medium

ze

Atom

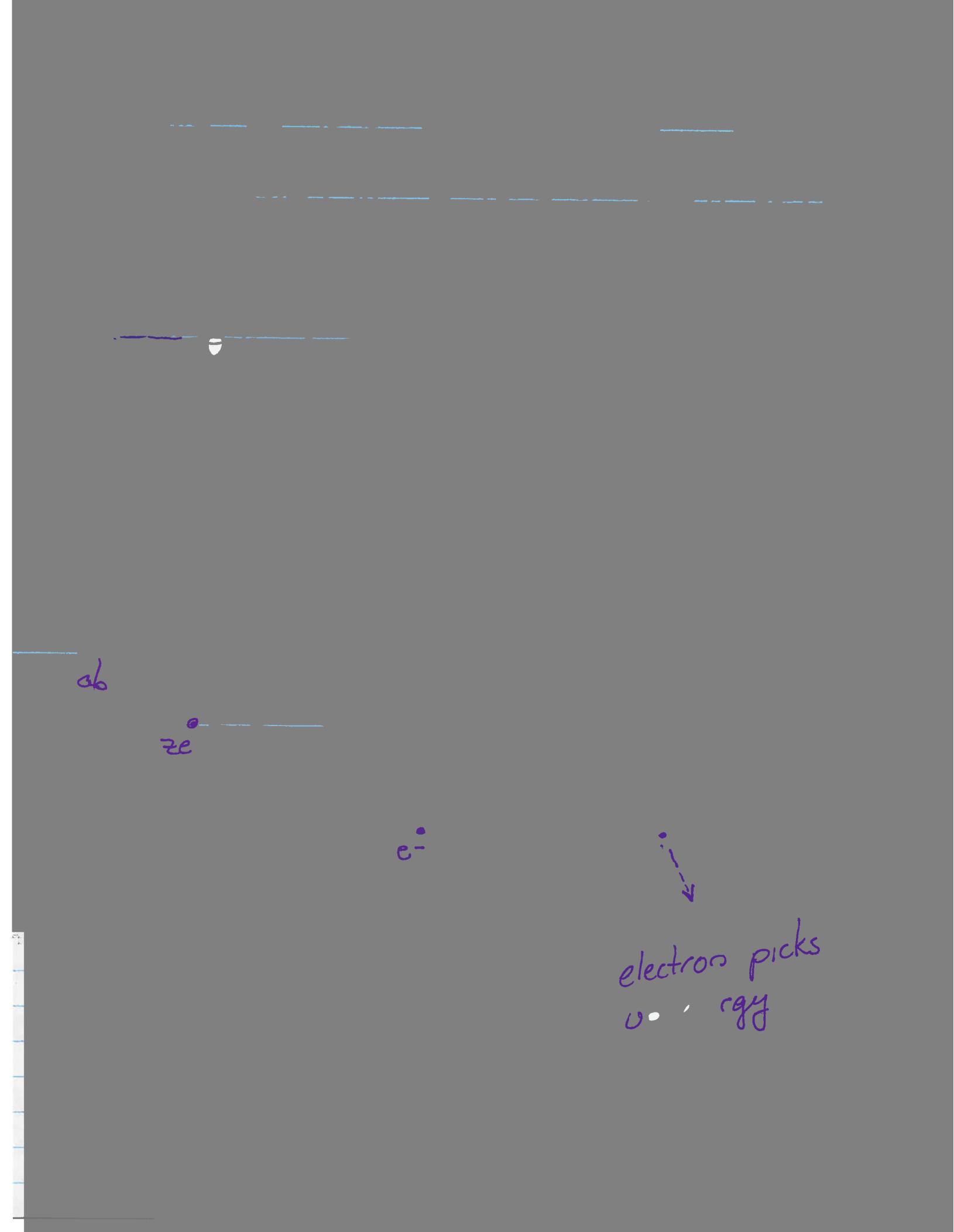
e^-

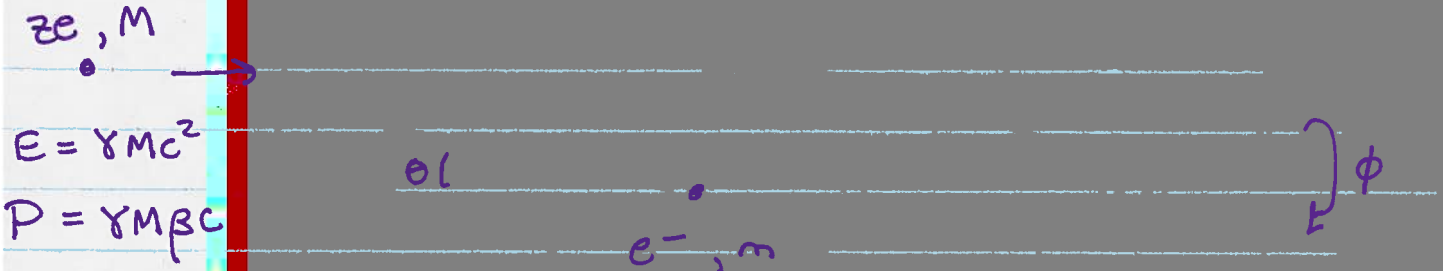
Here, interested in the interaction between the incoming particle and electrons or atomic nuclei

- Rutherford scattering
- ionization / atomic transitions

density effect

Bohr, Bethe, Fermi


ab
Ze
e-
electron picks
u. rgy



$$\frac{d^2\vec{r}}{dt} = -\frac{Ze^2}{mr^2}\hat{r}$$

или

$$\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2 + \frac{Ze^2}{mr^2} = 0$$

$$\frac{d^2\theta}{dt^2}: \quad \frac{2}{r}\frac{dr}{dt}\frac{d\theta}{dt} = 0 \Rightarrow L = r^2\frac{d\theta}{dt} = \text{const}$$

$$\frac{d^2r}{d^2} - \frac{L^2}{r^3} + \frac{ze^2}{mr^2} = 0$$

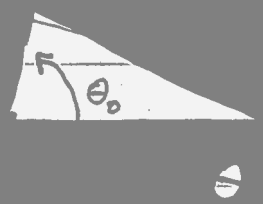
$$\frac{dr}{dt} = \frac{d}{dt}\frac{d}{d}\left(\frac{1}{u}\right. = -\frac{d\theta}{d}\frac{1}{u^2}du \qquad u = 1/r$$

$$= -L\frac{d}{d\theta}$$

so we $$-\frac{ze^2}{mL^2} = 0$$

solution $$u_0\cos(\theta - \theta_0) + \frac{ze^2}{m\upsilon^2 b} \qquad L = \upsilon b$$

also



scattering angle is

$$r \to \infty, \quad v \to 0 \qquad v_0 \cos(\theta_0) = -\frac{ze^2}{mv^2 b}$$
