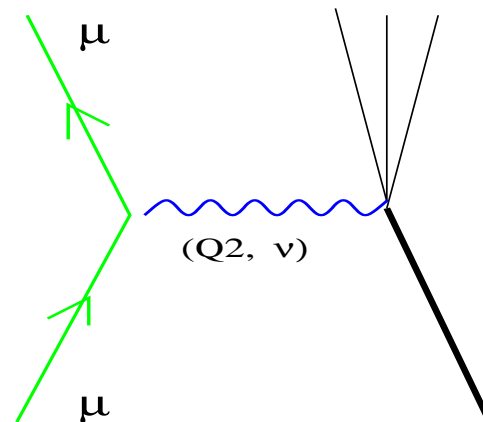# Muon photonuclear interaction

Muon photonuclear interaction

The inelastic interaction of muons with nuclei is important for high muon energies $E \geq 10$ TeV, at relatively high energy transfers $\nu/E \geq 10^{-2}$, in particular, in light materials, from view–point of the detector response for high energy muons, muon propagation and muon–induced hadronic background.

μ

(Q2, ν)

μ

dE/dx :   Average energy loss for this process is almost lineary increasing with energy, and at TeV muon energies constitutes about 10% in standard rock.

differential cross section :   The main contribution to the cross section $d\sigma/d\nu$ and energy loss is given by low Q^2–region :

$$Q^2 \ll 1 \; \text{GeV}^2$$

Most widely used are the expressions given by Borog and Petrukhin [Boro75] and Bezrukov and Bugaev [Bezr81]. Results of these authors agree within 10% for differential cross section and within about 5% for the average energy loss (if the same photonuclear cross section $\sigma_{\gamma N}$ is used in calculations).

Theoretical estimates show that inelastic muon scattering gives, along with multiple Coulomb scattering, appreciable contribution to muon deflection (and dominates at large angles).

see [Koko00] for a review of Borog and Petrukhin cross section.

References

[Boro75] V.V.Borog and A.A.Petrukhin, Proc. 14th Int.Conf. on Cosmic
    Rays, Munich,1975, **vol.6**, p.1949.

[Boro77] V.V.Borog, V.G.Kirillov-Ugryumov, A.A.Petrukhin, Sov. J.
    Nucl. Phys., **25**, 1977, p.46.

[Bezr81] L.B.Bezrukov and E.V.Bugaev, Sov. J. Nucl. Phys., **33**, 1981,
    p.635.

[Koko00] S.R.Kelner, R.P.Kokoulin, A.Rybin. Geant4 Physics Reference
    Manual, Cern (2000)