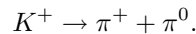


1. READING:

Styer, *The Strange World of Quantum Mechanics*
Chapters 5 - 10

2. QUESTIONS: DUE WEDNESDAY NOVEMBER 19, AT 5 PM

- Styer: Questions 4.8 - 4.10, 5.1 - 5.8, 5.13, 6.1 - 6.4 (Note the bit on page 10 about the solutions.)
- What is the significance of the magnetic arrow and projection in an in-homogeneous magnetic field? On the basis of this what does the result of the Stern-Gerlach experiment imply about electrons? Is there any way this result could be obtained with compasses? Explain.
- The particle known as K^+ is unstable and decays into two pions



The masses of these particles are, for K^+ , $M = 0.530$ u, for π^+ , $m_+ = 0.150$ u, π^0 , $m_0 = 0.145$ u, where $1\text{u} = 1.66 \times 10^{-27}$ kg and $1\text{uc}^2 = 931.5$ MeV (“million electron volts” - a unit of energy). Let’s work in the rest frame of the original particle, K^+ .

- Einstein showed that the change in mass before and after a process is equal to the change in kinetic energy - the meaning of $E = mc^2$. How much kinetic energy is available after this decay? Please state your result in MeV.
- Using the proper relativistic conservation laws, write down the conservation of momentum and p^0 . You might find it convenient to use the notation $\gamma_+ = 1/\sqrt{1 - \frac{v_+^2}{c^2}}$ for the particle π^+ , similarly for γ_0 .
- After much unpleasant algebra (please don’t attempt this, unless you find it amusing!), you obtain the result that

$$m_+\gamma_+ = \frac{M}{2} + \frac{m_+^2 - m_0^2}{2M} \quad (1)$$

$$m_0\gamma_0 = \frac{M}{2} - \frac{m_+^2 - m_0^2}{2M} \quad (2)$$

Find the two values of γ for each of the particles, π^+ and π_0 .

- What are the speeds of these particles in this frame? Did we need all that relativity?