

Particle Physics Exercise

Interaction strengths and cross sections

1. At which mass becomes the gravitation between two identical charged particles equal to the Coulomb force? **[2]**
2. Calculate the cross section $\sigma = G_F^2 s / \pi$ for the scattering of neutrinos on electrons and nucleons as a function of the neutrino energy E_ν ! To achieve that:
 - Calculate the total reaction energy s in the reaction centre-of-mass system!
 - Calculate the coupling constant G_F^2/π in units of $\hbar c$! **[4]**
3. What is the mean free path of neutrinos with an energy of 1 GeV through the Earth ($M = 6 \cdot 10^{24}$ kg, $R = 6400$ km)? Assume $\sigma (\nu N \rightarrow e^- N) = 10^{-38} \text{ cm}^2 (E_\nu/\text{GeV})$. **[3]**