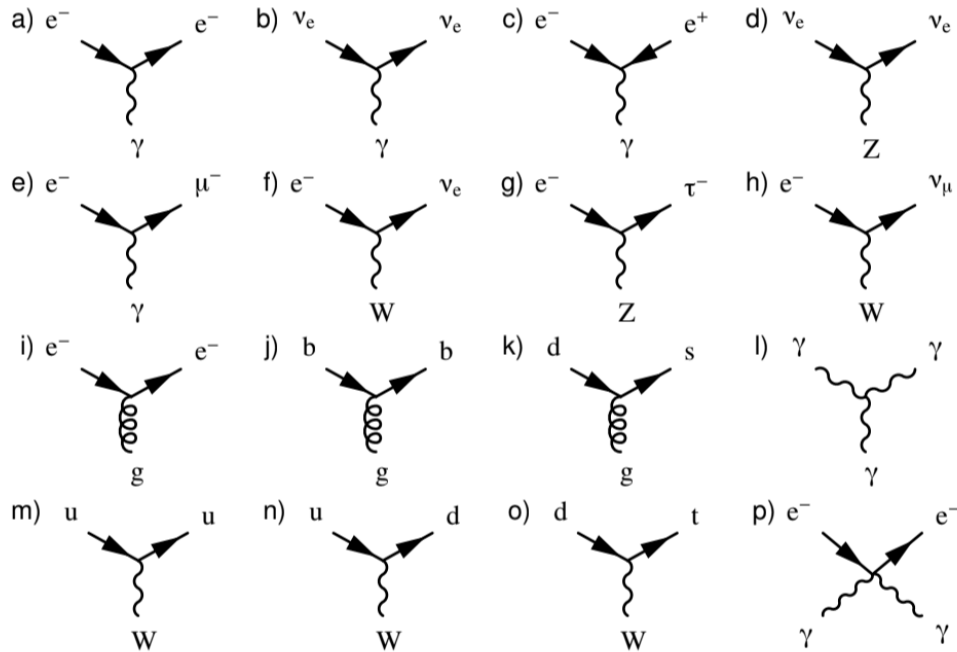


Particle Physics 1: Exercise 1

Exercise 1 - Feynman diagrams



- 1) State and explain your reasoning for whether each of the diagrams below represents a valid Standard Model vertex
- 2) Draw the Feynman diagram for $\tau^- \rightarrow \pi^- \nu_\tau$ (the π^- is the lightest of $\bar{u}d$ meson)
- 3) Draw the Feynman diagrams for the decays:
 - a) $\Delta(uud) \rightarrow n(udd)\pi^+(u\bar{d})$,
 - b) $\Sigma^0(uds) \rightarrow \Lambda(uds)\gamma$,
 - c) $\pi^+(u\bar{d}) \rightarrow \mu^+\nu_\mu$
 and place them in order of increasing lifetime

Exercise 2 - Lorentz transformation

- 1) In a collider experiment, Λ baryons can be identified from the decay $\Lambda \rightarrow \pi^- p$ that gives rise to a displaced vertex in a tracking detector. In a particular decay, the momenta of the π^- and p are measured to be 0.75 GeV and 4.25 GeV respectively, and the opening angle between the tracks is 9° . The masses of the pion and proton are 139.6 MeV and 938.3 MeV.
 - a) Calculate the mass of the Λ baryon
 - b) On average, Λ baryon of this energy are observed to decay at a distance of 0.35 m from the point of the production. Calculate the lifetime of the Λ
- 2) Find the minimum opening angle between the photons produced in the decay $\pi^0 \rightarrow \gamma\gamma$, if the energy of the pion is 10 GeV, given that $m_\pi^0 = 135$ MeV