The Contribution of plasminos to the shear viscosity of a hot and dense Yukawa-Fermi gas

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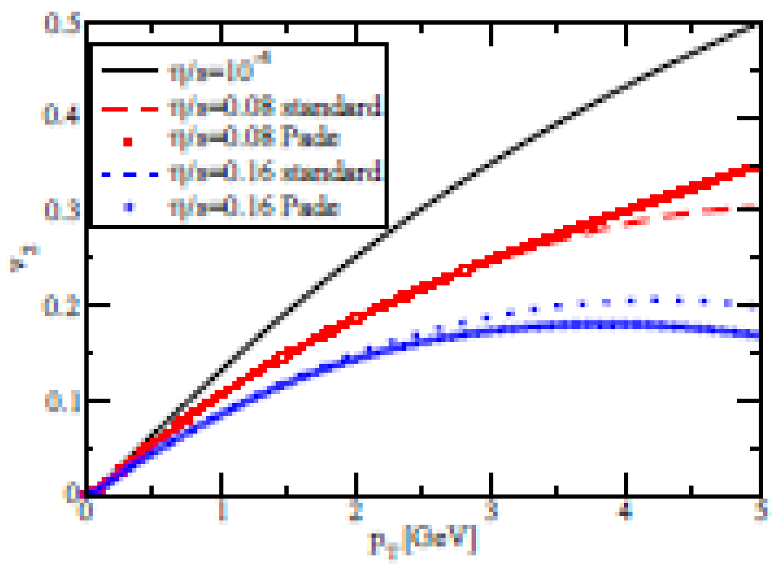
Collective signs of QGP and Transport Coefficient

It is believed that QGP created after HICs behaves as a fluid with small ratio of viscosity over entropy density. Transport coefficients characterize the off-equilibrium behavior of this new state of matter.



M. Luzum and P. Romatschke, Phys. Rev. **C79** (2009) 039903

v_2 transfers initial spatial anisotropy to the final momentum anisotropy

Anisotropy in momentum space

Shear viscosity equalizes the momenta in all directions

Suppression of v_2 in the presence of momentum anisotropy

Questions and expectations

FTFT calculations impose the existence of new degrees of freedom named Plasminos. They are important at High Temperature Field Theory calculations.

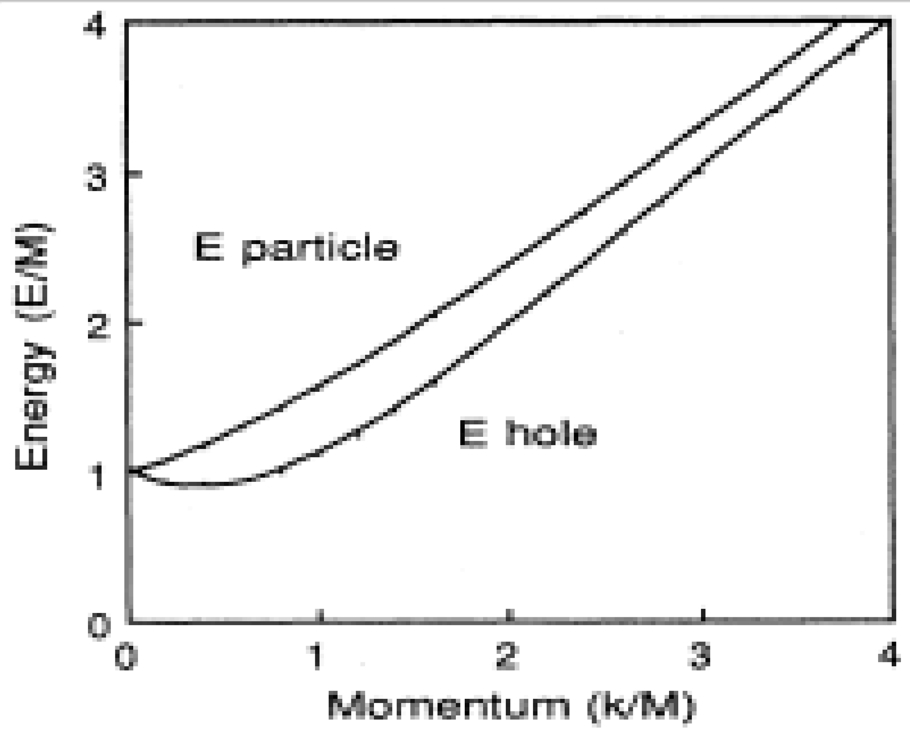
In particular, we are interested in

- T and μ dependence of the shear viscosity
- *Effect of Plasminos on the shear viscosity*

in the presence of μ and at finite T

What is a Plasmino?

