# How to Increase the $\pi/\mu$ Yield by a Factor of 2.5

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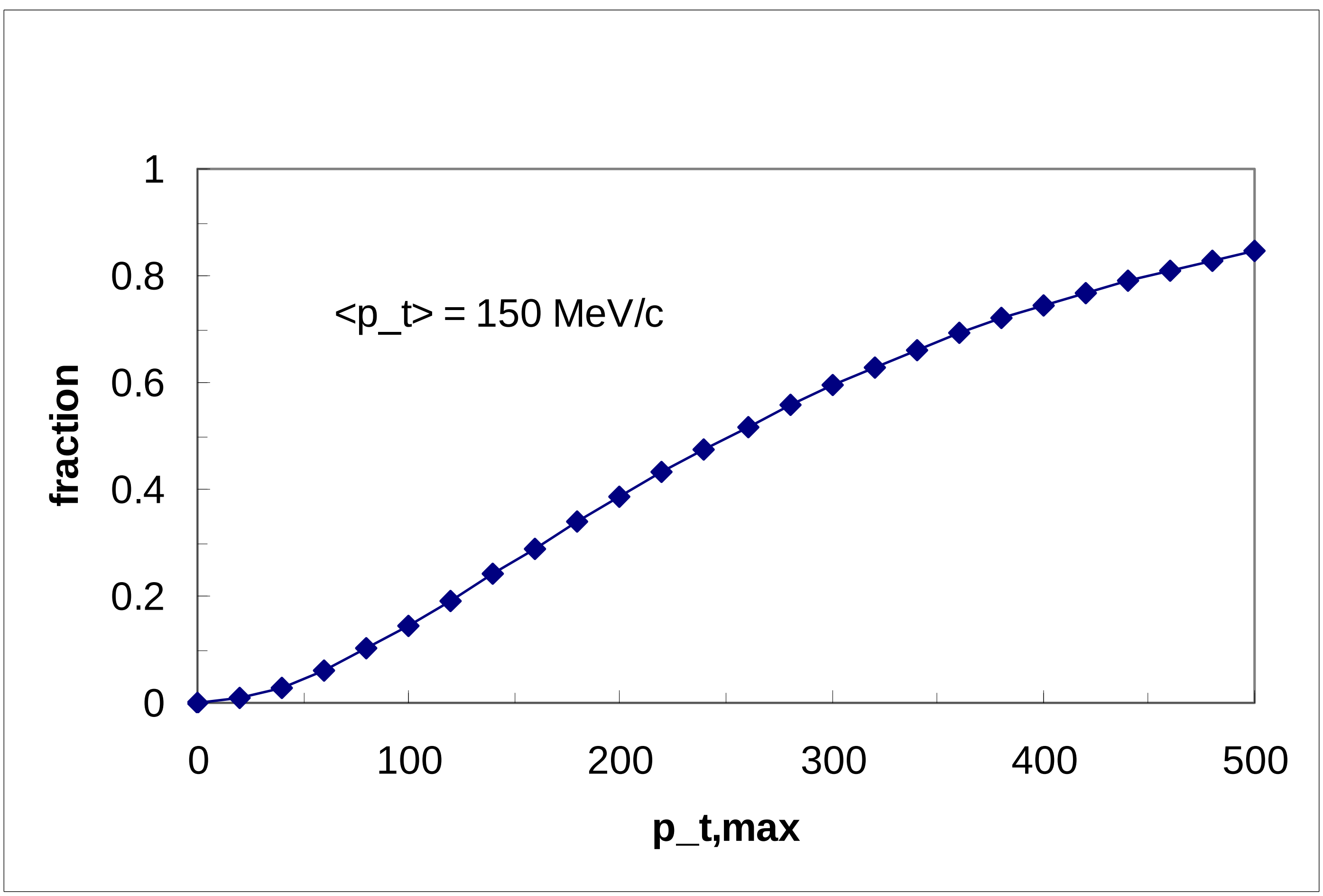
We can increase $\pi/\mu$ yield simply by increasing the maximum transverse momentum, $p_\perp$, captured.

Present design captures only up to $p_\perp \sim 200$ MeV/c
$\Rightarrow$ Captures only 40% of pions, assuming $< p_\perp > = 150$ MeV/c.

Of course, increasing the maximum $p_\perp$ captured increases the transverse (pseudo)emittance.

But, if we don't care about this, we could "easily" increase the $\pi/\mu$ yield by a factor of 2.5.



For fixed field $B_0$ at the target, the radius $r_0$ of the target vessel is linear in the maximum $p_\perp$ captured:

$$r_0[\mathrm{cm}] \approx 1 + \frac{0.6\, p_{\perp,\max}[\mathrm{MeV}/c]}{B_0[\mathrm{T}]}.$$

(The $1$-cm offset is due to the tilt of the target.)

All the magnetic flux, $\Phi = \pi B_0 r_0^2$, within this radius is adiabatically shaped into a circle of radius $r_f$ at the end of the “taper”, where the field is $B_f$,

$$r_f = r_0 \sqrt{\frac{B_0}{B_f}}.$$

Example: To increase the capture by 50%, we desire $p_{\perp,max} \sim 300$ MeV/c, which requires $r_0 \sim 10$ cm for $B_0 = 20$ T (rather than $r_0 = 7.5$ cm as in the baseline configuration).

Then we would need $r_f = 40$ cm for $B_f = 1.5$ T (rather than $30$ cm as in the baseline configuration).

Or, if we wish to keep $r_f = 30$ cm, then we would need $B_f = 2.25$ T.