Physical quantities involved

[some formulas]

radiation length

high energy electrons and photons

$$X_0 \rho \simeq \frac{716.4\ g\ cm^{-2}\ A}{Z(Z+1)\log(287/\sqrt{Z})}$$

$$E_e^{\ell}(x) = E_0\ (1 - \exp(-x/X_0))$$

$$P_{\gamma}^{e^-\,e^+}(x) = 1 - \exp(-7x/9X_0)$$

Molière radius

electromagnetic showers

$$R_M = X_0 E_s / E_c$$

$$E_s = 21.2\ MeV$$

$$E_c = 800\ MeV/(Z + 1.2)$$

inelastic scattering length

beam protons

$$\lambda\rho = \frac{A}{\sigma_R\, N_A} \qquad \sigma_R \simeq \pi r_0^2 A^{2/3}$$

$$P^{in}(x) = 1 - \exp(-x/\lambda)$$

multiple Coulomb scattering

beam protons

$$\theta_0 = \frac{13.6\ MeV}{\beta cp}\ z\sqrt{x/X_0}\,[1 + 0.038\log(x/X_0)]$$

Gaussian width (for small deflection angles)

Reviewing a few materials

[some numbers]

	ρ [g/cm^3]	Z	X_0 [cm]	λ [cm]
Be	1.85	4	35.28	37.06
CC	1.77	6	24.12	42.09
Al	2.70	13	8.90	35.35
Ti	4.54	22	3.56	25.04
Cu	8.96	29	1.44	13.86
W	19.3	74	0.35	8.90

Energy deposition profile

[some simulations]

for a 7 TeV proton impacting on a 92 cm long jaw