

**Silvia Zanolì**  
**12th March 2024**



# **LHC PHENOMENOLOGY IN THE PRECISION ERA**

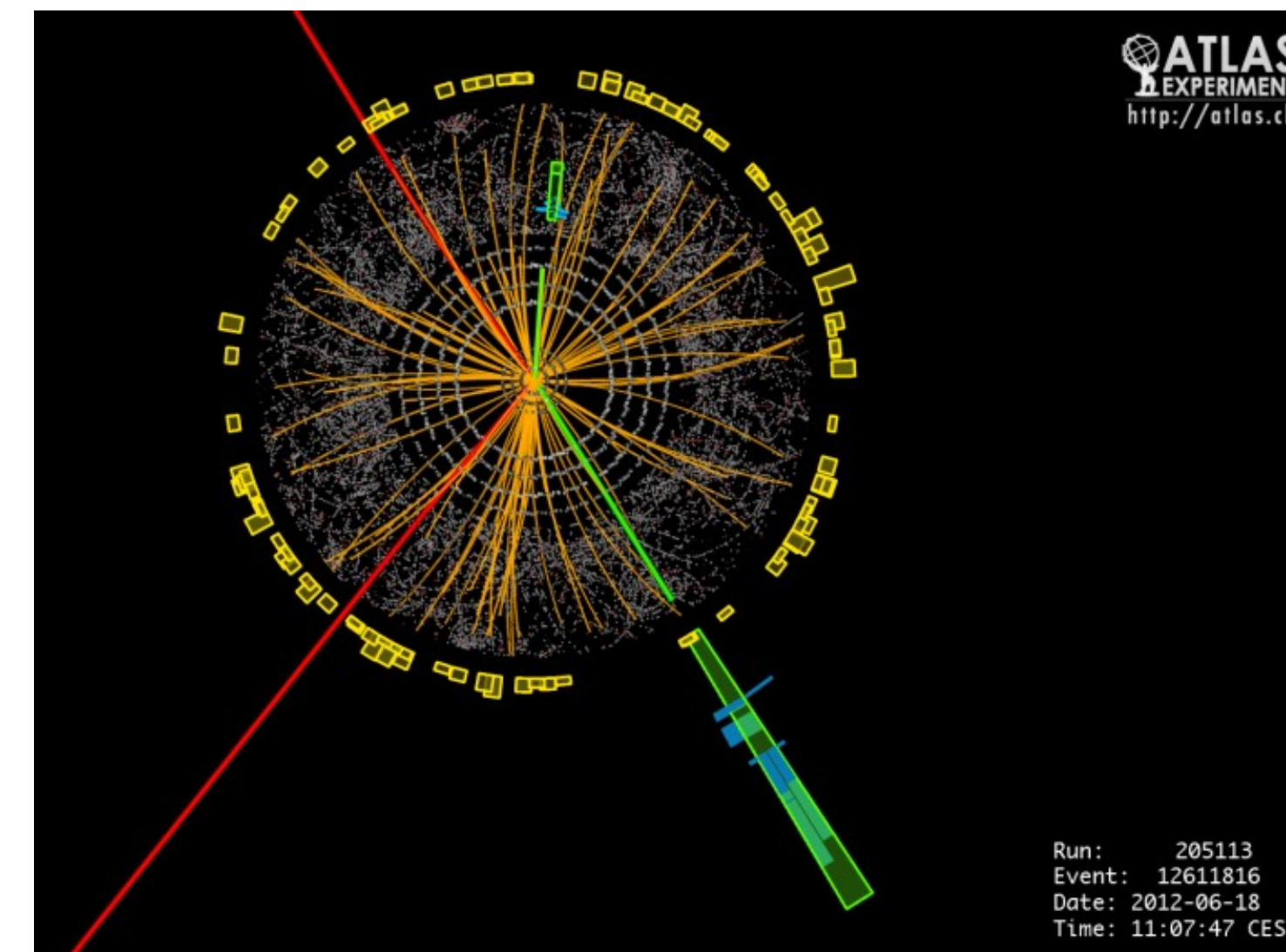
**Oxford Theoretical Studies of Particles and Strings Retreat**

# AN AMBITIOUS TASK

## THEORY

$$\begin{aligned}\mathcal{L} = & -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} \\ & + i\bar{\psi}\not{D}\psi \\ & + \chi_i Y_{ij} \chi_j \phi + \text{h.c.} \\ & + |D_\mu \phi|^2 - V(\phi)\end{aligned}$$

