Study of Diffractive Scattering at the LHC

Alexander Lind

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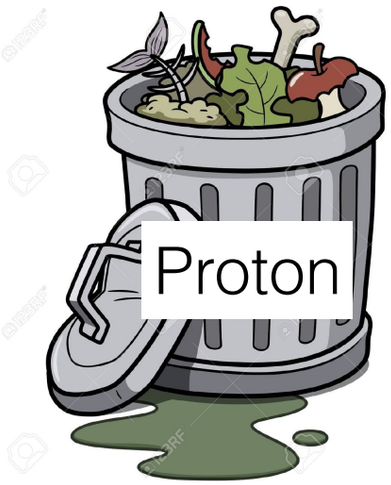
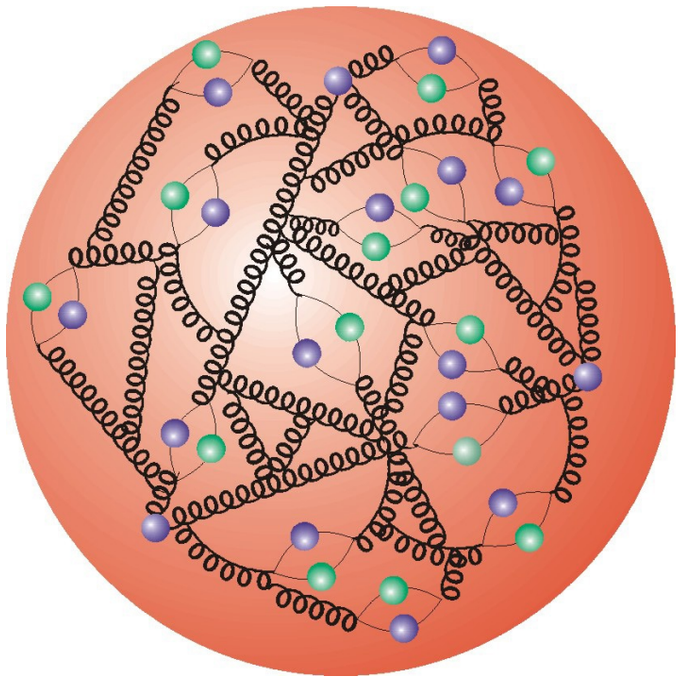
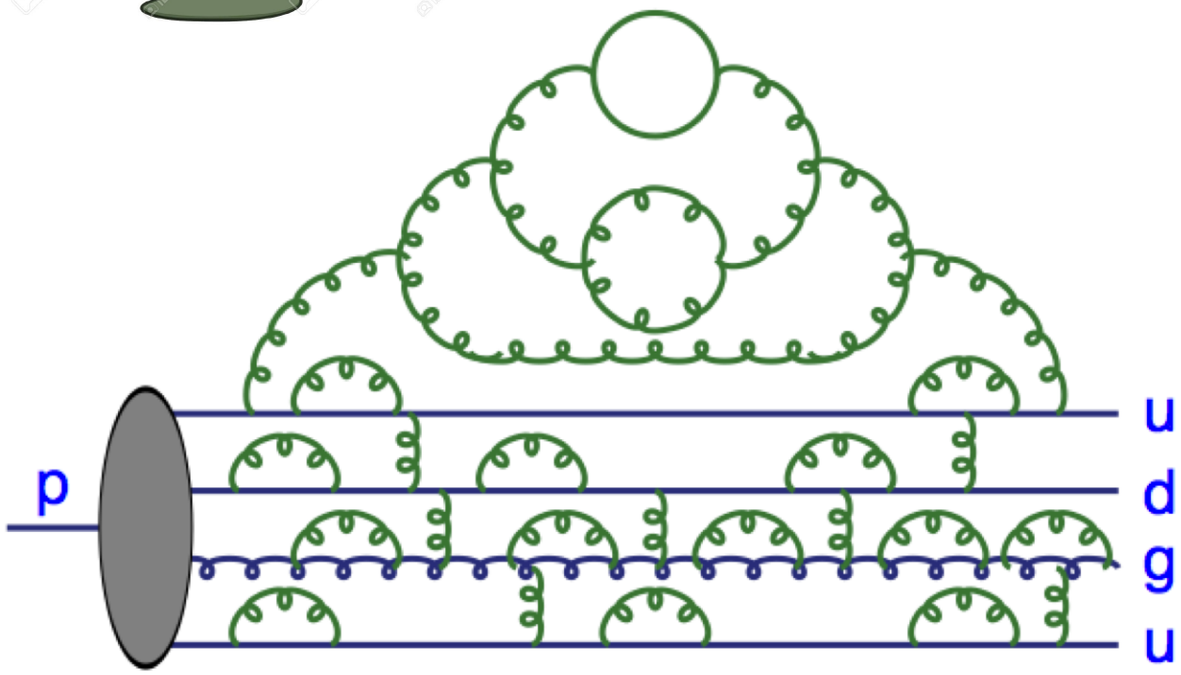
The Proton

