

because the momentum transfer (squared)  $Q^2$  carried by the  $W$  is very small. Thus the decay rate will be proportional to

$$\left( \frac{\sqrt{\alpha_W} \sqrt{\alpha_W}}{M_W^2} \right)^2 = \frac{\alpha_W^2}{M_W^4}.$$

In the case of the neutral pion, there are two vertices of strength  $\sqrt{\alpha_{em}}$ , but no propagator. Thus the decay rate will be proportional to  $\alpha_{em}^2$  and since  $\alpha_{em} \approx \alpha_W$ , the decay rate for the charged pion will be much smaller than that for the neutral decay, i.e. the lifetime of the  $\pi^0$  will be much shorter.