Radiative energy loss in absorptive medium

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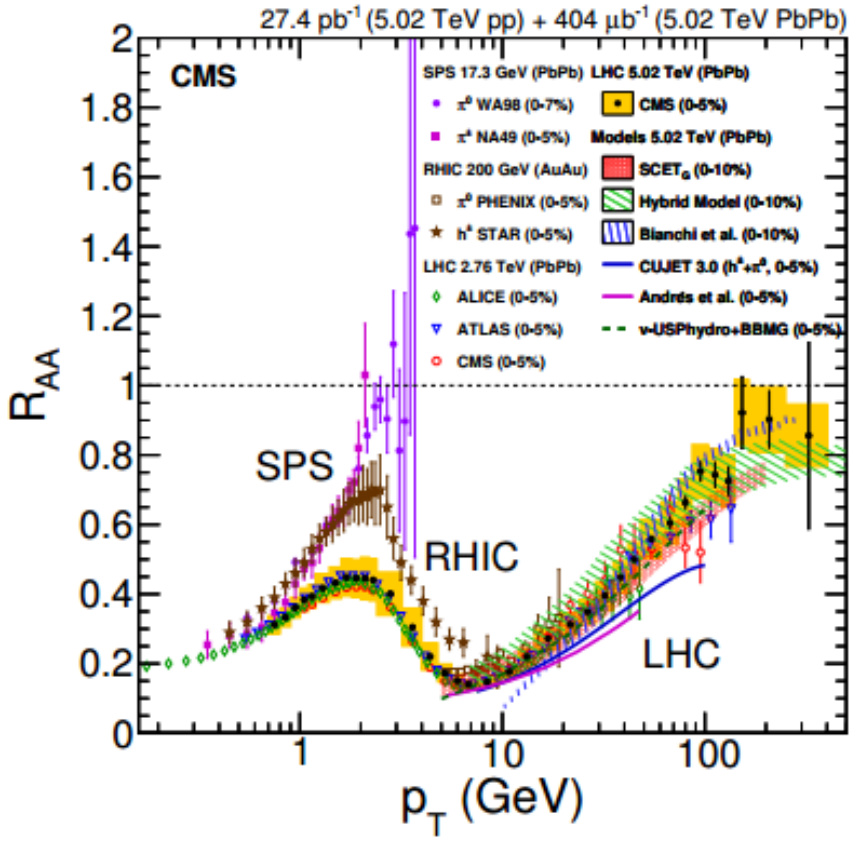
Study the QGP



R_{AA} in central heavy-ion collisions for neutral pions and charged hadrons (SPS, RHIC) and charged particles (LHC) compared to predictions of several models

CMS Collaboration, JHEP 04 (2017) 039

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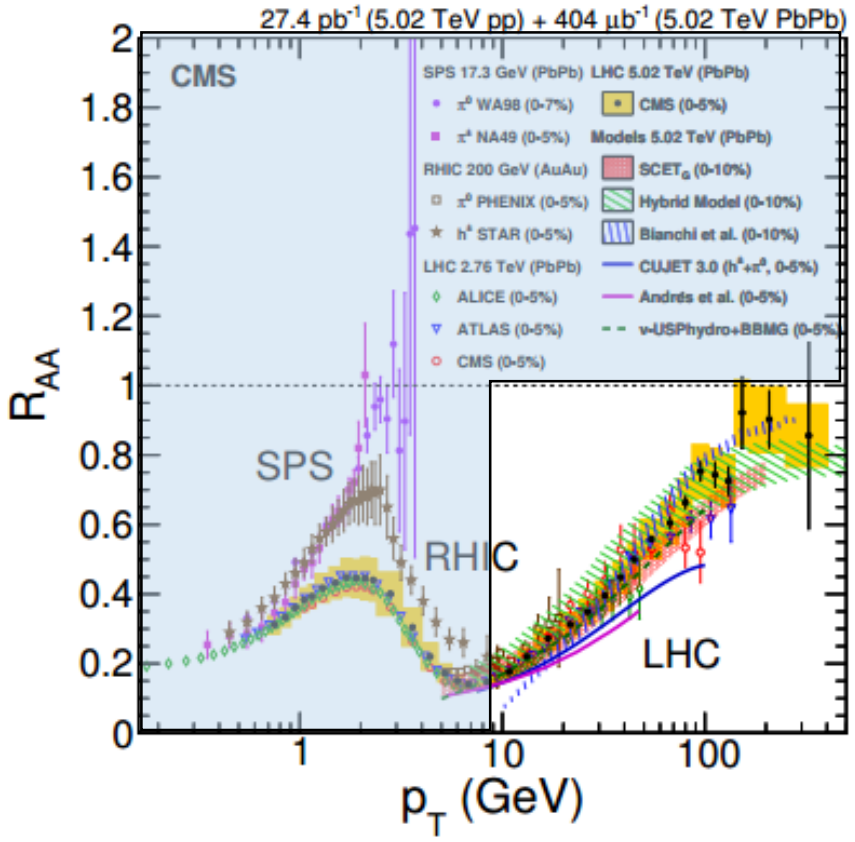


