Towards a Yoctosecond Imaging Tool for the Quark-Gluon Plasma

João Miguel Martins da Silva

PhD student at LIP-Lisbon/IST | 10th IDPASC School (06-17/09/2021)

Motivation and Introduction

Where and why would one study the Quark-Gluon Plasma?

Hot and dense soup of **deconfined quarks and gluons**!

- In **ultra-relativistic heavy-ion collisions,** conducted at the Large Hadron Collider and at the Relativistic Heavy Ion Collider with the aim to explore and characterize matter under extreme conditions – **Quark-Gluon Plasma** (QGP).
- Signaled by an **abrupt increase** in energy and particle densities about **~1 fm/c** (10^{-24} s) after the collision.
- **Collective** properties are lost on a timescale of **~10 fm/c** due to **fast fluid-like expansion**.
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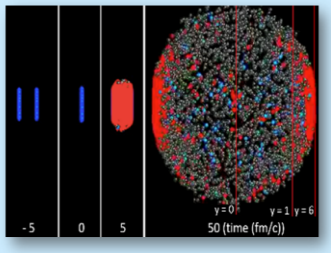

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How does one study the Quark-Gluon Plasma?

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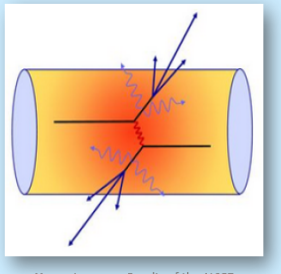

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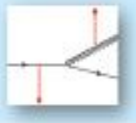
PhD research aim: To endow jets produced in heavy-ion collisions with the ability to serve as yoctosecond-resolution probes of the QGP.

State of the Art

Jet quenching – modifications of a jet's energy and internal structure (substructure) in comparison to the vacuum reference - has been identified as a **promising path to extract the time dependence of the QGP properties** [1]. For a model of in-medium jet evolution to be successful in this sense, one should be particularly concerned with:

Collisional energy loss [2] via elastic scatterings.



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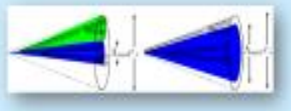

The interplay between the **QGP resolution length** and **transverse size of the jet** [4].

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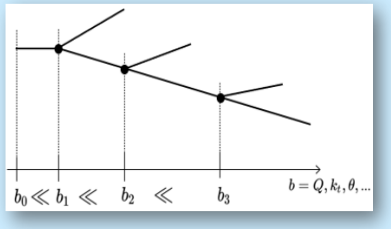

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What about the **space-time evolution**?

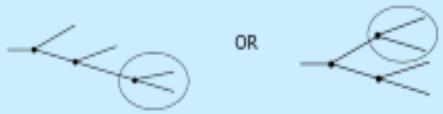
My proposal: To provide a first principles description of vacuum-like and medium-induced emissions as time-ordered processes.

Work Plan

1. Formulation and computational implementation of **in-medium time-ordered jet evolution**.

2. Identify **jet definition(s)** with optimal sensitivity to time dependence, exploring modern deep learning architectures.

Which branching history is most suitable?



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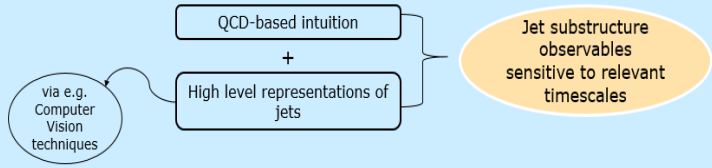

Acknowledgments

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References

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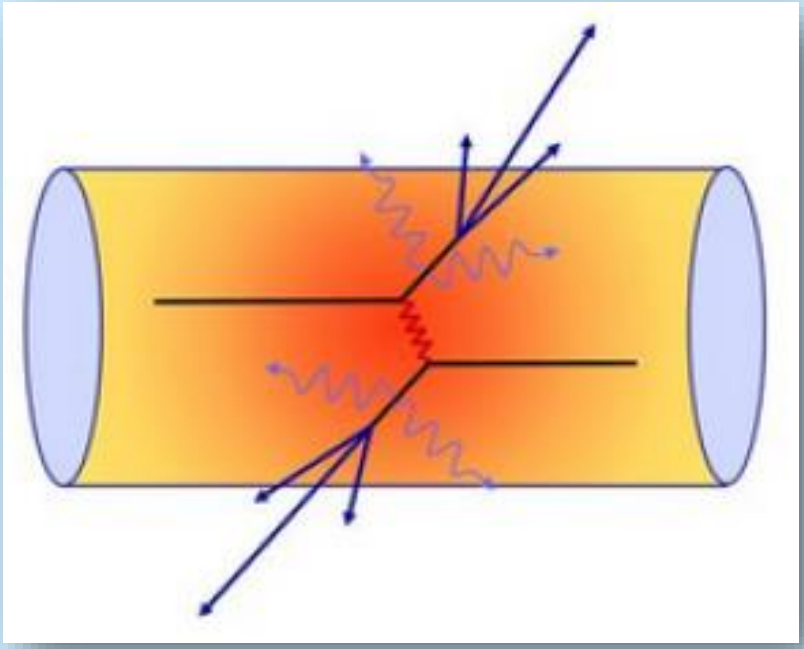

