QCD Evolution Workshop
May 14 -17, 2012
Jefferson Lab
Newport News, VA

Alexei Prokudin

INTRODUCTION

Jefferson Lab
EXPLORING THE NATURE OF MATTER

Welcome to QCD EVOLUTION workshop!

This is our
second workshop,
First one
JLab April 8-9, 2011
2 days, 35 participants,

2012:
4 days, 43 participants,
CEBAF building
room F 113

Program:
http://www.jlab.org/conferences/qcd2012/program.html

Jefferson Lab
EXPLORING THE NATURE OF MATTER

Organizing committee

Anatoly Radyushkin

Ian Balitsky

Leonard Gamberg

Harut Avakian

Alexei Prokudin

Organizing committee

Anatoly Radyushkin Ian Balitsky Leonard Gamberg

Harut Avakian Alexei Prokudin

+ support from

Jefferson Lab
EXPLORING THE NATURE OF MATTER

Small x

GPDs

TMDs

Experiment

Small x

GPDs

TMDs

Experiment

= idea of this meeting

http://www.merriam-webster.com/dictionary/evolution

EVOLUTION

noun \ˌe-və-ˈlü-shən

…
2: a process of continuous change from a lower, simpler, or worse to a higher, more complex, or better state
3: the process of working out or developing
…

Synonyms: development, expansion, growth, progress

Learn more about EVOLUTION!

What made you want to look up evolution?
Please tell us where you read or heard it
(including the quote, if possible).

http://www.merriam-webster.com/dictionary/evolution

EVOLUTION

noun \ˌe-və-ˈlü-shən

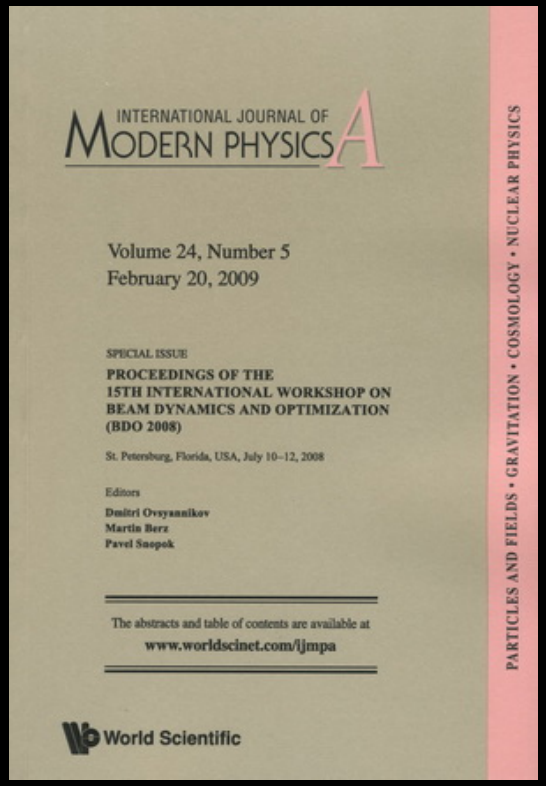
…
2: a process of continuous change from a lower, simpler, or worse to a higher, more complex, or better state
3: the process of working out or developing
4: a workshop
…

Synonyms: development, expansion, growth, progress

Learn more about EVOLUTION!

What made you want to look up evolution?
Please tell us where you read or heard it
(including the quote, if possible).

Proceedings



We will send you info soon about

Internet access

JLAB_GUEST

Password is in your folder!