R_{AA} in central heavy-ion collisions for neutral pions and charged hadrons (SPS, RHIC) and charged particles (LHC) compared to predictions of several models

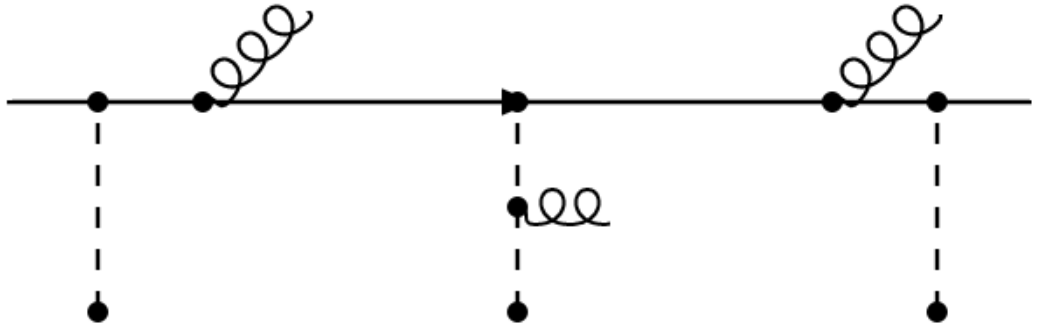
CMS Collaboration, JHEP 04 (2017) 039

- Radiative energy loss is important for analyzing the high-p_T R_{AA}

Need for a better theoretical understanding of the interaction between partons and QGP

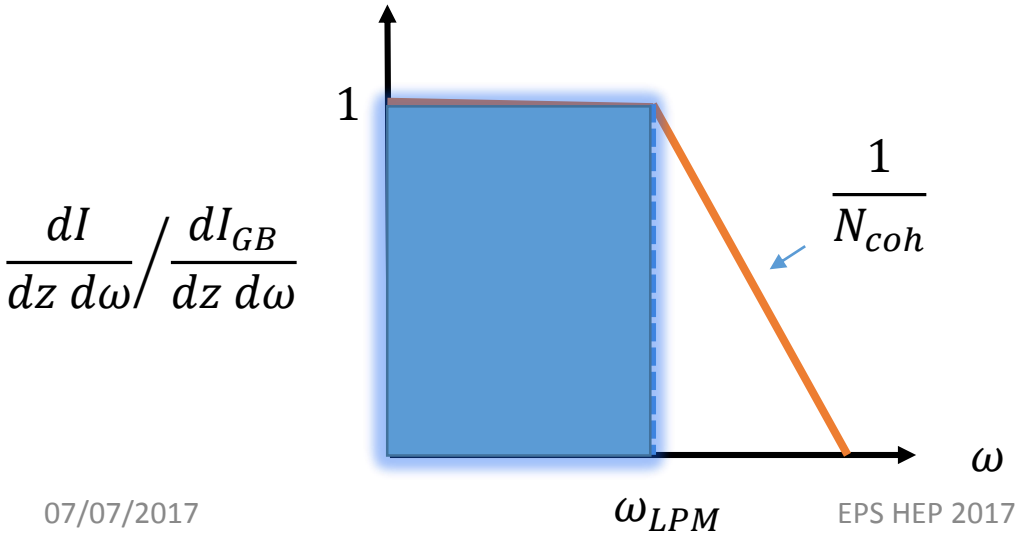
What we already know?

