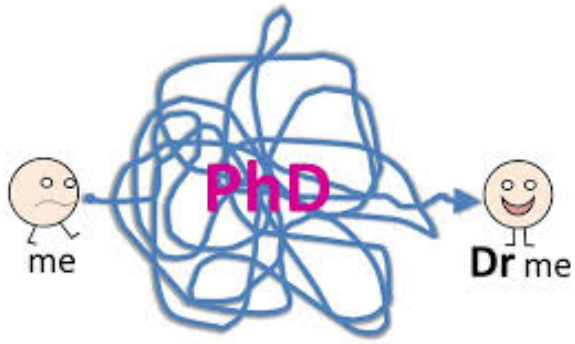
Centre de Physique Théorique

2018 Ph.D. day

CPhT - Polytechnique

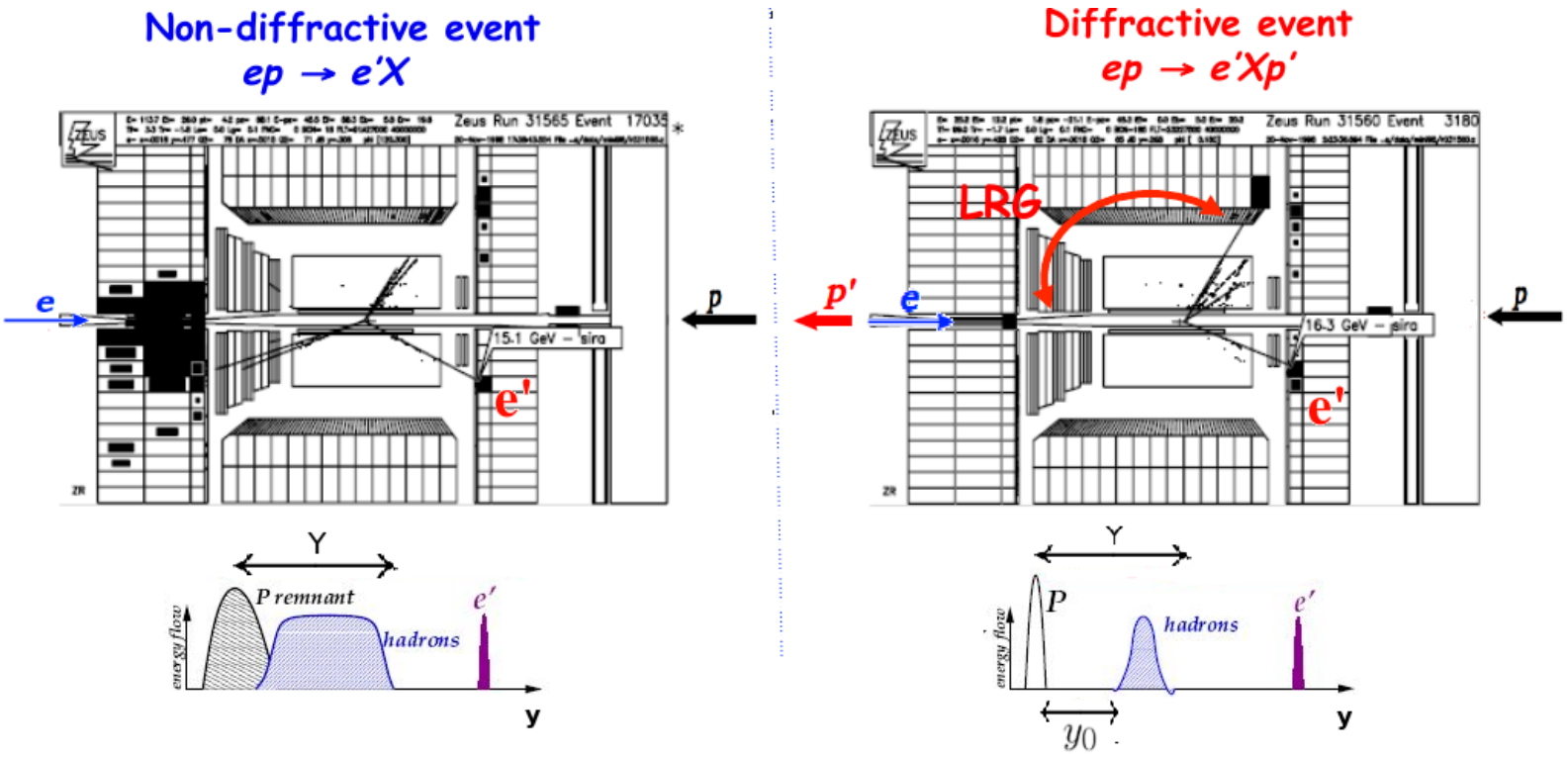
General information

- **Name**: LE Anh Dung
- **Status**: 1st year!
- **Group**: Particle Physics - CPhT
- **Advisor**: M. Stéphane Munier



