The W boson is not only an important force carrier, it is also the mediator between subatomic decays. For example, you'll see that the W boson has a role to play in muon decay or in the flavor change of quarks. Why is flavor change important? Well, it happens very often in neutron decay or proton-electron collisions as you'll see below!

Below, we'll look at a muon decaying into a muon neutrino and an electron. We'll also look at cases where a proton will decay into a neutron (via positron emission) or the case where a neutron may become a proton and an electron (via beta emission).

The figure below shows a muon decaying via a W^- boson into a muon neutrino. Notice that the W^- boson will then decay into an electron and electron neutrino.

Recall for a moment that the mass of a muon is 105.66 MeV and an electron's mass is 0.511 MeV. You might see then that it is completely possible for a muon at rest to decay into an electron.

Rememver that by the conservation of momentum, the momentum of e^- and $\overline{\nu}_e$ will be equal and opposite. We might surmise that the neutrino will be going much faster than the electron in this case. Let's delve a little deeper using Einstein's Energy-Momentum relation.

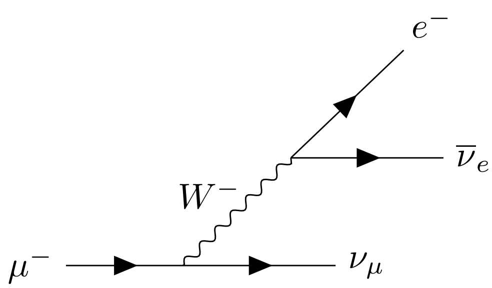

Figure 1: Muon decay via the $W^- boson$

Bear in mind that there is a very similar process when the reverse happens (a neutron will decay into an electron and a proton).

$$(i\gamma^\mu \partial_\mu - m)\psi = 0. \tag{1}$$

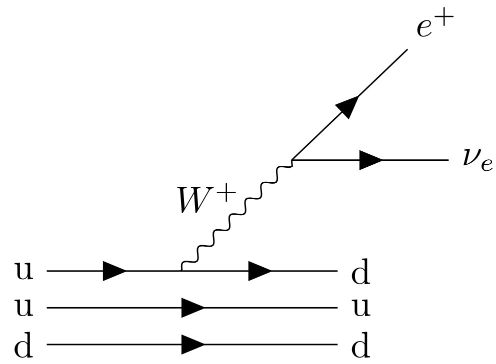

Figure 2: Proton becomes a neutron by emitting a positron.

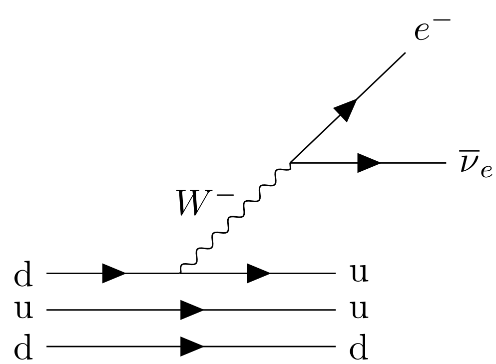

Figure 3: Neutron becomes a proton through emitting an electron