Elementary Particle Physics

Problem Sheet 1

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1. Draw a table showing all the elementary spin 1/2 fermions arranged in three families horizontally with the individual members of each family vertically. In the table give the names, symbols, electric charges, and approximate masses of each particle.

2. Although the quarks inside a neutron or proton interact via gluon exchange, the strong nuclear interaction between a proton and a neutron can be thought of as due to π meson exchange. If the π meson has a mass of 140 MeV/c^2 calculate the range of the strong nuclear force.

3. Draw Feynman diagrams to illustrate the following reactions, clearly labeling each quark, lepton and boson. In each case say which fundamental force is involved (if more than one could be involved give the most likely).

   (a) $e^- + p \rightarrow e^- + p$

   (b) $e^+ + e^- \rightarrow \nu_e + \overline{\nu_e}$

   (c) $e^- + p \rightarrow \nu_e + n$

   (d) $u + d \rightarrow u + d + d + \overline{d}$