Exercise Sheet 4 – Particle Physics – Summer 2016

N. Berger, A. Kozlinskiy

hand in: Mo 30.5. (in the lecture)

4.1 Completeness relation (4 points)

Prove the completeness relation for Dirac spinors:

$$\sum_{s=1,2} u_s \bar{u}_s = \gamma_\mu p^\mu + m \tag{1}$$

4.2 Proton form factor (3 points)

For Gaussian like charge distribution

$$\rho(r) \approx \exp(-\frac{r^2}{2r_0^2}) \tag{2}$$

show that form factor has a form

$$F(q^2) \approx \exp(-\frac{q^2 r_0^2}{2}) \tag{3}$$

4.3 Electron-proton scattering (5 points)

Consider the scattering of a 200 MeV momentum electron on a proton. Use the Mott scattering cross section formula to estimate a ratio of counting rates at 30° and 60° scattering angles. Compare the results for a point like form factor and Gaussian form factor with $r_0 = 0.8$ fm.