Jet Quenching
Take-home Lessons

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Holmganga 2023, Helsingborg, Sweden

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Clash on Jets

Liliana Apolinario

Even tough ML techniques are powerful tools to address jet quenching, we still need jet observables that can enhance the population of quenching effects while simultaneously allowing to learn something out of it.

"Does a spacetime description of jets within a medium makes sense?"
Better rephrase it as: "We need a spacetime description of jets within a medium"

Need more theoretical and phenomenological understanding of parton formation time. It will help to define early-developing vs late-developing jets (select quenched jets, estimate energy loss in small systems,…)

Jet observables are always dominated by selection biases that usually mislead any interpretation on jet quenching. However, for once, they might be used in our favour to establish the presence of energy loss in pA!

"v_2 vs R_{AA} puzzle driven by the onset of energy loss". There might be more to it… Need further work.

A few take-aways

- For interpreting both “standard” jet observables and machine-learned observables the choice of baseline is critical; physics motivation often necessary to understand and control the differences between the jets that contribute to an observable in baseline and measurement

- Understanding measurements (esp. in small systems) require calculations of jets interacting with pre-equilibrium phase that do not exist yet but can exist, for example based on QCD kinetic theory, modified potential in BDMPS, ..

- The spacetime structure of jets is not observable in vacuum but takes on meaning due to local interactions with a medium that is inhomogeneous, and can hope to be measurable, for example through changing the formation time of splittings in small systems

What did I learn?

Holmganga 2023

Raghav Kunnawalkam Elayavalli

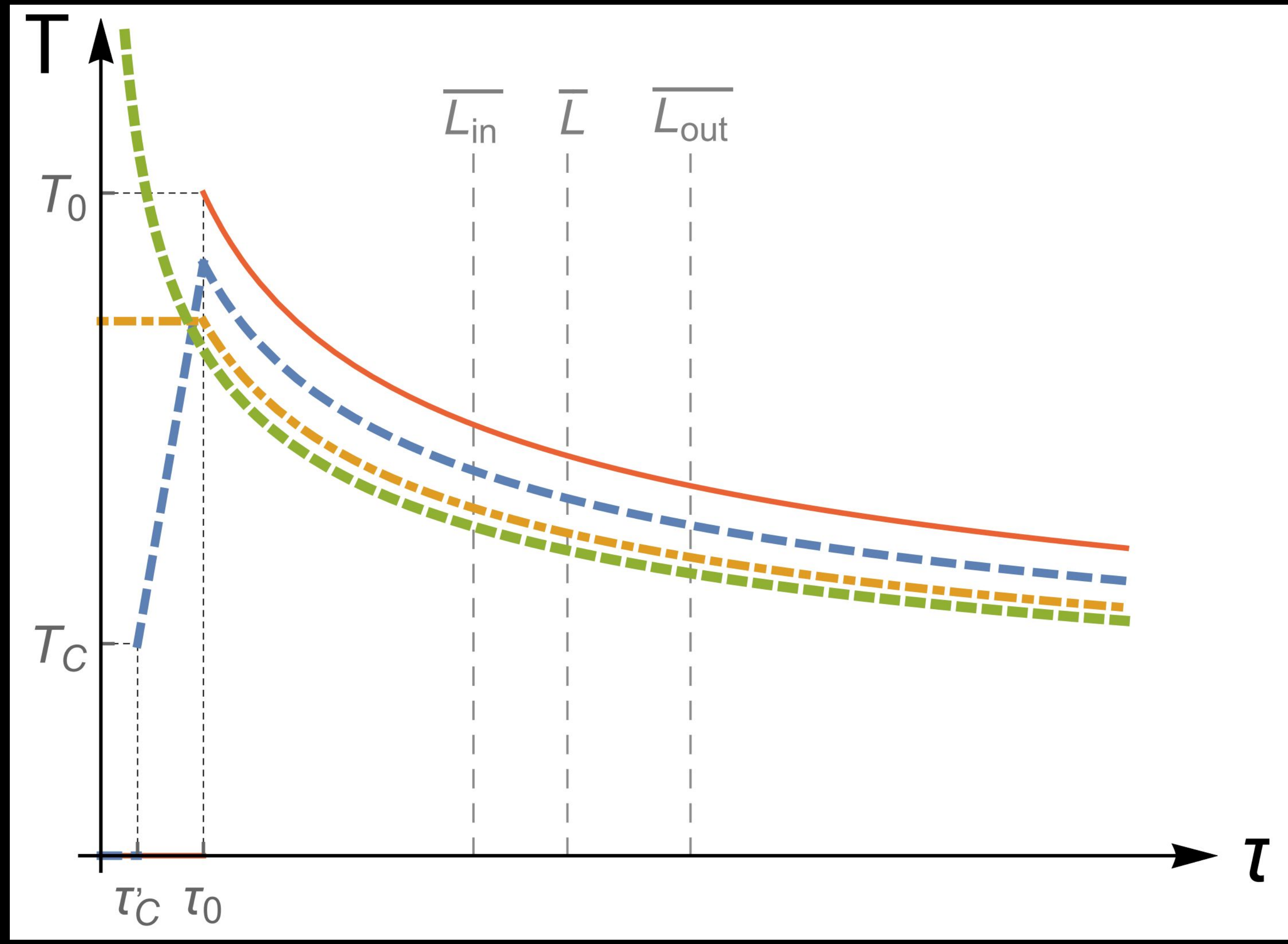
- ‘Kinetic theory’ - what, why - as much as an experimentalist can understand
- Comparison - what is a good reference? Both observables need to have same things done to them - maybe we skip pp as a reference!! Compare AA to AA…
- Angular ordering is a valid condition in pp collisions followed by potential effects in AA
- Varying grooming allow for different physics effects to come forth
- Space-time dependence of jet evolution can be considered physical *“In vacuum” - Rene Bellwied*
- Formation time selection could be special in small systems - early time, shorter distances .. large systems - jets can see pre-equilibrium structure and carry it forth

