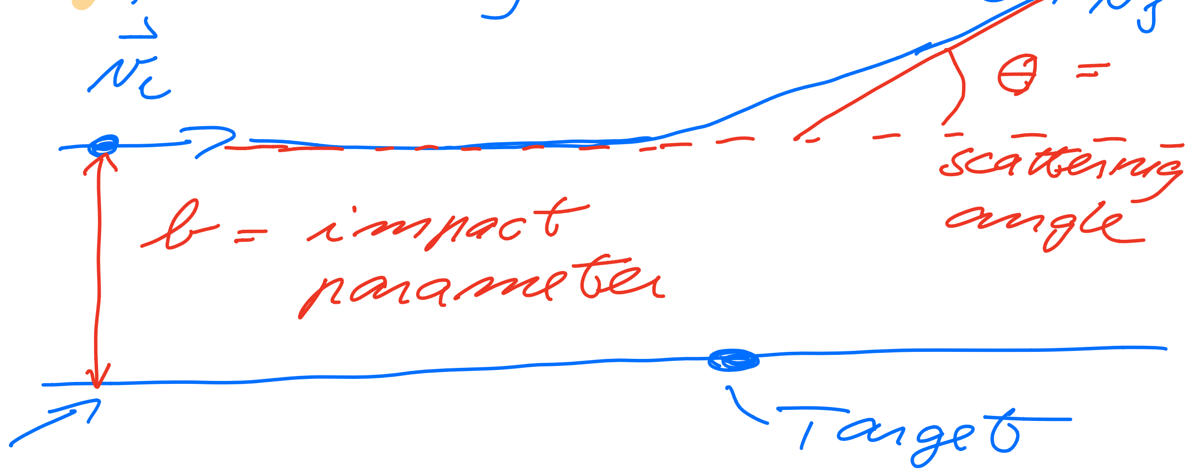
PHY 321 APRIL 2

two-body scattering



$$\boxed{r(\phi) = \frac{c}{1+\varepsilon\cos\phi}}$$

attractive force

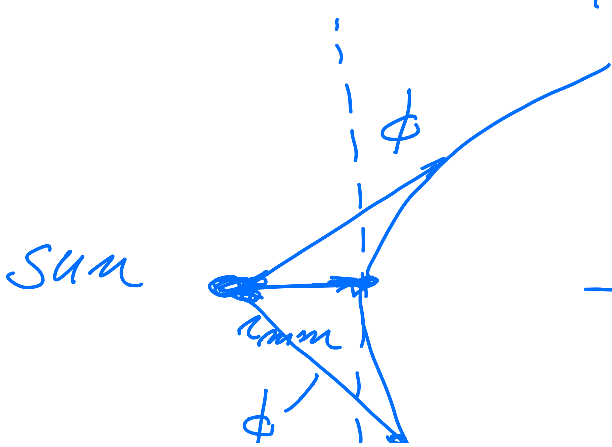
$-\alpha/r^2$

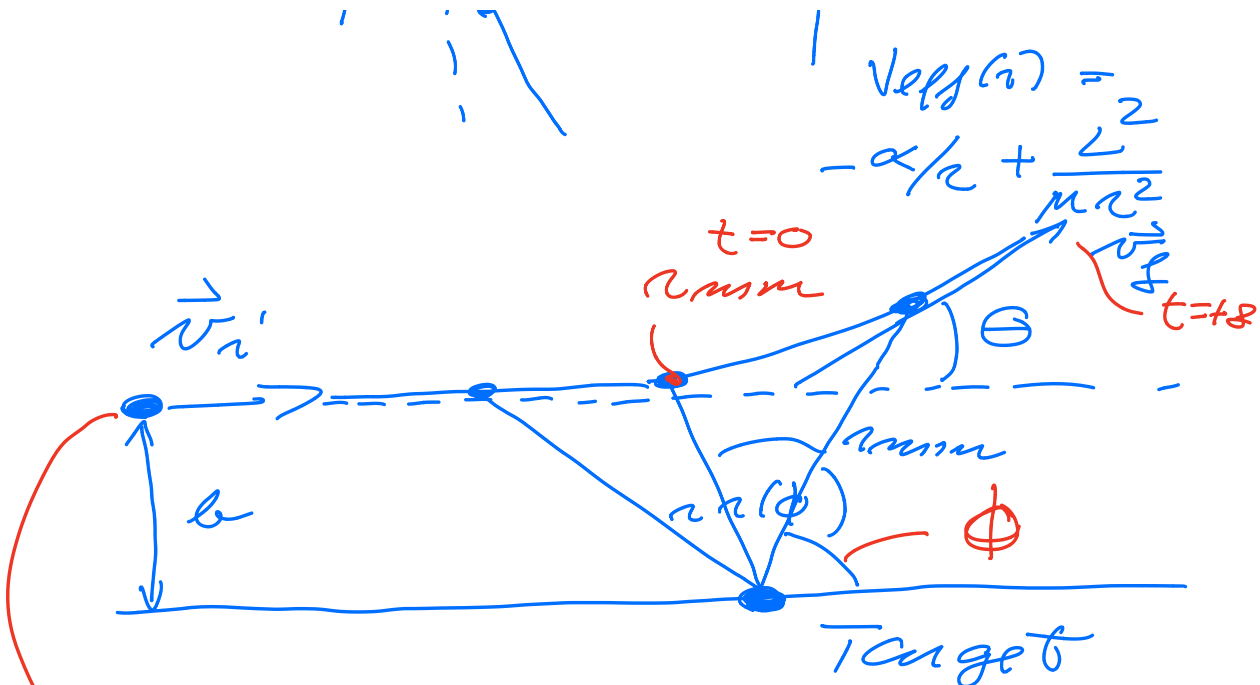
$(\alpha = G m_1 m_2$

$(\alpha = \frac{1}{4\pi\varepsilon_0} q_1 q_2$

$$= \frac{c}{\varepsilon\cos\phi - 1}$$

repulsive force.