Use WPA2 Personal

Internet access

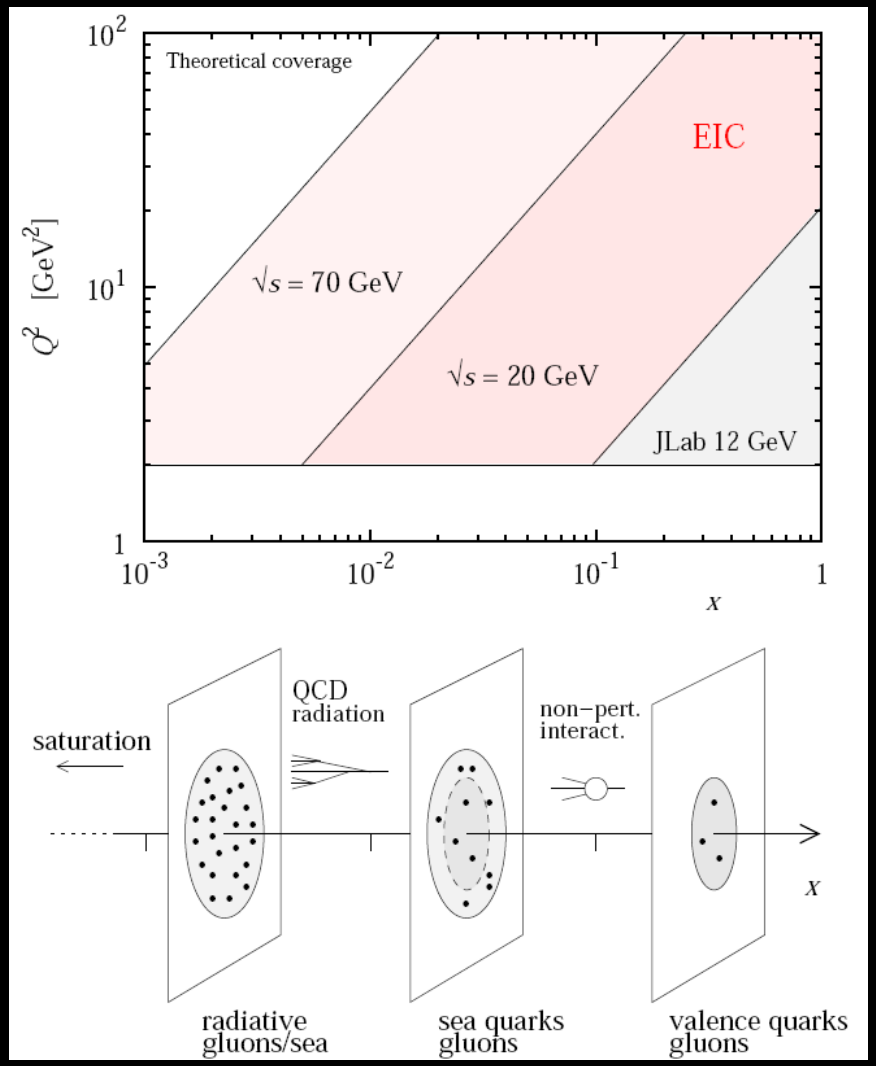
JLAB_GUEST

Password is in your folder!

Use WPA2 Personal

Dont use it too much –
we are here for a workshop!

PHYSICS



Plot courtesy of Christian Weiss

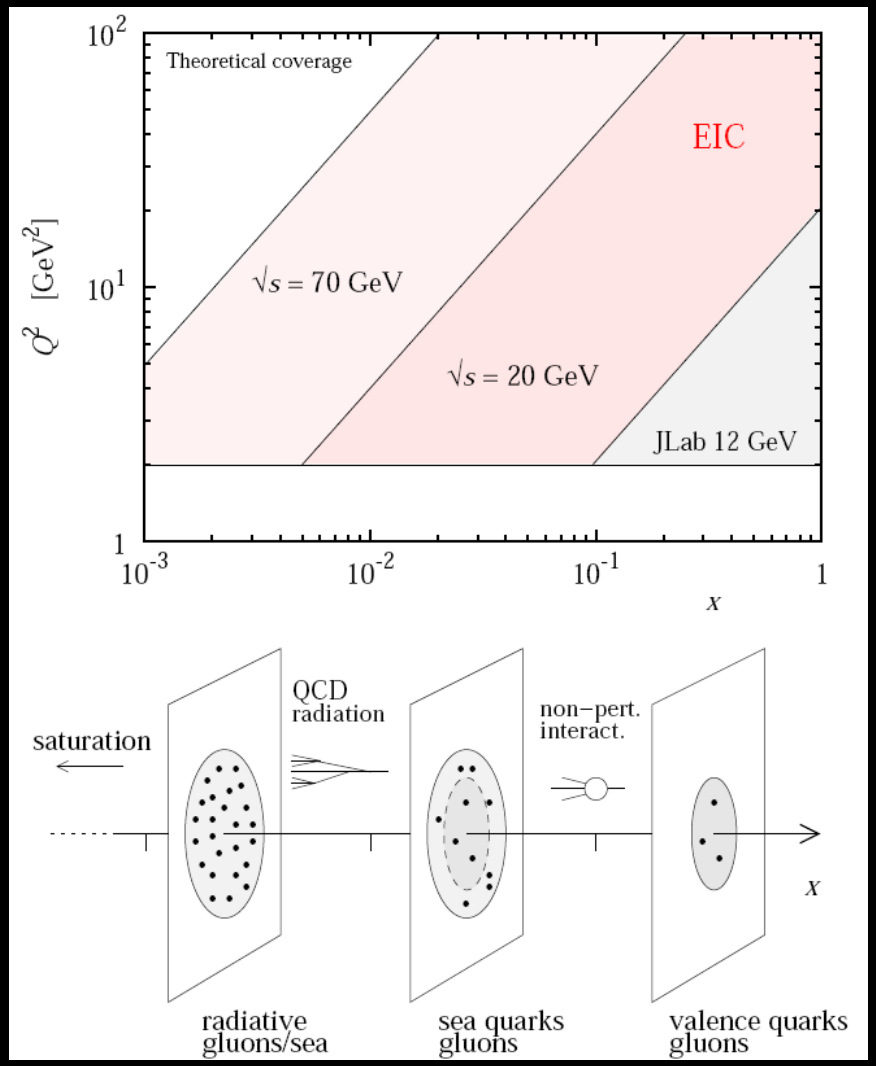
Nucleon is a many body dynamical system of quarks and gluons

