Advanced Topics in EFT

Homework 2 Due: Monday, October 20, 5PM


2. Consider an $SU(N)$ gauge theory with $L$ left handed fermions and $R$ right handed fermions. Suppose that the $L$ fermions transform under the representation of the gauge group, while the $R$ fermions transform as antifundamentals. For what values (if any) of $(L, R)$ does this theory make sense?

3. Consider a very generic situation - an $SU(N)$ gauge symmetry ($N \geq 3$) with an $SU(F)_L \times SU(F)_R$ global flavor symmetry, where $F$ left handed fermions transform in the fundamental of $SU(F)_L$ and a singlet of $SU(F)_R$; and $F$ right handed fermions transform in the antifundamental of $SU(F)_R$ and a singlet of $SU(F)_L$.

   (a) Derive a condition that a $U(1)$ must satisfy so that it is not anomalous if both $L$ and $R$ fermions are fundamentals (antifundamentals) under the gauge group.

   (b) Now add a new fermion that transforms in the adjoint of the gauge symmetry, but a singlet under the flavor symmetry. What charge must it have to keep the symmetries non-anomalous?

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1Recall that ALL fermions are in the $\frac{1}{2}$, 0 representation of the Lorentz group, so “right handed fermions” means “left handed antifermions”.

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