PH3520 (Particle Physics)
Problem sheet 7
To be turned in by 10:00 a.m., Thursday 17 November, 2011.

1: In one of the first pictures of a V^0 particle observed by Rochester and Butler (Fig. 1), the measured momenta of the two daughter particles were

$$\begin{aligned} p_1 &= 340\,\text{MeV} \\ p_2 &= 350\,\text{MeV}\,, \end{aligned}$$

and their opening angle was 66.6°. The identity of the daughter particles, i.e. whether they were pions, electrons, etc. was not certain.

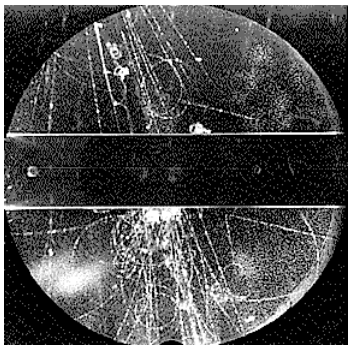

Figure 1: Cloud chamber photograph by Rochester and Butler showing a V^0 particle below the plate on the right.

(a) Compute the invariant mass of the original V^0 first assuming that the daughter particles were π^+ and π^-. (Use $m_\pi = 139$ MeV.)

(b) Compute the invariant mass assuming that the daughter particles were e^+ and e^-. (Use $m_e = 0.511$ MeV.) Look up the mass of the K^0 meson and compare it with the results you obtained from (a) and (b). You cand find the masses of all particles from the Particle Data Group's website, `pdg.lbl.gov`. Follow the links for summary tables, mesons, contents, etc.

2: Sketch Feynman diagrams for the following decays. Label all particles in the diagrams, including all of the quarks inside the hadrons. Indicate the coupling strengths for all vertices.

(a) $\Xi^- \to \Lambda\pi^-$

(b) $K^0 \to \pi^- e^+ \nu_e$ $\qquad (K^0 = d\bar{s})$

(c) $\Lambda \to n\ \pi^0$

(d) $\Sigma^+ \to p\ \pi^0$ $\qquad (\Sigma^+ = uus)$

(e) $\rho^+ \to \pi^+\pi^0$ $\qquad$ (has an intermediate gluon)

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