Changing x we probe different aspects of nucleon wave function

How parton densities evolve with resolution scale. What about multy parton correlations?

What happens at small x? Saturation of parton densities

How partons move and how they are distributed in space is one of the future directions of development of nuclear physics. Technically such information is encoded into Generalised Parton Distributions and Transverse Momentum Dependent distributions



Plot courtesy of Christian Weiss

Which experimental facilities do we need?

JLab 12 is going to explore valence region

Electron Ion Collider complements JLab 12 and existing fixed target experiments COMPASS, HERMES and explores sea quark region

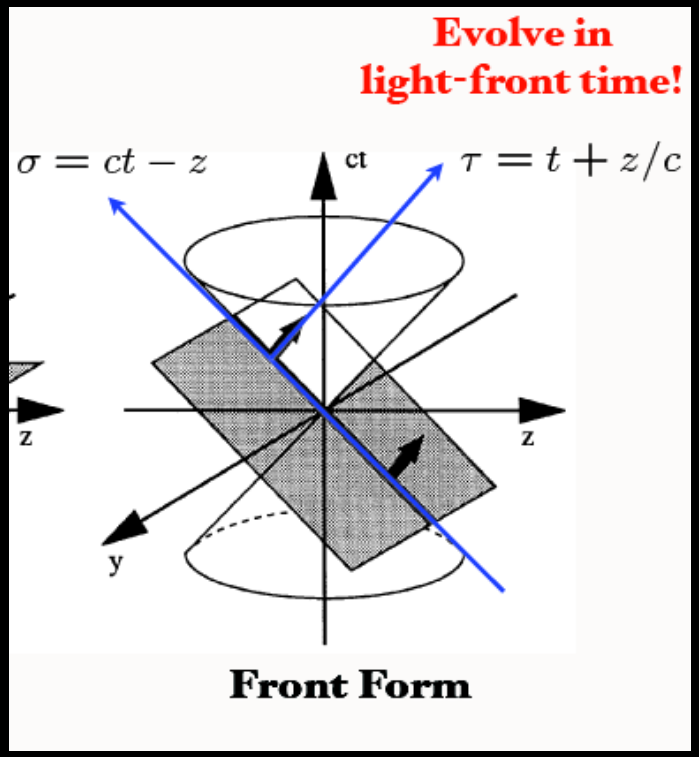
Talks by J.P.Chen,
Marco Contalbrigo,
Anna Martin,
Anselm Vossen,
Elke Aschenauer,
Pawel Nadel-Turonski

Role of RHIC, e+e- colliders
LHeC can explore small-x region

What language do we use?

What language do we use?

