

Energy Loss in Nuclear Medium through Radiation

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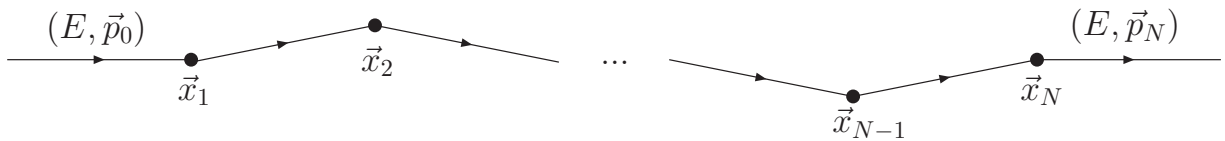
Dec. 7, 12:30-2pm, RLM 11.204

1 Introduction

Due to the importance of Quark Gluon Plasma research, the phenomenon of jet quenching needs to be put on solid theoretical ground, as it stands as one of the central pillars of evidence we have for QGP's existence. Because the nuclear modification factor R_{AA} reveals the suppression of high p_T , it would be useful to have a method for calculating R_{AA} from first principles. In this talk, I will explain how such a calculation can be done, emphasizing gluon radiation losses due to multiple scattering in the medium. Then I will discuss the interesting features of R_{AA} plots generated from this method. Finally, I will introduce the most promising modern methods for calculating emission spectra and compare their advantages to the methods previously elaborated. One possible path my research may take in this area is an investigation of the Zeno effect on the R_{AA} prediction.

2 Model for Multiple Scattering and emission (following BDMPS[1])

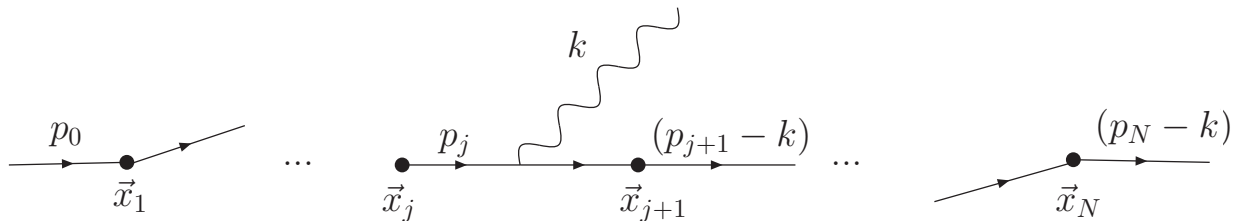
- Born approximation to scattering integral eqs



- Scattering matrix element:

$$S_{scatt} \propto \delta(p_N^0 - p_0^0) \sum_{\sigma} \int \prod_{i=1}^{N-1} \left(\frac{d^3 \vec{p}_i}{p_i^2 + i\epsilon} \right) \prod_{i=1}^N \left(\frac{e^{-i\vec{q}_i \cdot \vec{x}_{\sigma(i)}}}{\vec{q}_i^2 + \mu^2} \right)$$

- Discussion of poles and why only forward scattering is important



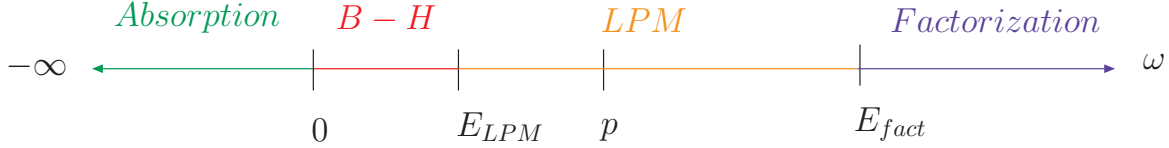
- Scattering with radiation matrix element
- Explanation of different coherence regimes and corresponding spectra

3 Evaluation of R_{AA} using obtained gluon spectra (following Turbide et al.[2])

- Derivation of R_{AA} from multiple gluon scattering:

$$R_{AA}(p) = \exp \left[- \int_{-\infty}^{\infty} d\omega J(p, \omega, t) + \int_{-\infty}^{\infty} d\omega J(p + \omega, \omega, t) e^{-\omega/(p/n)} \right]$$

- Integration of gluon momentum over different coherence regimes



- Discussion of R_{AA} plots and the importance of absorption

4 A Contemporary Model (Arnold, Moore, Yaffe-AMY[3])

- Radiation diagrams and resummation
- Fokker-Planck probability flow eqs

$$\frac{dP_{q\bar{q}}(p)}{dt} = \int_k P_{q\bar{q}}(p+k) \frac{d\Gamma_{qg}^q(p+k, k)}{dkdt} - P_{q\bar{q}}(p) \frac{d\Gamma_{qg}^q(p, k)}{dkdt} + 2P_g(p+k) \frac{d\Gamma_{q\bar{q}}^g(p+k, k)}{dkdt}$$

- Advantages: dynamic scatterers, thermal calculation, smooth transition between different coherence spectra
- Results

5 Quantum Zeno Effect

The quantum Zeno effect was proposed by Misra and Sudarshan[4] and its effect on pion production in p-nucleus collisions studied by Valanju et al.[5] It was also discussed in a recent talk by Chiu[6]. I plan to investigate how the quantum Zeno effect will modify the prediction of R_{AA} .

References

- [1] R. Baier, Yu. L. Dokshitzer, et al., Nucl. Phys. B478 (1996) 577-597.
- [2] S. Turbide, C. Gale, et al, Phys. Rev. C, 72, (2005) 014906.
- [3] P. Arnold, G. Moore, G. Yaffe, JHEP, 06, (2002) 030.
- [4] B. Misra and E.C.G. Sudarshan, J. Math. Phys. 10, (1977) 756.
- [5] P. Valanju, E.C.G. Sudarshan, and C.B. Chiu, Phys. Rev. D, 21, (1980) 1304.
- [6] C. Chiu, A talk presented at Sudarshan: 7 Science Quests Symposium, UT, Austin, 2006.