Charged Particle Reactions

$$\sigma(E) \propto e^{-2\pi\eta}$$

$$\sigma(E) \propto \pi ƛ^2 \propto \frac{1}{E}$$

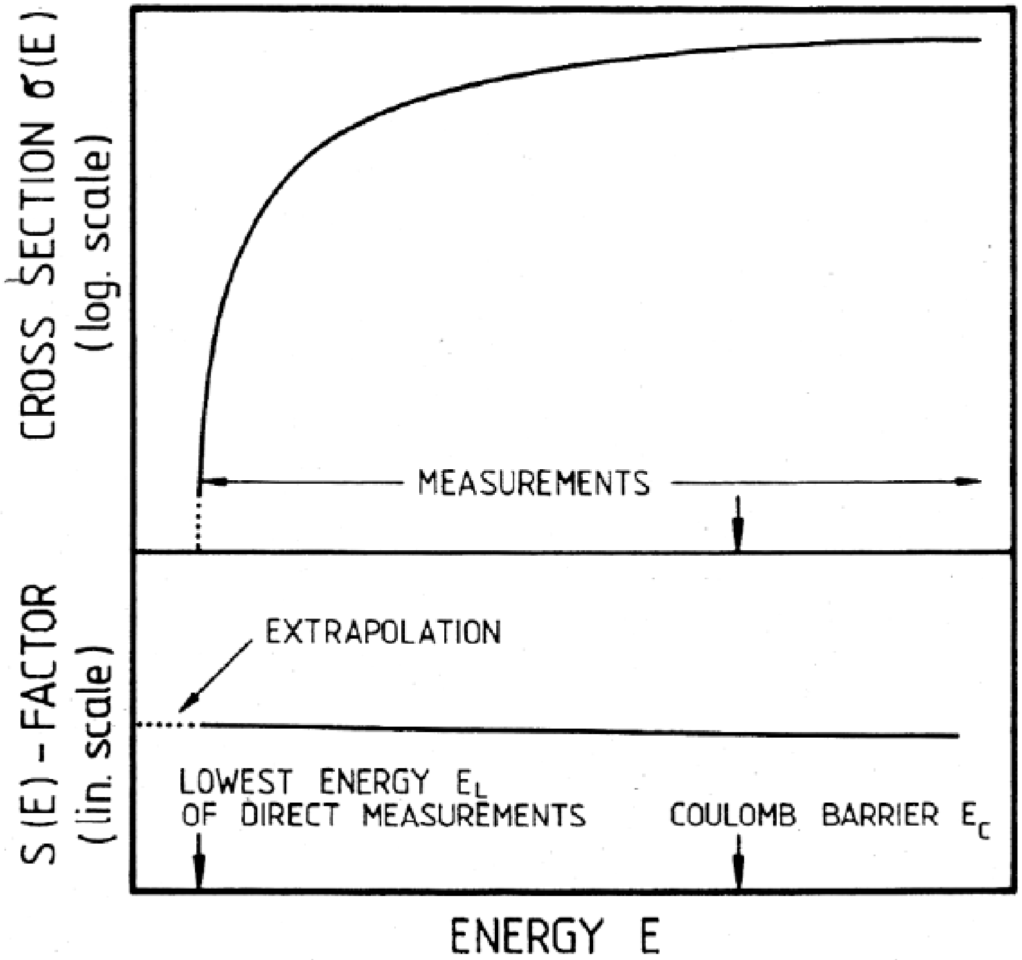
$$ƛ = \frac{m_a + m_X}{m_X}\frac{\hbar}{\sqrt{2m_a E_a}} = \frac{\hbar}{\sqrt{2\mu_{aX} E_{aX}^{CM}}}$$