Hadrons are composite objects with a time-dependent structure



Curious Particle Physicist





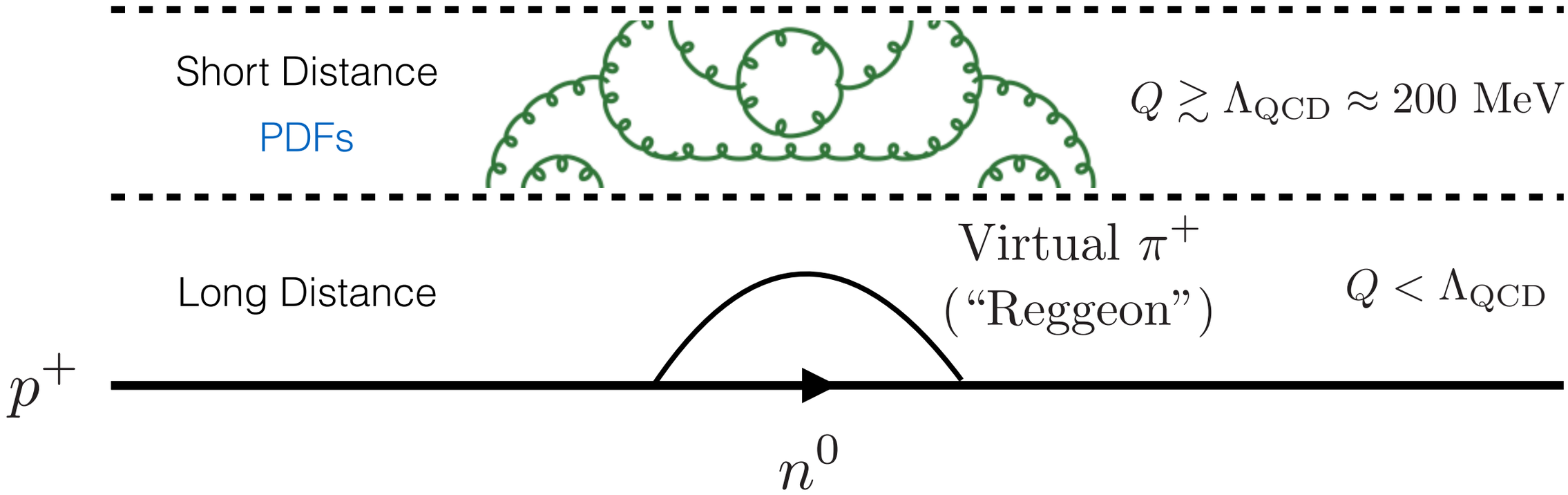
Parton distribution function (PDF):

$f_i(x, Q^2)$ = number density of partons i at momentum fraction x and probing scale Q^2

