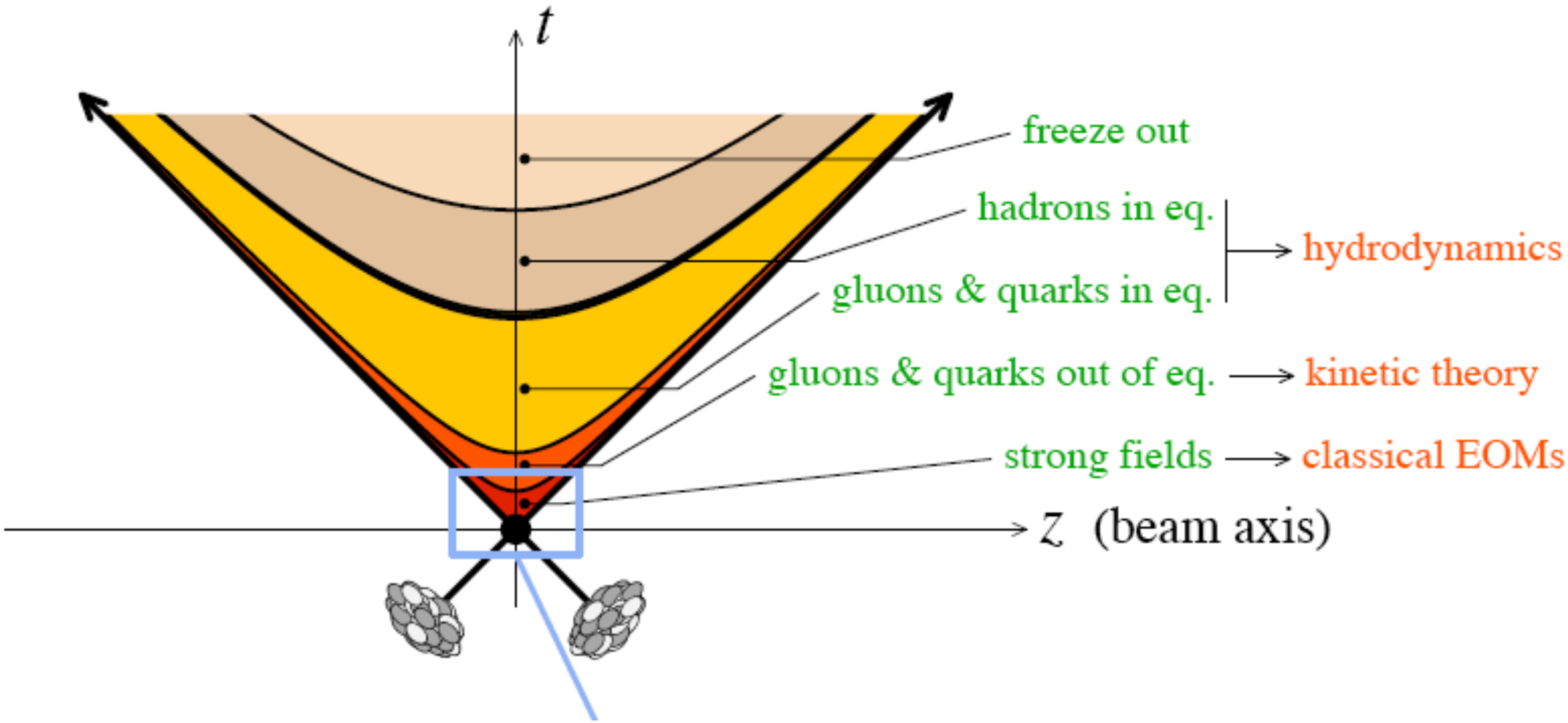
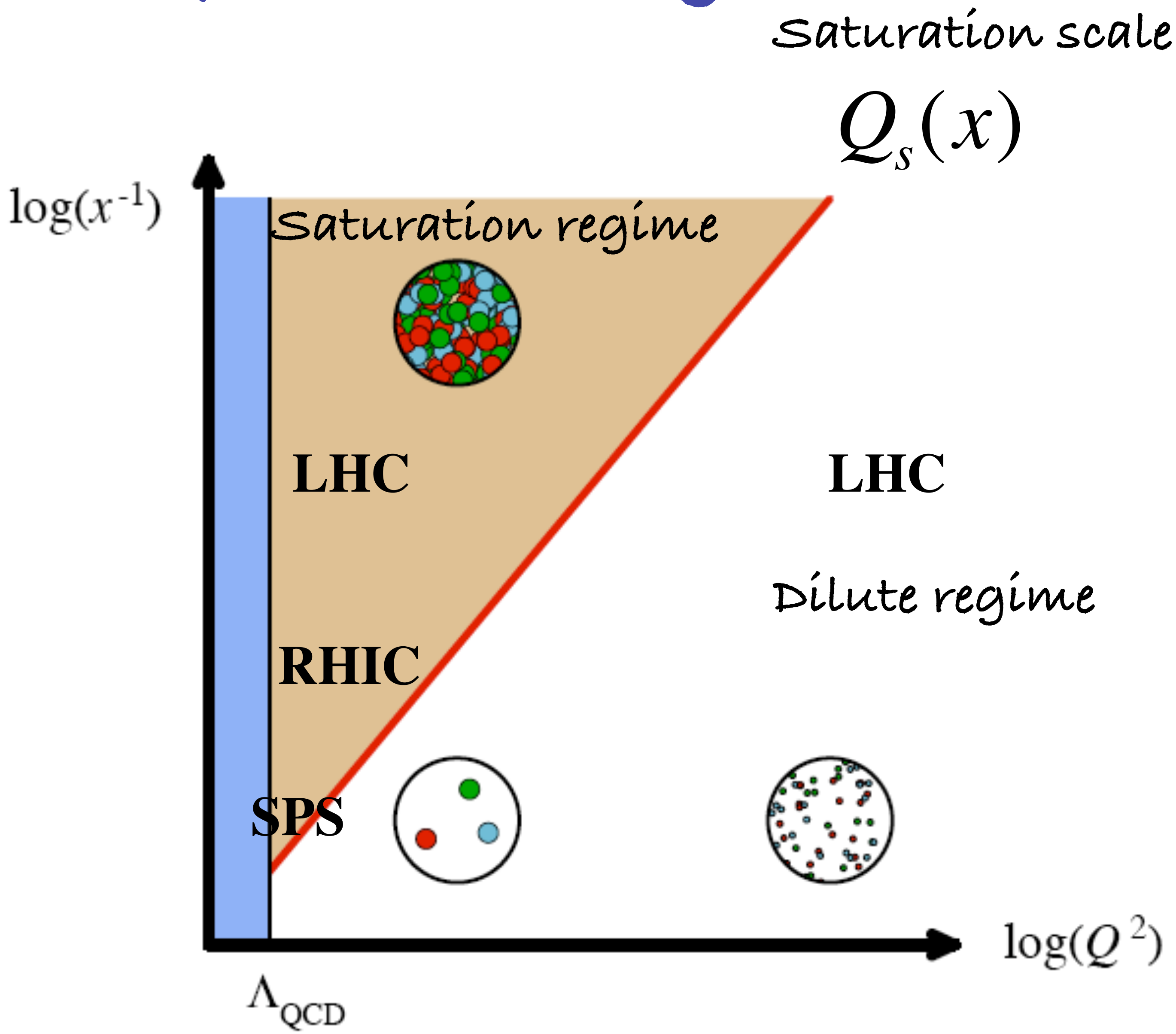
The LHC and the physics of high density QCD