HW 5

$$\pi ƛ^2(b) = \frac{656.7}{\mu(u)E^{CM}(keV)}$$

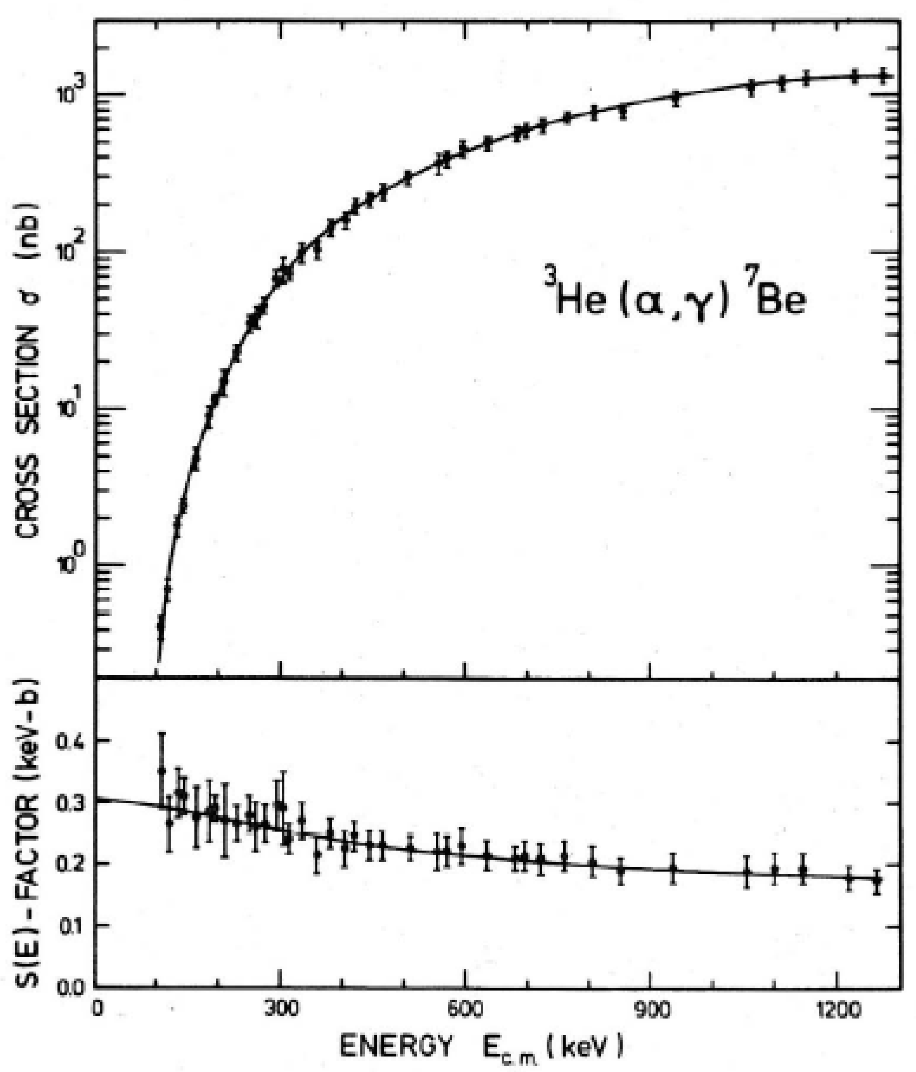
$$\sigma(E) = \frac{1}{E}e^{-2\pi\eta}S(E)$$

Nuclear (or astrophysical) *S*-factor



Charged Particle Reactions

$E_C = ??$



Resonance Reactions

322 *S.O.F. Dababneh et al. / The reaction $^{19}F(p,\alpha\gamma)^{16}O$*

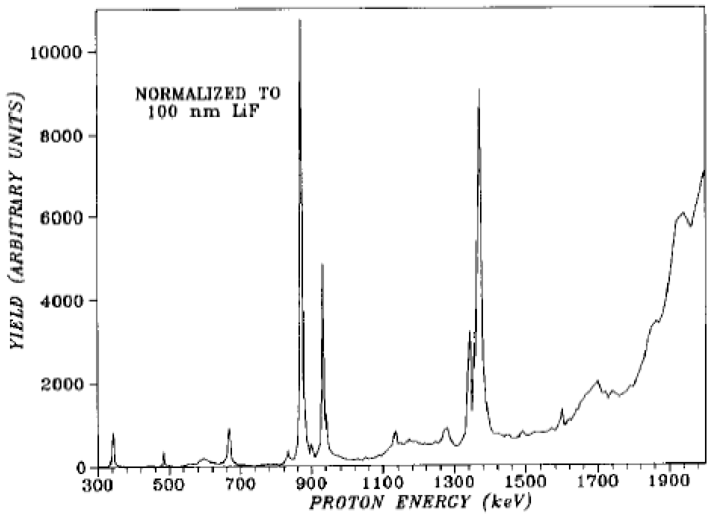


Fig. 1. Overview of the excitation curve from $E_p = 0.3–2.0$ MeV, where isolated and narrow resonances are found.

