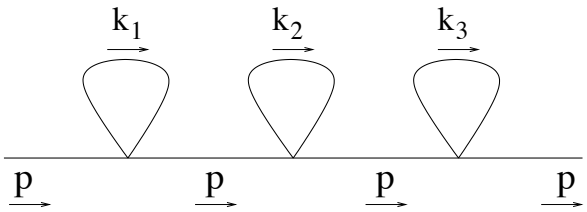
HW assignment 2. Due Feb 25 on the lecture

On page 61 of lecture notes Fig. 9 contains some Feynman diagrams for exact propagator (two-point Green function) of scalar particle. Draw all diagrams in the λ^3 order and write down corresponding expressions for reduced Green function (with symmetry coefficients).

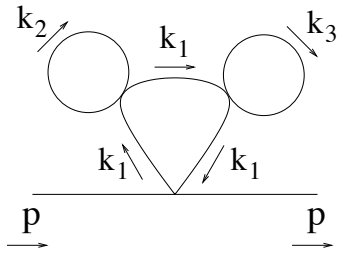
Solution



S=8

FIG. 1. Diagramma 1

$$\mathcal{G}(p) \overset{\text{Fig. 1}}{=} -\frac{\lambda^3}{8}\frac{1}{(m^2-p^2-i\epsilon)^4}\int\frac{đ^4k_1}{i}\frac{đ^4k_2}{i}\frac{đ^4k_3}{i}\frac{1}{(m^2-k_1^2-i\epsilon)(m^2-k_2^2-i\epsilon)(m^2-k_3^2-i\epsilon)} \tag{1}$$



S=8

FIG. 2. Diagramma 2

$$\mathcal{G}(p) \overset{\text{Fig. 2}}{=} -\frac{\lambda^3}{8}\frac{1}{(m^2-p^2-i\epsilon)^2}\int\frac{đ^4k_1}{i}\frac{đ^4k_2}{i}\frac{đ^4k_3}{i}\frac{1}{(m^2-k_1^2-i\epsilon)^3(m^2-k_2^2-i\epsilon)(m^2-k_3^2-i\epsilon)} \tag{2}$$

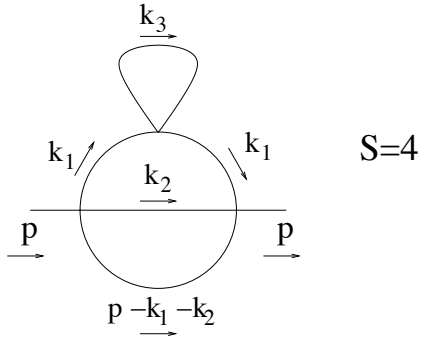


FIG. 3. Diagramma 3

$$\mathcal{G}(p) \overset{\text{Fig. 3}}{=} -\frac{\lambda^3}{4}\frac{1}{(m^2-p^2-i\epsilon)^2}\int\frac{đ^4k_1}{i}\frac{đ^4k_2}{i}\frac{đ^4k_3}{i}\frac{1}{(m^2-k_1^2-i\epsilon)^2(m^2-k_2^2-i\epsilon)(m^2-k_3^2-i\epsilon)[m^2-(p-k_1-k_2)^2-i\epsilon]} \tag{3}$$

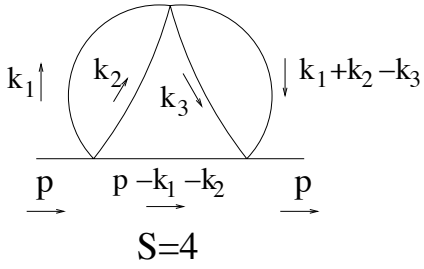


FIG. 4. Diagramma 4

$$\mathcal{G}(p) \overset{\text{Fig. 4}}{=} -\frac{\lambda^3}{4}\frac{1}{(m^2-p^2-i\epsilon)^2}\int\frac{đ^4k_1}{i}\frac{đ^4k_2}{i}\frac{đ^4k_3}{i} \times \frac{1}{(m^2-k_1^2-i\epsilon)(m^2-k_2^2-i\epsilon)(m^2-k_3^2-i\epsilon)[m^2-(p-k_1-k_2)^2-i\epsilon][m^2-(k_1+k_2-k_3)^2-i\epsilon]} \tag{4}$$

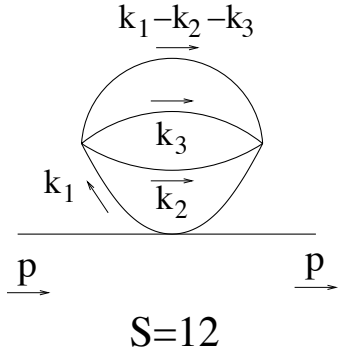


FIG. 5. Diagramma 5

$$\mathcal{G}(p) \overset{\text{Fig. 5}}{=} -\frac{\lambda^3}{12}\frac{1}{(m^2-p^2-i\epsilon)^2}\int\frac{đ^4k_1}{i}\frac{đ^4k_2}{i}\frac{đ^4k_3}{i}\frac{1}{(m^2-k_1^2-i\epsilon)^2(m^2-k_2^2-i\epsilon)(m^2-k_3^2-i\epsilon)[m^2-(k_1-k_2-k_3)^2-i\epsilon]} \tag{5}$$