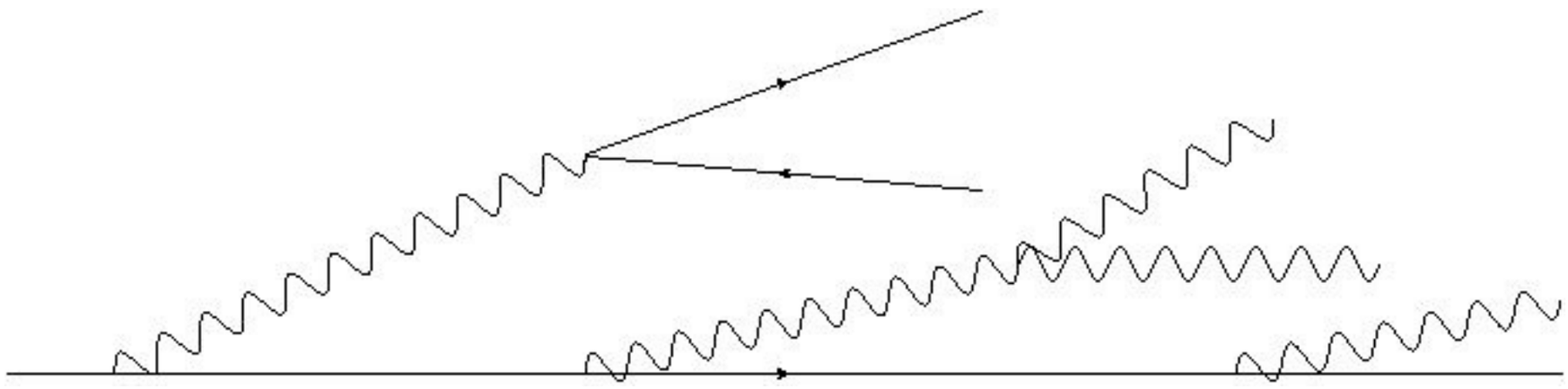
The Quark Gluon Plasma as a Jet Resolver

Jorge Casalderrey-Solana

UNIVERSITAT DE BARCELONA

Jets



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- At high energies evolution leads to several fragments
- When embedded in a medium, more than one fragment probe the medium simultaneously

- Can the medium differentiate among all those?

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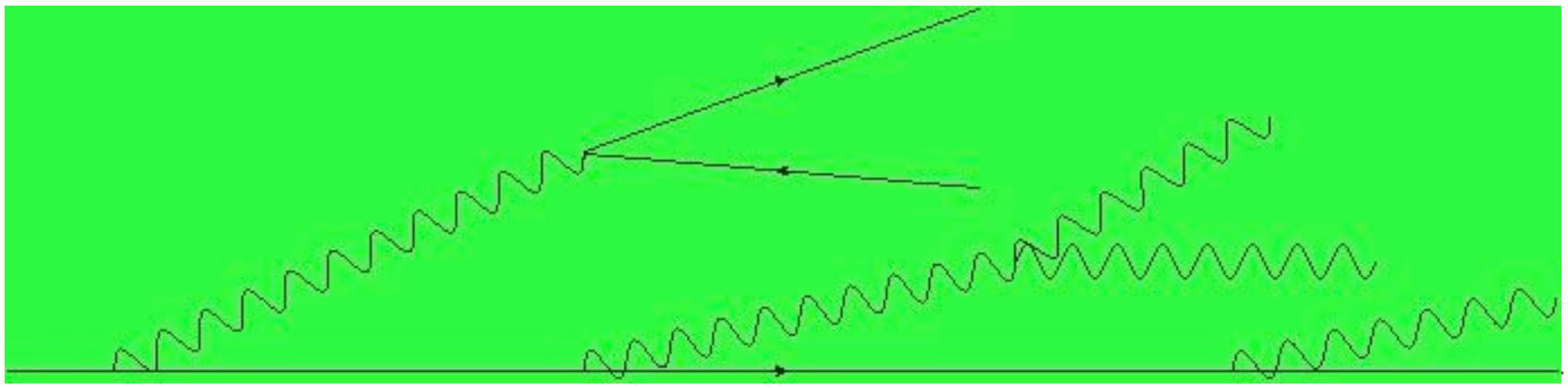

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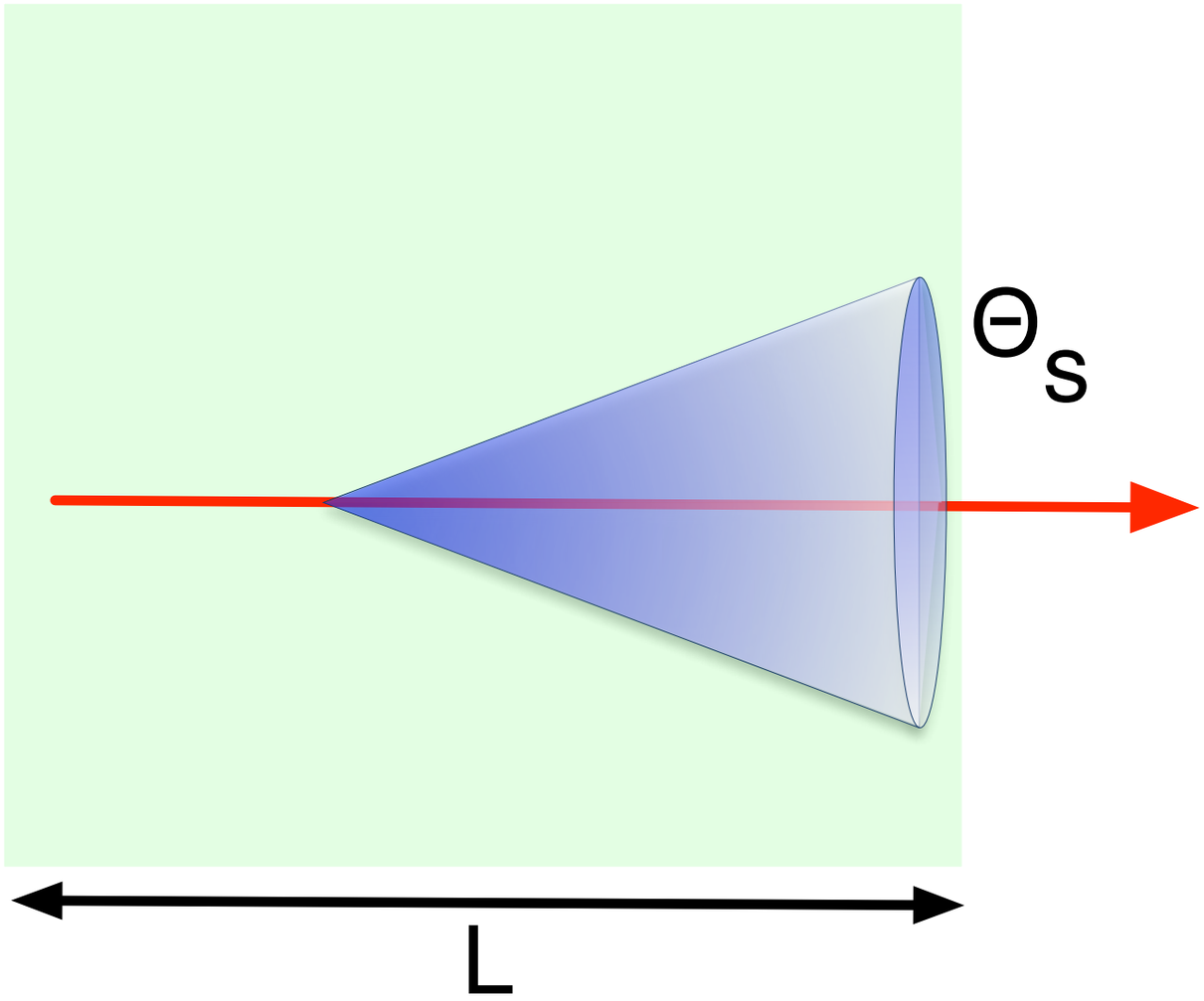

