Homework Set No. 5, Physics 880.08

Deadline – Wednesday, December 7, 2011

1. Consider real scalar φ^4-theory described by the Lagrangian density

$$\mathcal{L} = \frac{1}{2}\,\partial_\mu\varphi\,\partial^\mu\varphi - \frac{m^2}{2}\,\varphi^2 - \frac{\lambda}{4!}\,\varphi^4.$$

a. (7 pts) Draw all connected Feynman diagrams contributing to the two-point function

$$\langle\psi_0|T\varphi(x)\varphi(y)|\psi_0\rangle$$

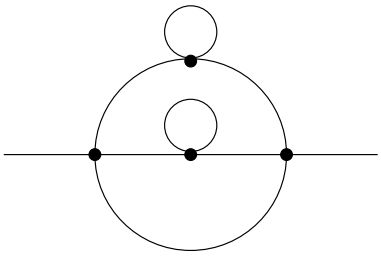
at the order λ^3. (Connected = no vacuum bubbles, no disjoint graphs.) Find the symmetry factors for all the graphs.

b. (10 pts) Draw all connected Feynman diagrams contributing to the four-point function

$$\langle\psi_0|T\varphi(x_1)\varphi(x_2)\varphi(x_3)\varphi(x_4)|\psi_0\rangle$$

up to the order λ^3. Calculate the symmetry factors. (Again, connected = no vacuum bubbles, no disjoint graphs.)

c. (3 pts) What is the symmetry factor of the following Feynman diagram?



2. Consider real scalar φ^3-theory described by the Lagrangian density

$$\mathcal{L} = \frac{1}{2}\,\partial_\mu\varphi\,\partial^\mu\varphi - \frac{m^2}{2}\,\varphi^2 - \frac{\lambda}{3!}\,\varphi^3.$$

a. (5 pts) Draw all connected Feynman diagrams contributing to the two-point function

$$\langle\psi_0|T\varphi(x)\varphi(y)|\psi_0\rangle$$

up to the order λ^4. Find the symmetry factors. (Connected = no vacuum bubbles, no disjoint graphs.)

b. (5 pts) Draw all connected Feynman diagrams contributing to the three-point function

$$\langle\psi_0|T\varphi(x_1)\varphi(x_2)\varphi(x_3)|\psi_0\rangle$$

up to the order λ^3. Calculate the symmetry factors. (Connected = no vacuum bubbles, no disjoint graphs.)