

Standard Model and Beyond Exercises week 10

Exercise 16: Transformers of the Higgs doublet, assemble!

The Higgs doublet $\Phi(x)$ was introduced as transforming under $SU(2)$ according to

$$\Phi(x) \rightarrow \Phi'(x) = \exp\left(\frac{i}{2}\vec{\tau} \cdot \vec{e}_n \theta(x)\right) \Phi(x). \quad (1)$$

In the lecture $\tilde{\Phi}(x)$ was introduced as $\tilde{\Phi} \equiv i\tau^2 \Phi^*(x)$, where $*$ denotes complex conjugation, \vec{e}_n and θ are real, and τ^2 the second Pauli spin matrix. Prove that $\tilde{\Phi}$ has the same $SU(2)$ transformation property as $\Phi(x)$. *Hint*: first figure out what happens if you bring τ^2 to the other side of $(\tau^j)^*$ for $j = 1, 2, 3$.