
Quantum Field Theory 2 – Tutorial 10

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Problem 1: Casimir operator 2

Consider a combination of Lie algebra generators in some representation r ,

$$t_r^b t_r^a t_r^b = t_r^b t_r^b t_r^a + t_r^b [t_r^a, t_r^b]. \quad (1)$$

Use $t_r^a t_r^a = C_2(r) \cdot \mathbb{1}$ and $f^{acd} f^{bcd} = C_2(G) \delta^{ab}$ to show that

$$t_r^b t_r^a t_r^b = [C_2(r) - \frac{1}{2} C_2(G)] t_r^a. \quad (2)$$