- **Thesis title**: QCD at high energy and high density: theory, links with statistical physics problems, and phenomenology
  - ✓ Theory: better understanding of the nonlinear equations which emerge from QCD in the high-energy/high-density regime.
  - ✓ Phenomenology: search and formulation of relevant observables in view of comparing with the current LHC (and promising future EIC) data.

Diffractive dissociation in DIS (DDIS)

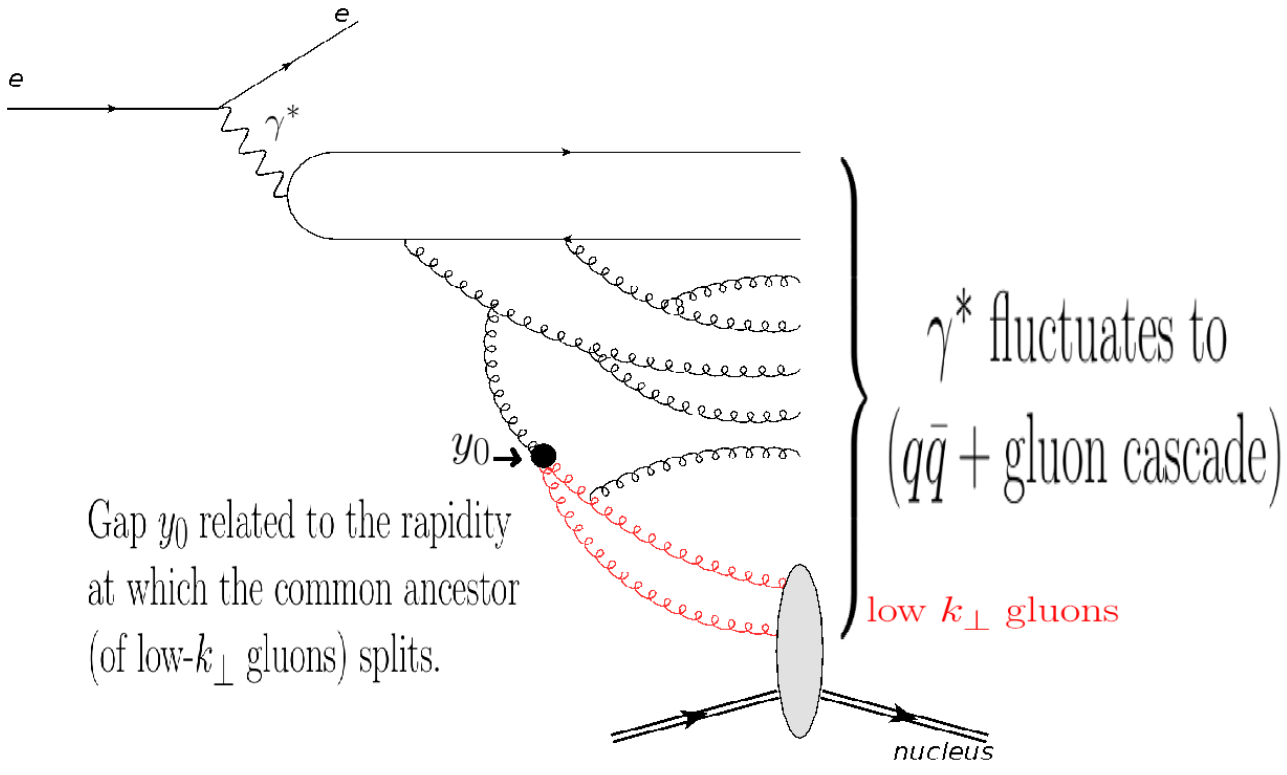


ZEUS experiment (HERA - DESY)

(LRG: Large Rapidity Gap)

- Diffractive events characterised by an angular sector around scattered proton in which NO particles were seen $\equiv$ rapidity gap y_0 ($0 \leq y_0 \leq Y$, Y fixed).
- Problem of interest: **event-by-event distribution of rapidity gap** y_0.

