Heavy quark potential in anisotropic medium

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Outline:

- Motivation
- Overview of the formalism
- Results
- Conclusions

Motivation:

- A model of anisotropic expansion: (PhysRevD.68.036004)

$$n_\xi(k) = n_{\rm eq}\left(\sqrt{k^2 + \xi_9\left(\vec{k}\cdot\hat{n}_3\right)^2}\right). \qquad (1)$$

  where $n_{\rm eq}(k)$ represents the FD or BE distribution function.
- Have been used in several scenarios: (dispersion, instability, aHydro, HQ dynamics and so on).
- Our interest here is the HQ potential (real part) in anisotropic medium.

Motivation:

- HQ potential:

$$V(\vec{r}) = -g^2 C_F \int \frac{d^3p}{(2\pi)^3} (e^{i\vec{p}\cdot\vec{r}} - 1)\mathcal{D}_{00}(p^0 \to 0, \vec{p}) \qquad (2)$$

  where g is the strong coupling constant and $C_F = \frac{4}{3}$.
- In RTF:

$$\mathcal{D}^{-1}_{\mu\nu}(p_0, \vec{p}) = (\mathcal{D}_0)^{-1}_{\mu\nu}(p_0, \vec{p}) + \Pi_{\mu\nu}(p_0, \vec{p}) \,. \qquad (3)$$

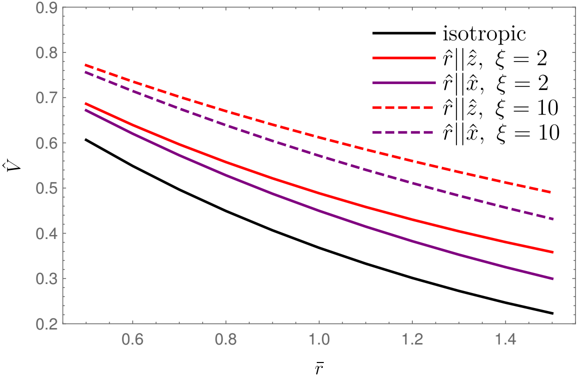
- where $(\mathcal{D}_0)^{-1}_{\mu\nu}(p_0, \vec{p})$ is the inverse of the free gluon propagator

$$\mathcal{D}^{\mu\nu}_0(p_0, \vec{p}) = -\frac{g^{\mu\nu}}{P^2} + (1-\chi)\frac{P^\mu P^\nu}{P^4} \,. \qquad (4)$$

- The anisotropic distribution function appears within $\Pi_{\mu\nu}$.

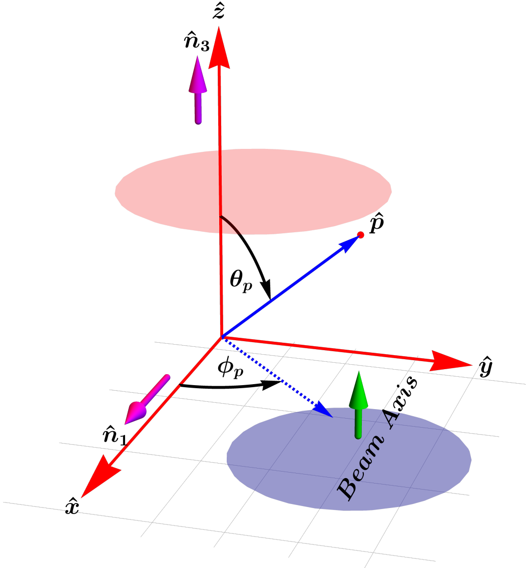
Motivation:

- Phys. Lett. B 662, 37 (2008) :



- There is stronger attraction on distance scales on the order of the inverse Debye mass for quark pairs aligned along the direction of anisotropy than for transverse alignment.

Formalism:



Formalism:

- Generalization of the one parameter model:

$$n_\xi(k) = n_{\rm eq}\left(\sqrt{k^2 + \xi_9\left(\vec{k}\cdot\hat{n}_3\right)^2}\right) \\ = n_{\rm eq}\left(k\sqrt{1 + \xi_9\left(\vec{v}\cdot\hat{n}_3\right)^2}\right) . \quad (5)$$

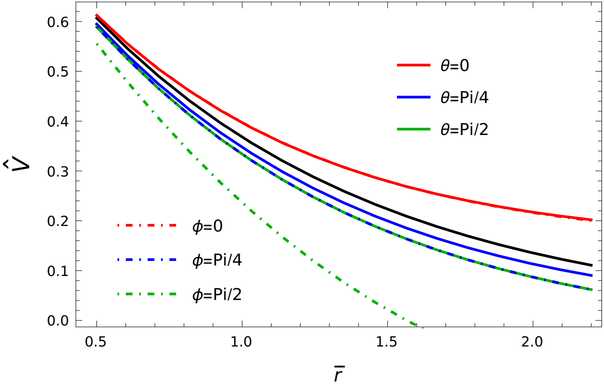
can be achieved by defining:

$$n(\vec{k}) = C_\xi\, n\big(kH_\xi(\vec{v})\big) \quad (6)$$

- We restrict ourselves to:

$$H_\xi^2(\vec{v}) = (1+\xi_0) + \xi_2(\vec{n}_1\cdot\vec{v})^2 + \xi_9(\vec{n}_3\cdot\vec{v})^2 + \xi_6(\vec{n}_1\cdot\vec{v})(\vec{n}_3\cdot\vec{v}) \\ + \xi_4(\vec{n}_1\cdot\vec{v})^4 + \xi_8(\vec{n}_1\cdot\vec{v})^3(\vec{n}_3\cdot\vec{v}) + \xi_{11}(\vec{n}_1\cdot\vec{v})^2(\vec{n}_3\cdot\vec{v})^2 \\ + \xi_{13}(\vec{n}_1\cdot\vec{v})(\vec{n}_3\cdot\vec{v})^3 + \xi_{14}(\vec{n}_3\cdot\vec{v})^4 . \quad (7)$$

Results: PhysRevC.110.035203



- The scaled potential for three values of θ at $\phi = \pi/4$ and three values of ϕ at $\theta = \pi/2$.
- $(\xi_0, \xi_2, \xi_4, \xi_6, \xi_8, \xi_9, \xi_{11}, \xi_{13}, \xi_{14}) = (5, 8, 37, -21, 21, 8, 15, -28, 40)$.

Conclusions:

- General anisotropic scenario is expected to provide more realistic description of the evolving medium.
- Directional dependence of the potential is more complex.
- Imaginary part of the potential is an interesting future direction.

Thank You