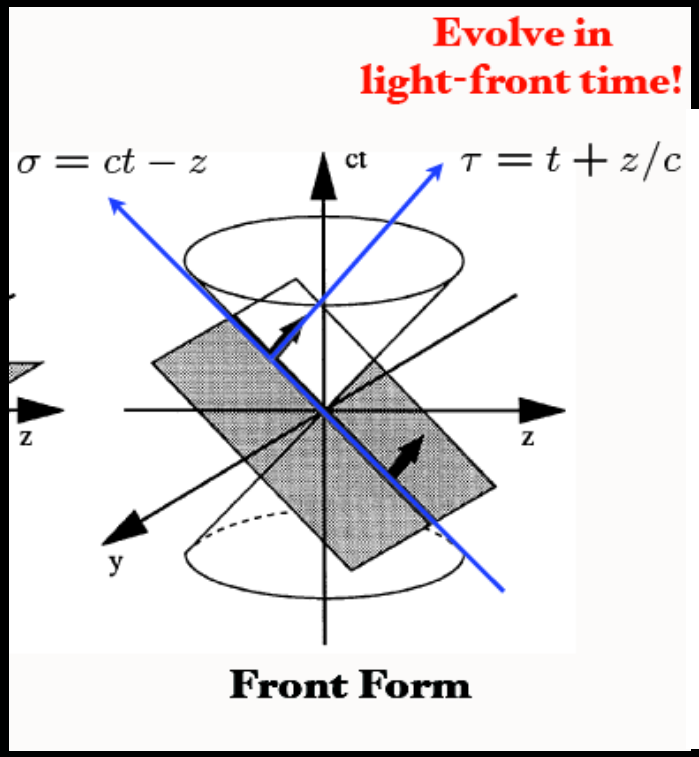
Stan Brodsky

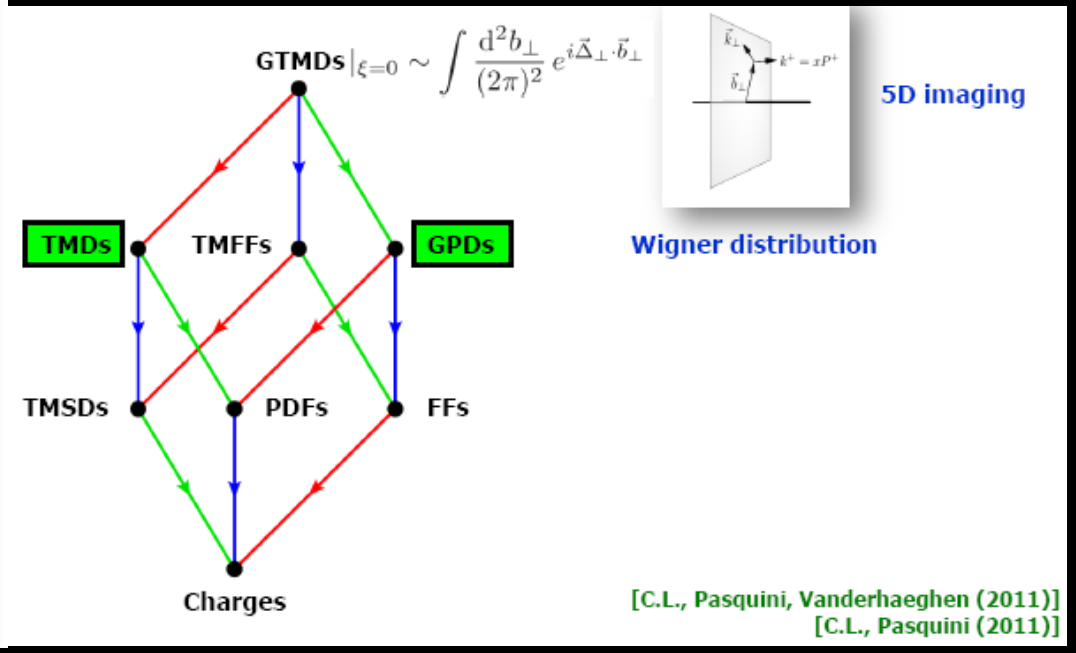


What language do we use?

Stan Brodsky

Light Front Wave Function + Lensing → Wigner function

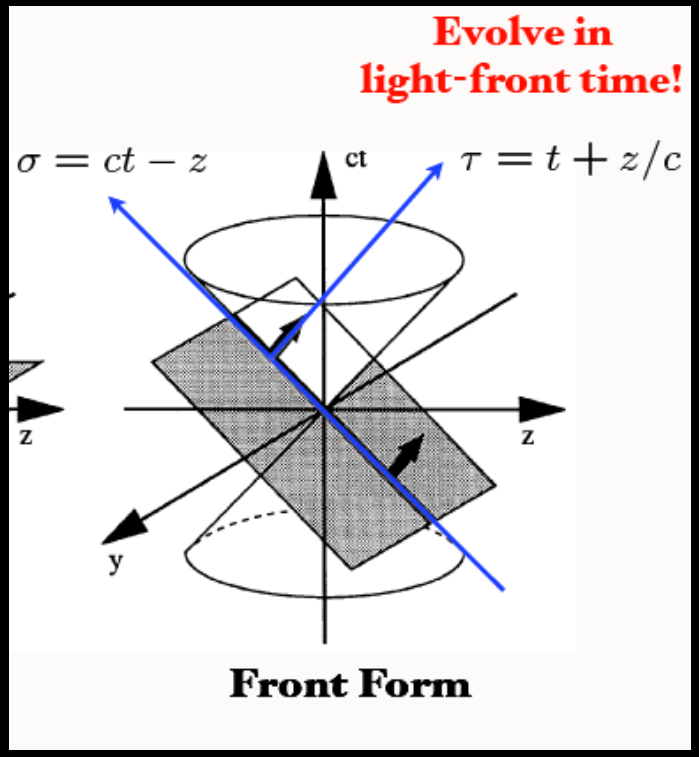




Cedric Lorce, Matthias Burkardt, Simonetta Liuti, Anatoly Radyushkin, Gary Goldstein

What reference frame do we use?

