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Phys 313 class Notes
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Neutrinos (ν) - Lepton

Fermions $\leftrightarrow$ Bosons

- Fermions
  - Leptons (spin 1/2)
    - Charged: e^-, μ^-, τ^- (+antiparticles): e^+, μ^+, τ^+
    - Neutral: ν_1, ν_2, ν_3 (l)(m)(h) or ν_e, ν_μ, ν_τ
  - quarks (spin 1/2)

- Difference between charged leptons is mass: mass operator eigen states
- Neutral leptons are not discernable in mass: weak force eigenstates
- Neutral leptons can only be observed through the weak force
- Neutrino oscillation is responsible for an apparent 2/3 loss of neutrinos

In sun

$p \rightarrow n + W^+$ (gauge boson)

$W^+ \rightarrow e^+ + \nu_e$

To measure lighter

$\nu_e \rightarrow e^-$

W^+

+

$n \rightarrow p$

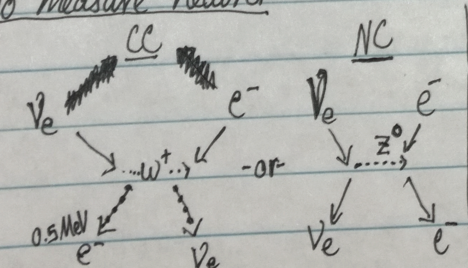
(e.g. $^{37}Cl \rightarrow {}^{37}Ar$)

Perform what the sun does in reverse (making sure that all momentum is conserved)

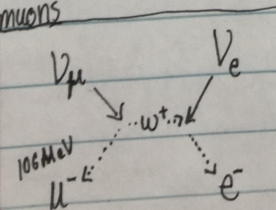
Example: Converting chlorine to argon

To measure heavier

CC -or- NC



muons



Take an electron (from some atom) and merge it with a neutrino from the sun. Using a gauge boson, the two particles swap types. Doing this causes the new electron to give off Cherenkov radiation (as the new electron is free). The light given off by this radiation can be measured by photodetectors (Water is typically used for the source of electrons)