$r(\phi)$

$t = -\infty$ (far away)

$E = \quad v_i \neq 0 \quad$ kinetic only

$E = \frac{1}{2} v_i^2 \mu$

$t = +\infty$ (far away)

$E = \frac{1}{2} v_f^2 \mu \quad$ kinetic only.

$F = -\alpha/r^2$

Is E conserved? Yes

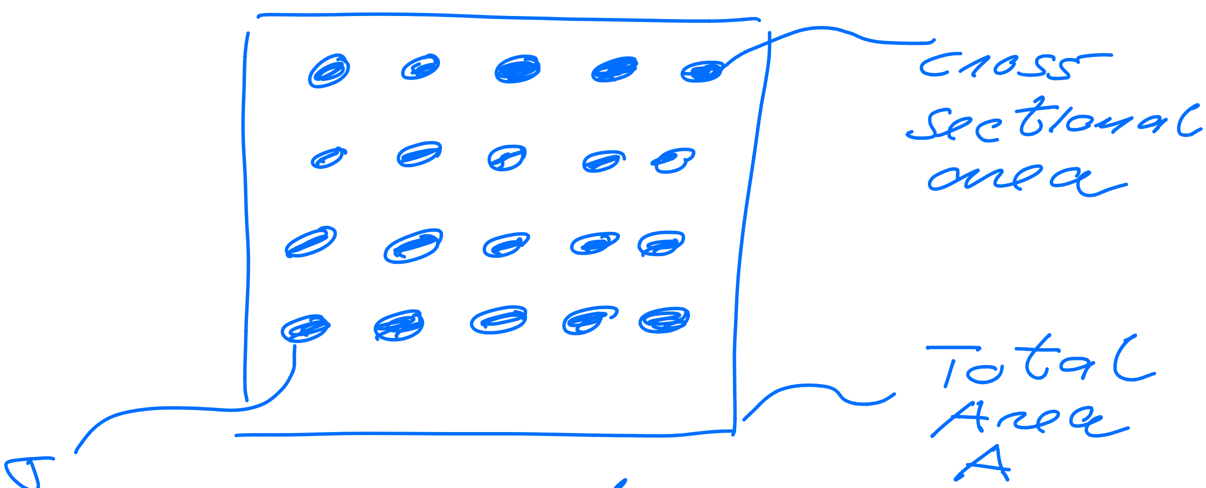
We want to relate $r(\phi)$ to Θ, b

E, L — observable

- more definitions

collision cross section

Target assembly



ρ_t = number of targets per area

\# targets = number targets

$= \rho_t \cdot A$

- likelihood of making a hit.

- cross sectional area

$$\sigma = \pi R^2$$

- Total area of all targets

$$= \sigma \cdot \rho_t \cdot A$$

- probability of hit

$$= \frac{\text{area occupied by targets}}{\text{total area}}$$

$$= \frac{\rho_t \cdot A \cdot \sigma}{A} = \rho_t \cdot \sigma$$

want this

$\sigma(\theta, b)$

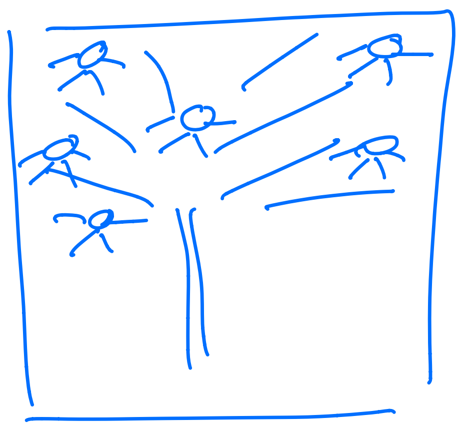
- Number of scattered

$$= \underline{N_{scatter}} = \overset{\text{incoming}}{\underline{N_{inc}}}\, \rho_t \cdot \sigma$$

σ = effective area of

the target for
interacting with
the projectile

Example [Taylor]



oak Tree

Total
$A = 150\,ft^2$

50 pigeons each
with $\sigma = \frac{1}{2}\,ft^2$

Fire 60 bullets
randomly $= N_{inc}$

$$N_{hits} = N_{inc}\,\rho_{pigeons}\,\sigma$$

$$\rho_{pigeons} = \frac{50}{150} = \frac{1}{3}\,ft^{-2}$$

$$N_{hits} = 60 \times \left(\frac{1}{3}\,ft^{-2}\right)\left(\frac{1}{2}\,ft^{2}\right)$$

$$= 10 \text{ pigeons}$$

In nuclear physics

$R \approx 10^{-14}\,m \implies$

$\sigma \approx 10^{-28}\,m^2 = 1$ barn