Reggeons and Pomerons

A proton minding its own business…

…can for a short (virtual) while
emit a Reggeon…

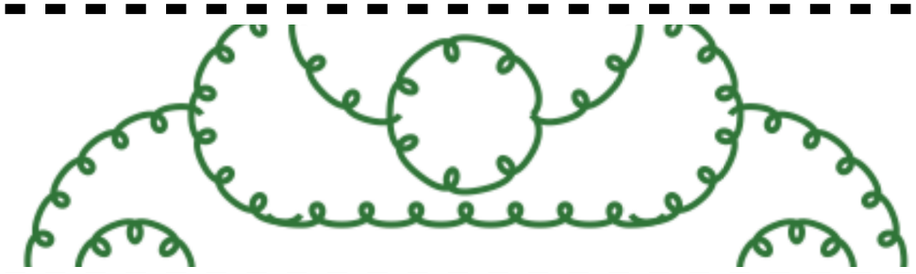


Reggeons and Pomerons

…or emit a **Pomeron**,
a hypothetical glue-ball state with
the quantum numbers of the vacuum

Short Distance

PDFs



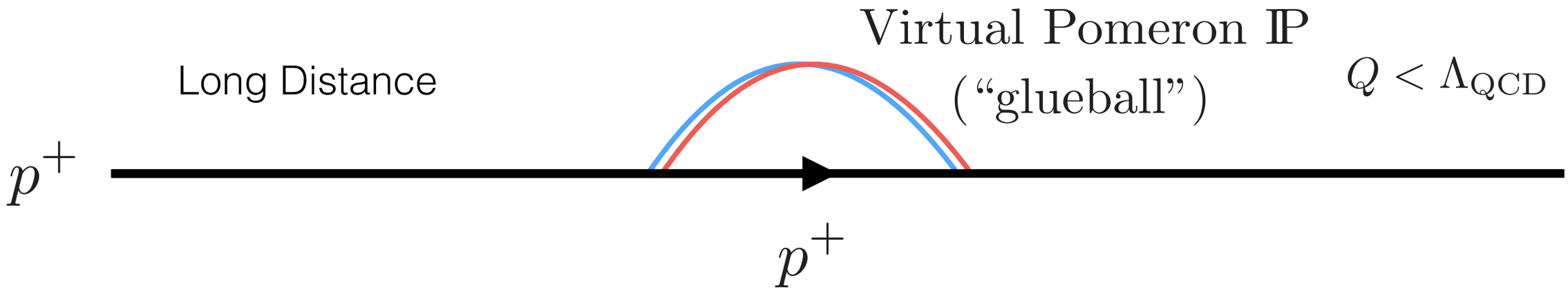
$Q \gtrsim \Lambda_{\mathrm{QCD}} \approx 200\ \mathrm{MeV}$

