Medium Effects

time-ordered correlation function:

$$\Pi_{\mu\nu}(q) = -i \int d^4x\, e^{iqx} \ll\mathcal{T}(J^{\rm em}_\mu(x), J^{\rm em}_\nu(0))\gg$$

$$\mathrm{Im}\Pi_{\mu\nu}(q) = -\frac{1}{2}(e^{\beta q_0}+1)H_{\mu\nu}(q)$$

virial expansion: (low T, small μ)

$$\Pi_{\mu\nu}(q) = \Pi^\circ_{\mu\nu}(q) + \sum_h n_h(T,\mu)\Pi^h_{\mu\nu}(q)$$

$$\Pi^\circ_{\mu\nu}(q) = -(g_{\mu\nu} - \frac{q_\mu q_\nu}{q^2})\Pi^\circ(q^2)$$

$$R(s) = -\frac{12\pi}{s}\mathrm{Im}\Pi^\circ(q^2)$$

dominant contribution from pions and nucleons

$$n_\pi \Pi^\pi_{\mu\nu}(q) = \int \frac{d^3k}{(2\pi)^3}\frac{n(\omega_k)}{2\omega_k} C^\pi_{\mu\nu}(q,k)$$