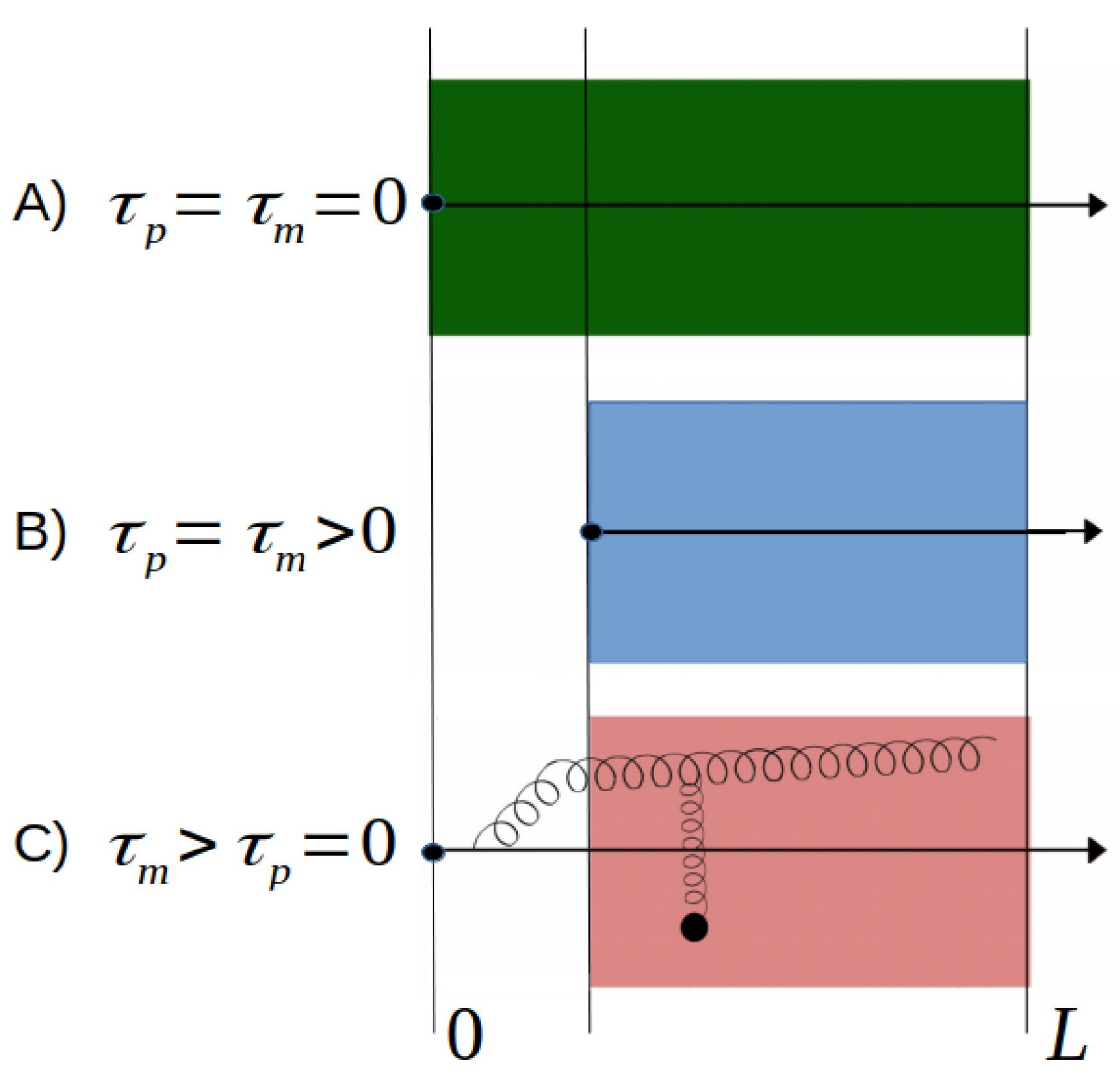
Folks will measure a bunch of different things - all good (well.. doesnt hurt)
Differential measurements will point the way