Long Distance

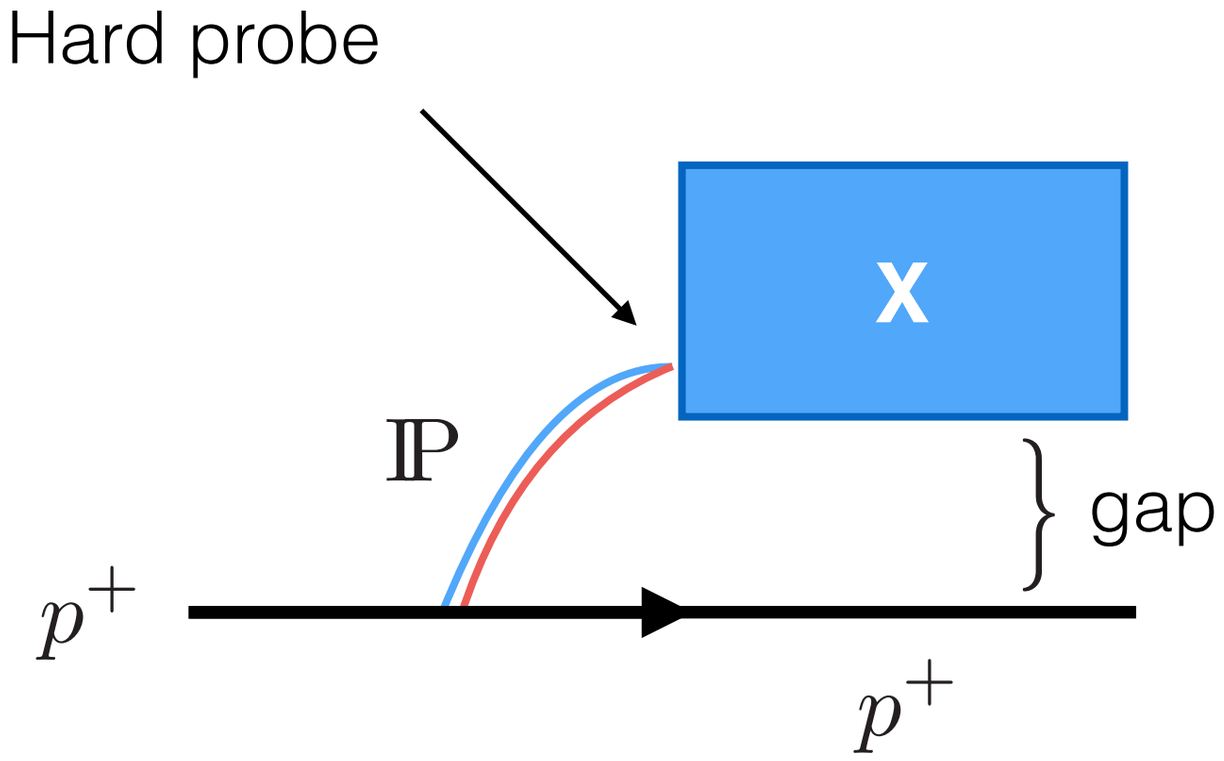
Virtual Pomeron $\mathbb{P}$

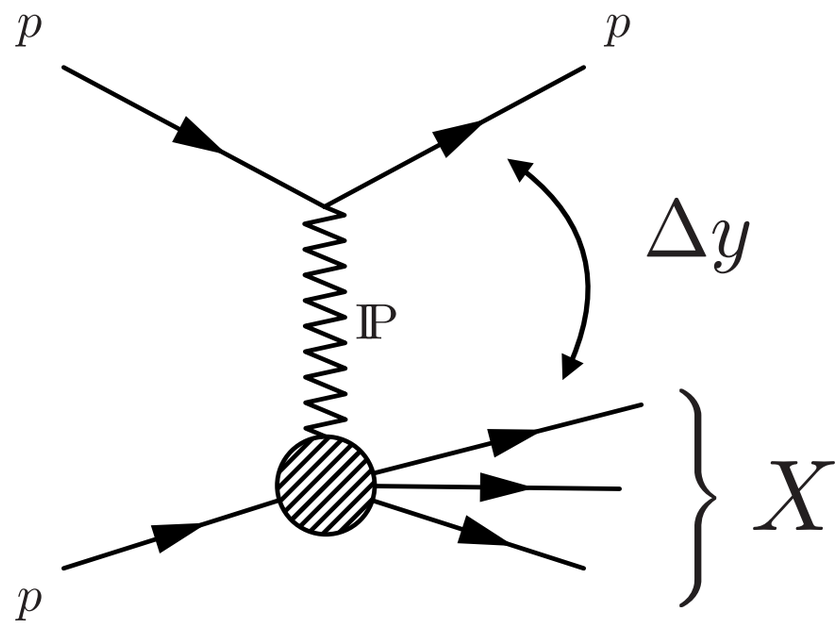
("glueball")

$Q < \Lambda_{\mathrm{QCD}}$



Diffractive Events





Not physical to ask whether there was an (unmeasurable) Pomeron

Physical to ask if there was a large rapidity gap

Hard Diffraction

Single Diffractive Cross-section using Factorization:

$$\frac{\mathrm{d}\sigma_{\mathrm{SD}}}{\mathrm{d}\xi \mathrm{d}t} = \underbrace{f_{\mathbb{P}/p}(\xi, t)}\sigma_{\mathbb{P}/p}$$