- Gluons are emitted with a typical angle Θ_s
- Emissions occur all along the medium: $dN \propto L$
- Soft gluons are formed (decohered) at a short time τ_f
- There is a minimum value for emissions Θ_C

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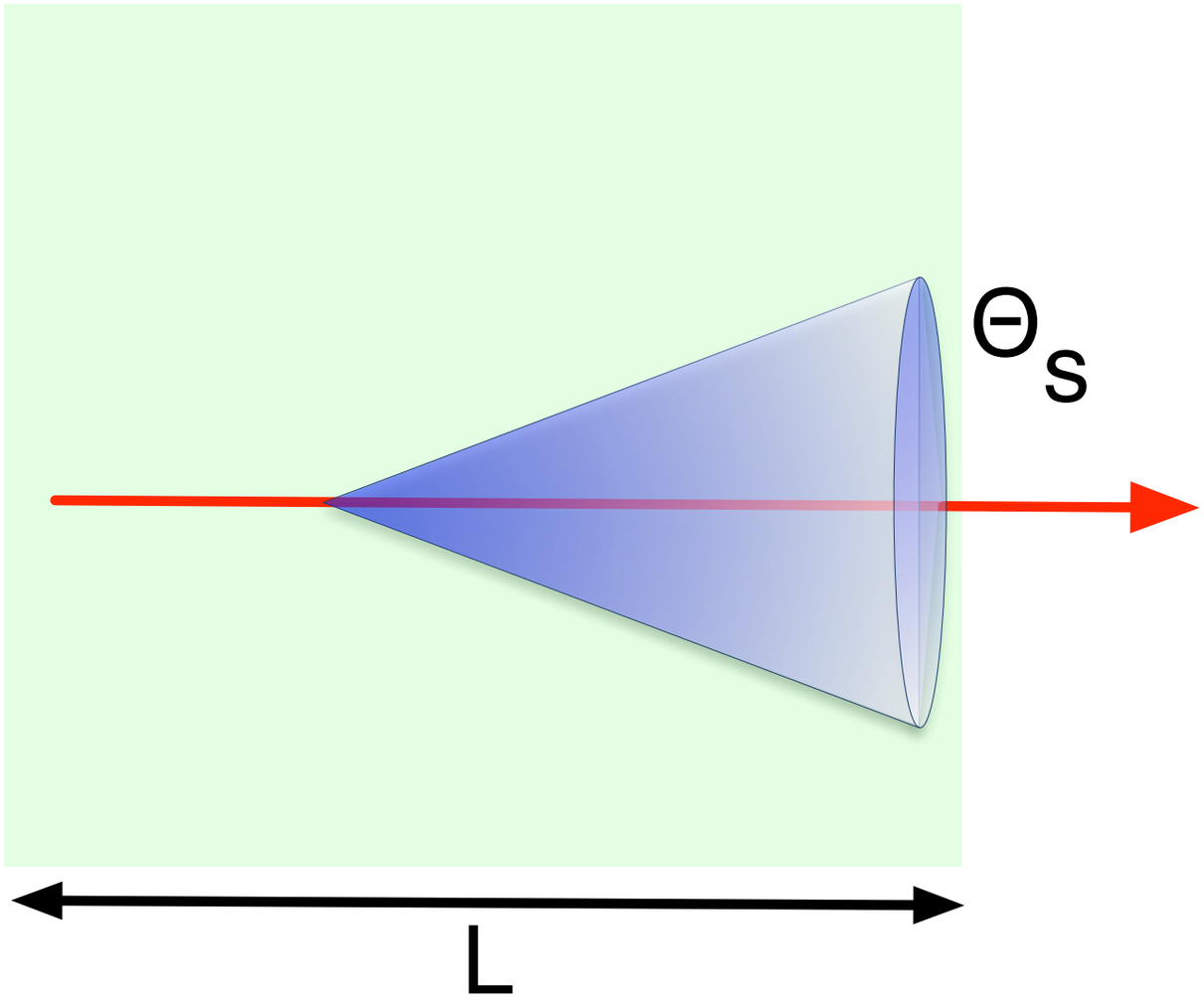

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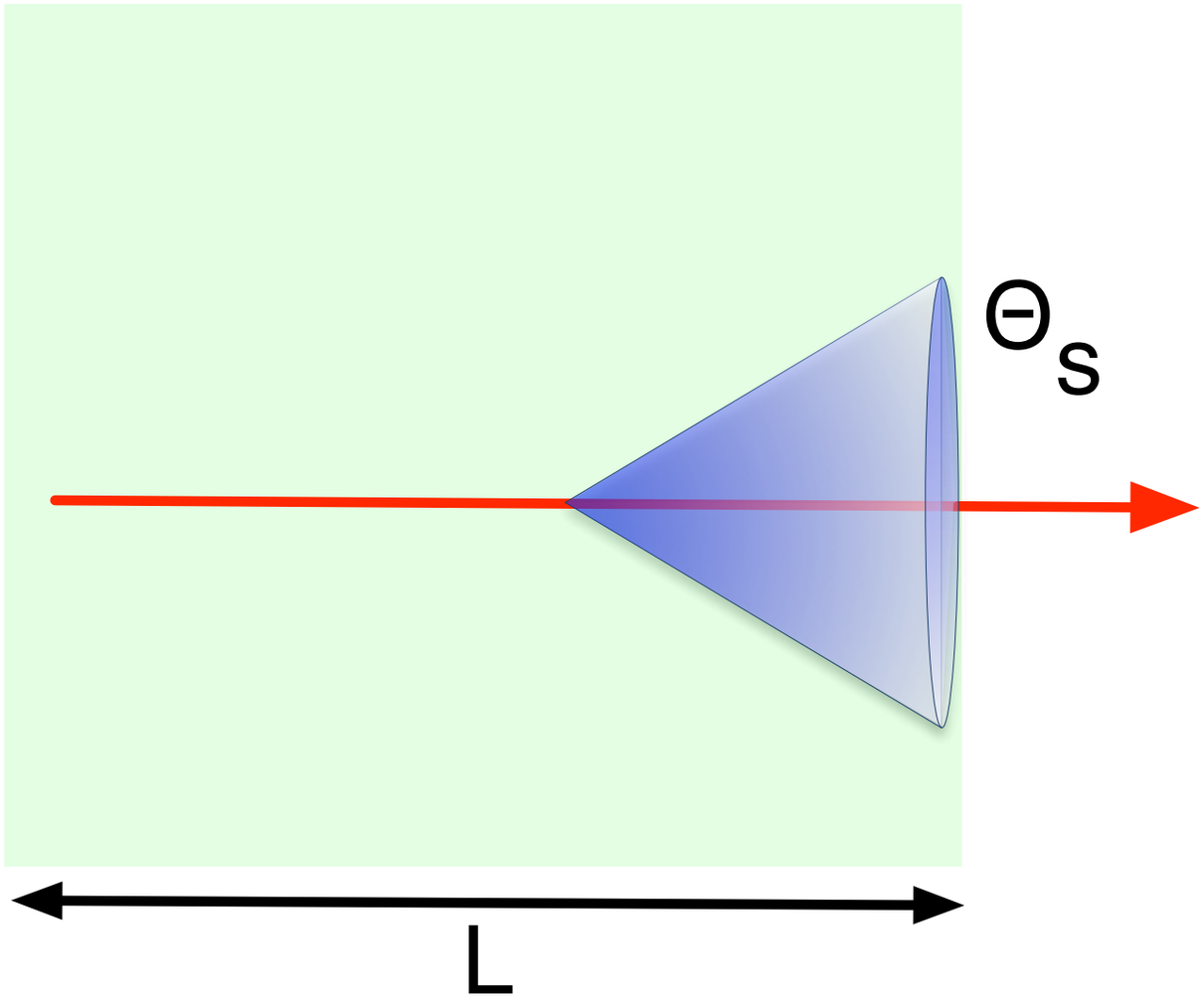