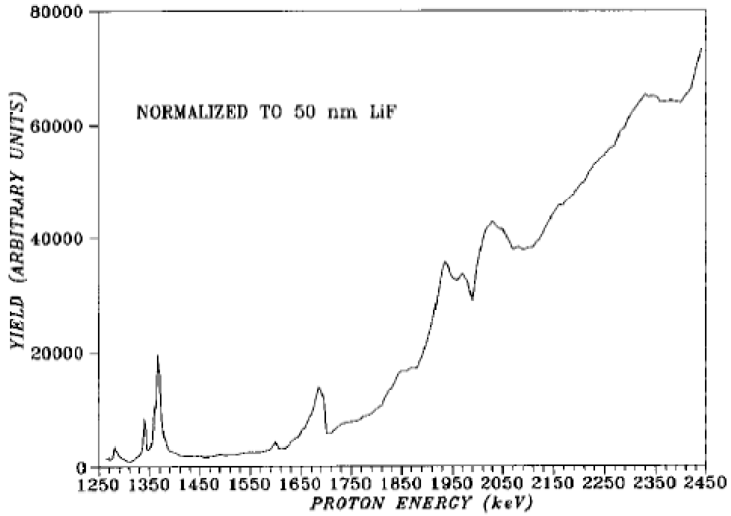
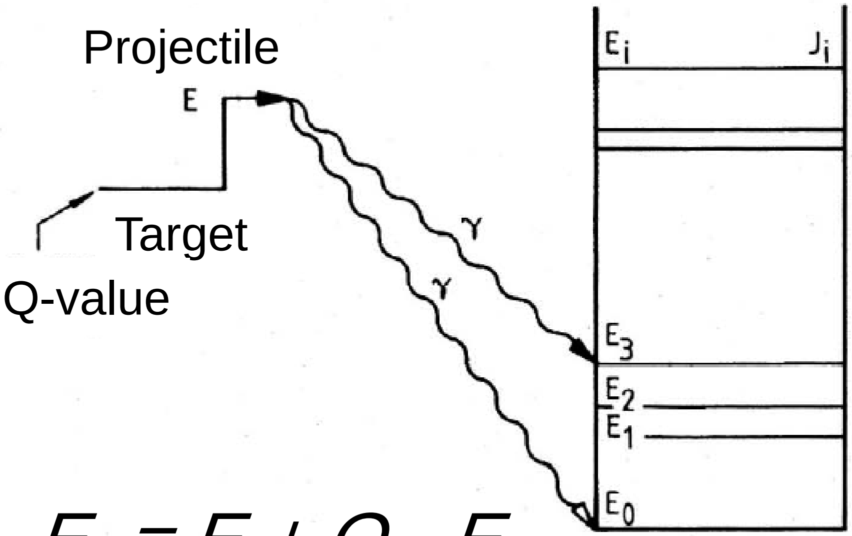
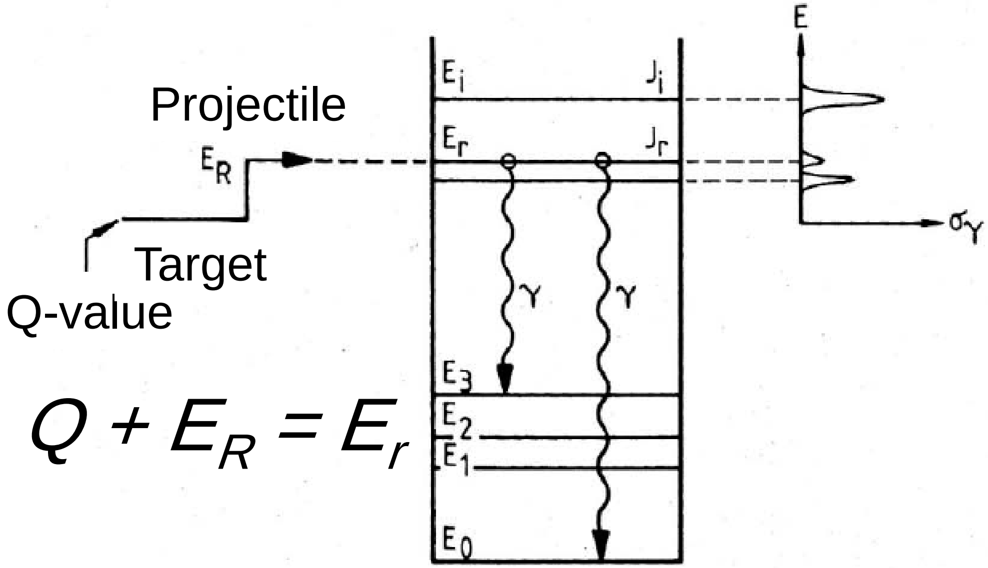