Mechanism for DDIS



Low-$k_\perp$ gluons which interact with target are produced at rapidity $y_0 \rightarrow$ leaving a gap y_0

DDIS: Kovchegov - Levin equation

- $S(y)$: S-matrix element of the forward onium $(q\bar{q})$ - nucleus scattering.
- $S_2(\tilde{y})$: S-matrix-like function $\sim$ probability of having a gap $\geq y_0$

  $(\tilde{y} = y - y_0)$

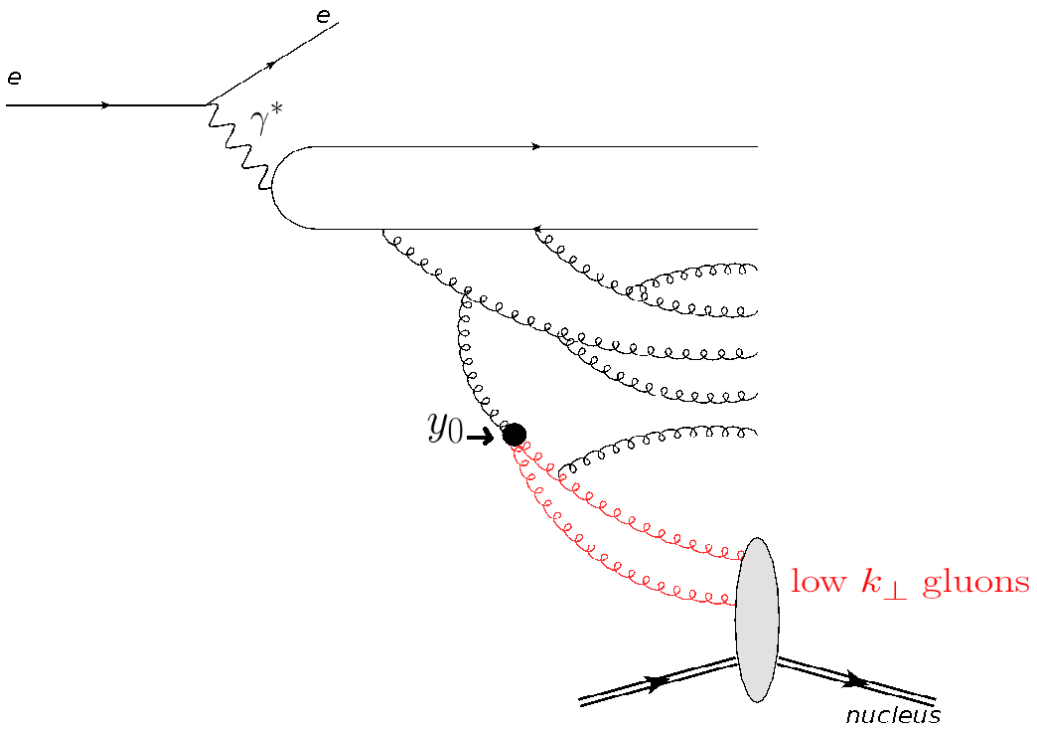
The Kovchegov - Levin (KL) set of equations for distribution of y_0:

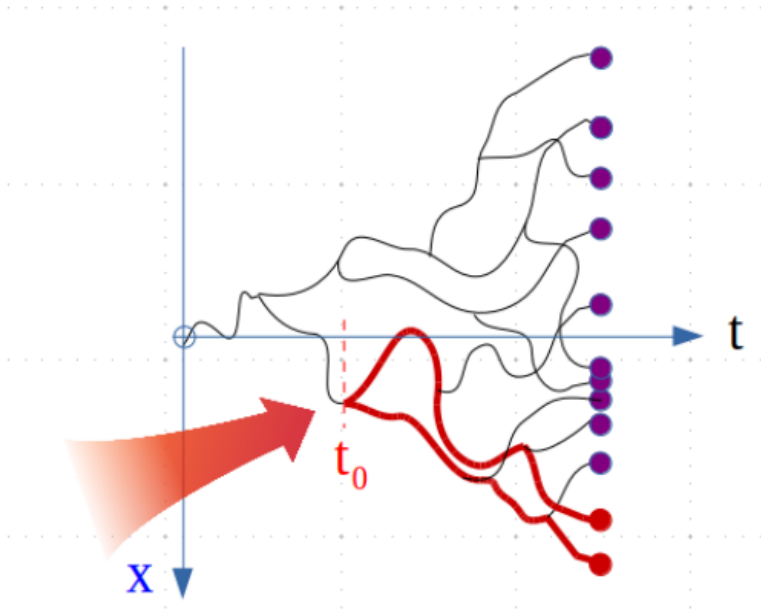
$$\partial_{\tilde{y}} S_2 \propto (S_2 \otimes S_2) - S_2, \quad S_2(\tilde{y} = 0) = [S(y_0)]^2$$

