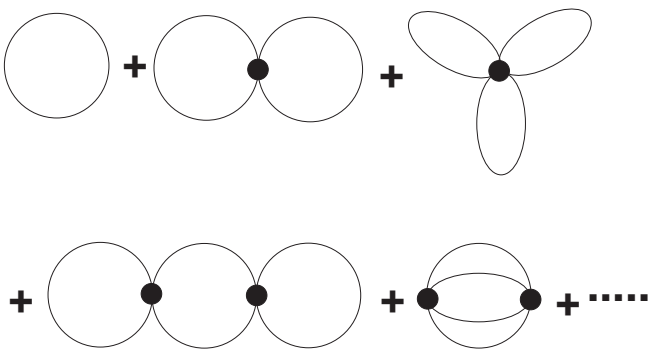
Chiral Perturbation Theory

interacting pion gas

loop expansion :



pressure: (three-loop order, $N_f = 2$)

$$p = \frac{\pi^2}{30} T^4 \left[1 + \left(\frac{T^2}{6F_\pi^2} \right)^2 \ln\left(\frac{\Lambda_p}{T} \right) \right] + O(T^{10})$$

quark condensate:

$$\frac{\langle\langle \bar{\psi}\psi \rangle\rangle}{\langle \bar{\psi}\psi \rangle} = 1 - \frac{T^2}{8F_\pi^2} - \frac{T^4}{384F_\pi^4} - \frac{T^6}{288F_\pi^6} \ln\left(\frac{\Lambda_q}{T} \right) + \cdots$$

$$\ln\left(\frac{\Lambda_q}{\Lambda_p} \right) = \frac{5}{48} + 0.491$$