Temperature and temporal dependence of quenching

Guilherme: Technology exists to formally resum the correct number of scatterings set by L.

Liliana: already investigating effect of temperature profile

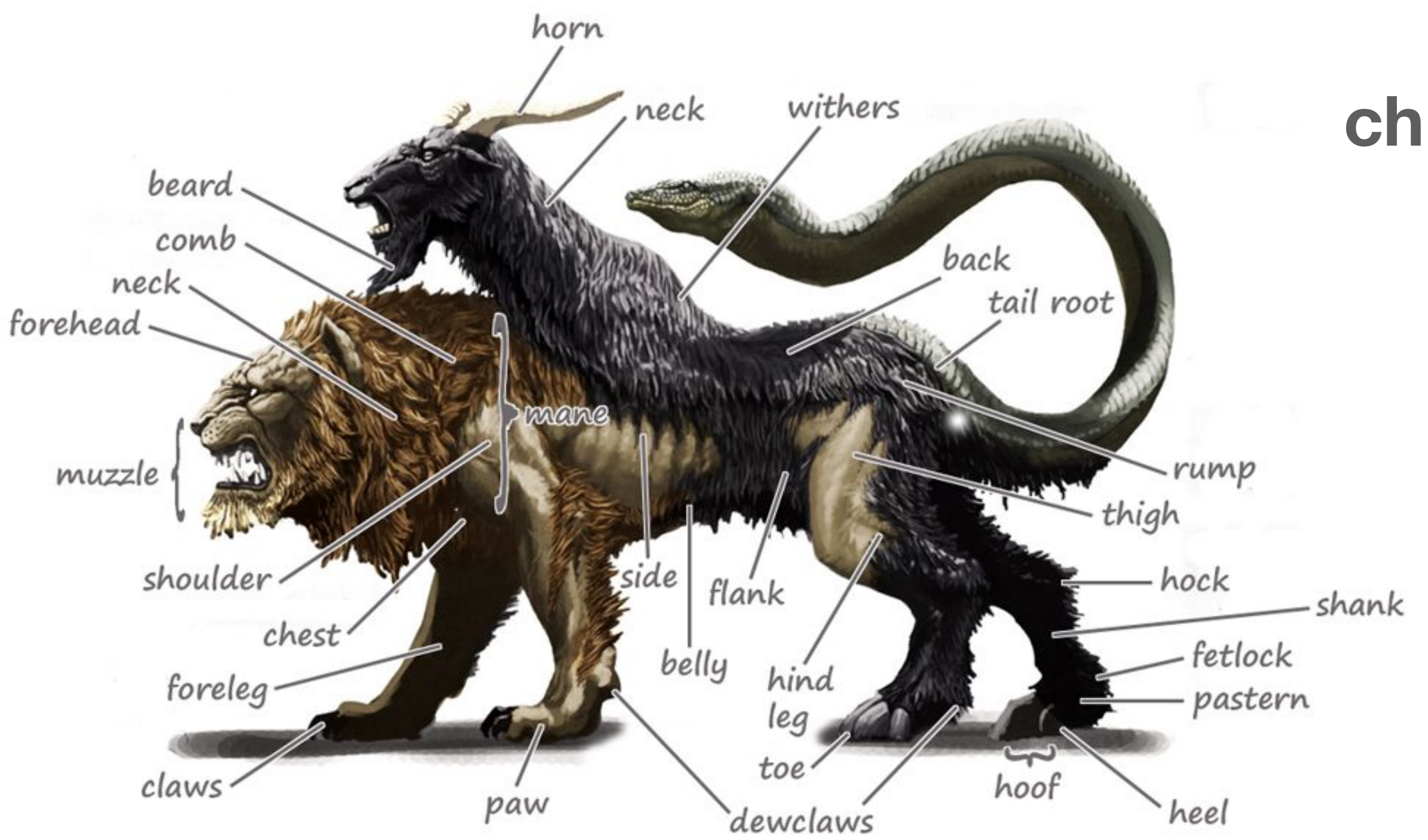




Idea from Jasmine:
Maybe one can get hold of a potential for the quenching before tau_0 from kinetic theory?

Then use this in Liliana's formalism in small systems

Guilherme Milhano



chimera :: *mythical creatures formed from parts of various creatures*

quenched jets are chimeras ::
vacuum-like structure
\+ modifications due to interaction with QGP [including QGP response]
\+ remnants from soft event [no subtraction is perfect]
some more vacuum-like some less [no real pure features we know of so far]

how do we see what we want
:: modifications due to interaction with QGP [including QGP response] ≡ jet quenching