Pomeron Flux Factor

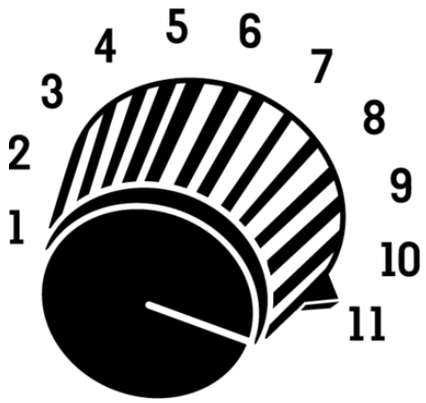
We don’t know the exact Pomeron flux
(can’t calculate it from first principles)
But we can phenomenologically model it

Pomeron Flux Parameters

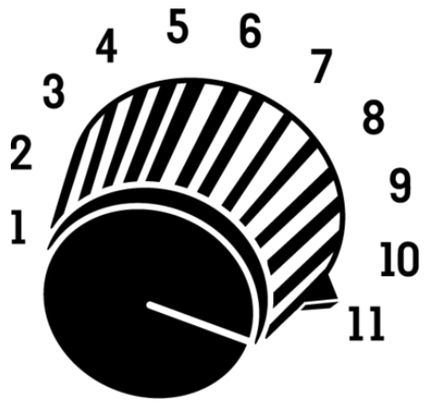
The Pomeron Flux depends on
the Regge trajectory for the Pomeron

$$\alpha(t) = 1 + \varepsilon + \alpha' t$$

The Monte Carlo Event Generator **Pythia** allows us to
simulate diffractive pp collisions