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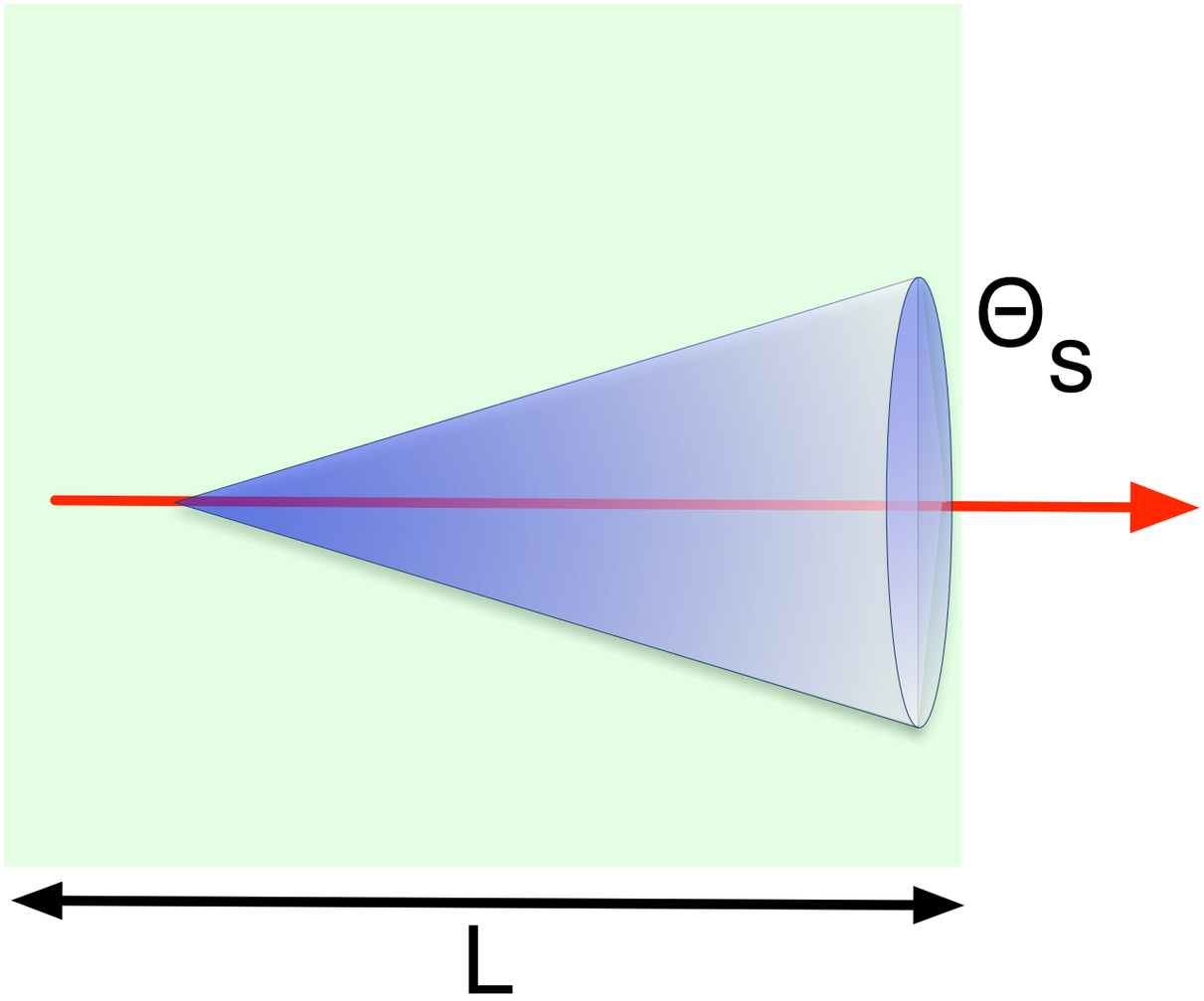

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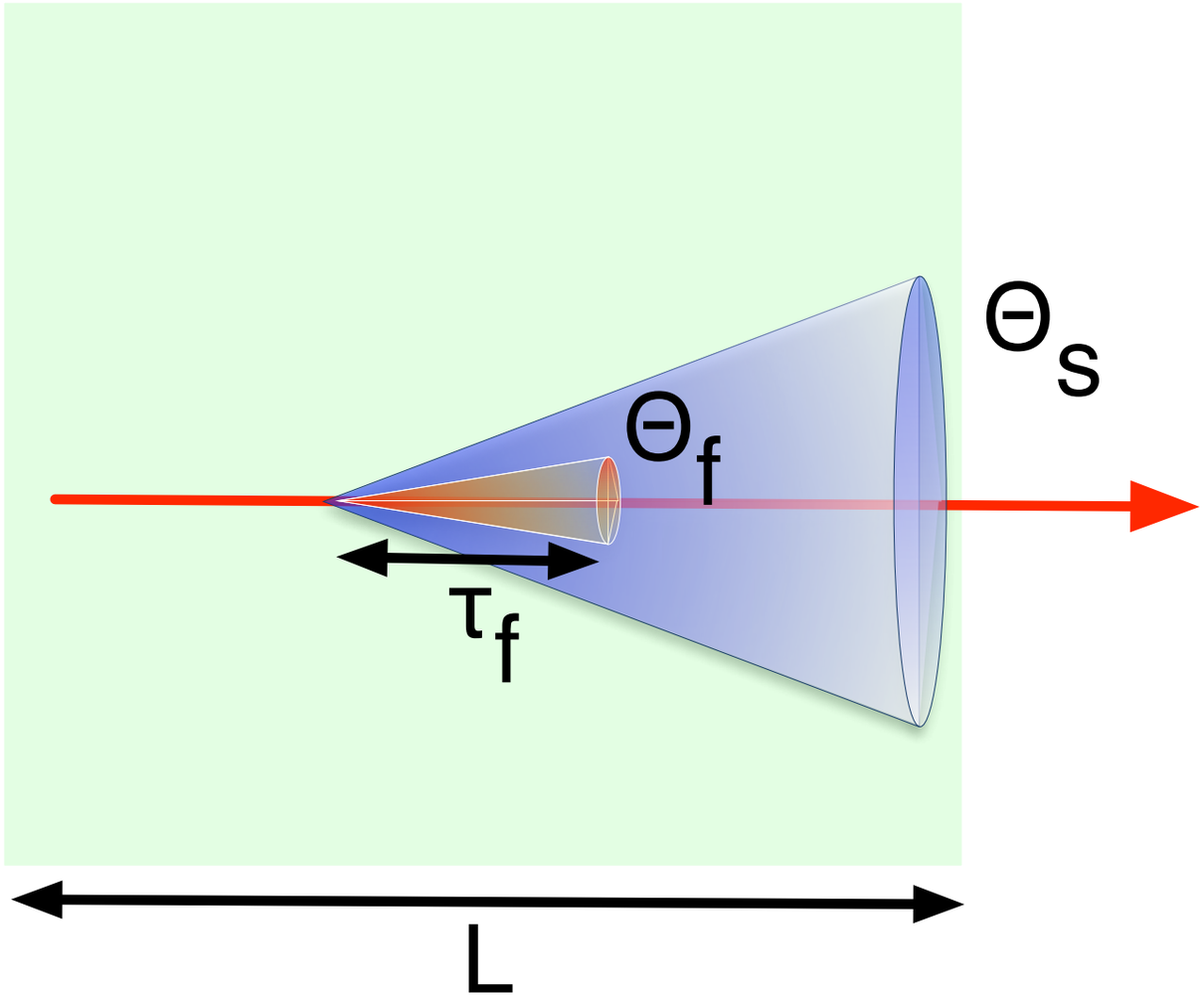