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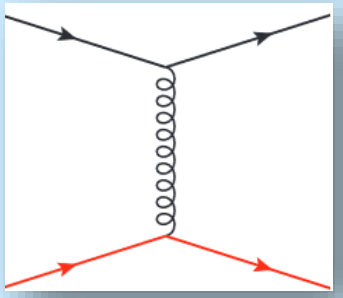

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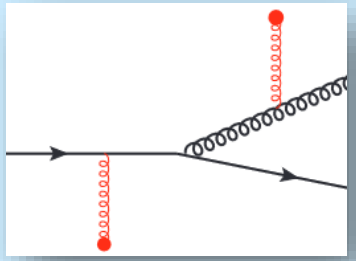

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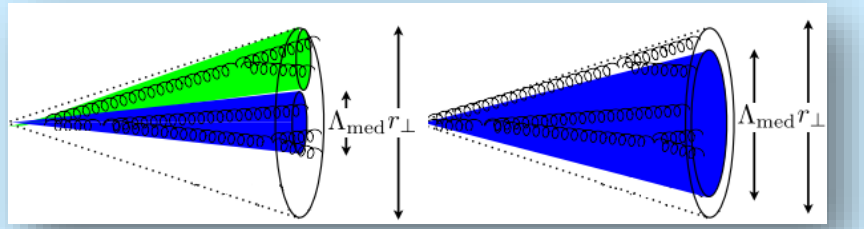

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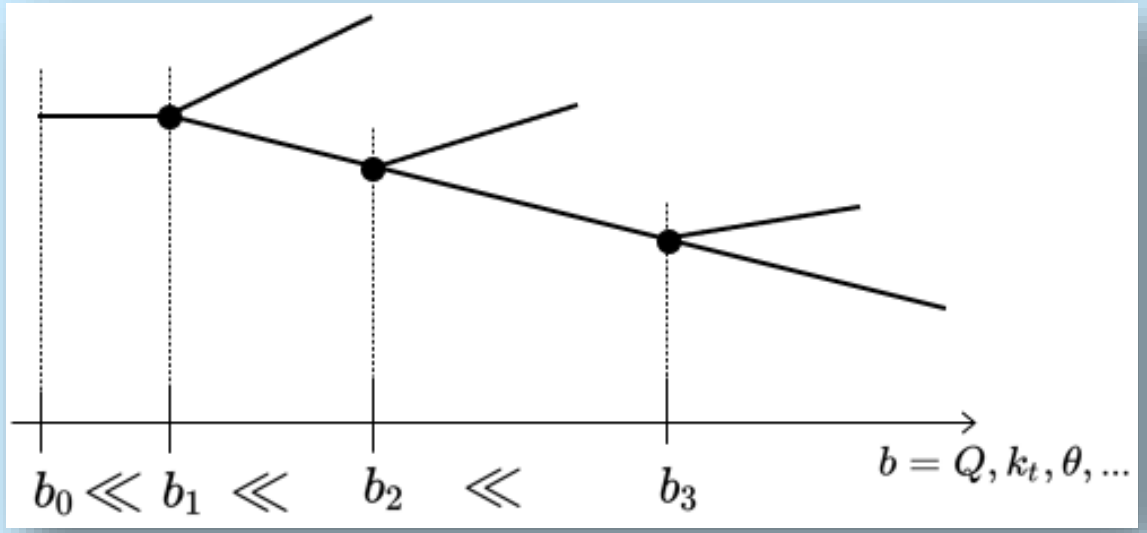

