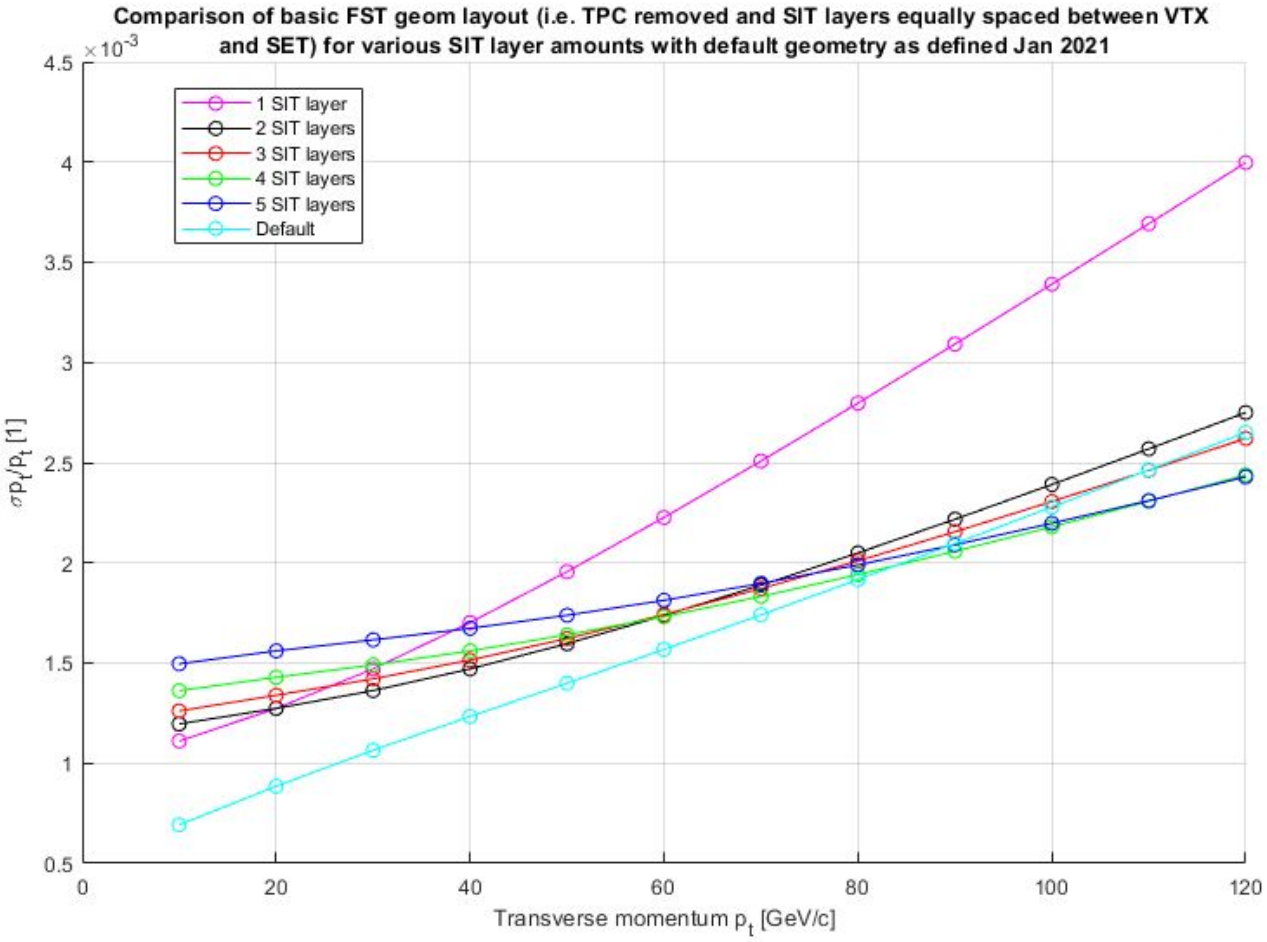


Question: If we remove the TPC completely (i.e. FST concept), how many silicon layers do we need to have a comparable momentum resolution?

Answer: We will struggle to have a comparable resolution. Tracker with TPC is better than all without, up to ~85GeV, at which point 4 tracker layers becomes preferable.

Notes:

- Basic simulation in LDT
- TPC was completely removed but VTX and SET were retained.
- SIT layers were distributed evenly throughout.



Question: For completion, if we remove the inner tracker layers and expand the TPC to fill the space, what happens to our momentum resolution.

Answer: Default tracker (i.e. with SIT) is better than a TPC-only tracker, except at lower momenta (<~38 GeV)

Notes:

- Basic simulation in LDT
- All SIT layers were removed, but VTX and SET were retained.
- TPC layers were added in the space where the SIT layers were at a density of 1 TPC layer per 10mm, which was the same as was already present (150 layers in 1500 mm)