- Goal: a better evaluation of the **radiative energy loss**
- Formation time ∝ gluon energy
- Dilute medium : iterate Gunion-Bertsch



$\tau_f < \lambda$

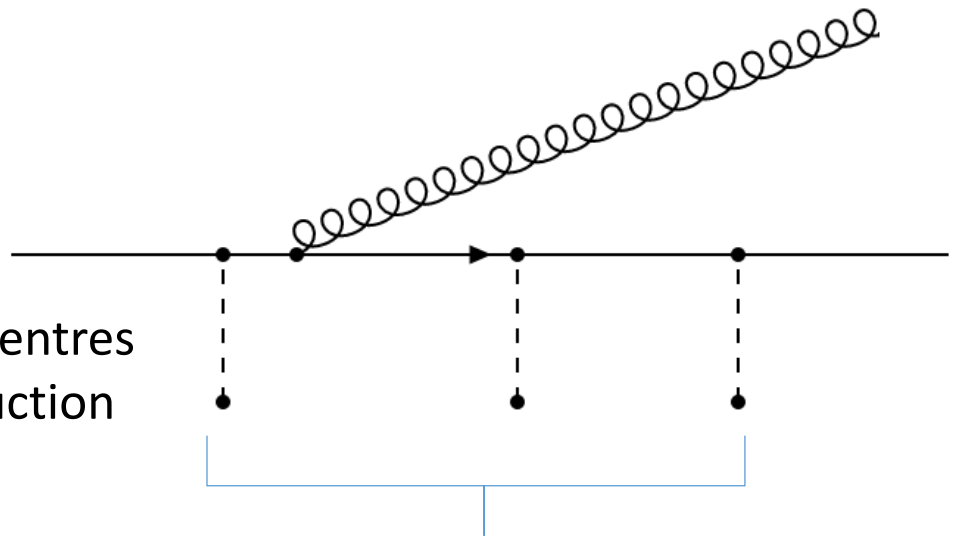
incoherent emissions



Gunion, Bertsch, Phys.Rev D25 (1982) 746

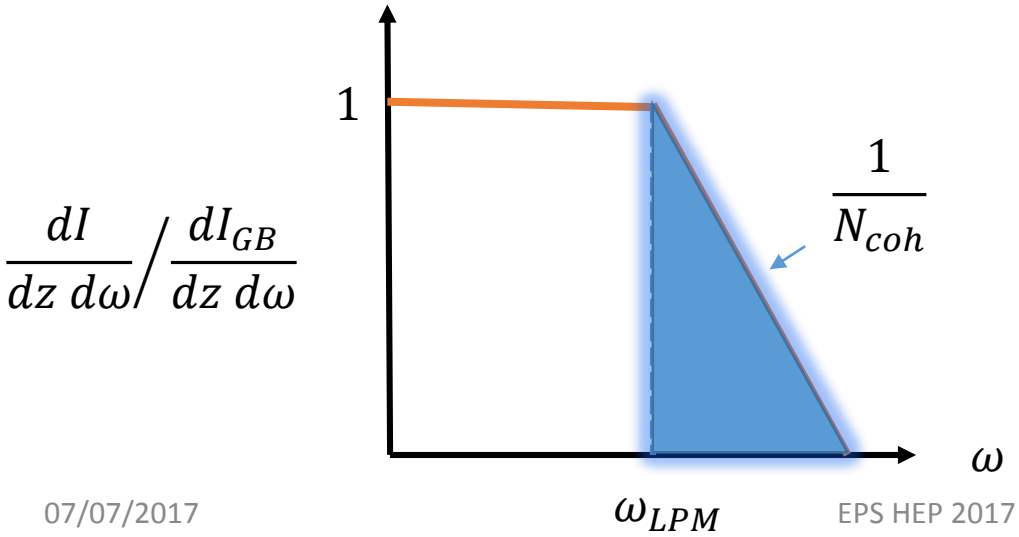
What we already know?

