

## QFT Home Assignment # 5. Submission date 30.01.2022

1. Fill gaps through self-education: read Peskin and Schroeder, Chapter 11, 12.4, 12.5.
2. Peskin and Schroeder: Problem 12.3.
3. We made a distinction between kinetic terms, which are bilinear in fields and interactions, which have 3 or more fields. Time-evolution with the kinetic terms is solved exactly as part of the free Hamiltonian. Suppose instead, we only put the derivative terms in the free Hamiltonian and treated the mass as an interaction. So

$$H_0 = \frac{1}{2}\phi\partial^2\phi \qquad H_{int} = \frac{1}{2}m^2\phi^2$$

- a) Draw the (somewhat degenerate looking) Feynman graphs which contribute to the two point function  $\langle 0|T\phi(x)\phi(y)|0\rangle$ , using only this interaction, up to order  $m^6$ .
- b) Evaluate the graphs.
- c) Sum the series to all orders in  $m^2$  and show you reproduce the propagator which would have come from taking  $H_0 = \frac{1}{2}\phi\partial^2\phi + \frac{1}{2}m^2\phi^2$
- d) Repeat the exercise classically: Solve for the massless propagator using an external current, perturb with the mass, sum the series, and show you get the same answer as if you included the mass to begin with.