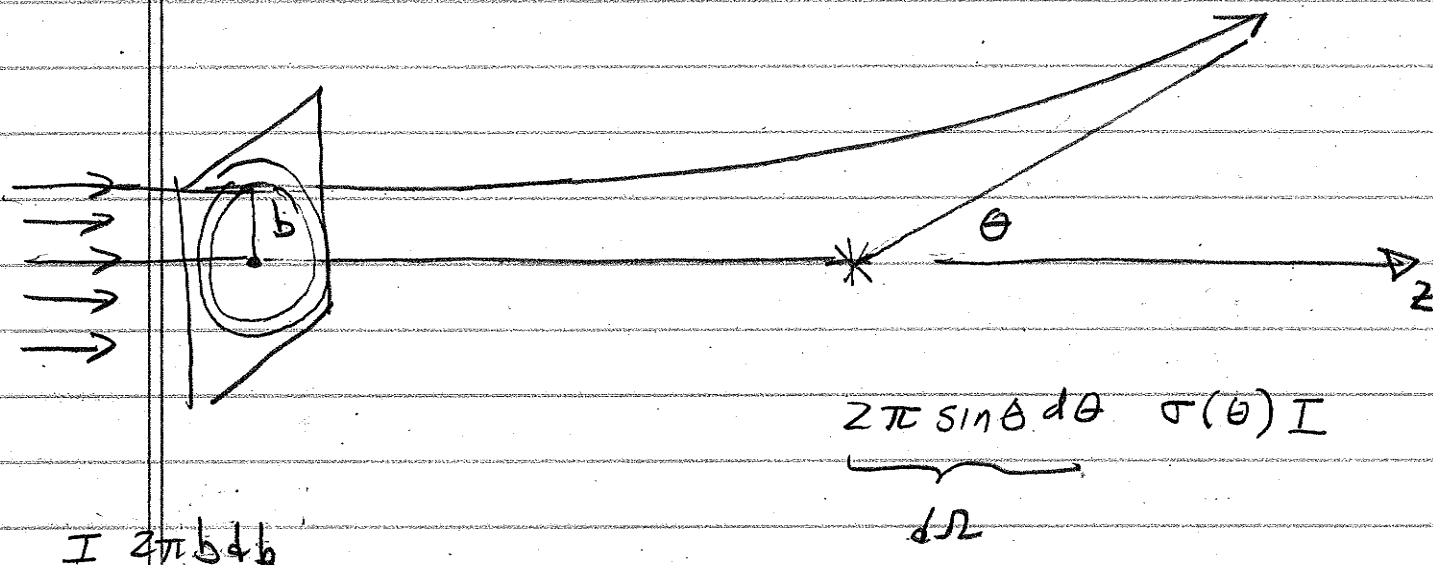


Scattering Theory in Classical Mechanics

Definition of "cross section"

$$\sigma(\Omega) d\Omega \equiv \frac{\# \text{ particles scattered into solid angle } d\Omega \text{ per unit time}}{\text{incident intensity}}$$



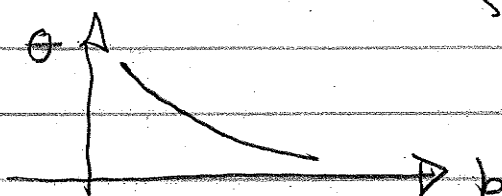
Central force problem σ only depends on θ not ϕ

$$\sigma(\theta) = \frac{b}{\sin\theta} \left| \frac{db}{d\theta} \right|$$

Q What are dimensions of σ ?

A: L^2 !

In words scattering angle θ depends on impact parameter b (In general as b gets larger θ gets smaller)



so $db/d\theta < 0$

hence // sign in eqn for σ .

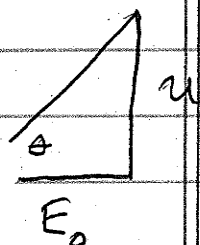
CM-502

to to a classical scattering problem "just"

need to compute how θ depends on b .

But we just did this for a very fast incoming particle!

HW \downarrow



$$E_0 = \frac{1}{2} m v_x^2$$

$$\tan \theta = -GMm/bE_0$$

$$\sec^2 \theta \, db = \frac{GMm \, db}{b^2 E_0}$$

$$\sec^2 \theta = 1 + \tan^2 \theta$$

$$U = \frac{GMm}{b} \text{ grav PE}$$

$$db/db = \sec^2 \theta / \frac{GMm}{b^2 E_0} = \left(\frac{1 + (U/E_0)^2}{U/E_0} \right) b$$

$$\sigma(\theta) = \frac{b}{U/E_0} \frac{1 + (U/E_0)^2}{U/E_0} b = \frac{b^2}{(U/E_0)^2}$$

$$\sin \theta \approx U / \sqrt{U^2 + E_0^2}$$

$$\approx \tan \theta = U/E_0$$

probably okay to write

$$1 + (U/E_0)^2 = 1$$

under same assumptions
that E_0 large

Correct? Seems funny
 σ increases (diverges?)
as $U/E_0 \rightarrow 0$!