

Multiple scattering in injection channel

$$\phi_{rms} = \langle \phi^2 \rangle^{1/2} = \frac{21 \text{ MeV}}{E} \sqrt{\frac{t}{X_0}}$$

$$X_0(\text{helium}) = 4.8 \times 10^3 \text{ m} \quad t = 1 \text{ m}$$

$$X_0(\text{Be}) = 353 \text{ mm} \quad t = 0.075 \text{ mm}$$

$$\sigma' = \phi_{rms} = \sqrt{\frac{\epsilon}{\beta}} \quad \epsilon = \phi^2 \beta$$

At 300 MeV

$$\phi_{rms} = 1.4 \times 10^{-3} \rightarrow \epsilon = (40 \text{ m}) \phi^2 = 8 \times 10^{-5} \text{ m} - \text{rad}$$

If $\beta = 5$ at the injection point then

$$\epsilon = 9.8 \times 10^{-6} \text{m} - \text{rad}$$

And $\sigma = \sqrt{\beta \epsilon}$

$$\beta = 5 \rightarrow \sigma = 7 \text{mm}$$