$$\theta = 0$$

$$v_0 \sin(\theta_0) = -\frac{v}{L}$$

$$= \frac{1}{\tan\left(\frac{\theta}{2} + \right.} \quad 2$$

for cross section

$$I\, b\, db\, d\phi = -\frac{d\sigma}{d\Omega} d\Omega$$

$$= \frac{ze^2}{mv^2} \frac{1}{\tan\theta/2} \frac{ze^2}{mv^2} \frac{1}{\sin^2\theta/2} \frac{1}{\cos^2\theta/2} \frac{1}{2} \frac{1}{2\sin\theta/2\cos\theta/2}$$

* with $p = mv$

$$= ($$

θ is sca

$= 2p^2$

$= 4$

$\frac{d\sigma}{d\Omega^2}$

so $\frac{d\sigma}{dQ^2} =$

$$p^4 \sin^4 \theta/2 = Q^4/16$$

$$\frac{d\sigma}{dQ^2} = 4\pi \left(\frac{e^2}{\upsilon Q^2} \right)^2$$

Q^2 in initial rest fr

$$Q^2 = -(p - p')^2$$

$$= -\left((\gamma - 1)^2 - \gamma^2 \beta^2 \right) m^2 c^2$$

kinetic

e^- fl... $\gamma mc^2, \gamma m\beta c$

boost to lab frame

$$E = \gamma(E' + \beta c p') = \gamma^2(mc^2 + mc^2\beta^2)$$

$$= 2\gamma^2\beta^2 mc^2$$

$$\frac{dE}{dx}\langle\epsilon\rangle = 2\pi N Z \frac{z^2 e^4}{mc^2\beta^2} \left[B_q^2\right]$$

$$\beta(\epsilon) = \frac{\gamma v \sqrt{2m\epsilon}}{\hbar\langle\omega\rangle}$$

d t.. expres

lo