- Formation time $\tau_f \propto$ gluon energy
- Dilute medium : iterate Gunion-Bertsch
- Dense medium: LPM effect (BDMPSZ)
  - **coherent emission** over several scattering centres
  - **reduction** of the emission spectrum → reduction of energy loss



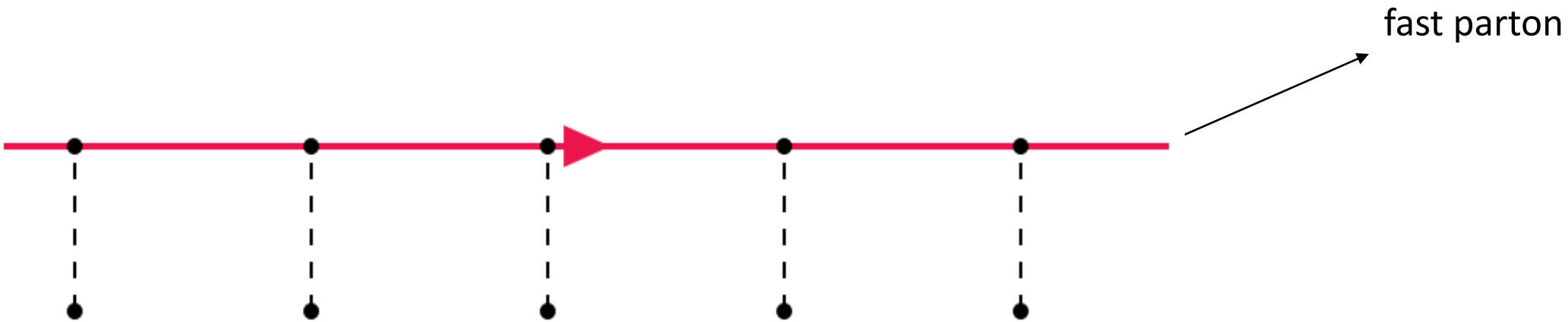
$\tau_f > \lambda$

coherent emission over 3 centres: $N_{coh} = 3$



Baier et al, Phys.Lett. B345 (1995) 277-286

What we want to evaluate?