## EXPERIMENTAL DATA



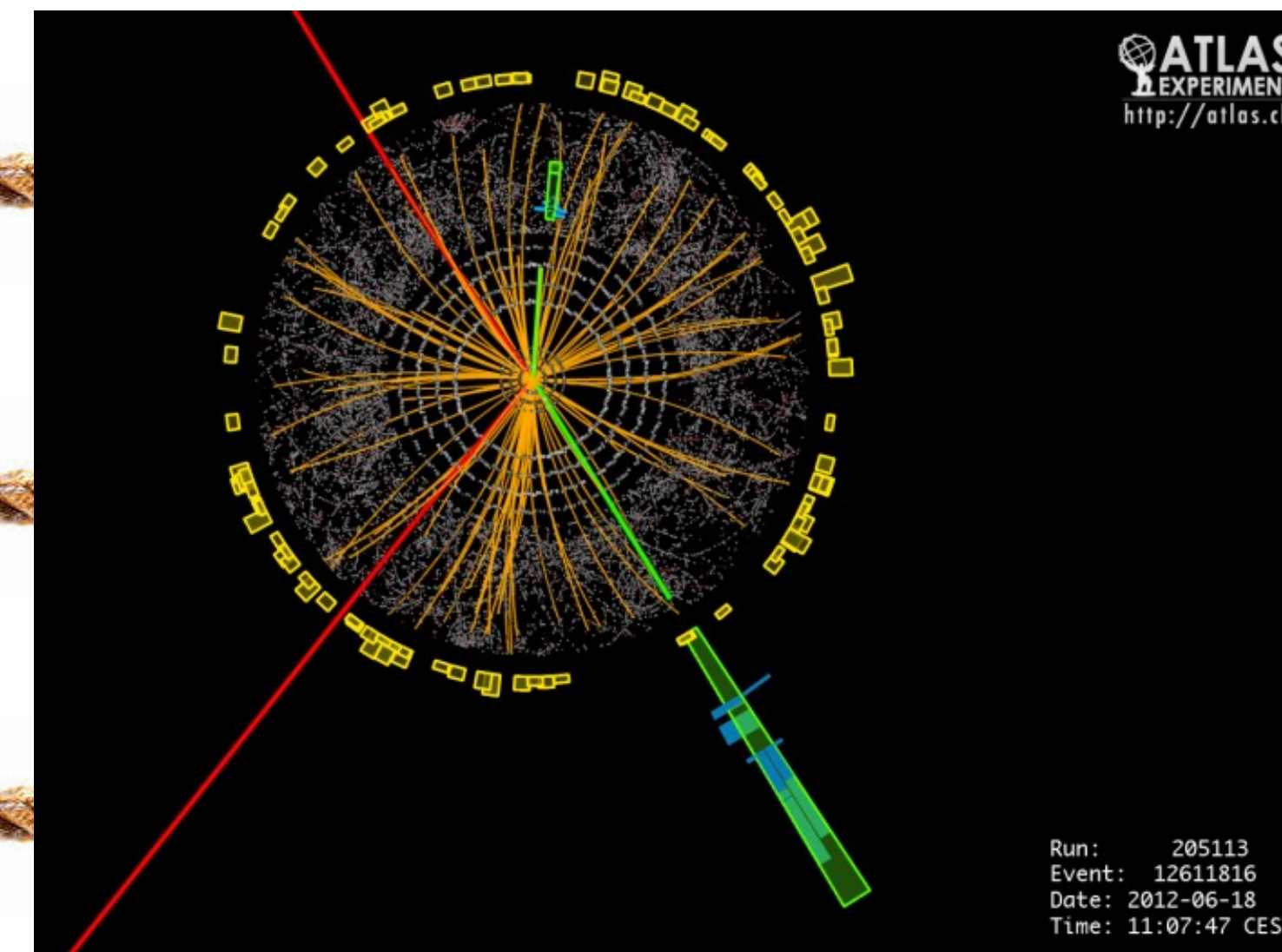
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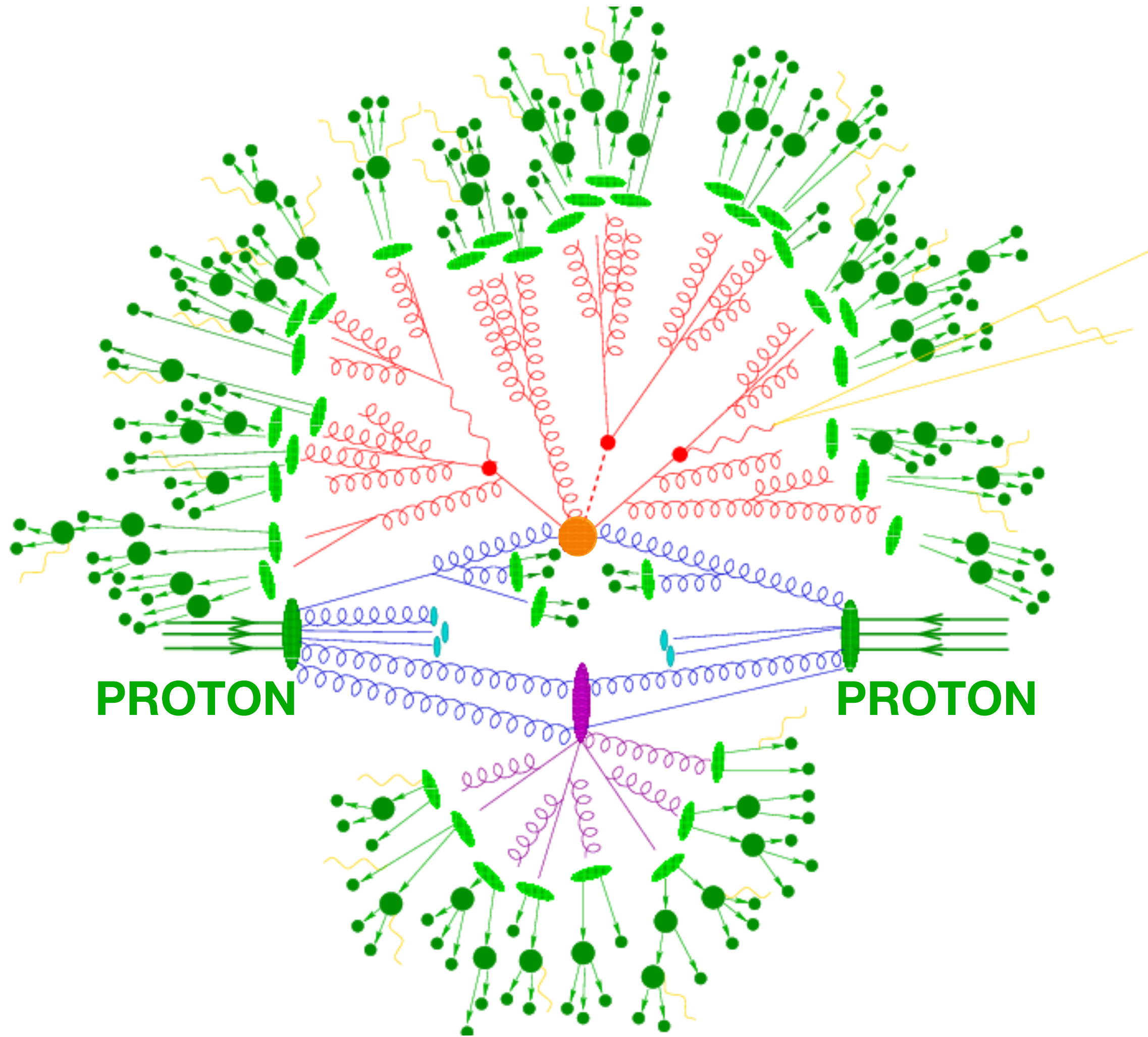
## EXPERIMENTAL DATA



