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Heavy Quarkonia in a Magnetic Field

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It is predicted that for the noncentral events in
ultrarelativistic heavy-ion collisions (URHICs),
a strong magnetic field is generated at the very early
stages of the collisions. However, as we know
the quarkonia, the physical resonances of $Q\bar{Q}$
states, are formed in the plasma frame at a time,
t_F (=$\gamma\tau_F$), which is order of 1-2 fm,
depending on the resonances and their momenta.
By the time elapsed, the magnetic field may become
weak. This motivates us to explore the effects of
both the weak and strong magnetic fields on the
properties of heavy quarkonia immersed in a thermal medium of
quarks and gluons and then studied how the magnetic field affects the
quasi-free dissociation in the aforesaid medium.
For that purpose, we have revisited the structure of
gluon self-energy tensor in the presence of both weak and strong
magnetic fields in thermal QCD and obtained the relevant form factors,
that in turn computes the real and imaginary parts of the
resummed gluon propagator. Then the linear response theory yields
the real and imaginary parts of the dielectric permittivity from
the respective resummed propagators. Finally, the inverseFourier transform of the permittivities of the above propagators
in the static limit obtains the complex heavy quark potential.
This is the first study to compute the heavy quark potential
perturbatively in the weak magnetic field as compared to earlier
known study of the strong magnetic field. We have observed
that the real-part gets screened more in the presence of weak
magnetic field, whereas it becomes less screened in the strong
magnetic field compared to their counterparts in the
absence of magnetic field. On the other hand, the magnitude of
the imaginary-part becomes larger both in weak and strong
magnetic field as compared to that in the absence of magnetic
field. Further, the real-part of the
potential is used in the Schr\"{o}dinger
equation to obtain the binding energy, whereas the
imaginary part is used to calculate the
thermal width of heavy quarkonia. With the weak and
strong magnetic field both the observed screening in
the real-part of the potential can be attributedin terms of the decrease in the binding energy, whereas
the increase in the magnitude of the imaginary-part of the

potential will leads to the enhancement of decay width of quarkonia. Finally we have studied the quasi free dissociation of quarkonia and found that the dissociation temperature in the presence of weak magnetic field becomes slightly lower, whereas in the presence of strong magnetic field it becomes higher compared to the one in absence of magnetic field.

Collaboration (if applicable)

Track

Heavy Flavor and Quarkonia

Contribution type

Contributed Talk

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