## Exercise 1: Electron inelastic scattering

An electron with a $E = 20$ GeV kinetic energy collides inelastically on a proton at rest. The electron is scattered at an angle $\theta = 5$ with respect to its original direction and with an energy $E' = 12$ GeV. Calculate the effective mass of the final hadronic system.

## Exercise 2: Structure function

The momentum distribution of the $u$-type quark in the proton can be parametrized by the formula:

$$F_u(x) \approx xu(x) = a(1 - x)^2 \tag{1}$$

Determine the constant $a$ with the assumption that the $u$ quarks carry 33% of the proton momentum.

## Exercise 3: Gluon structure function

It is believed that the structure function describing the distribution of the gluon momentum inside the nucleons, $g(x)$, strongly increases with decreasing $x$. Estimate the number of gluons that would be possible to resolve with deep inelastic

$$e + p \longrightarrow e + X \tag{2}$$

collisions at $Q^2 = 104$ GeV$^2$ at low $x$ values (in the intervals $0.0001 \div 0.001$, $0.001 \div 0.01$, $0.01 \div 0.1$). Assume that at these $Q^2$ values the distribution function of the gluons is:

$$xg(x) = 0.36x^{-0.5} \tag{3}$$