σ_T, σ_I, λ_T, and λ_I are energy dependent. Values quoted apply to high energy range given in footnote *a* or *b*, where energy dependence is weak.

a. $\sigma_{\rm total}$ at 80–240 GeV for neutrons ($\approx \sigma$ for protons) from Murthy *et al.*, Nucl. Phys. **B92**, 269 (1975). This scales approximately as $A^{0.77}$.

b. $\sigma_{\rm inelastic} = \sigma_{\rm total} - \sigma_{\rm elastic} - \sigma_{\rm quasielastic}$; for neutrons at 60–375 GeV from Roberts *et al.*, Nucl. Phys. **B159**, 56 (1979). For protons and other particles, see Carroll *et al.*, Phys. Lett. **80B**, 319 (1979); note that $\sigma_I(p) \approx \sigma_I(n)$. σ_I scales approximately as $A^{0.71}$.

c. Mean free path between collisions (λ_T) or inelastic interactions (λ_I), calculated from $\lambda = A/(N \times \sigma)$, where N is Avogadro's number.

d. For minimum-ionizing heavy particles (muons, pions, protons, *etc.*). Minimum dE/dx calculated in 1994, using density effect correction coefficients from R. M. Sternheimer, M. J. Berger, and S. M. Seltzer, Atomic Data and Nuclear Data Tables **30**, 261–271 (1984). For electrons and positrons see S.M. Seltzer and M.J. Berger, Int. J. Appl. Radiat. **35**, 665–676 (1984). Ionization energy loss is discussed in Sec. 10.

e. From Y.S. Tsai, Rev. Mod. Phys. **46**, 815 (1974); X_0 data for all elements up to uranium may be found here. Corrections for molecular binding applied for H_2 and D_2. Parentheses refer to gaseous form at STP (0°C, 1 atm.).

f. Values for solids, or the liquid phase at boiling point, except as noted. Refractive index given for sodium D line.

g. For pure graphite; industrial graphite density may vary 2.1–2.3 g/cm^3.

h. Standard shielding blocks, typical composition O_2 52%, Si 32.5%, Ca 6%, Na 1.5%, Fe 2%, Al 4%, plus reinforcing iron bars. The attenuation length, $\ell = 115 \pm 5$ g/cm^2, is also valid for earth (typical $\rho = 2.15$), from CERN–LRL–RHEL Shielding exp., UCRL–17841 (1968).

i. Density may vary about ±3%, depending on operating conditions.

j. Values for typical working conditions with H_2 target: 50 mole percent, 29°K, 7 atm.

k. Typical scintillator; *e.g.*, PILOT B and NE 102A have an atomic ratio H/C = 1.10.

ℓ. Main components: 80% SiO_2 + 12% B_2O_3 + 5% Na_2O.

m. For typical fused quartz; density may vary. The specific gravity of crystalline quartz is 2.64.

n. Solid ethane density at −60°C; gaseous refractive index at 0°C, 546 mm pressure.

o. $n(SiO_2) + 2n(H_2O)$ used in Čerenkov counters, ρ = density in g/cm^3. From M. Cantin *et al.*, Nucl. Instr. and Meth. **118**, 177 (1974).

p. G10-plate, typical 60% SiO_2 and 40% epoxy.