Short HW 8: **Higher order interactions**

Course: Physics 165, *Introduction to Particle Physics* (2018)
Instructor: Prof. Flip Tanedo (flip.tanedo@ucr.edu)
Due by: **Thursday**, February 22

Note that this short assignment is due in class on Thursday.

1 Higher order interactions

Here's a summary of the fields in the Standard Model. (One generation of particles.)

	SPIN	SU(3) COLOR	SU(2) WEAK	U(1) HYPER
Q	Q^α	Q^m	$Q^a = \begin{pmatrix} u_L \\ d_L \end{pmatrix}$	$Y_Q = \frac{1}{6}$
$\bar{U}$	$\bar{U}^\alpha$	$\bar{U}_n$	(none) $\bar{U} = u_R^\dagger$	$Y_{\bar{U}} = -\frac{2}{3}$
$\bar{D}$	$\bar{D}^\alpha$	$\bar{D}_n$	(none) $\bar{D} = d_R^\dagger$	$Y_{\bar{D}} = -\frac{1}{3}$
L	L^α	(none)	$L^a = \begin{pmatrix} \nu_L \\ e_L \end{pmatrix}$	$Y_L = -\frac{1}{2}$
$\bar{E}$	$\bar{E}^\alpha$	(none)	(none) $\bar{E} = e_R^\dagger$	$Y_E = 1$
H	H	(none)	$H^a = \begin{pmatrix} H^1 \\ H^2 \end{pmatrix}$	$Y_H = \frac{1}{2}$
G	G_μ	$G^M (T^M)^m{}_n$	(none)	(none)
W	W_μ	(none)	$W^A (T^A)^a{}_b$	(none)
B	B_μ	(none)	(none)	(none)

Write down three interactions that are gauge invariant (indices all contracted, net hypercharge zero) that we have *not* written in class. The net dimension of the fields should be greater than 4. For example, $|L^a \varepsilon_{ab} H^b|^2$ is a term with mass dimension 5.

Extra credit: once you get the hang of this, it's easy to make up arbitrarily crazy ones. Write down five more.

2 Reading

Read Prof. John Baez's article on **renormalizability**[1]. Explain why the higher order interactions in problem 1 are only 'effective' interactions and not fundamental.

[1] http://math.ucr.edu/home/baez/renormalizability.html