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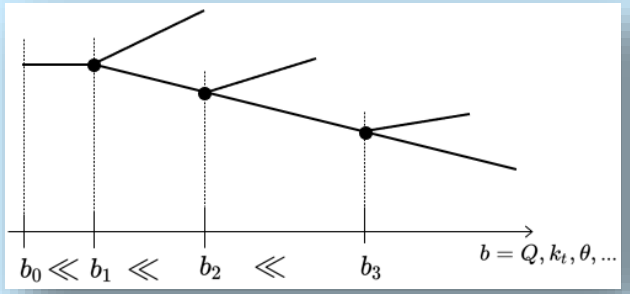

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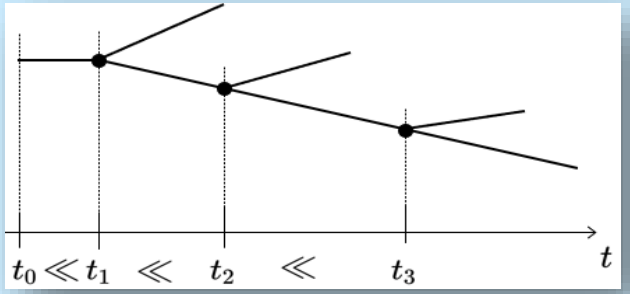

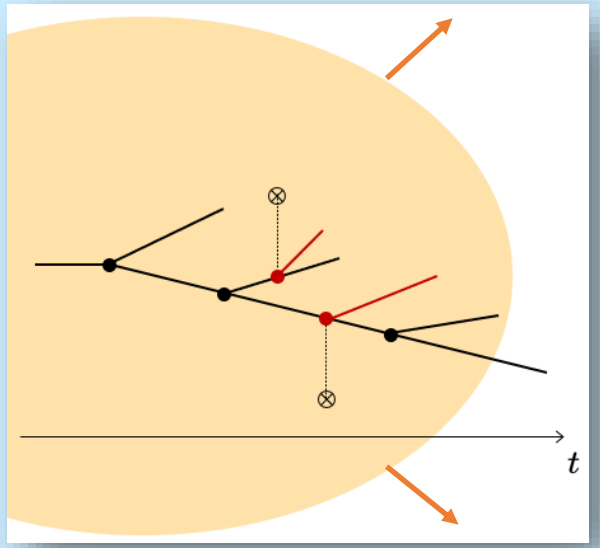

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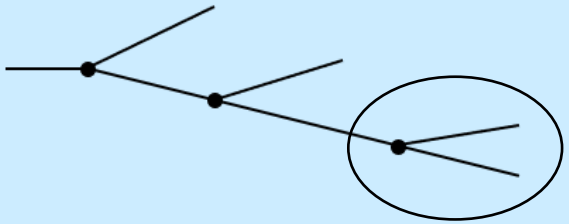

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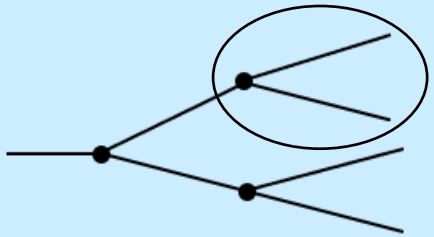

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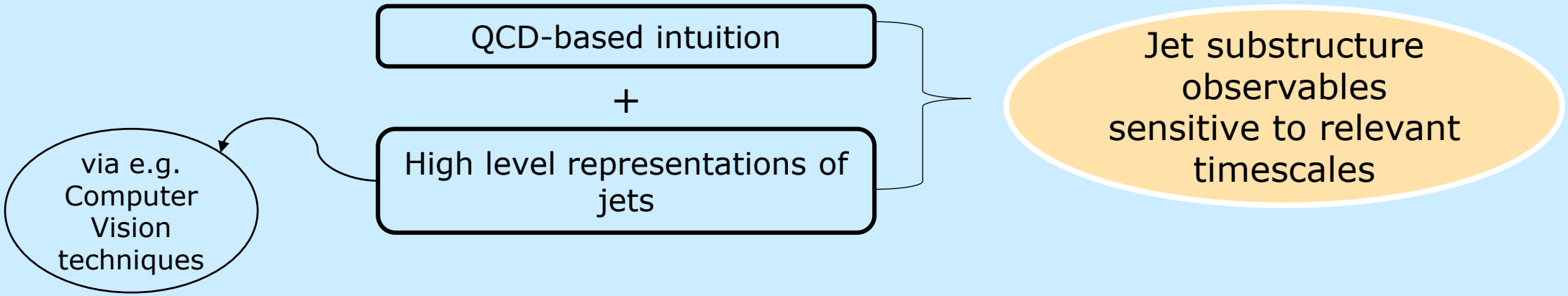

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