Calculating Jet Transport Coefficients in Lattice QCD

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Why should we do this?

1) A first principles calculation of Jet modification would calculate the $\hat{q}$ and $\hat{e}$ in each unit cell given temperature.

2) Will allow a test of transverse momentum dependence of the exchange interaction via $k_\perp$ moments of $\hat{q}$.

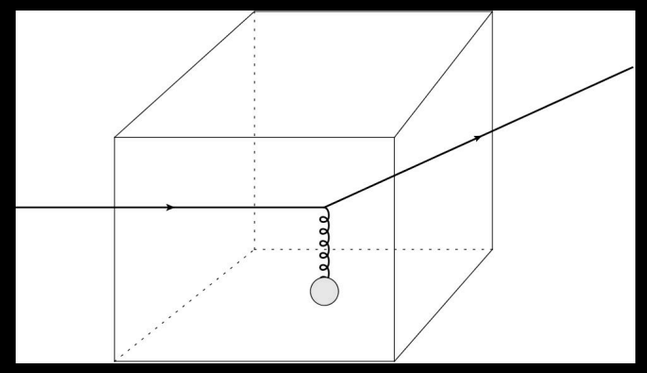
3) Will allow for a study of T dependence of $\hat{q}$ and $\hat{e}$.

4) Will allow an independent arena to test jet quenching in a thermal bath. Search for other transport coeffs

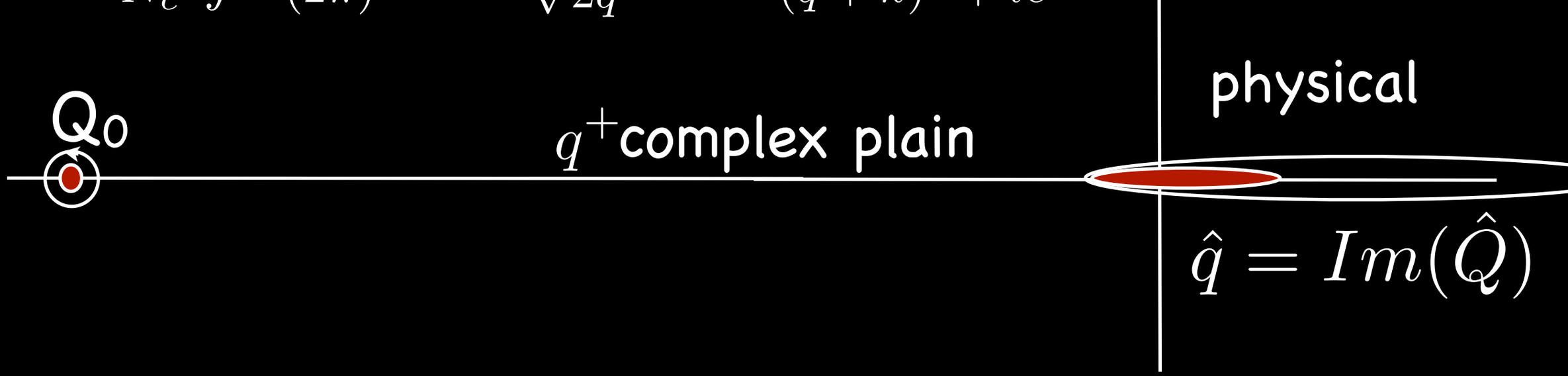
5) Once suitably interfaced with a jet MC can continue this study past the lifetime of RHIC and LHC

How it can be done?