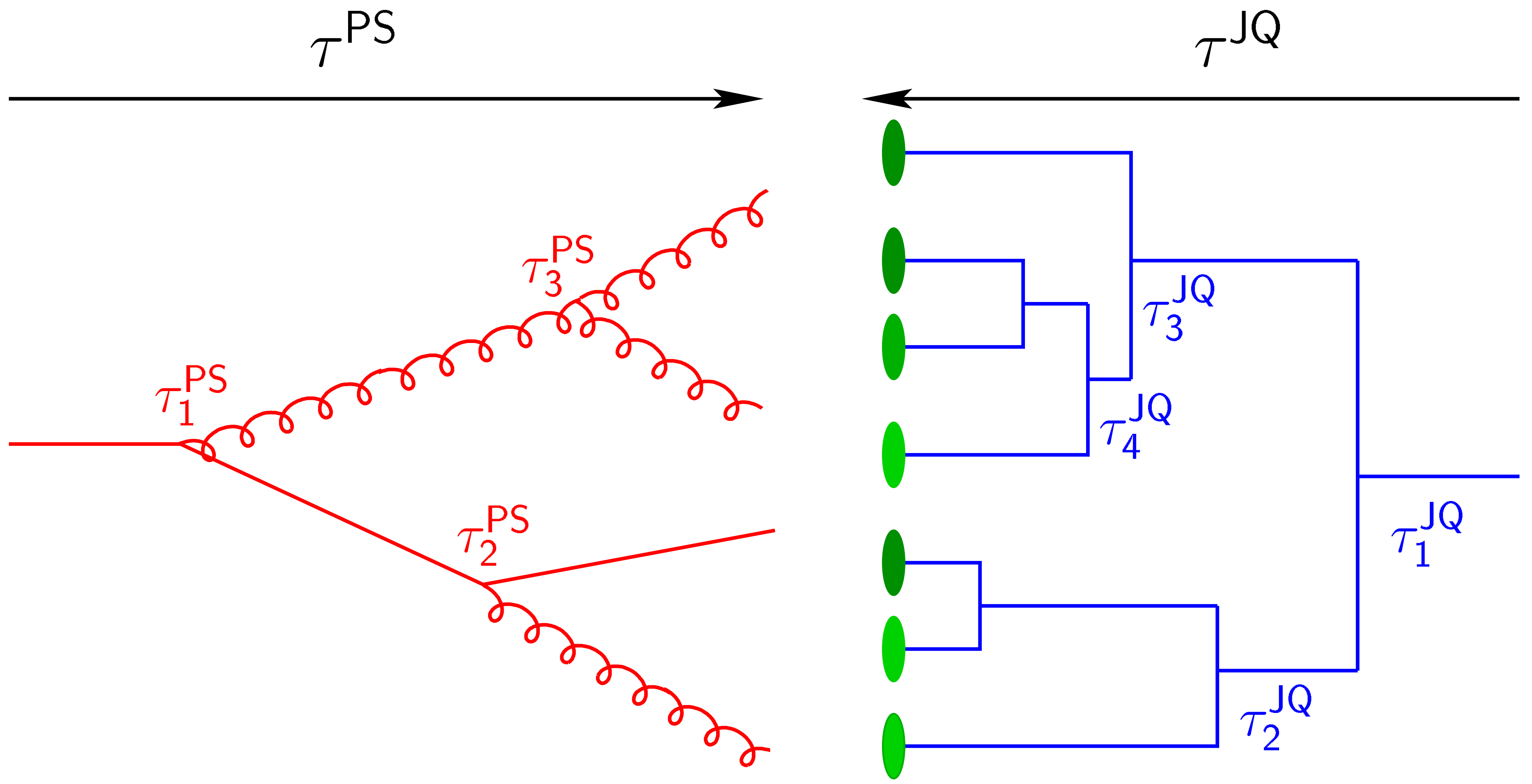
construct ::
vacuum jet
\+ remnants from soft HI event
chimera to compare with quenched jets :: distinction becomes even more blurred but much more faithful

:: with this done we should know what quenching effects are ::

my big take out from this week
:: all attempts to differentiate different sources of quenching [induced radiation, elastic energy loss, QGP response, parton decorrelation, …] are
MISGUIDED

only holistic, and vaguely right, descriptions of jet quenching can be meaningfully compared with data
and used to learn anything about QGP

Korinna Zapp



1. it does not seem completely nonsensical to interpret structures in jets in terms of formation time

→ try to understand this better

→ try to use this for small systems, i.e. do a calculation

2. try to find a way of measuring colour coherence

#16

Is there a hadronization end-game? like given infinite resources, person-power, computer power - is the end goal to find a deterministic solution to hadronization? is that even possible? if not, which i assume everyone would think so, why?

#25

The Lund people have added collectivity by introducing the notion of what happens when strings sit on top of each other… what is the difference of this with a, let’s say, 2+1D hadronic transport picture

#27

It is my understanding that the energy density of a Lund string and of a CGC string/hydrodynamics develops very differently. While the CGC strings and hydro decreases fast like ~1/tau, the energy density of a Lund string in the local rest frame is AFAIK constant (because the Lund string only expands at the ends).

My questions: is this correct? If yes, can one differentiate? And will it affect jet quenching differently, e.g., can one explain high pT elliptic flow easier with a constant energy density?