

XIV. PREDAVANJE

RASPRŠENJE ELEKTRONA NA MIONU I NUKLEONU

- **KINEMATIKA U LAB. SUSTAVU**
- **MOTTOVO RASPRŠENJE**
- **PROCESI VAŽNI U ASTROFIZICI**

ELASTIČNO RASPRŠENJE (mjerjenje dimenzija protona)

Raspršenje e^- na p

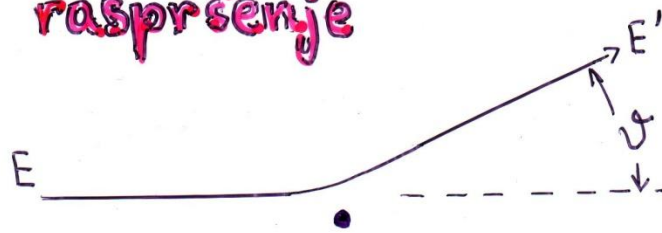
KVANTNA INAČICA

Keplerovog problema

§4.2

stanja raspršenja

Rutherfordovo
raspršenje



FEČ | str. 199

$$\frac{d\sigma}{d\Omega} = \frac{Z^2 \alpha^2}{4E^2} \frac{1}{\sin^4 \frac{\theta}{2}}$$



§3.1

vezano stanje

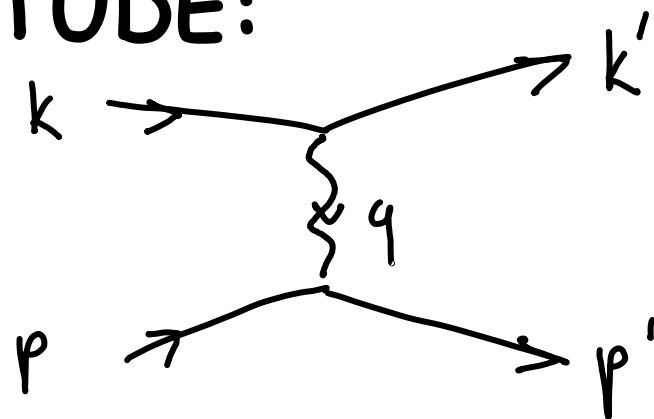
H-atom

FEČ | str. 110

$e^- \mu^- \rightarrow e^- \mu^-$ U LAB. SUSTAVU

- XII. PRED.** USREDNJEN KVADRAT INVARIJANTNE AMPLITUDE:

$$\overline{|M|^2} = \frac{e^4}{q^4} L_e^{\mu\nu} L_{\mu\nu}^{\text{mion}}$$



$$L_e^{\mu\nu} = 2 \left[k'^{\mu} k^{\nu} + k'^{\nu} k^{\mu} - (k' \cdot k - m_e^2) g^{\mu\nu} \right]$$

$$L_{\mu\nu}^{\text{mion}} = 2 \left[p'^{\mu} p^{\nu} + p'^{\nu} p^{\mu} - (p' \cdot p - m_{\mu}^2) g_{\mu\nu} \right]$$

$$L_e^{\mu\nu} L_{\mu\nu}^{\text{mish}} = 8 \left[(k' \cdot p')(k \cdot p) + (k' \cdot p)(k \cdot p') - \cancel{m^2 p' \cdot p} - M^2 k' \cdot k + \cancel{2m^2 M^2} \right]$$

$$k^2 = k'^2 = 0, \quad q^2 = -2k \cdot k'$$

$$p' = q + p$$

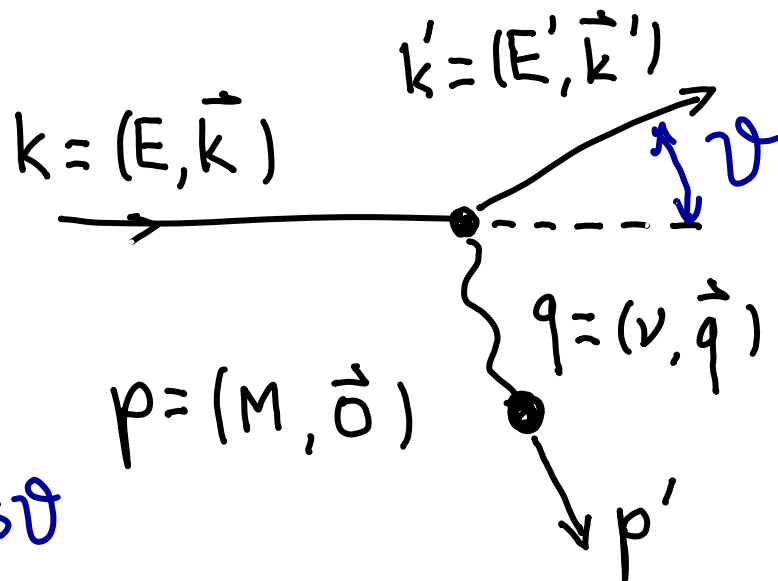
$$= 8 \left[-\frac{1}{2} q^2 (k \cdot p - k' \cdot p) + 2(k' \cdot p)(k \cdot p) \right]$$

Za proton sa strukturom: $+ \frac{1}{2} M^2 q^2$

$$L_e^{\mu\nu} \left(K_{\mu\nu}^{\text{protona}} \right) = -K_1 g_{\mu\nu} + \frac{K_2}{M_p^2} p_\mu p_\nu + \frac{K_4}{M_p^2} q_\mu q_\nu + \frac{K_5}{M_p^2} (p_\mu q_\nu + p_\nu q_\mu)$$

KINEMATIKA U LAB. SUSTAVU

Za sudar umjerene energije $E, E' \gg m_e c^2$



$$\vec{k} = E(1, \hat{k})$$

$$\vec{k}' = E'(1, \hat{k}'), \quad \hat{k} \cdot \hat{k}' = \cos \vartheta$$

$$q^2 = (\vec{k} - \vec{k}')^2 \approx -2\vec{k} \cdot \vec{k}' = -2EE'(1 - \cos \vartheta) = -4EE' \sin^2 \frac{\vartheta}{2}$$

$$|M|^2 = \frac{8e^4}{q^4} 2M^2 E' E \left\{ \cos^2 \frac{\vartheta}{2} - \frac{q^2}{2M^2} \sin^2 \frac{\vartheta}{2} \right\}$$

Mottovo raspršenje

$$\left. \frac{d\sigma}{d\Omega} \right|_{\text{lab}} = \frac{\alpha^2}{4E^2 \sin^4 \frac{\vartheta}{2}} \frac{E'}{E} \left\{ \cos^2 \frac{\vartheta}{2} \right\}$$

učinak spina
elektrona (još uvijek
zabravljeno raspršenje
unutraž)

$$-\frac{q^2}{2M^2} \sin^2 \frac{\vartheta}{2}$$

uključeni spin protona, ali
točkasti proton