Initial conditions are crucial. At high energy the wfs involve large parton densities

High parton density at small x



The saturation scale Q_s

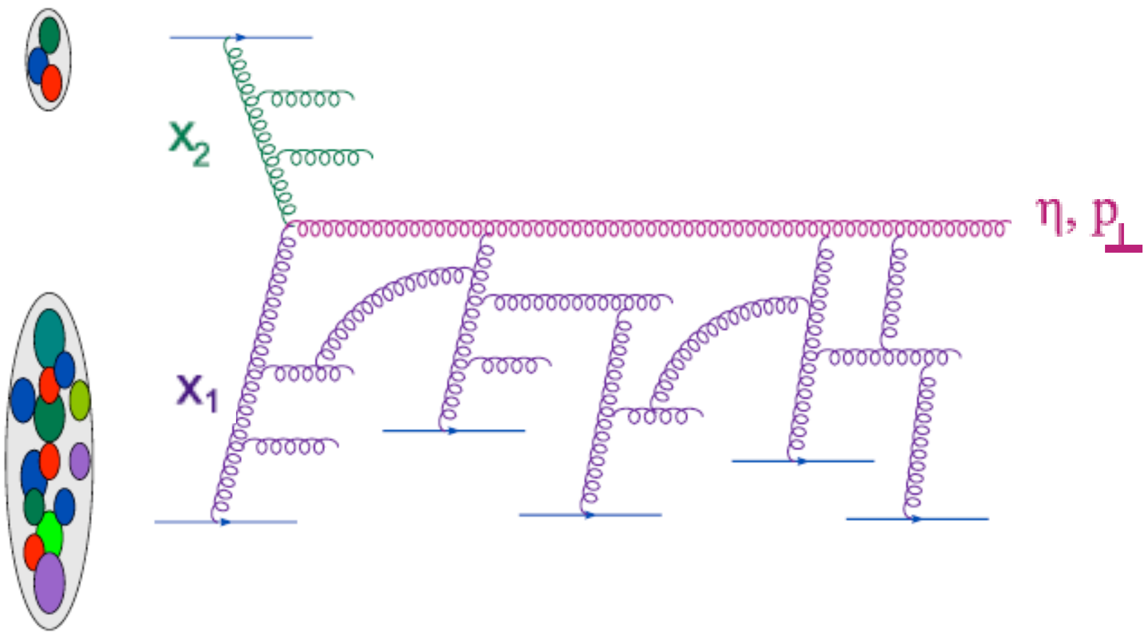
$$Q_s^2 \sim \frac{\alpha_s x G_A(x, Q_s^2)}{\pi R_A^2} \sim A^{1/3} \frac{1}{x^{0.3}}$$

RHIC $Q_s \approx 1.2$ **[GeV]**

LHC $1.6 \le Q_s \le 1.9$ (T. Lappi)

The saturation scale plays an important role in the phenomenology of HI reactions : most produced Partons have $p_T \approx Q_s$

Playing with the kinematics to get lower x



$$x_1 = \frac{p_\perp}{\sqrt{s}}\, e^{-\eta}\,, \qquad x_2 = \frac{p_\perp}{\sqrt{s}}\, e^{\eta}$$

- Increasing $\eta \iff$ Decreasing x_1 for the nucleus
  - RHIC: $\eta \simeq 3$ & $\sqrt{s} = 200\,\text{GeV}$: $x_1 \sim 10^{-4}$ for $p_\perp = 2\,\text{GeV}$
  - LHC : $\eta \simeq 6$ & $\sqrt{s} = 8.8\,\text{TeV}$: $x_1 \sim 10^{-6}$ for $p_\perp = 10\,\text{GeV}$

Major theoretical progress in the last decade:

Non linear evolution equations (BK and JIMWLK eqs) and the Color glass condensate

Much remains to be understood

- effect of fluctuations
- effect of running coupling constant
- multigluon correlations
- etc

Interesting proposals to reach large Qs at the LHC, In pp (and pA) using Mueller-Navelet jets

(Iancu and Triantafyllopoulos)