# Cross Sections

- **cross section:** $\sigma = \pi R^2$

  $[\sigma]$ = barn  1 b = $10^{-24}$ cm$^2$

  1 mb = $10^{-27}$ cm$^2$

  1 fb = $10^{-39}$ cm$^2$

  strong interaction: $\sigma(\pi N) \sim 100$ mb

- **interaction radius:** $R = \sqrt{\sigma/\pi}$

  R (strong) ~ $\sqrt{10^{-30}\ m^2} \sim 10^{-15}$ m = 1 fm = 1 fermi

- **lifetime:** $\tau = R / c$ = reaction time

  $\tau$ (strong) = 1 fm / c = 3 x $10^{-24}$ s

- **uncertainty relation:** $\hbar = \Gamma \tau$

  $\hbar c$ = 200 MeV fm = $\Delta E \, \Delta R$

- **decay width:** $\Gamma = \hbar / \tau = \hbar c / R$

  **energy scale** $\Gamma = E$

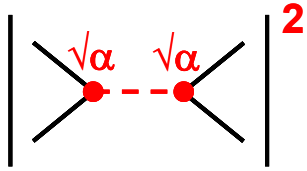
  $\Gamma$ = 200 MeV fm / R

  E (strong) = 200 MeV  $\Gamma$ (strong: $\Delta$, $\rho$) = 120-150 MeV

- **coupling constant:** $F = \alpha \hbar c / r^2$ electric force

  $\alpha = e^2 / (4\pi \hbar c)$ dimensionless ($\varepsilon_0$=1)

$$E = \Gamma = \hbar/\tau = \hbar c / R = \hbar c \sqrt{\pi/\sigma} \sim$$




$$^2 \sim \alpha^2$$