FYS3500 - Problem set 6

Spring term 2019

Problem 1

Discuss why the process $e^- + e^+ \to \gamma$ is not possible.

Problem 2

Describe briefly why it was necessary to introduce the strangeness and lepton numbers.

Problem 3 Space-time symmetries 1

a) Show that parity invariance leads to parity conservation, that is $[H, \hat{P}] = 0$, where

$$\hat{P}\Psi(\boldsymbol{r}_1, \boldsymbol{r}_2, \ldots, t) = P_1 P_2 \cdots \Psi(-\boldsymbol{r}_1, -\boldsymbol{r}_2, \ldots, t) \tag{1}$$

b) Why is the reaction $\pi^- + d \to n + n + \pi^0$ effectively forbidden for a π^- at rest, but proceeds at a normal rate for a strong reaction at higher energies?
Hint: Think about what spins the 2 neutrons would need at low energies to obey total angular momentum conservation.

Problem 4 Space-time symmetries 2

a) A neutral spin-2 meson M^0 can decay via the strong interaction to a $\pi^+\pi^-$ final state. Use this to deduce its parity and charge conjugation quantum numbers.

Problem 5 Relativistic kinematics

a) Problem A.1

b) Problem A.4 in M&S