Plasminos are new fermionic degrees of freedom which arise at finite temperature. Their properties are similar to antiparticles, except that they have different energy dispersion relations.



H. A. Weldon, Phys. Rev. D40 (1989) 40

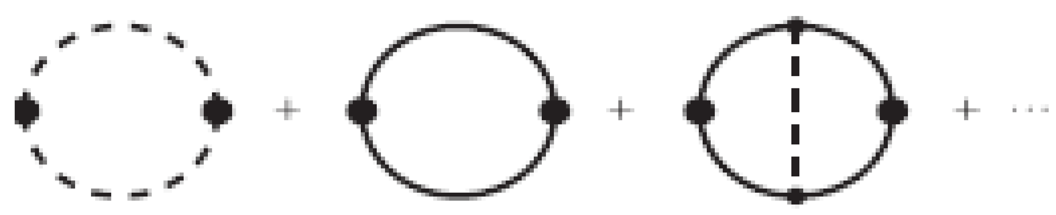
Method of Computation

$$\eta = \frac{\beta}{10}\int_{-\infty}^{t} dt' \int d^3x \, (\tilde{\pi}^{\mu\nu}(0), \tilde{\pi}^{\mu\nu}(x,t))$$

$$\tilde{\pi}^{\mu\nu} = (\Delta^{\rho\mu}\Delta^{\sigma\nu} + \Delta^{\rho\nu}\Delta^{\sigma\mu} - \frac{2}{3}\Delta^{\mu\nu}\Delta^{\rho\sigma})T_{\rho\sigma}$$

$T_{\rho\sigma}$ can be derived from the underlying microscopic theory

Ladder resummation in the Yukawa theory leading to η



Diagrams contributing to η of a Yukawa theory in the leading order of perturbative expansion. Higher order diagrams are suppressed In FTFT calculations.
[S. Ghosh, Int. J. Mod. Phys. **A 29, (2014) 1450054**]

Modified Green-function including plasminos

$$S(\mathrm{p},\omega) = -\frac{1}{\omega-(\omega_f+\Sigma_+)}\hat{g}_+ - \frac{1}{\omega+(\omega_f+\Sigma_-)}\hat{g}_-$$

$g_\pm$ denote Green-functions for normal and plasmino modes. $\Sigma_\pm$ define self-energy of these modes, respectively.