$$I_1 = \oint \frac{dq^+}{2\pi i} \frac{\hat{Q}(q^+)}{(q^+ + Q_0)}$$



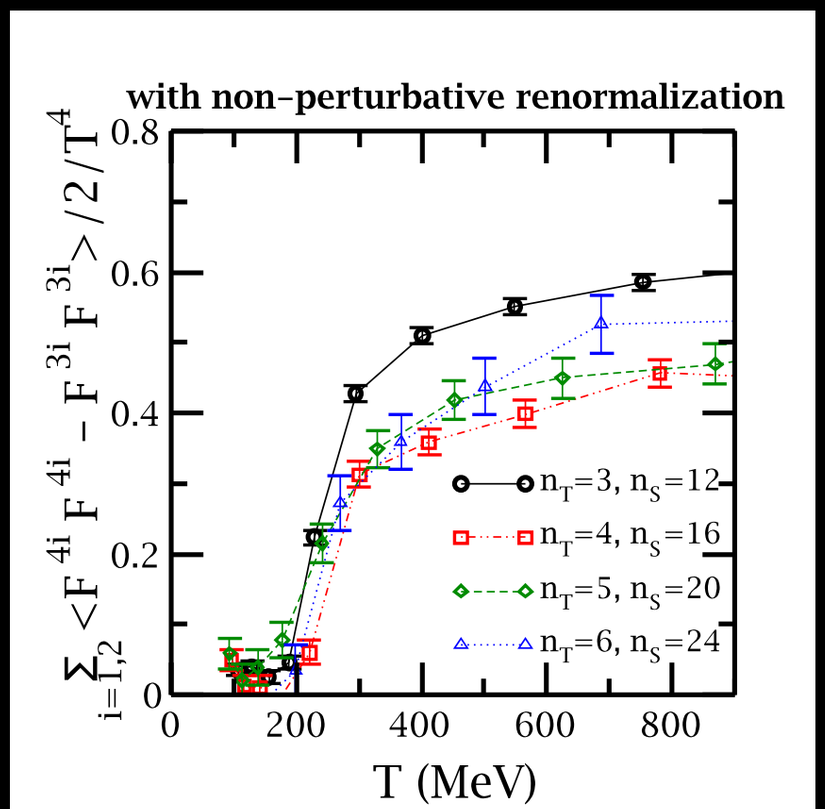
$$\hat{Q} = \frac{4\pi^2\alpha_s}{N_c}\int \frac{d^4y d^4k}{(2\pi)^4} e^{ik\cdot y} \frac{2(q^-)^2}{\sqrt{2}q^-} \frac{\langle M|F^{+\perp}(0)F^+_{\perp,}(y)|M\rangle}{(q+k)^2+i\epsilon}.$$



For $Q_0 \sim -Q$, can Taylor expand $\hat{Q}$ in terms of local operators

$$I_1 = \frac{4\sqrt{2}\pi^2\alpha_s\langle M|F^{+\mu}_\perp \sum_{n=0}^{\infty}\left(\frac{-q\cdot i\mathcal{D}-\mathcal{D}^2_\perp}{2q^-Q_0}\right)^n F^+_{\perp,\mu}|M\rangle}{N_c 2Q_0}$$

What can be done?



Calculated in quark less SU(2) gauge theory. scale answer up by N_c and N_f

A.M. Phys. Rev. C87 (2013) 034905,
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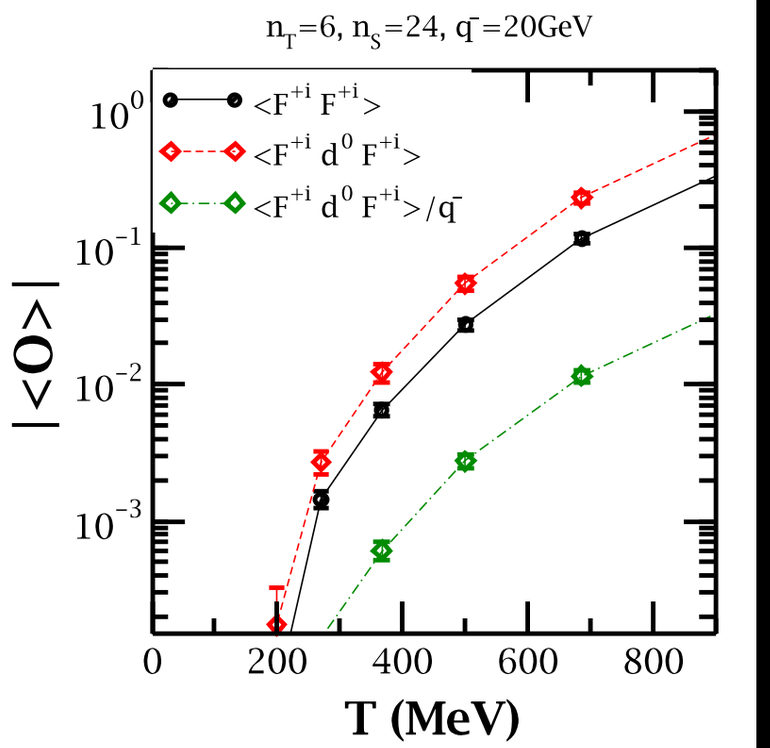

$$\hat{q}(T = 400\mathrm{MeV}) = 1\mathrm{GeV}^2/\mathrm{fm} - 2\mathrm{GeV}^2/\mathrm{fm}$$

Need extension to full QCD.
Attempt a calculation of ê
Carry out E-by-E simulations with a MC shower
with q̂ taken from lattice calculation
Can also study e-by-e fluctuations of q̂