

THEORY OVERVIEW

QGP-FRANCE 10 years!

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OFTEN ASKED QUESTIONS

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What are the ^{main} questions that we are trying to answer?

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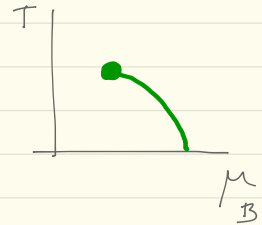
Are we progressing towards our goals?

INITIAL MOTIVATIONS

Hot and dense matter: expected simplicity due to asymptotic freedom .

Deconfinement, restoration of chiral symmetry

Phase diagram (and its possible critical point)



These issues can be addressed with a variety of theoretical tools

Complexity of heavy ion collisions

Complex phenomena

details of the dynamics matter! (→ One needs models)

The field is driven by experiment (and theoretical predictions)

Signatures?

Surprises from experiment and new questions

Multitude of probes available

truly high energy

Study of detailed properties of the QGP possible

The QGP is not quite like we thought ("perfect liquid")

VISCOUS HYDRO AND THE PERFECT LIQUID

Hydro description in terms of a few local fields

$$E(x), P(x), N^{\mu}(x) \dots$$

Accounts well for collective behavior ("elliptic flow", etc)

What does it mean?

- Strong Coupling (AdS/CFT)?
- fast thermalization?
- Small systems?

Hydro applies even if mom[±] distribution is not isotropic

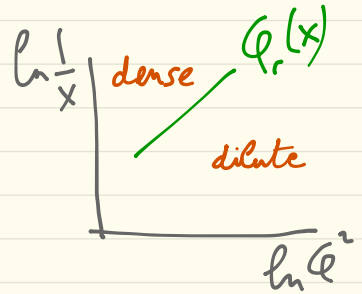
$$(P_L / P_T \gtrsim 0.5)$$

What is the fluid made of?

High gluon densities (CGC)

Saturation and Saturation momentum Q_s

$$Q_s^2 \sim \alpha_s \frac{x G(x, Q^2)}{\pi R^2}$$



Initially "matter" is mostly gluons, then quarks are produced.
(for strong color fields)

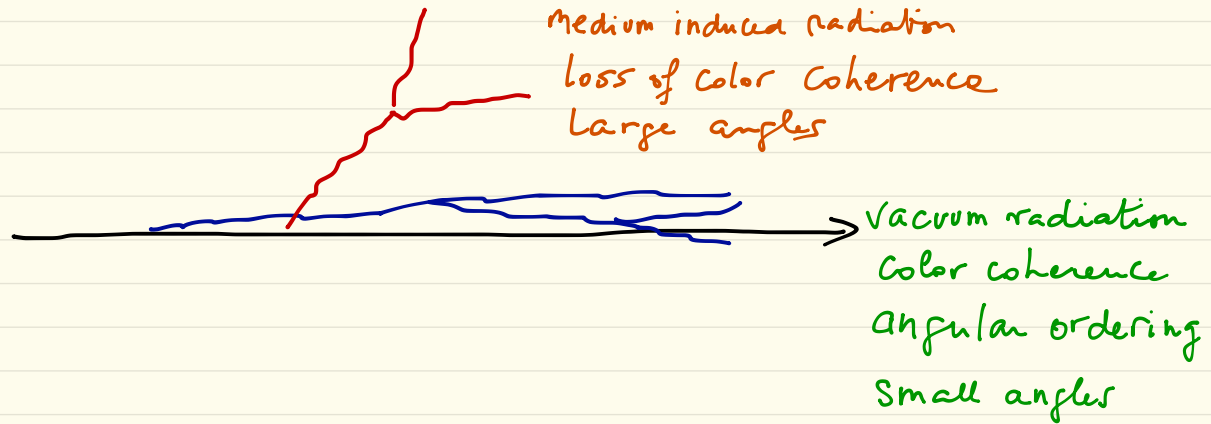
How does this system thermalize?

Do correlations present in initial 'Wave function'

Survive later stage of collisions (initial state effects)?

Jets in medium

Energy Loss - momentum broadening - \hat{Q}



Vacuum cascade and medium-induced cascade are very different

Turbulent flow in medium-induced cascade

Quarkonia in matter

Sensitive probe of deconfinement (?)

screened potential

collisions with plasma constituents

(\hookrightarrow complex potential)

color (de-) coherence

One needs a full dynamical treatment

Open quantum system (difficult!)

\hookrightarrow but quality of new data are

worth renewed theoretical effort



Conclusions

What is so interesting in heavy ion physics?

the variety of physics questions

fundamental issues beyond the "details"

Conclusions

What is so interesting in heavy ion physics?

What are the ^{main} questions that we are trying to answer?

perhaps no sharply defined questions

but general exploration of QCD in extreme environment

Many interesting issues raised by experiments

OFTEN ASKED QUESTIONS

What is so interesting in heavy ion physics?

What are the ^{main} questions that we are trying to answer?

Are we progressing towards our goals?

Definitely!

Albeit in a somewhat unexpected fashion!