Fig. 2. Excitation function in the proton energy region from 1.25 to 2.45 MeV, including the last narrow resonances, and the beginning of the continuum.

Resonance Reactions



$$E_\gamma = E + Q - E_{ex}$$



$$Q + E_R = E_r$$

Direct Capture
(all energies)

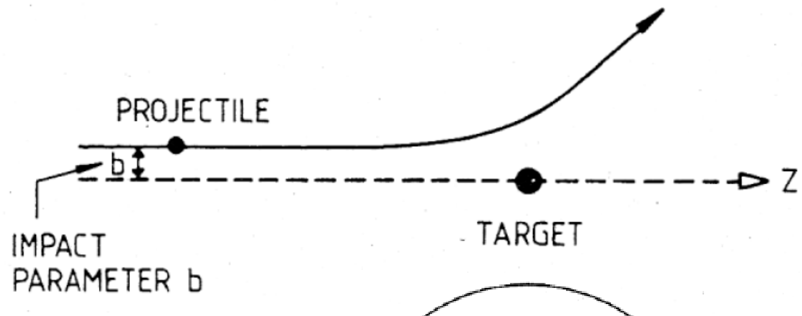
Resonant Capture
(selected energies with large X-section)

$$\sigma_\gamma \propto \left| \langle Y | H_\gamma | a + X \rangle \right|^2$$

$$\sigma_\gamma \propto \left| \langle E_f | H_\gamma | E_r \rangle \right|^2 \left| \langle E_r | H_{CN} | a + X \rangle \right|^2$$

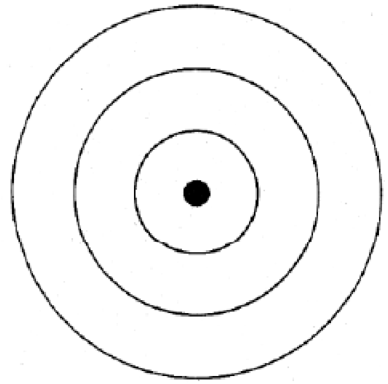
Statistical Factor

$$L = l\hbar = bp = b\frac{\hbar}{\lambda\!\!\!^{-}}$$

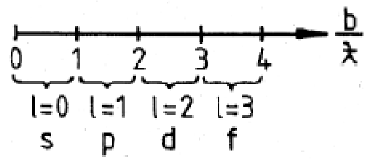


$$b = l\lambda\!\!\!^{-}$$

$$\sigma_{l,\max} = \pi b_{l+1}^2 - \pi b_l^2 = (2l+1)\pi\lambda\!\!\!^{-}{}^2$$



$$\pi\lambda\!\!\!^{-}{}^2(b) = \frac{656.7}{\mu(u)E^{CM}(keV)}$$



Generalization

$$\sigma_{\max} = \pi\lambda\!\!\!^{-}{}_{aX}^{2}\underbrace{\frac{2J+1}{(2J_a+1)(2J_X+1)}(1+\delta_{aX})}_{\omega}$$