Infinite Momentum Frame?
For GPDs TMDs



Target Rest Frame?
More appropriate for
physical interpretation?

Christian Weiss

What kinematical limit do we use?

Bjorken limit

$$Q^2 \to \infty \, , s \to \infty$$

$$x_B \propto \frac{Q^2}{s} \to const$$

DGLAP

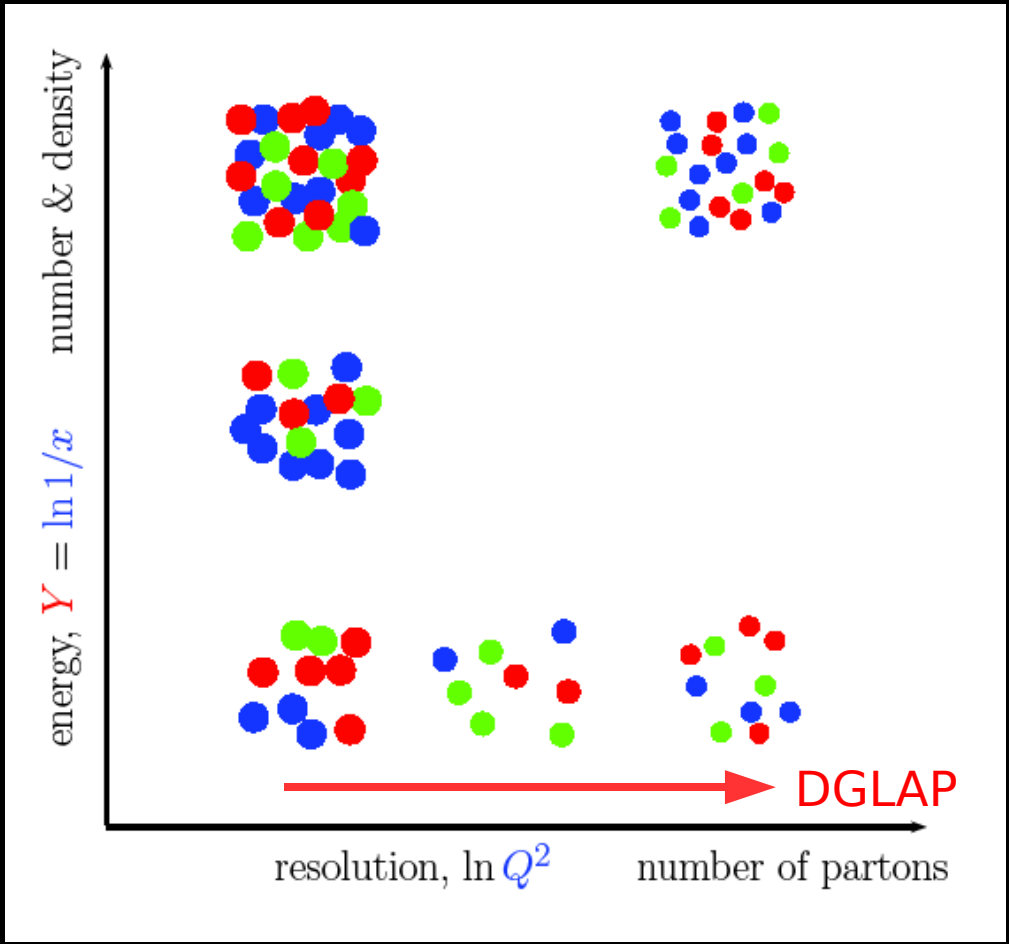
Regge limit

$$Q^2 fixed \, , s \to \infty$$

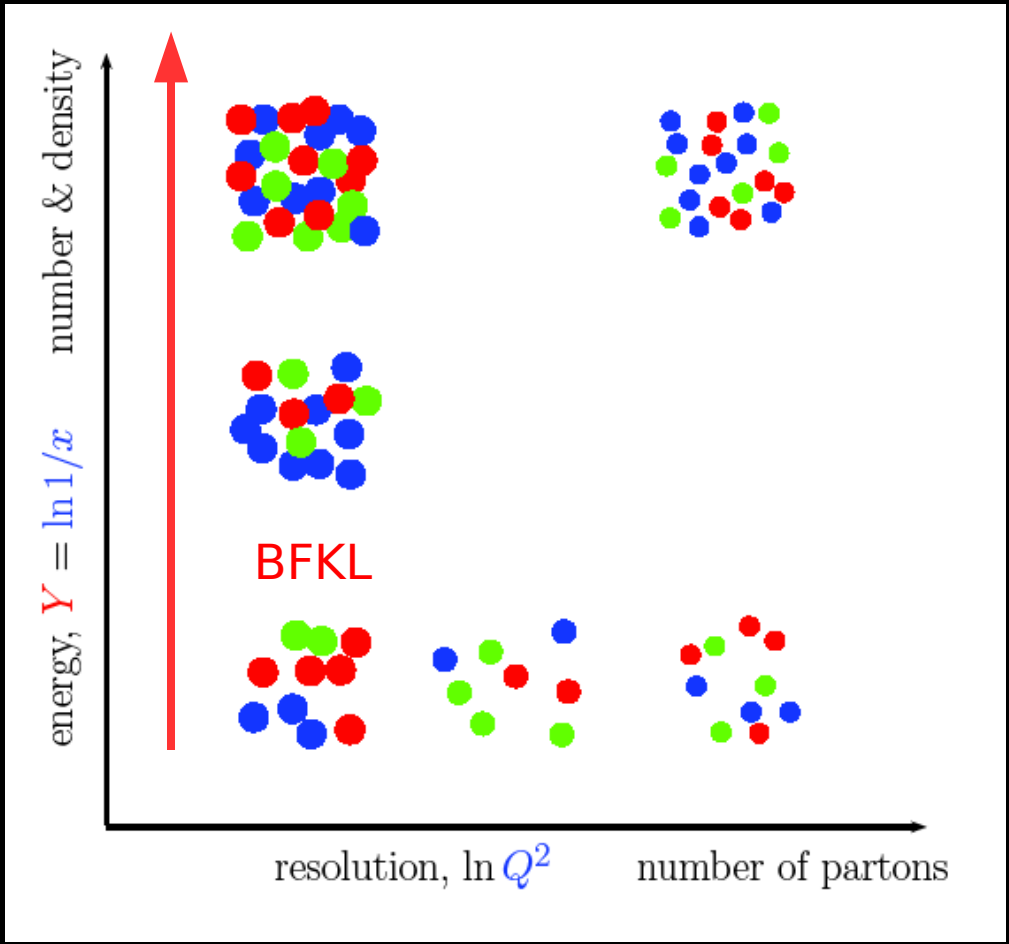
$$x_B \propto \frac{Q^2}{s} \to 0$$

BFKL

What kinematical limit do we use?