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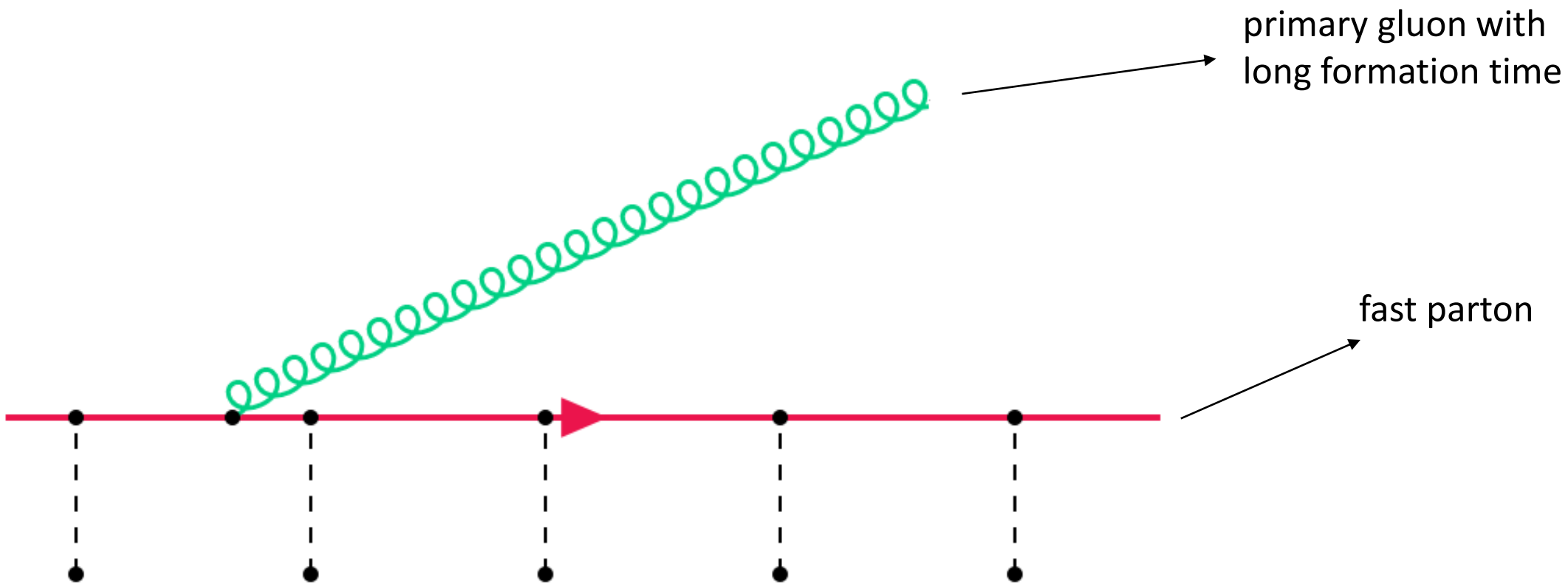
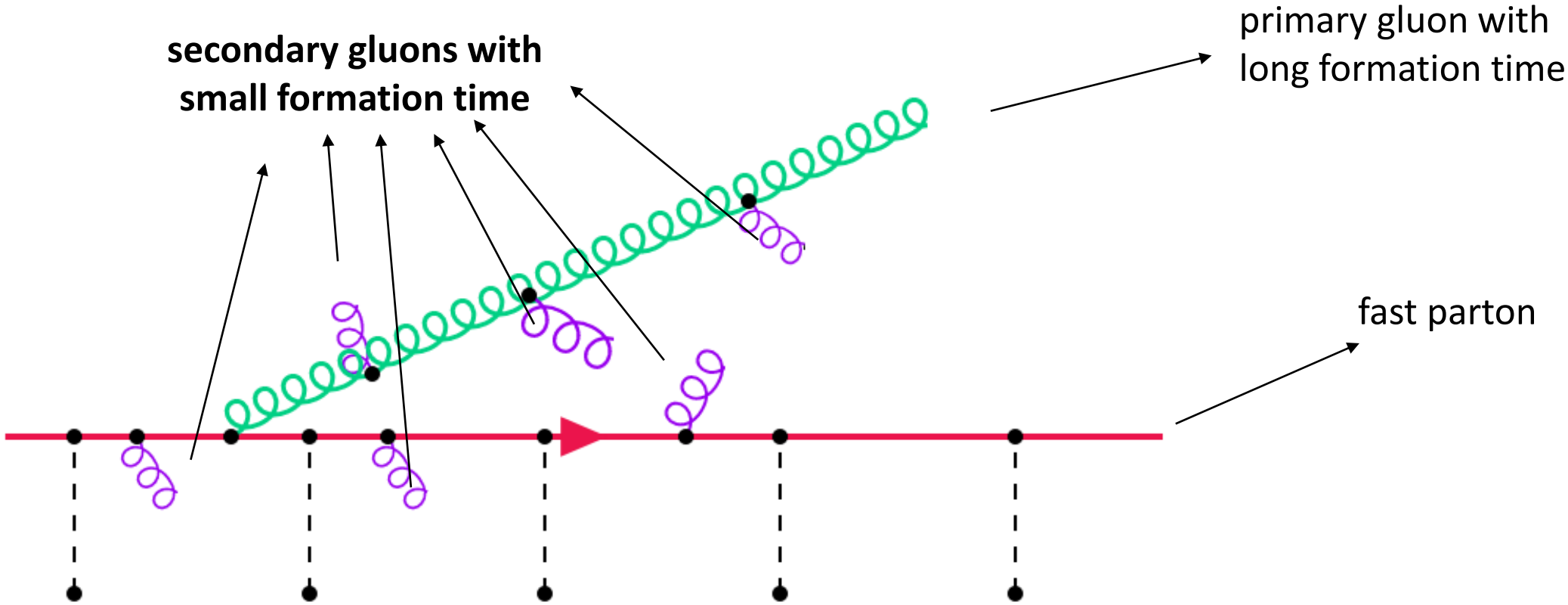


What we want to evaluate?

