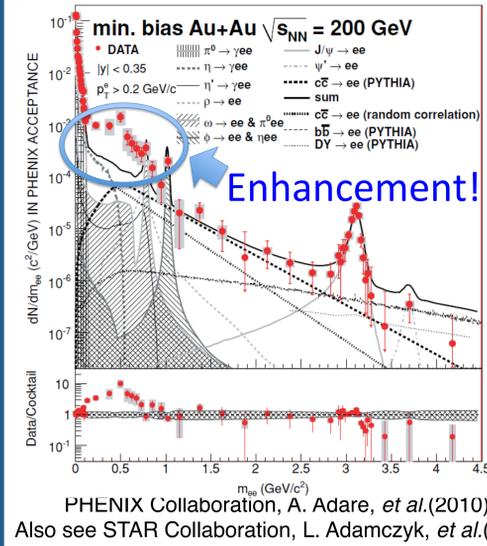


First principle calculation of dilepton production rate in strongly interacting QGP

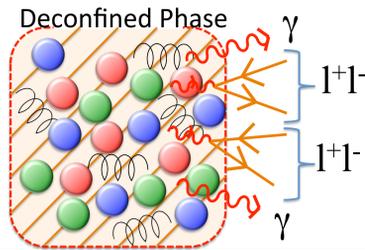
Taekwang Kim, Masayuki Asakawa, Masakiyo Kitazawa (Osaka Univ.)

Motivation

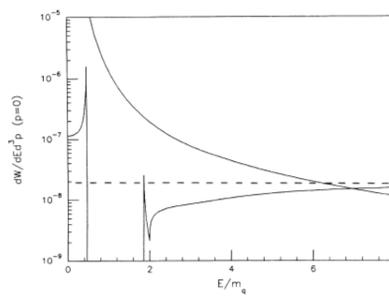


Dilepton production at PHENIX shows an enhancement at low energy.

QGP contribution?



Previous study: HTL resummed perturbation theory at 1-loop order



HTL quark propagator

HTL vertex

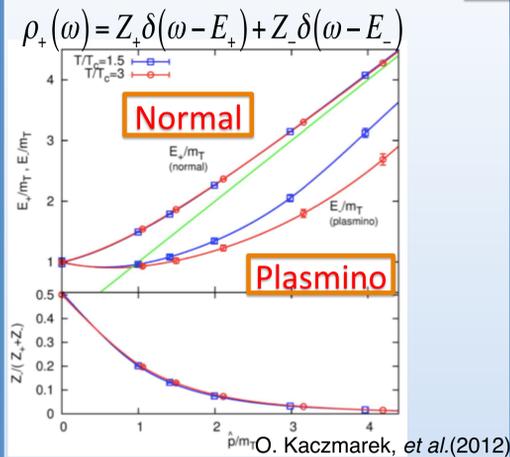
$$\Pi_{\mu\nu} = \text{diagram}$$

E. Braaten, R. D. Pisarski and T. C. Yuan (1990)

Non-perturbative analysis is desirable

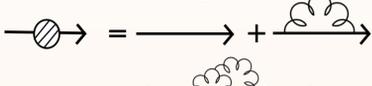
Lattice

2-pole quark spectral function obtained by quenched IQCD.



Strategy

Lattice quark propagator



SDE



"Dilepton production rate"

$$\frac{d^4\Gamma}{dq_0 d^3q} \Big|_{\vec{q}=0} = \frac{\alpha}{12\pi^4} \frac{1}{q_0^2} \frac{1}{e^{\beta q_0} - 1} \text{Im} \Pi_{\mu}^{R,\mu}$$

