

Homework Set 5*

September 1, 2019

1. Homework: Check that the current for the global $U(1)$ symmetry of the complex scalar field theory, $j^\mu = i \left(\Phi \partial^\mu \Phi^\dagger - \Phi^\dagger \partial^\mu \Phi \right)$, is conserved i.e. obeys the continuity equation $\partial_\mu j^\mu = 0$ not just for the free case (i.e. when $V = m^2 \Phi^\dagger \Phi$) but for a potential which is a more general function of $\Phi^\dagger \Phi$, i.e. $V = V(\Phi^\dagger \Phi)$. (Hint: Use the Euler-Lagrange equation of motion).

2. Homework: Check that the scalar electrodynamics (SED) lagrangian

$$\mathcal{L}_{SED} = (\partial^\mu \Phi)^\dagger (\partial_\mu \Phi) - m^2 \Phi^\dagger \Phi - \frac{1}{4} F_{\mu\nu} F^{\mu\nu} - g A_\mu j_{(0)}^\mu + g^2 A_\mu A^\mu \Phi^\dagger \Phi$$

leads to consistent equations for the scalar and Maxwell fields.

3. By evaluating the appropriate Poisson Brackets, check that the boost charge, L^{0i} is also conserved i.e. $\frac{dL^{0i}}{dt} = 0$.

*due on Friday Sept. 6, 2019