ANOMALOUS DILEPTON PRODUCTION AS PRECURSORY PHENOMENA OF COLOR SUPERCONDUCTIVITY

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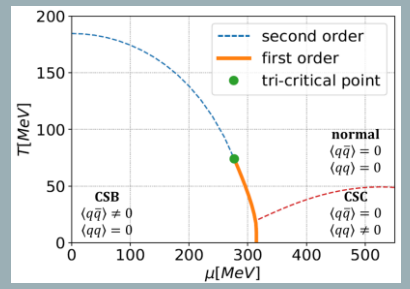
Color Superconductivity (CSC)

- Induced by **diquark-pair** condensation
- **Low-temperature** and **high-density**
- **Difficult to observe in experiment.**



QCD Phase Diagram

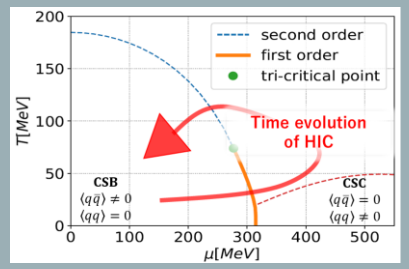
Heavy Ion Collisions

to search for dense quark matter

Active exps. all over the world!!

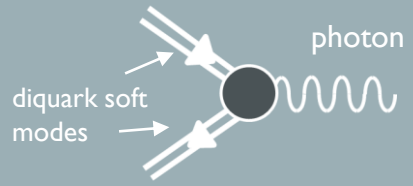
Difficulty to Measure CSC

1. T of the system produced by HIC is high ➔ CSC would not be produced.
2. CSC is realized only in **the early stage** ➔ Strongly interacting probes cannot be used.



Solution: 1. use dipepton production rate
2. consider effects of precursory soft mode

Process:
pair annihilation of diquark soft modes into virtual photons



Model

2-flavor NJL model

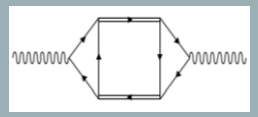
$$\mathcal{L} = \bar{\psi} i\partial\psi + \mathcal{L}_S + \mathcal{L}_C$$
$$\mathcal{L}_S = G_S[(\bar{\psi}\psi)^2 + (\bar{\psi} i\gamma_5 \boldsymbol{\tau}\psi)^2]$$
$$\mathcal{L}_C = G_C(\bar{\psi} i\gamma_5 \tau_2 \lambda_A \psi^C)(\bar{\psi}^C i\gamma_5 \tau_2 \lambda_A \psi)$$

parameter
$G_S = 5.01\text{MeV}, G_C = 3.11\text{MeV}, \Lambda = 650\text{MeV}$
Kitazawa, Koide, Kunihiro, Nemoto (2002)

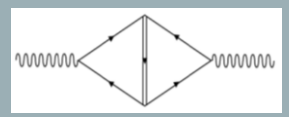
- Chiral Symmetry
- $SU_C(3)$ Symmetry
- Lorentz Symmetry

Photon Self-Energy

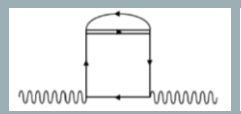
- Aslamasov-Larkin

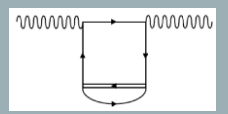


- Maki-Thompson



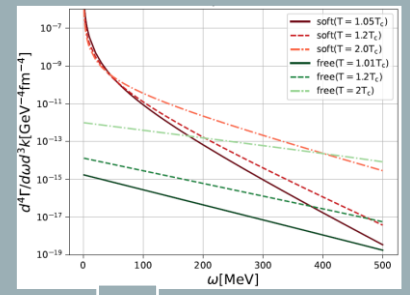
- Density of States



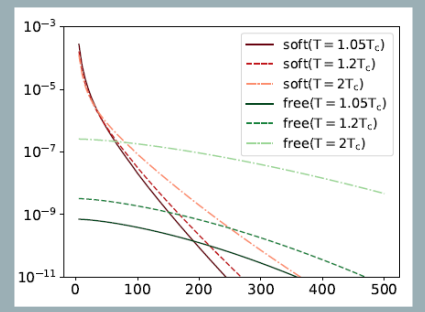


Results: Dilepton Production

at k=0



invariant-mass SPC



- **Enhancement at low**
- **Measureable in exps.?**

Red: AL+MT
Green: free quarks

Summary

- We calculated the contribution of **"soft mode"** to the **"dilepton production rate"** to observe CSC at HIC.
- Effects of the AL term and MT terms are considered as the photon self-energy.
- Enhancement of the dilepton production in low invariant-mass region is observed.
- This enhancement would be used for the signal of the CSC in HIC!