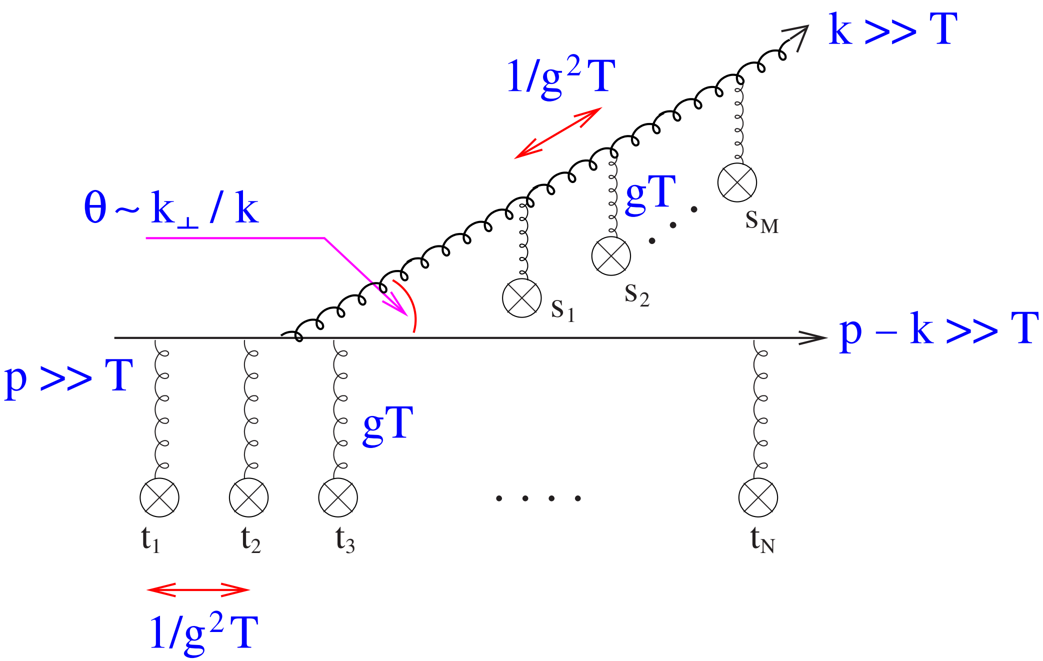
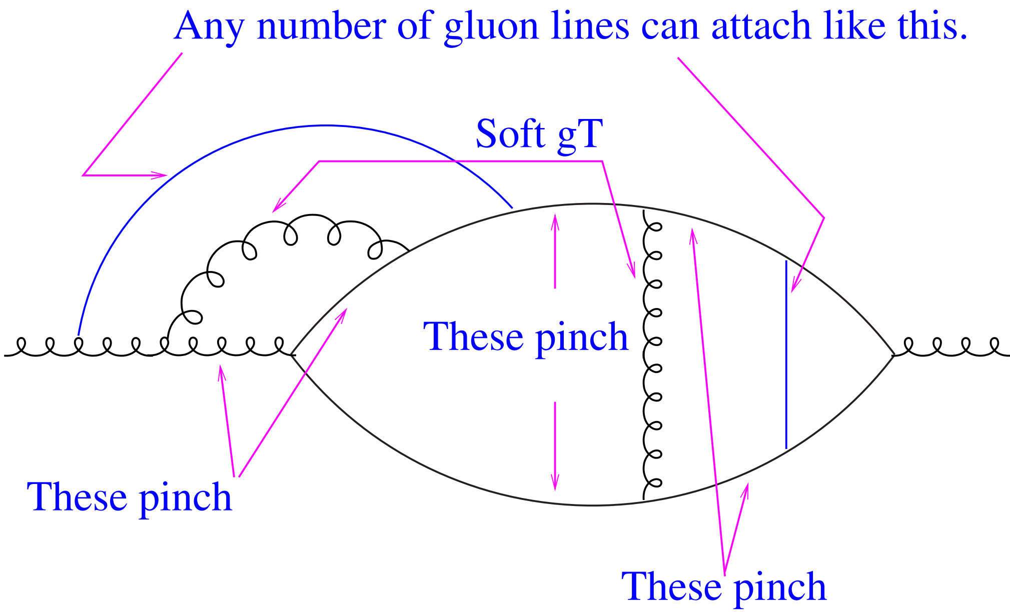
Physical Process





Adding one more rung = O(1).
Need to resum.

$R(k_{\rm soft}) \sim 1/\lambda \sim g^2 T, \quad \tau_{\rm coh} \sim \frac{1}{g^2 T}\sqrt{k/T}, \quad N_{\rm coll} \sim \sqrt{k/T}$

$\langle k_\perp^2 \rangle \sim (gT)^2 \sqrt{k/T}$ during $\tau_{\rm coh}$,

$E_{\rm LPM} = m_D^2 \lambda \sim T, \quad E_{\rm fact} = E_{\rm LPM}(L/\lambda)^2$

What are we doing?

– "Better" BDMPS

- Full leading order α_s momentum space calculation of the emission + absorption rate in fully dynamic thermal medium. Includes
  - Bremsstrahlung
  - Pair annihilation
  - Absorption from the medium
  - Thermal dispersion corrections
  - Correct and smooth transition from Bethe-Heitler to LPM
- Solve Fokker-Planck equation for the *distribution* instead of Poisson ansatz. Includes nuclear geometry and can accomodate expansion scenarios.

Validity

- Caveat: Weak coupling limit. $g \ll 1$.
- $\tau_{\rm coh} \ll L$
- $\tau_{\rm coh} \ll (d \ln T(x)/dx)^{-1}$
- One must distinguish what's important for ΔE and R_{AA} (BDMPS, JM).
  - R_{AA} dominated by many soft emissions.
    - Fully treated in AMY.
  - ΔE dominated by rare hard emissions.
    - $k > E_{\rm fact}$ is not fully treated in AMY. But not important for R_{AA}.
- Rough estimates (Bounds for the emitted energy):

  $E_{\rm LPM} \sim T \sim 300\,{\rm MeV}$,

  $E_{\rm fact} \approx (0.3\,{\rm GeV}) \times (L/\lambda)^2 \approx 7.5 - 30\,{\rm GeV}$ for $L/\lambda = 5 - 10$

Results

– Goes back to BDMPS for high E and large L: ($E_{\text{LPM}} = \lambda m_D^2$)

$$
\begin{aligned}
\Delta E &\approx \frac{\alpha_s}{\pi} N_c \frac{m_D^2}{\lambda} L^2 \quad \text{for } L < \lambda\sqrt{E/E_{\text{LPM}}} \\
\Delta E &\approx \frac{\alpha_s}{\pi} \frac{N_c}{\lambda} \sqrt{E_{\text{LPM}} E}\, L \quad \text{for } L > \lambda\sqrt{E/E_{\text{LPM}}} \\
\hat{q} &= \frac{dp_\perp^2}{dx} = g^2 C_f T \int \frac{d^2 q_\perp}{(2\pi)^2} \frac{q_\perp^2 m_D^2}{q_\perp^2 (q_\perp^2 + m_D^2)} = \frac{g^2 C_f m_D^2 T}{2\pi} \left(\ln \frac{T}{m_D} + K \right)
\end{aligned}
$$

Primary parameters

- $T_i = 370\,\text{MeV}$
- $\tau_i = 0.26\,\text{fm}/c$
- $\alpha_s = 0.34$

Correspond to

(with $\ln(T/m_D) + K \sim 1.5$)

- $\hat{q} \approx 2\,\text{GeV}^2/\text{fm}$