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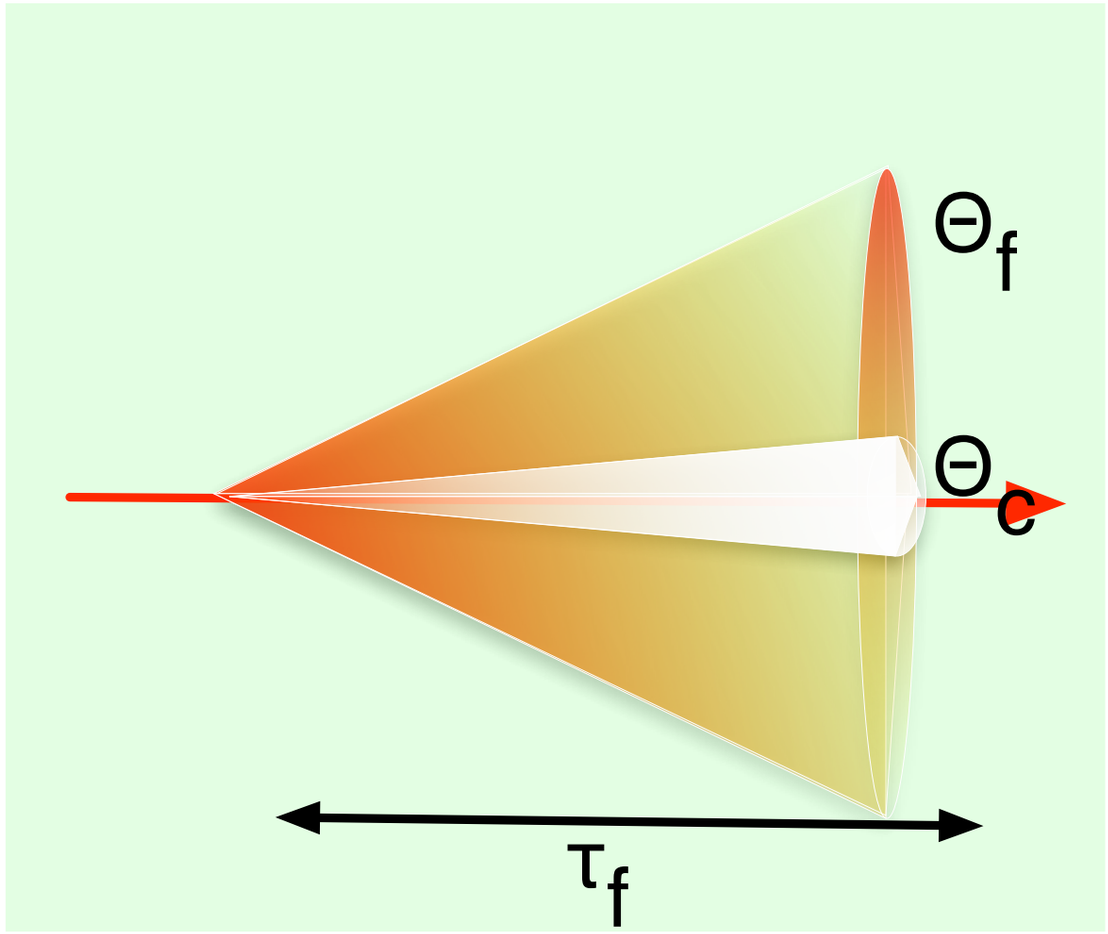

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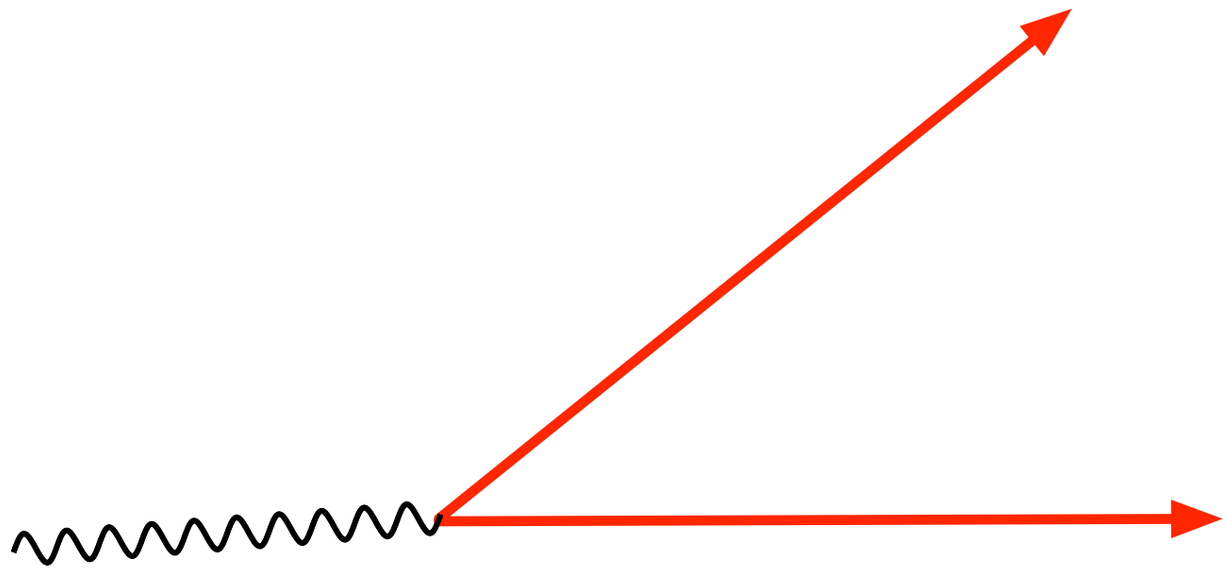