$$\partial_y S \propto (S \otimes S) - S$$

$\Rightarrow$ analytical solution: BIG challenge!!

DDIS and parton genealogy





$$\frac{1}{\sigma_{tot}}\frac{d\sigma_{diff}}{dy_0} = \text{const} \times \left[\frac{\mathrm{Y}}{\mathrm{y_0}(\mathrm{Y}-\mathrm{y_0})}\right]^{3/2}$$

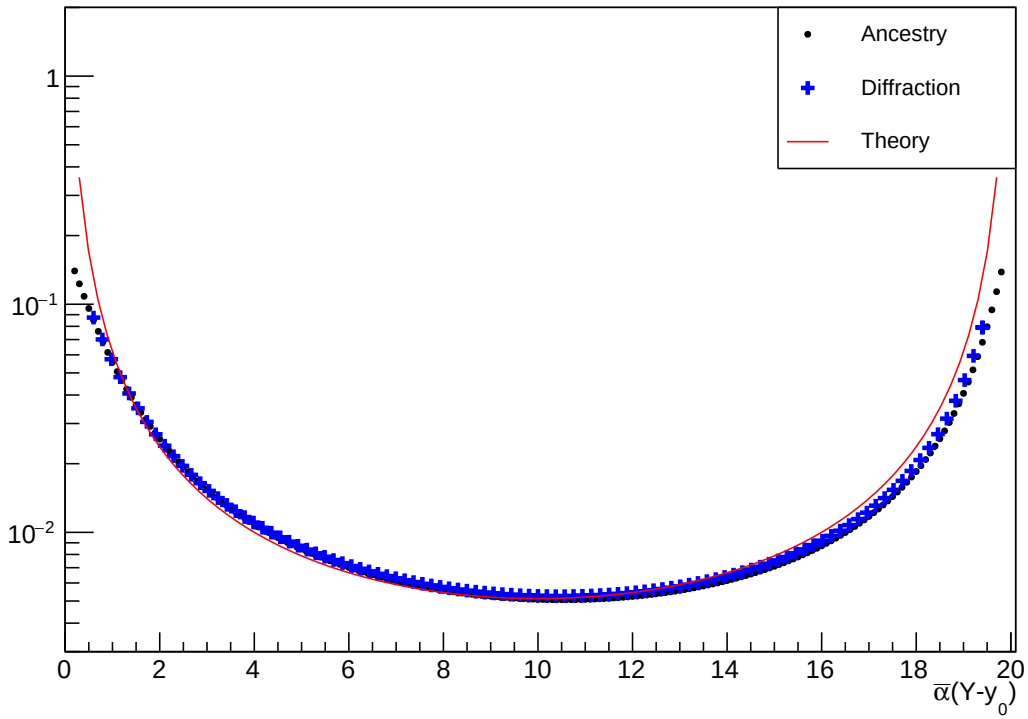
[A. Mueller & S. Munier (2018)]
(Diffraction, asymptotic)

$$P(t_0|t) = \frac{1}{\sqrt{4\pi}}\left[\frac{t}{t_0(t-t_0)}\right]^{3/2}$$

[B. Derrida & P. Mottishow (2016)]
(1D Branching random walks, asymptotic)

DDIS and parton genealogy

Numerical solutions of diffraction (KL eqs.) and ancestry problem



Theory:

$$p(y_0|Y) = const \times \left[\frac{Y}{y_0(Y-y_0)}\right]^{3/2}$$

Prospective works (on diffraction)

- ✓ Determination of "const"
- ✓ Estimation of sub-asymptotic (low Y) corrections
- ✓ Phenomenology for a future electron - ion collider
- ✓ Extension to diffractive proton - nucleus scattering (LHC)