$$\text{neutrino scattering cross section } \sigma \sim 10^{-47}\mathrm{m}^2$$

$$\text{volume swept out } V_s = L\sigma$$

$$\text{mass of cube } M = \rho V = \rho\,(1\mathrm{m}^3)$$

$$\text{number of nucleons per cubic meter } N = \frac{M}{m_p} = \frac{\rho}{m_p}$$

$$\text{volume per nucleon } V_N = \frac{m_p}{\rho}$$

$$\text{volume swept out } V_s = \text{volume per nucleon } V_N$$

$$L\sigma = \frac{m_p}{\rho}$$

$$L = \frac{m_p}{\rho\sigma}$$