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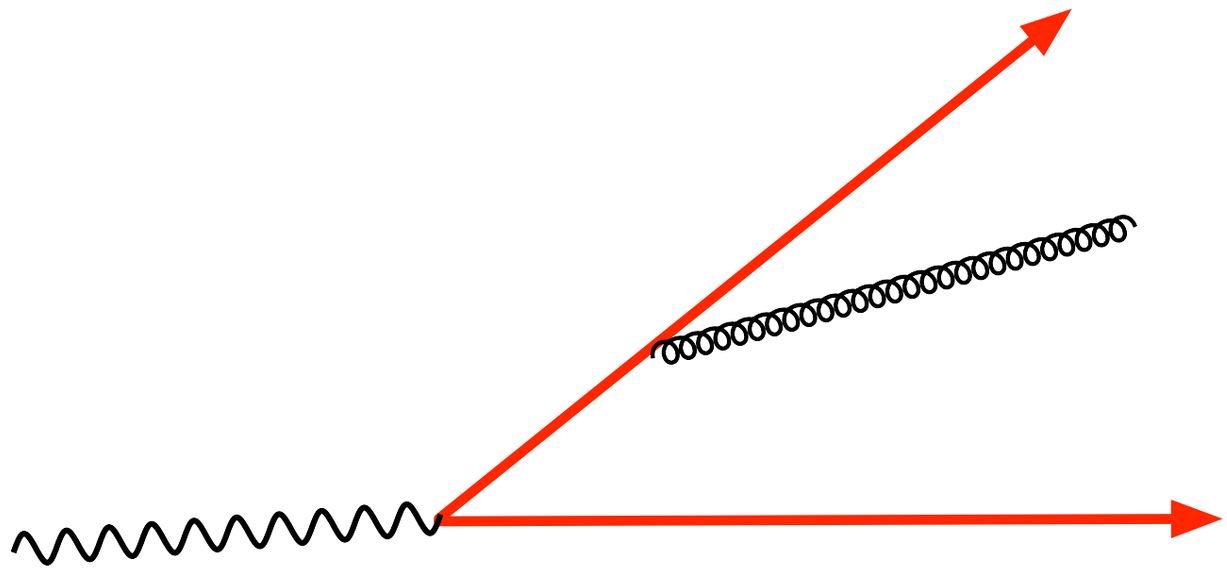

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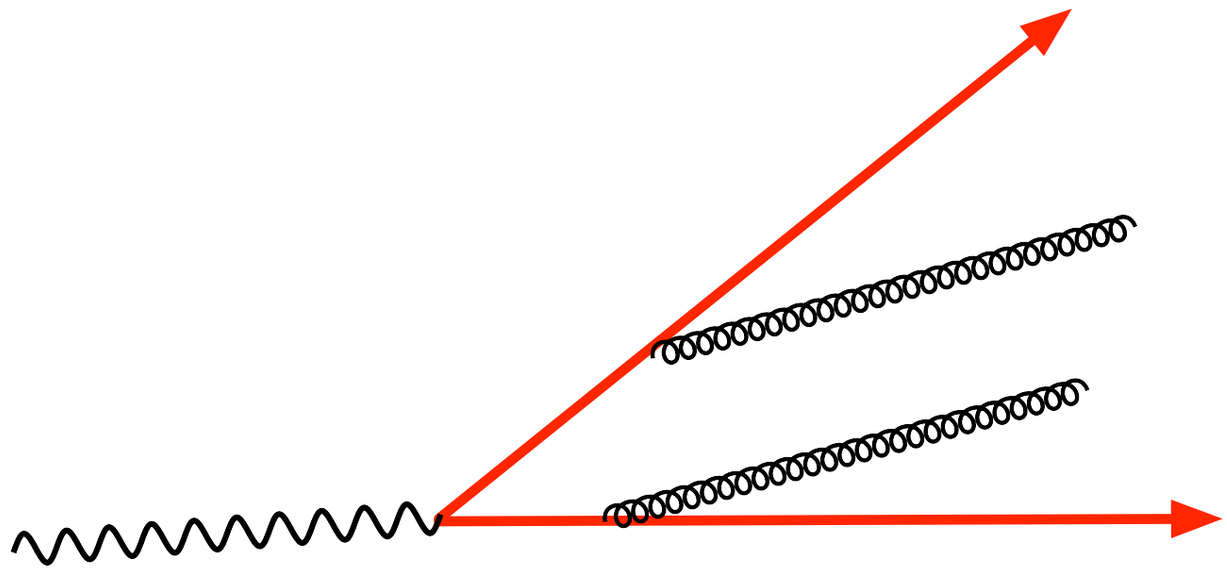

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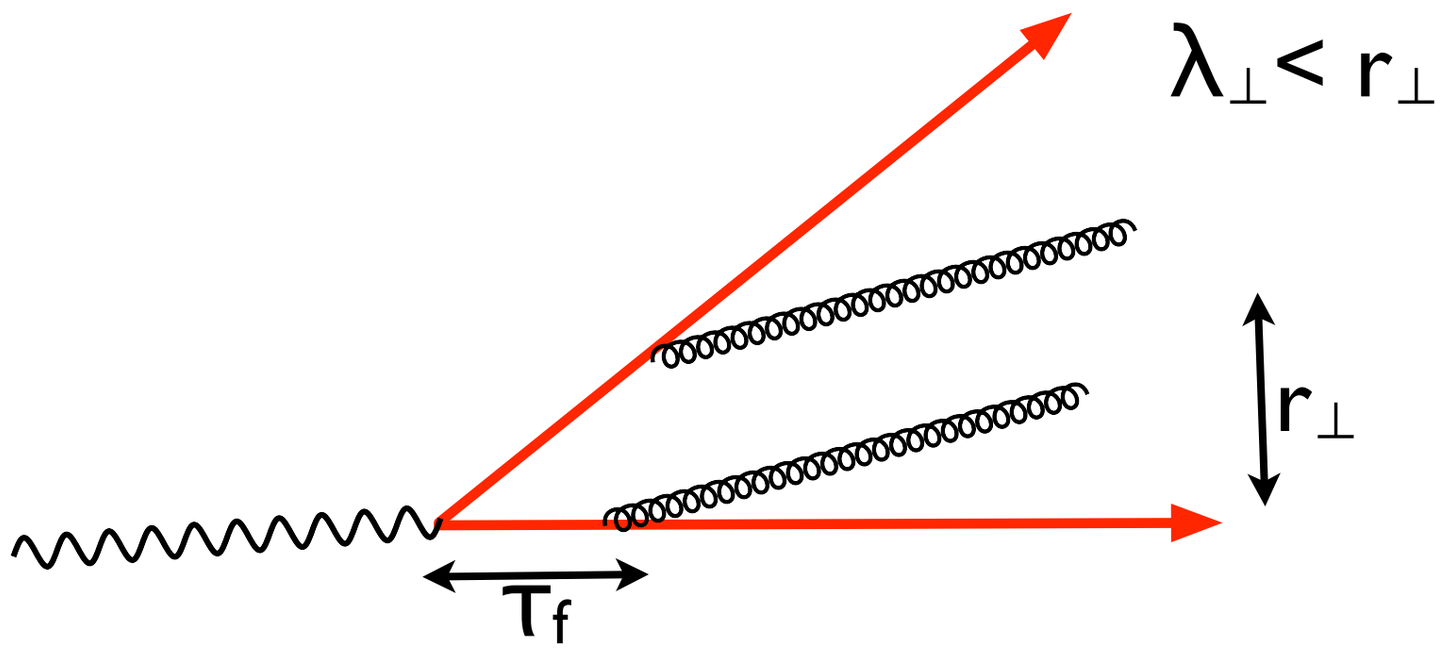