Secondary gluons = microscopic representation of the medium absorptive character



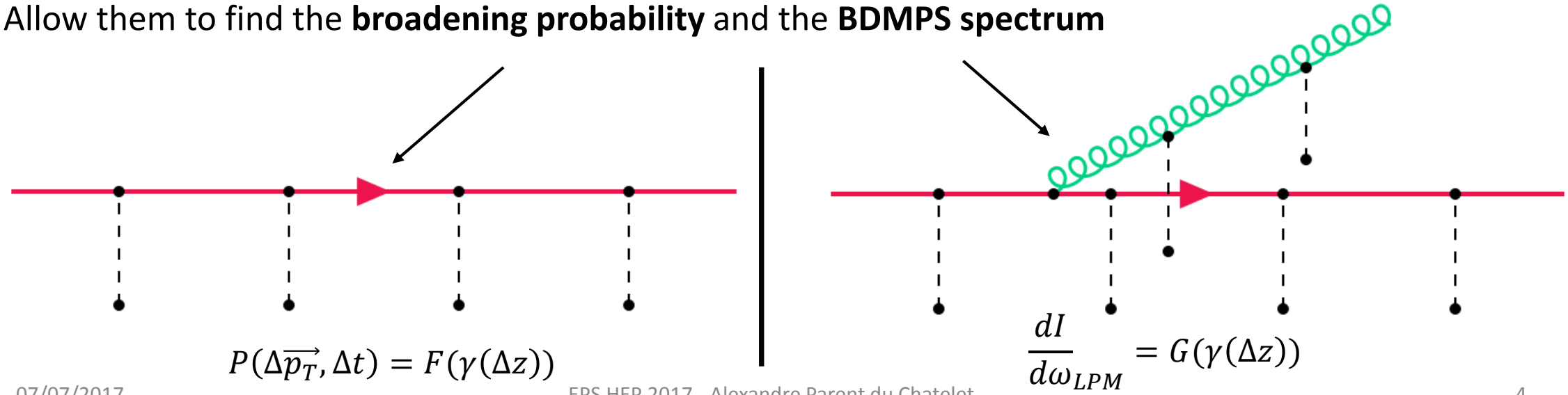
Blaizot Dominguez Iancu Mehtar-Tani (BDIM) formalism

- Study of the propagation of a hard parton in a quark-gluon plasma

Blaizot et al, JHEP 1301 (2013) 143

- Use of a 2-point function γ called **correlator** which is the correlation function for the random color field describing the medium
  - Fonction of Δz : difference between the space-time position of the interaction parton-field in the amplitude and in the complex conjugate amplitude
  - Help to construct an effective propagator and vertex

- Allow them to find the **broadening probability** and the **BDMPS spectrum**

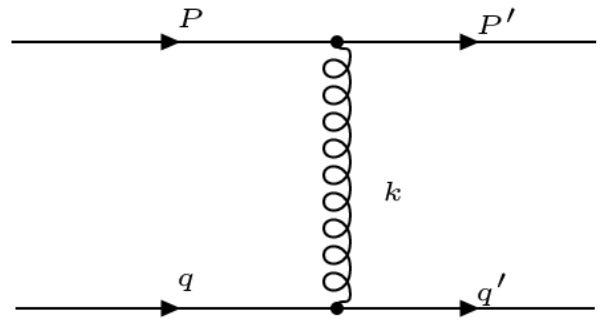


$$P(\Delta\overrightarrow{p_T}, \Delta t) = F(\gamma(\Delta z))$$

$$\frac{dI}{d\omega_{LPM}} = G(\gamma(\Delta z))$$

Our version of broadening

- Calculating the diffusion probability on **1 scattering centre**



$$\frac{dW}{d^4Z\, d^3\widetilde{P'}} = \rho_1(Z)\, g^2\, \frac{\sqrt{s}}{2} \int d^4\Delta z\, e^{i(P'-P).\Delta z}\, \gamma(\Delta z)$$