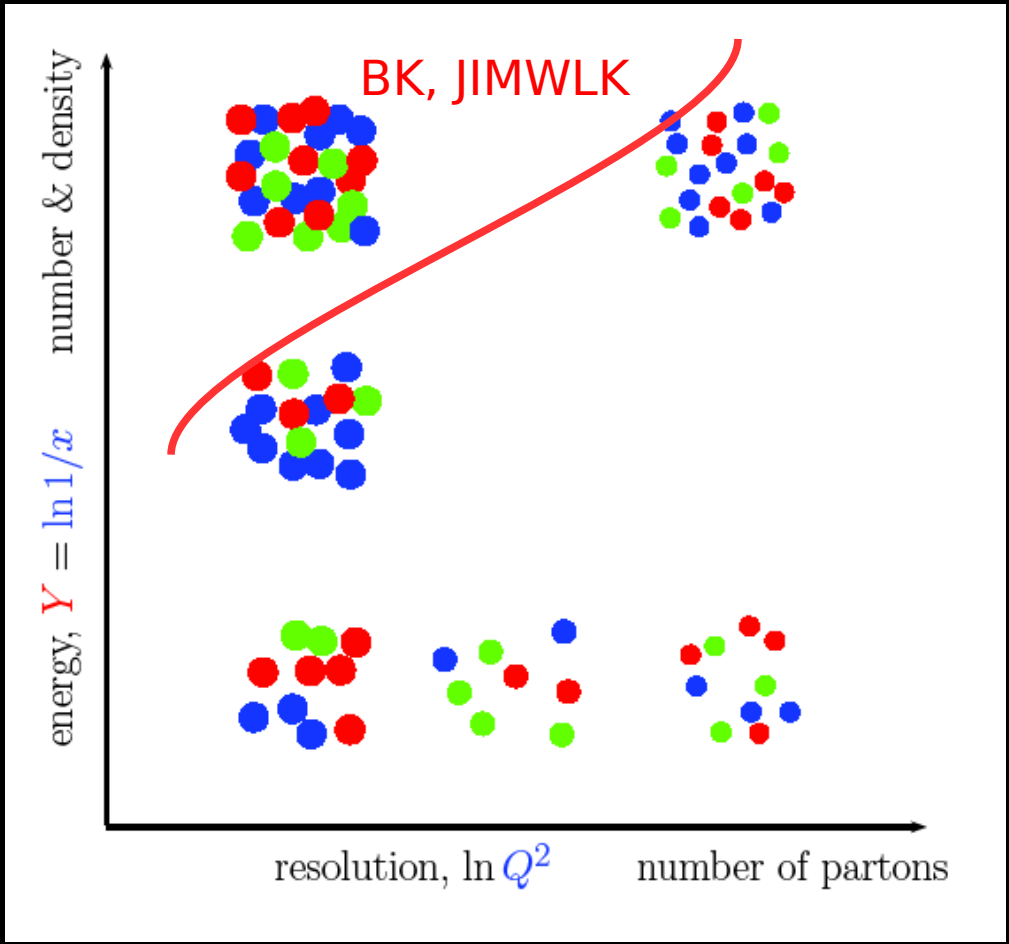


What kinematical limit do we use?



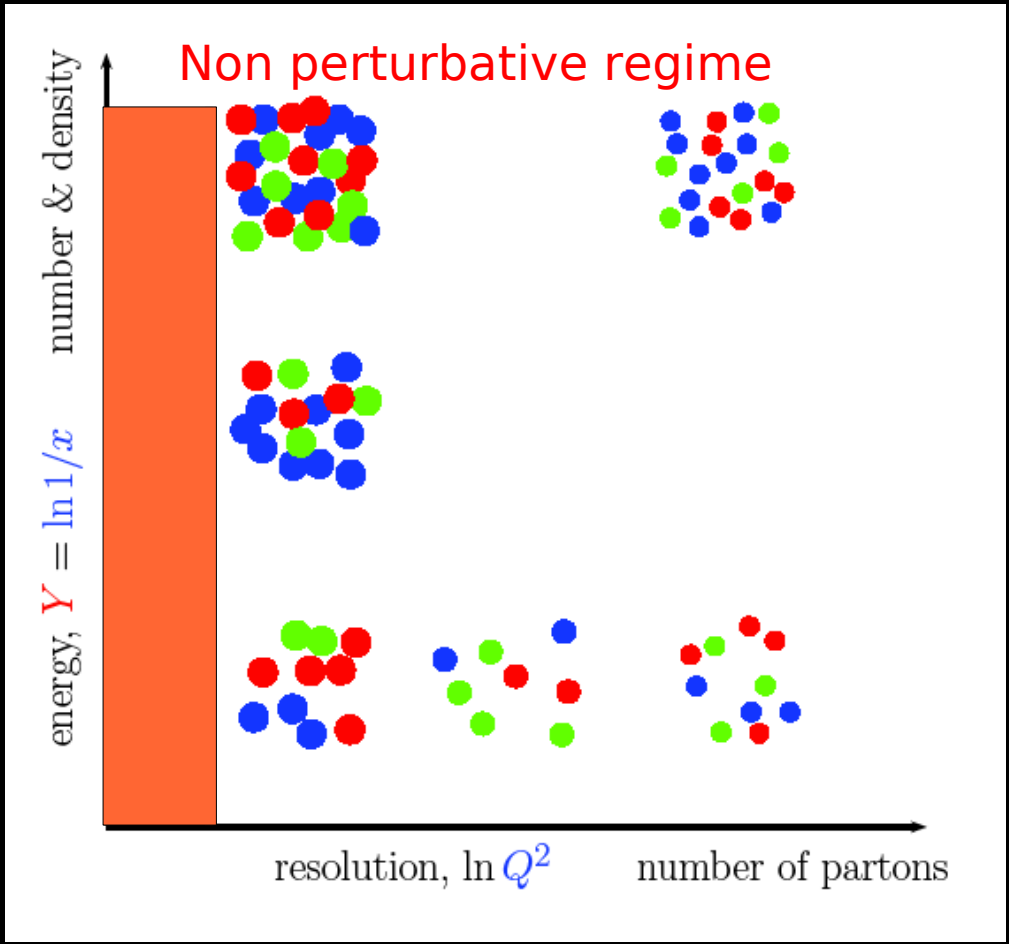
What kinematical limit do we use?