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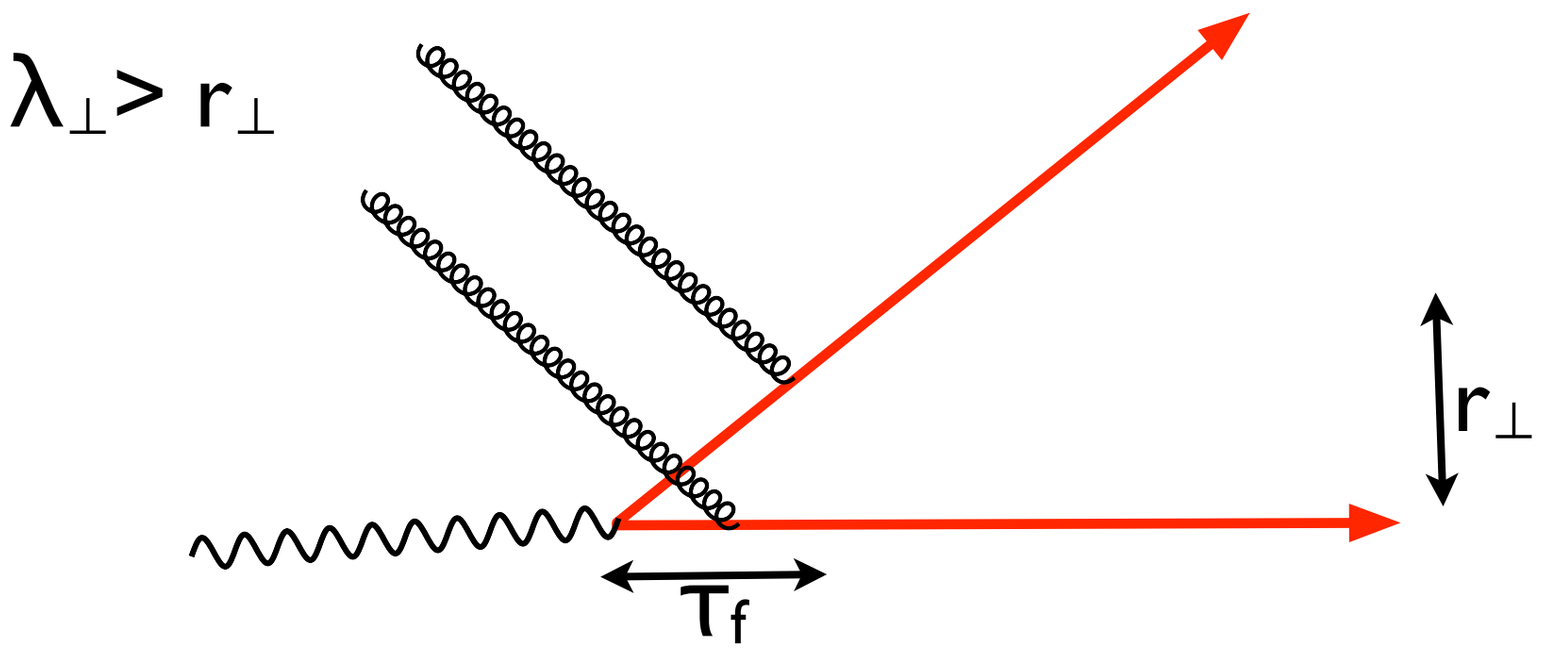


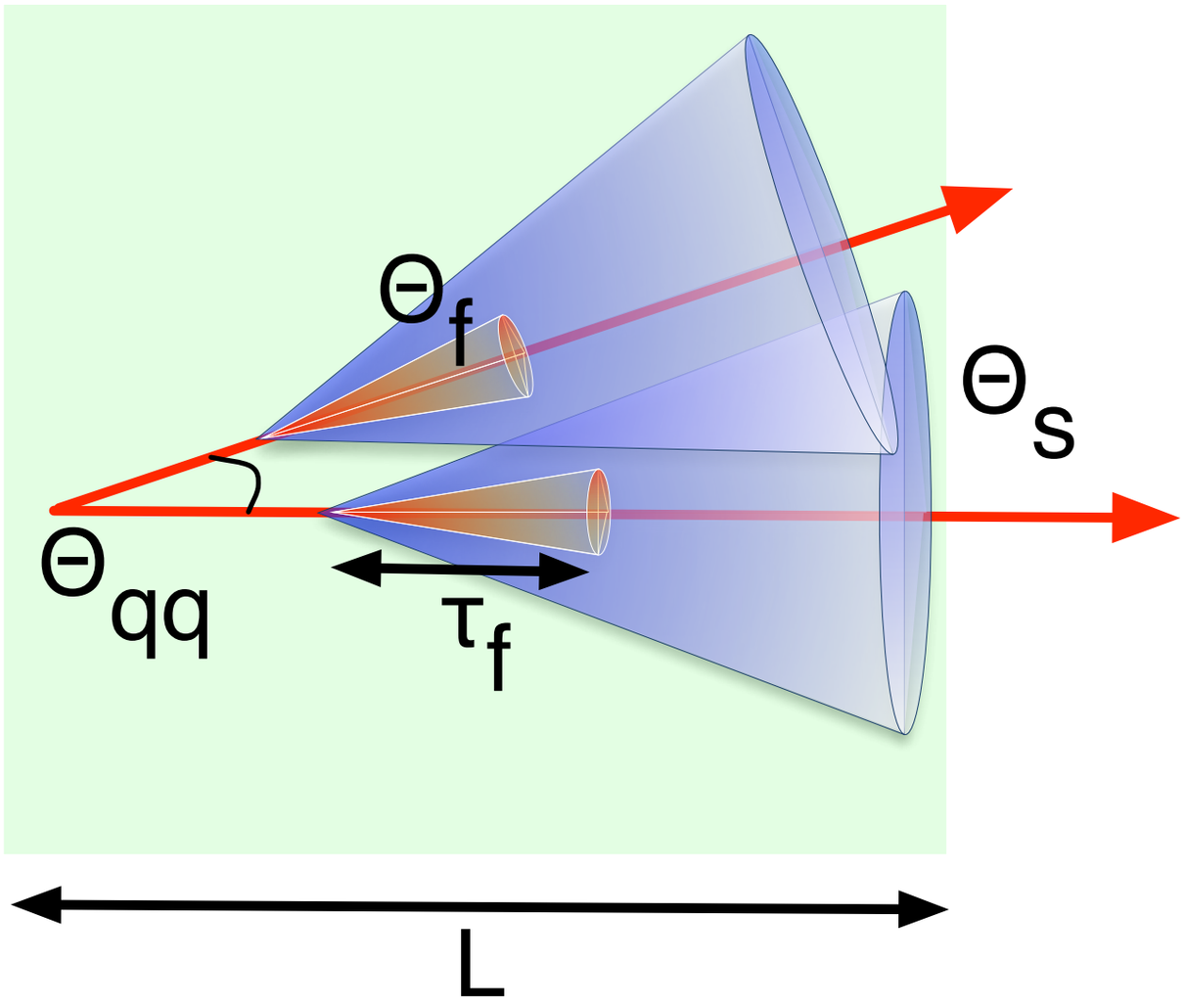
- The emissions from two sources can interfere.
- In cone emissions:

$\lambda_\perp < r_\perp \Rightarrow$ Two color charges are resolved $\Rightarrow$ Independent emission

- Out of cone emissions:

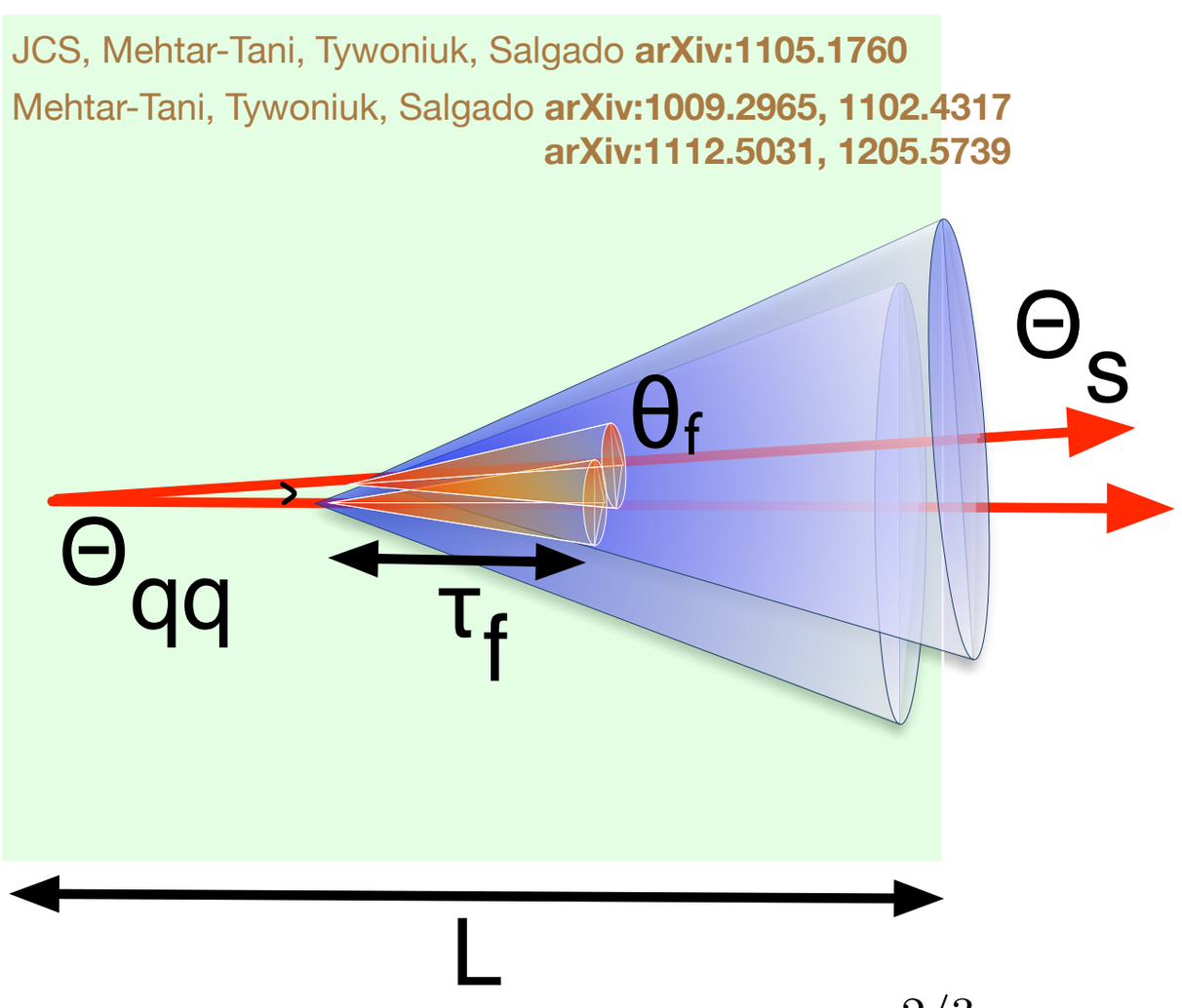
$\lambda_\perp > r_\perp \Rightarrow$ Gluons feel the total charge $\Rightarrow$ coherent radiation

Lessons from in-Medium antena



JCS, Mehtar-Tani, Tywoniuk, Salgado **arXiv:1105.1760**

Mehtar-Tani, Tywoniuk, Salgado **arXiv:1009.2965, 1102.4317**
arXiv:1112.5031, 1205.5739



- The qq pair rotates color before emission. At $\tau_{coh} = \left(\frac{\theta_c}{\theta_{q\bar{q}}}\right)^{2/3} L$

the color of each quark is randomized ⇒color charges are resolved

Θ_c plays the role of the medium resolution scale

A new picture

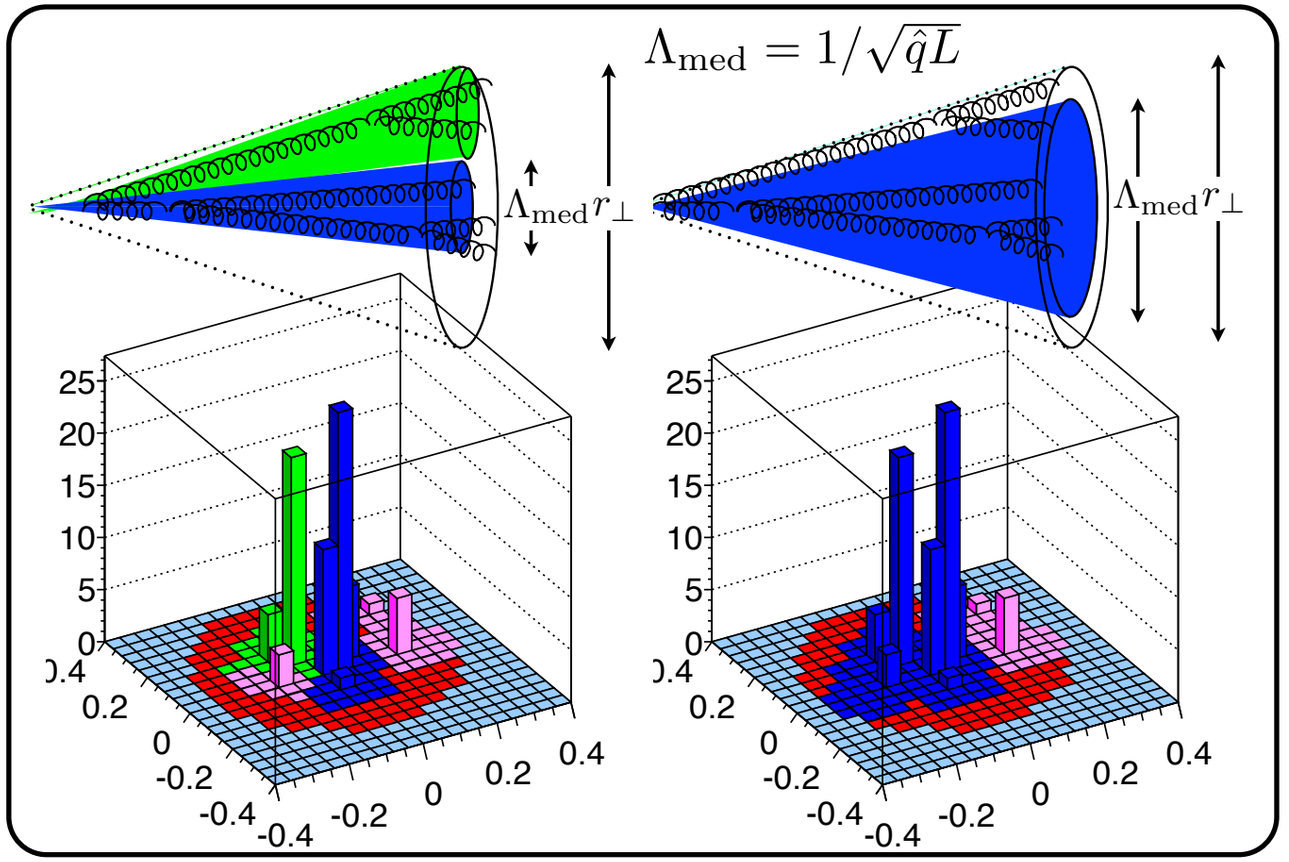
- Extrapolate the antenna results to the complete shower:
  - ➤ The medium has a finite angular resolution scale
  - ➤ Each jet is subdivided into an effective number of emitters
  - ➤ For each emitter, energy loss effects independent of one another
  - ➤ Within each emitter, jet substructure is unchanged

