University of California at San Diego – Department of Physics – Prof. John McGreevy

Physics 220 Symmetries Fall 2020
Assignment 8

Due 12:30pm Monday, November 30, 2020

Thanks for following the submission guidelines on hw 01. Please ask me by email if you have any trouble.

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1. Prove that any generator in any representation of a compact, semisimple Lie algebra is traceless. (This fact has important implications for grand unification of forces.)

2. **Some subgroups of SU(3).**

   (a) Consider the subalgebra of su(3) generated by T_1, T_2, T_3 (where $T_A \equiv \lambda_A/2$ and λ_A are the Gell-Mann matrices). What algebra is it? How does the **3** of SU(3) decompose into representations of this algebra? What about the adjoint of SU(3)?

   (b) Consider the subalgebra of su(3) generated by T_2, T_5, T_7. What algebra is it? How does the **3** of SU(3) decompose into representations of this algebra? What about the adjoint of SU(3)?

   Hint: the adjoint of SU(3) is $\mathbf{3} \otimes \bar{\mathbf{3}}$ minus the singlet. So if you know how the **3** transforms under a subgroup, you can figure out how the adjoint transforms, too.