Modified spectral function including plasminos

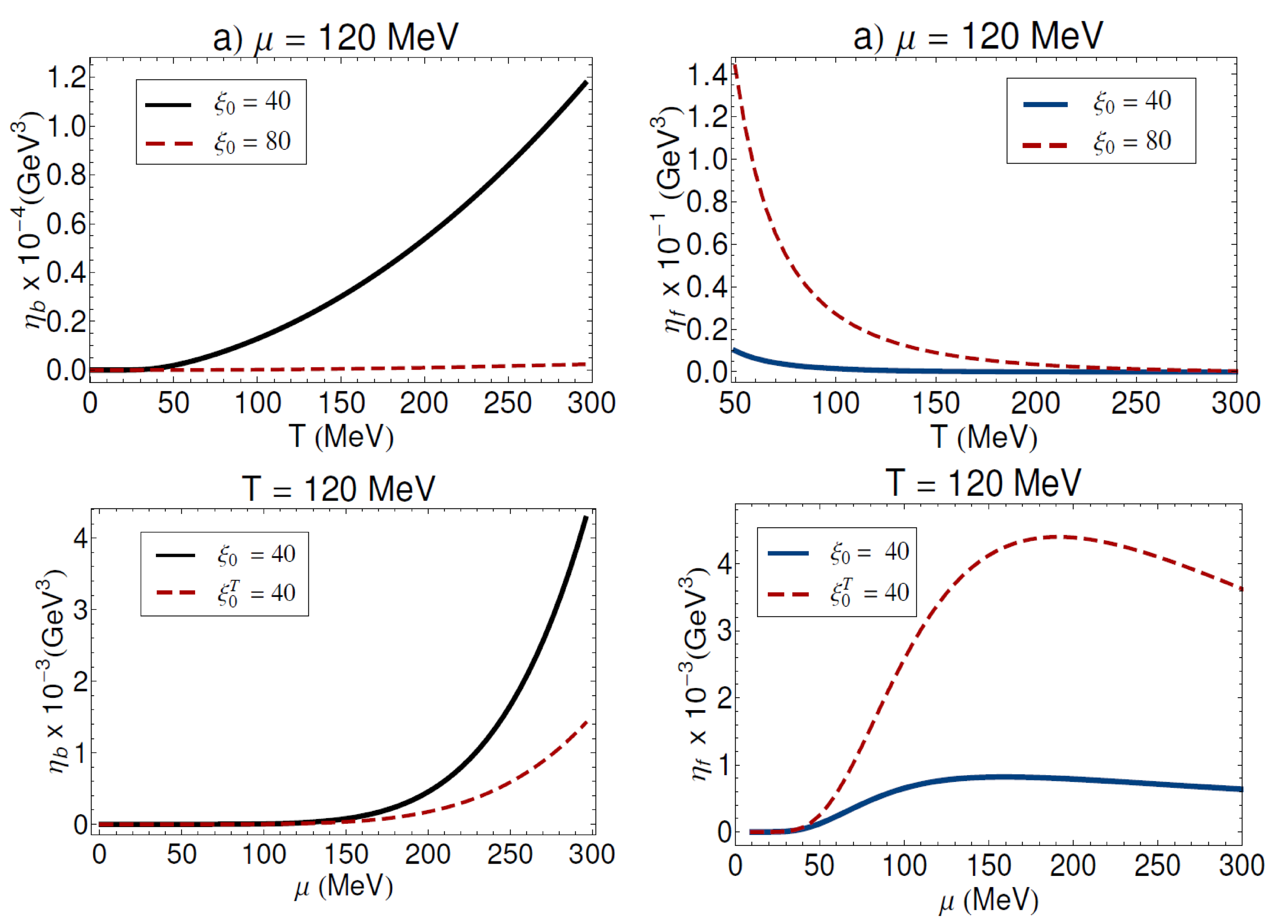
$$\rho_f(\mathbf{p},\omega) = \frac{2\Gamma_+(\mathbf{p},\omega_f)}{[\omega - E_+(\mathbf{p},\omega_f]^2 + \Gamma_+^2(\mathbf{p},\omega_f)}\hat{g}_+(\mathbf{p},\omega_f) - \frac{2\Gamma_-(\mathbf{p},\omega_f)}{[\omega + E_-(\mathbf{p},\omega_f)]^2 + \Gamma_-^2(\mathbf{p},\omega_f)}\hat{g}_-(\mathbf{p},\omega_f)$$

Spectral function is proportional to the imaginary part of the Green-function

Results: N. Sadooghi and F. T., PRD 89 (2014) 125005

T and μ dependence of bosonic part of *η* for μ=120 MeV and at T= 120 MeV

T and μ dependence of fermionic part of η for μ=120 MeV and at T=120 MeV



Summary

Considering Plasminos in FTFT calculations is unavoidable. They emerge due to difference between T=0 and T≠0 Hilbert space. While plasminos don't have any significant effect on the T dependence of bosonic η, for fermionic η, their effect can be ignored with increasing (decreasing) T (μ).

Based on:
[1] N. Sadooghi and **F. Taghinavaz**, Phys. Rev. **D89** (2014) 125005
[2] R. Lang, N. Kaiser and W. Weise, Eur. Phys. J. **A 48** (2012) 109

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