High-energy $Q\bar{Q}$ bound state penetrating through random color fields

H. Fujii and T. Matsui

Insitute of Physics, University of Tokyo, 3-8-1 Komaba, Meguro, Tokyo 153-8902

Multiple scattering of a high energy quark–anti-quark bound state in nuclear medium is described in terms of a color dipole propagating in random color fields. This subject has a fundamental importance in the problems of the J/ψ suppression in relativistic heavy ion collisions, the high energy diffractive processes in nuclear targets, etc.

In the high energy limit, the Lorentz time-dilatation enforces the transverse motion of the pair kept frozen while passing through the target and the pair will see a local color fields created by the quantum fluctuations of the internal quarks and gluons in the hadrons. The interaction of the dipole with external color fields will cause color rotation and diffusion of the transverse momentum of each constituent of the pair. We compute the transmission amplitude of the dipole traversing a frozen color field configuration of thickness L in the eikonal approximation, and then average over the distribution of the random color fields.

We show that as L increases the internal color state of the dipole will relax exponentially in L to the equilibrium distribution exhibiting equi-partitioning of all possible color states of the pair. This stochastic behavior results from the fact that the random color averaging completely erases the color interference. We find, however, the diffusion of the internal momentum of the pair leads to a non-exponential, L^{-1} decay of the penetration probability of a particular pair bound state. Based on the ideas of *color transparency* and the Lorentz time-dilatation, Baym *et al.* have found the same L^{-1} dependences treating the problem semi-classically. Our framework fully takes into account the quantum interference of the amplitudes corresponding to the different-size dipoles in the pair wavefunction; it is shown that the large-size dipole components contribute to the penetration probability as well as the small-size ones, contrary to the simple color transparency argument.

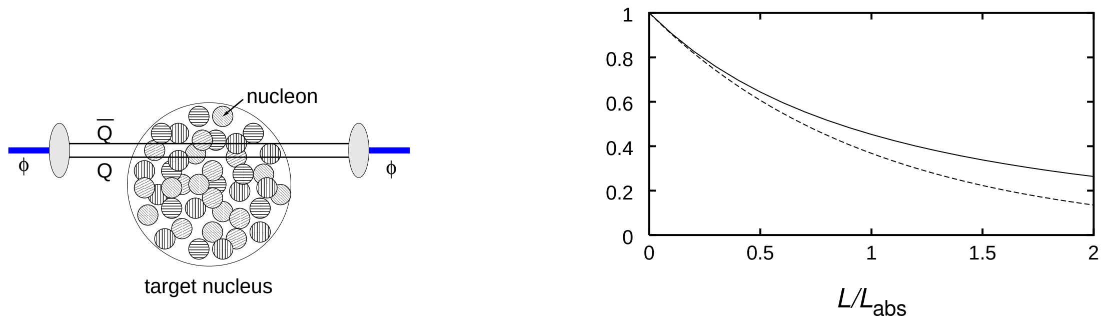

Figure 1: The bound state attenuates in $1 - L/L_{\rm abs}$ for a thin target, but asymptotically in $1/L$ (solid line), different from the exponential form (dashed line).

References

[1] H. Fujii and T. Matsui, UT-KOMABA 02-04, nucl-th/0204065.
[2] G. Baym, Adv. Nucl. Phys. **22** (1996) 101; and the references therein.