JCS, Mehtar-Tani, Tywoniuk, Salgado **arXiv:1210.7765**

- In a dynamical medium the anglular scale is:

$$R_{\rm med} \equiv 2 \left(\int d\xi \, \xi^2 \hat{q}(\xi) \right)^{-1/2}$$

- Jets look different within different medium



Estimates

- Quenching increases with the number of emitters ⇒

  bias towards few emitters

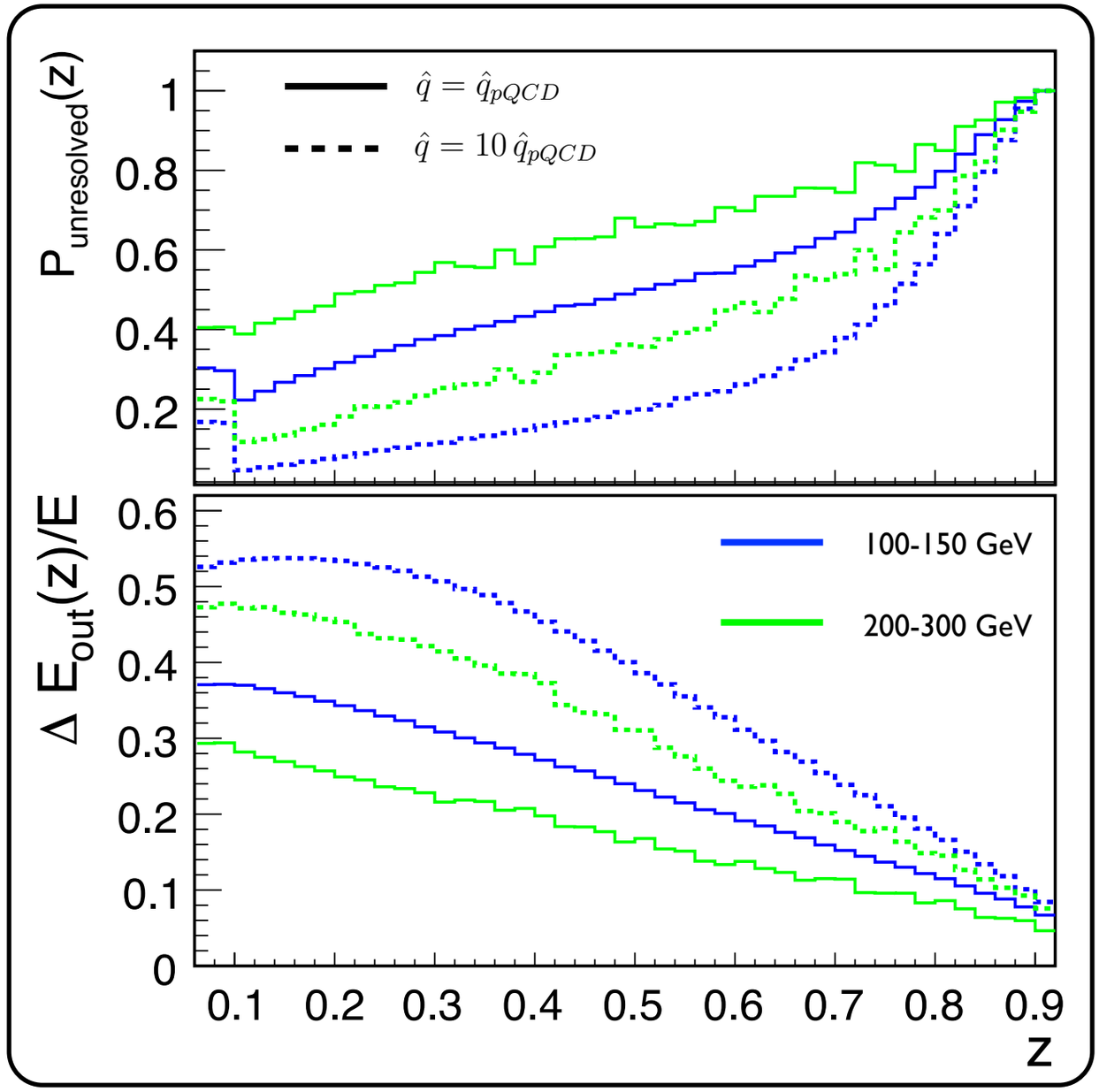
- Fraction of unresolved jets is:

  ➤ Large for typical med parameters

  ➤ Sensitive to med parameters

  ➤ Dependent on fragmentation pattern

  ➤ Jet energy dependent



- Significant fraction of unresolved jets ⇒ they behave like one parton

Qualitative Features

- Natural explanation of the non-modification of FF
  - ➤ Jets loose energy as a single object without altering its structure
- Large energy, large Q^2 jets always loose energy (as a single parton)
- Non-trivial dependence of e-loos in jet mass
  - ➤ For a fixed jet mass (M), increasing jet energy (E) decreases eloss
  - ➤ For a fixed jet energy (E), increasing jet mass (M) increases eloss
  - ➤ For fixed E/M eloss remains (roughly) the same
- Jet energy loss is not a function of jet multiplicity. Depends on the subject distribution

Conclussions

- Color coherence effects are important for in-medium jets
- We have provided a simple way to incorporate them
  - ➤ reorganize the jet into effective emitters
  - ➤ medium-counterpart of the angular ordering criterium
  - ➤ can readily be introduced into Monte-Carlo implementations