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Physics 3710 – Problem Set #13

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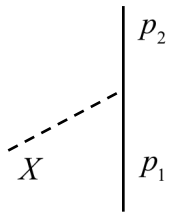
Questions 1-4 refer to the diagram at the right. In it, a particle p_1 absorbs a particle X and transforms into a particle p_2. Time increases vertically.



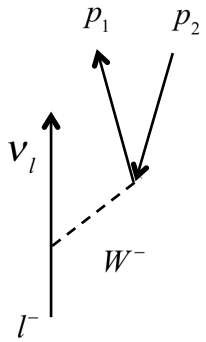
1. Suppose p_1 is a *charged lept*on and p_2 is a *neutrino* in the same lepton family. What must X be?

2. Suppose p_1 is a *charged anti-lepton* and p_2 is an *anti-neutrino* in the same lepton family. What must X be?

3. Suppose $p_1 = p_2$ is the same *neutrino*. What must X be?

4. Suppose $p_1 = p_2$ is the same *charged lepton*. What *might* X be? (Careful.)

Questions 5-8 refer to the diagram at the right, which shows the decay of a lepton l^-. Refer to the masses in the tables in notes SM1. Remember, a virtual particle does not have to have the same mass as the corresponding real particle.



5. Suppose l^- is an electron. What must p_1 and p_2 be? (Careful.)

6. Suppose l^- is an muon. What must p_1 and p_2 be?

7. Suppose l^- is an tau lepton. What *leptons* might p_1 and p_2 be?

8. The tau lepton can sometimes decay into *quarks*, the most likely ones being the lightest. What would p_1 and p_2 be in that case? (Note that the two quarks so produced are not free; they immediately exchange gluons forming a pion, which is much heavier than the two quarks. The muon doesn't decay into quarks because it isn't sufficiently heavy.)