- On the way, we find a relation between the correlator and the matrix amplitude

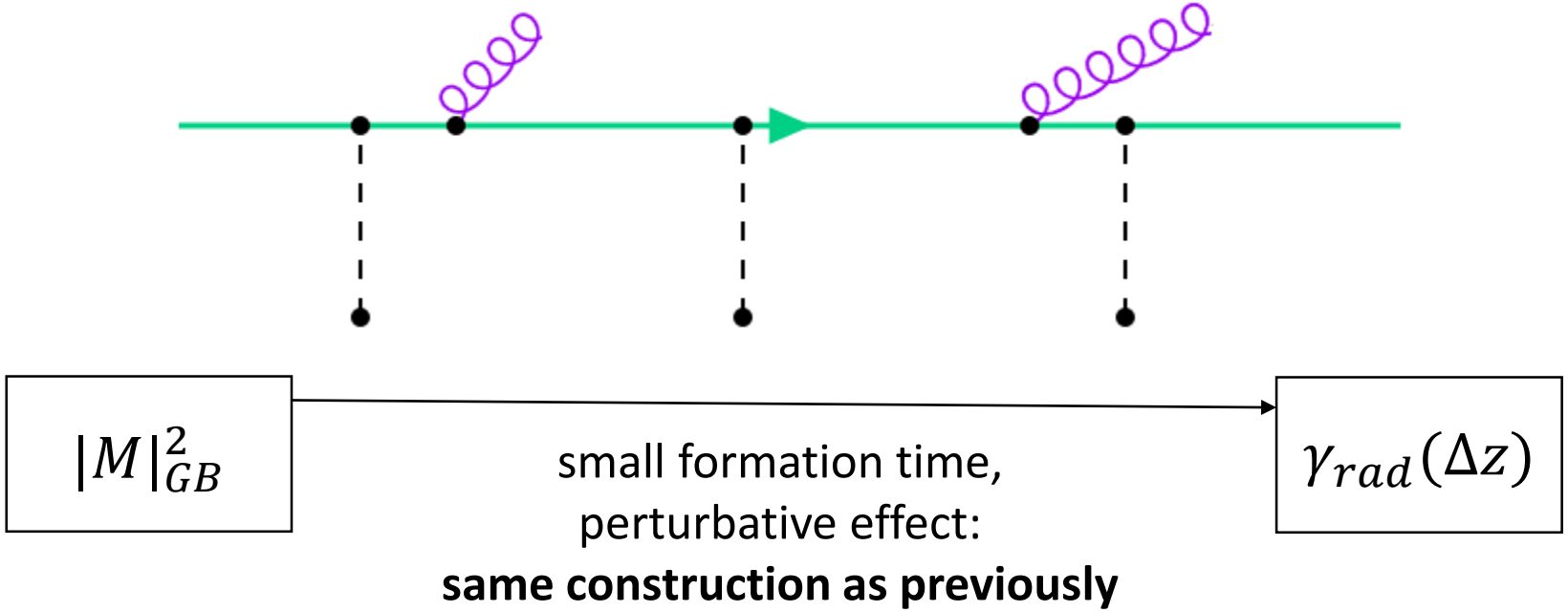
$$\gamma(\Delta z) = \frac{\rho_2(Z)}{2\, g^2(\sqrt{s})^3} \int d^4P' d^3\widetilde{p'} e^{-i(P'-P).\Delta z} \delta^{(4)}(P' + p' - P - p)|M|^2_{ela}$$

- **Resummation** along the parton line, we get back the BDIM formula for the broadening

  - In the hypothesis $\lambda \gg \mu^{-1}$: successive scatterings are independent
  - Exponentiation of the correlator gives us the F function

Include radiative process

- Construction of a new correlator integrating soft radiation ($\tau_f \leq \lambda$) to see if secondary gluons destroy the coherence of the emission



- Ultimately, we want to derive the new spectrum in the same way as in the BDIM formalism with a superposition of the original and the new correlator.

Conclusions & Outlooks

CONCLUSIONS

- Attempt to include some radiative effects in the propagation of a fast parton through dense matter
- Use of a formalism developed by Blaizot, Dominguez, Iancu and Mehtar-Tani for propagation with broadening (only collisional effects)
- Ansatz for a 2-point function called correlator modeling a medium which can interact both with collisional and radiative effects

OUTLOOKS

- Determine the emission spectrum and the radiative energy loss coming from the adding of this correlator in the BDIM formalism
- If possible associate a damping rate to the gluon propagation
- Investigate the effect of more energetic secondary gluons (with longer formation time)

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Thanks for your attention!

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