Introduction to Strangeness
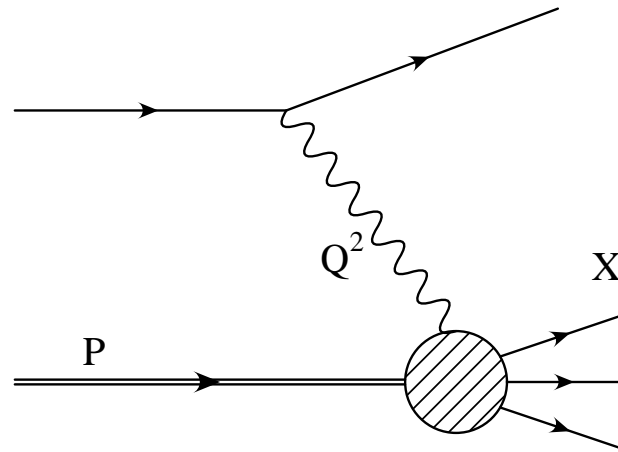
Structure Functions

$$\frac{d^2\sigma}{d\Omega d\epsilon_2} = \frac{\alpha^2}{4\epsilon_2 \sin^4 \theta/2} \left[W_2(\nu, Q^2) + 2\tan^2 \theta/2 W_1(\nu, Q^2) \right]$$

Elastic Contribution

$$W_1(\nu, Q^2) = 2M \frac{G_E^2(Q^2) + \frac{Q^2}{4M^2} G_M^2(Q^2)}{1 + Q^2/4M^2} \delta(W^2 - M^2)$$

$$W_2(\nu, Q^2) = 2M \frac{Q^2}{4M^2} G_M^2(Q^2) \delta(W^2 - M^2)$$

Kinematics

$$Q^2 = 4\epsilon_1 \epsilon_2 \sin^2 \theta/2 \quad \text{Laboratory}$$

$$Q^2 = \frac{E_{jet}^2 \sin^2 \theta_{jet}}{1 - (E_{jet}/E)}) \sin^2 \theta_{jet} \quad \text{Collider}$$

$$\nu = \epsilon_1 - \epsilon_2$$

$$x_{Bjorken} = \frac{Q^2}{2M\nu}; \quad W^2 = Q^2 \left(1 - \frac{1}{x_{Bjorken}}\right) + M^2$$

ElectroWeak Interactions: Virtual $W^\pm$

$$e^- p \to \nu X, \, e^+ p \to \overline{\nu} X, \, \nu p \to \mu^- X, \, \overline{\nu} p \to \mu^+ X$$

$$\frac{d^2 \sigma^\pm}{d\Omega d\epsilon_2} = \frac{G_F^2 \epsilon_2^2}{2\pi^2 (1 + Q^2/M_W^2)^2} \times$$

$$\left[\cos^2 \theta/2 W_2(\nu, Q^2) + 2 \sin^2 \theta/2 W_1(\nu, Q^2) \mp \frac{\epsilon_1 + \epsilon_2}{M} \sin^2 \theta/2 W_3(\nu, Q^2) \right]$$

Quark Parton Content

$$\nu W_2^p(\nu, Q^2) \quad = \quad F_2^p(x_{Bj}) = 2x_{Bj}F_1(x_{Bj})$$

$$\frac{1}{x_{Bj}}F_2^p(x_{Bj}) \quad = \quad \left[4/9(u(x) + \overline{u}(x)) + 1/9(d(x) + \overline{d}(x)) + 1/9(s(x) + \overline{s}(x))\right]$$

$\mu^+\mu^-$ Production in Hadron-Hadron Collisions

$$q + \overline{q} \to \mu^+\mu^- + X$$

$$d\sigma = (q(x_a)dx_a)\,(q(x_b)dx_b)\hat{\sigma}(q + \overline{q}- \to \gamma^* \to \mu^+\mu^-) \tag{1}$$

Several Sub-Processes:

$$q + \overline{q}- \to \gamma^* + g$$

$$q + g- \to \gamma^* + q$$

$$\frac{d^2\sigma^\pm}{dMdy} = \frac{16\pi^2\alpha^2}{9Ms}K\sum_q e_q^2 q(x, M^2)\overline{q}(x, M^2) \tag{2}$$