Non linear regime Balitsky, Kovchegov, Jalilian-Marian, Chirilli



What kinematical limit do we use?

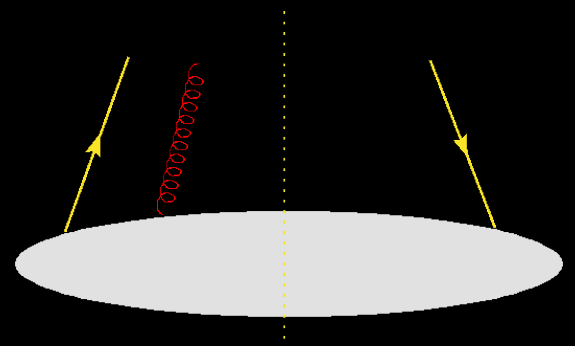
Non perturbative regime Weiss, Courtoy



What definition we use?

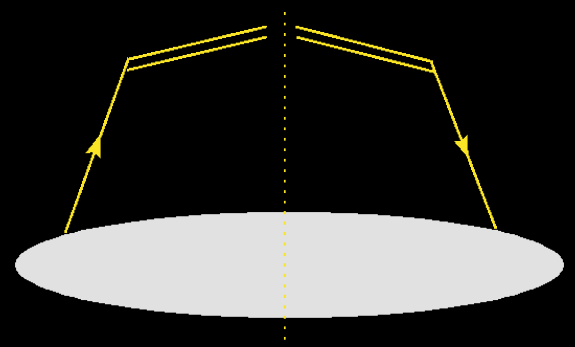
Multy-parton correlators $T_F(x, y)$

Qiu, Kang, Metz, Guzzi



TMD correlators $\Phi(x, k_\perp)$

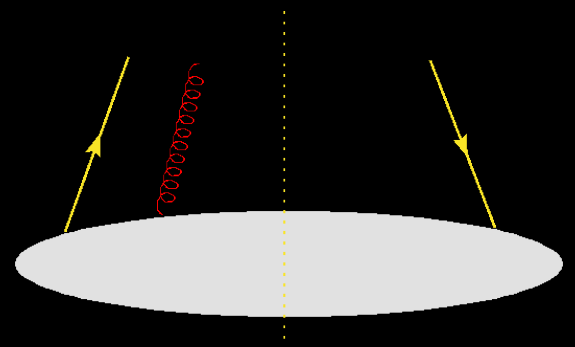
Qiu, Cherednikov, Idilbi, Scimemi, Mulders, Buffing, Mukherjee, Pitonyak, Melis



How they evolve?

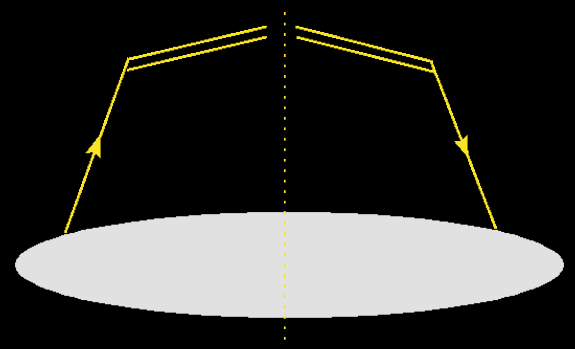
Multy-parton correlators $T_F(x, y)$

Qiu, Kang



TMD correlators $\Phi(x, k_\perp)$

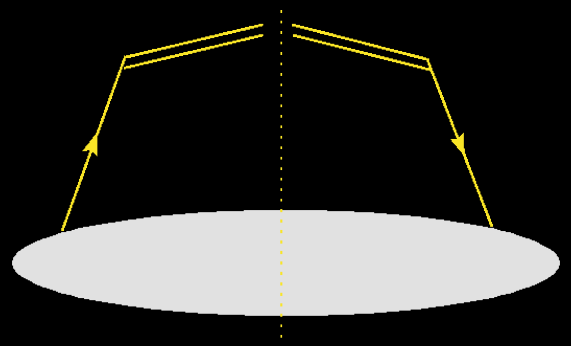
Qiu, Cherednikov, Idilbi, Scimemi, Mulders, Melis



Dicussion on Tuesday:
16:50 -17:30
Think about your contribution!

How we calculate them?

TMD correlators on lattice $\Phi(x, k_\perp)$ Engelhardt



What about nuclei? Xiao, Chirilli

What is our future? JLAB12 J.P. Chen,

EIC Aschenauer, Nadel-Turonski

The goal of the workshop:

? → !