

Physics 221A

Quantum Field Theory

Fall 2012

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ASSIGNMENT #8

Due: Weds., Nov. 28, 5pm in graders' mailbox.

1. For ϕ^4 theory in $d = 4$, write down the Noether current for the scale symmetry $\delta_s \phi = \alpha \phi + \alpha x^\mu \partial_\mu \phi$. Verify that it is conserved.
2. Write down the most general renormalizable Lagrangians with the following fields and symmetries:
 - a) In $d = 3$, a single real scalar with the discrete symmetry $\phi \rightarrow -\phi$.
 - b) In $d = 3$, a single complex scalar with the continuous symmetry $\phi \rightarrow e^{i\theta} \phi$.
 - c) In $d = 3$, a single complex scalar with the discrete Z_6 symmetry $\phi \rightarrow e^{i\pi/3} \phi$
 - d) In $d = 4$, two real scalars, with the Lagrangian invariant under both $(\phi_1, \phi_2) \rightarrow (-\phi_1, \phi_2)$ and $(\phi_1, \phi_2) \rightarrow (\phi_2, \phi_1)$.
3. Srednicki 24.4. In addition to counting the generators, give the condition that they satisfy (analogous to imaginary antisymmetric for $SO(N)$) and verify that $[T, T']$ is a generator if T and T' are.
4. Srednicki 28.1