ε

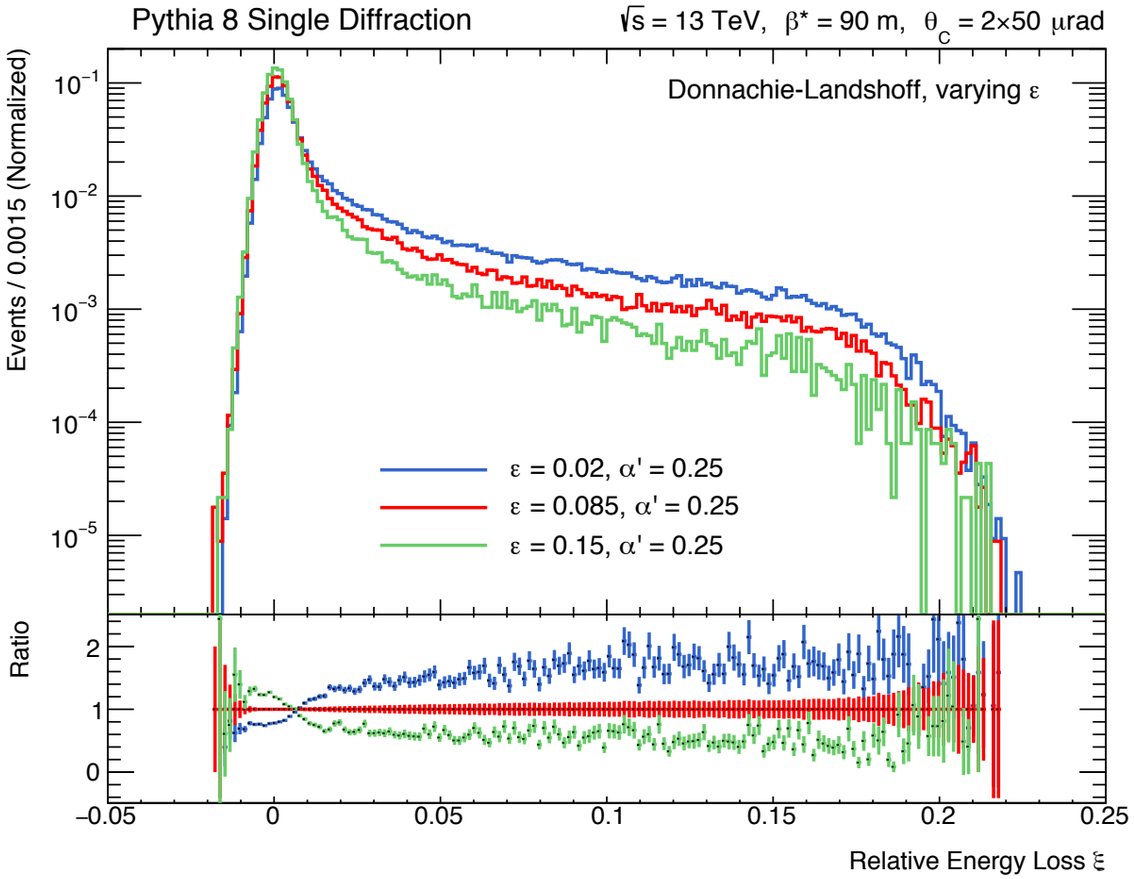


α'

Sensitivity to Model Parameters

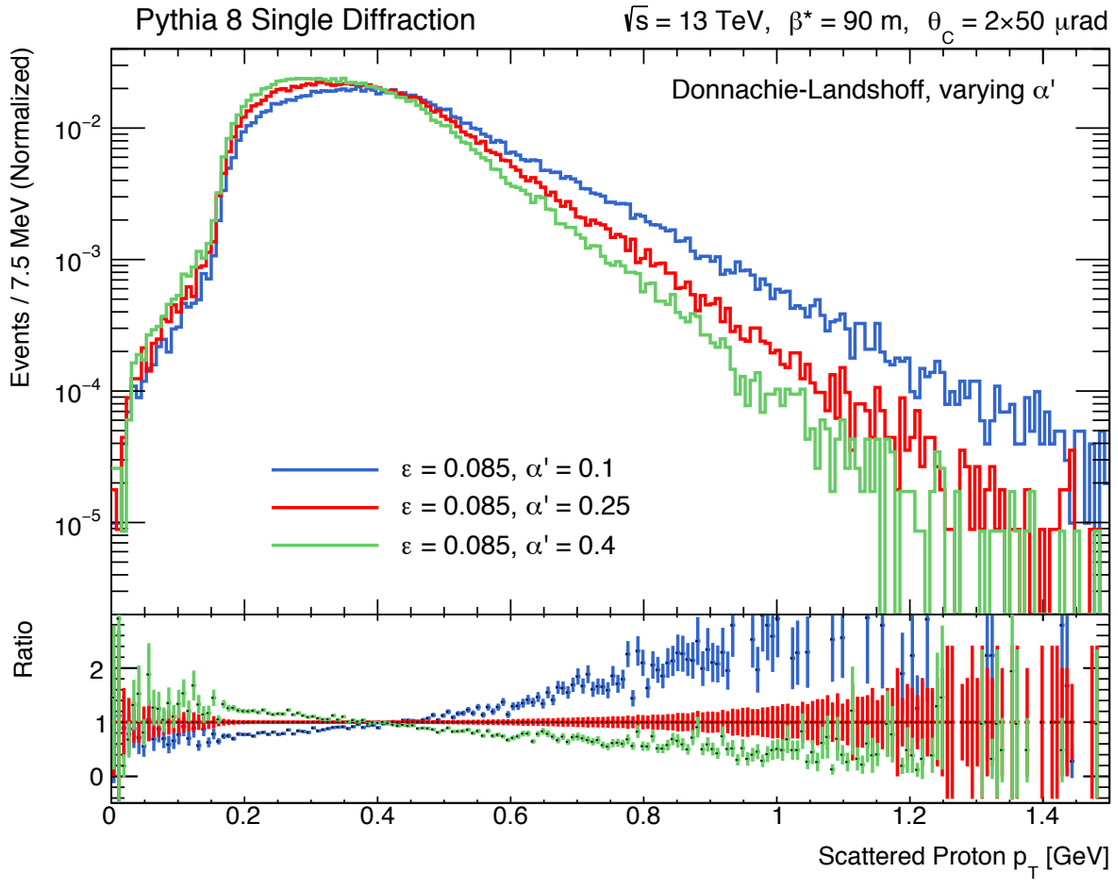
Relative Energy Loss ξ

Varying ε



Transverse Momentum p_T

Varying α'



Thank you for listening!