L. D. McLerran, T. Toimela (1985); H. A. Weldon (1990); C. Gale, J. I. Kapusta (1991)

Vertex

Propagator determines vertexes by Ward-Takahashi identity and isotropy

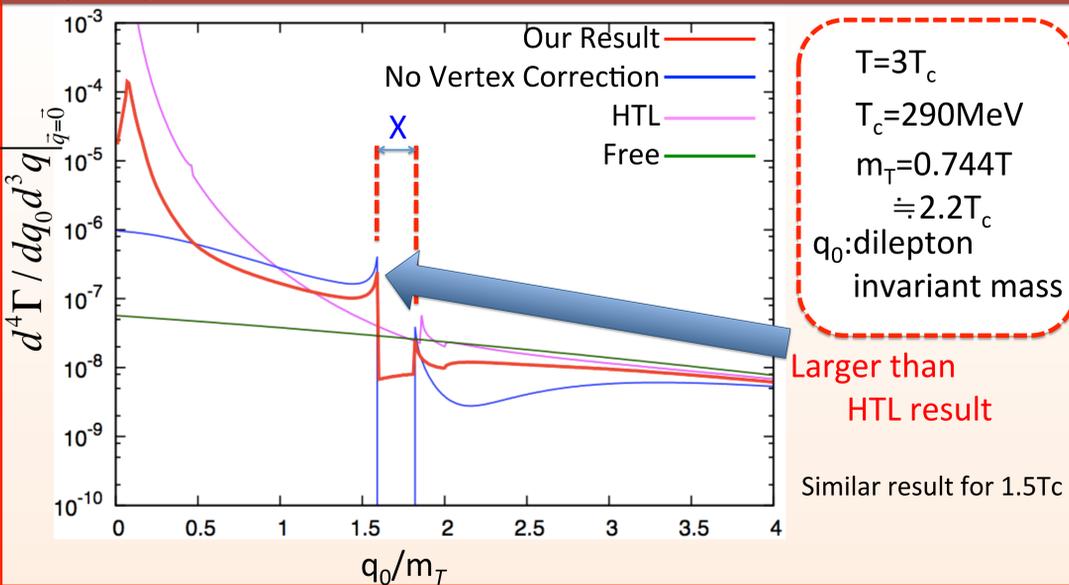
$$k \cdot \left(\text{diagram} \right) = S^{-1}(p+k) - S^{-1}(p)$$

$$\Gamma_0(p+k;p) \Big|_{\vec{k}=0} = \frac{S^{-1}(p_0+k_0, \vec{p}) - S^{-1}(p_0, \vec{p})}{k_0}$$

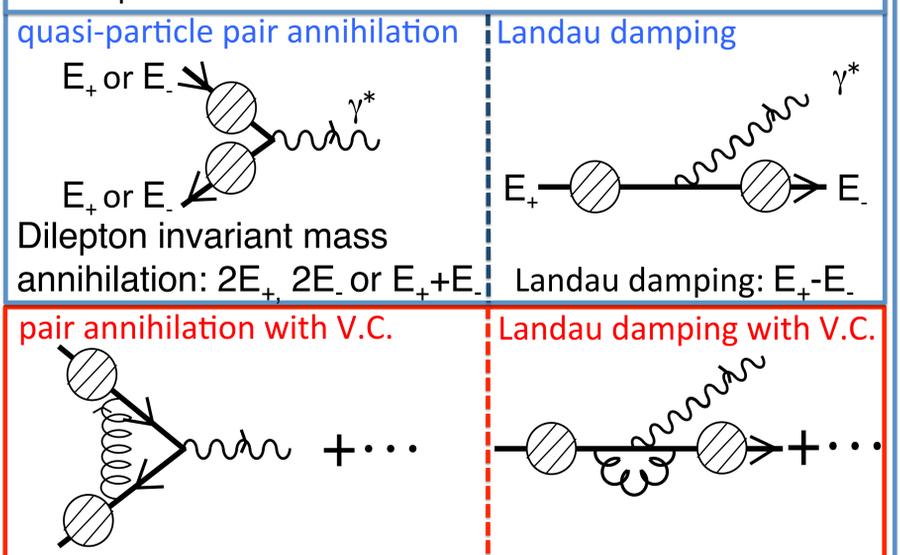
$$\Gamma_i(p+k;p) \Big|_{\vec{k}=0} = \frac{\partial S^{-1}(p_0+k_0, \vec{p})}{\partial p^i}$$

Results

Dilepton production rate



Virtual photon emission



Enhancement around $1.5m_T$ is caused by Landau damping.

Rescattering of thermally excited quasi-particles enhance dilepton production rate.

2 divergence comes from van Hove singularity.

Plasmino density of states and density of integrated states diverse.

Nonzero strength in region X.

No corresponding annihilation process nor Landau damping of two quasi-particles.

The strength comes from a pole of photon self energy.

two poles of quark spc

Summary

- We calculated dilepton production rate from static QGP using the quark propagator obtained in quenched lattice QCD and SDE.
- Production rate enhanced for $q_0 = 300 \sim 600$ MeV. \Rightarrow origin of the large enhancement reported at RHIC by PHENIX group?
- Future: dilepton production "yield" from QGP using these data.