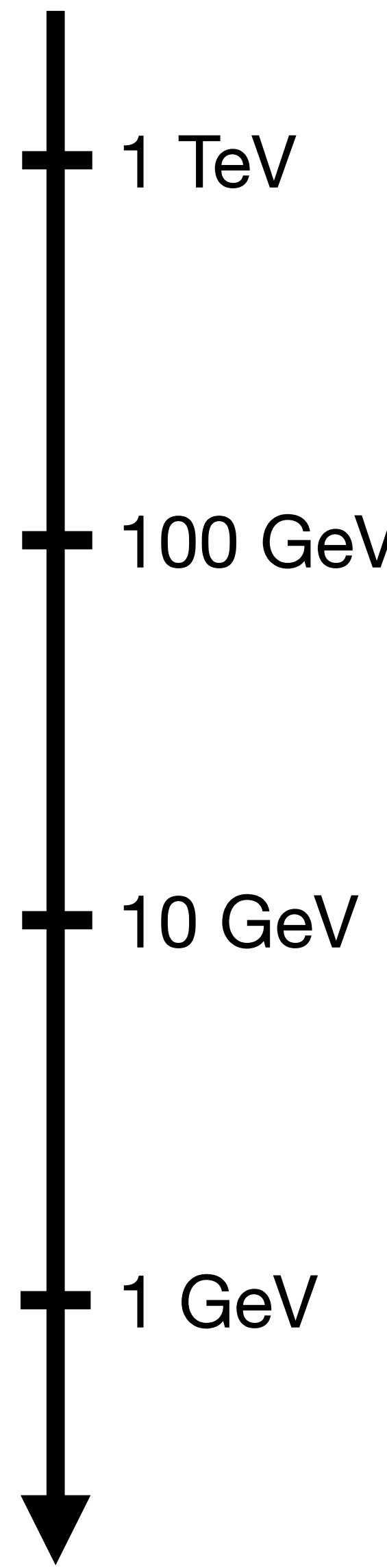
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**PRECISE AND REALISTIC  
THEORETICAL PREDICTIONS**

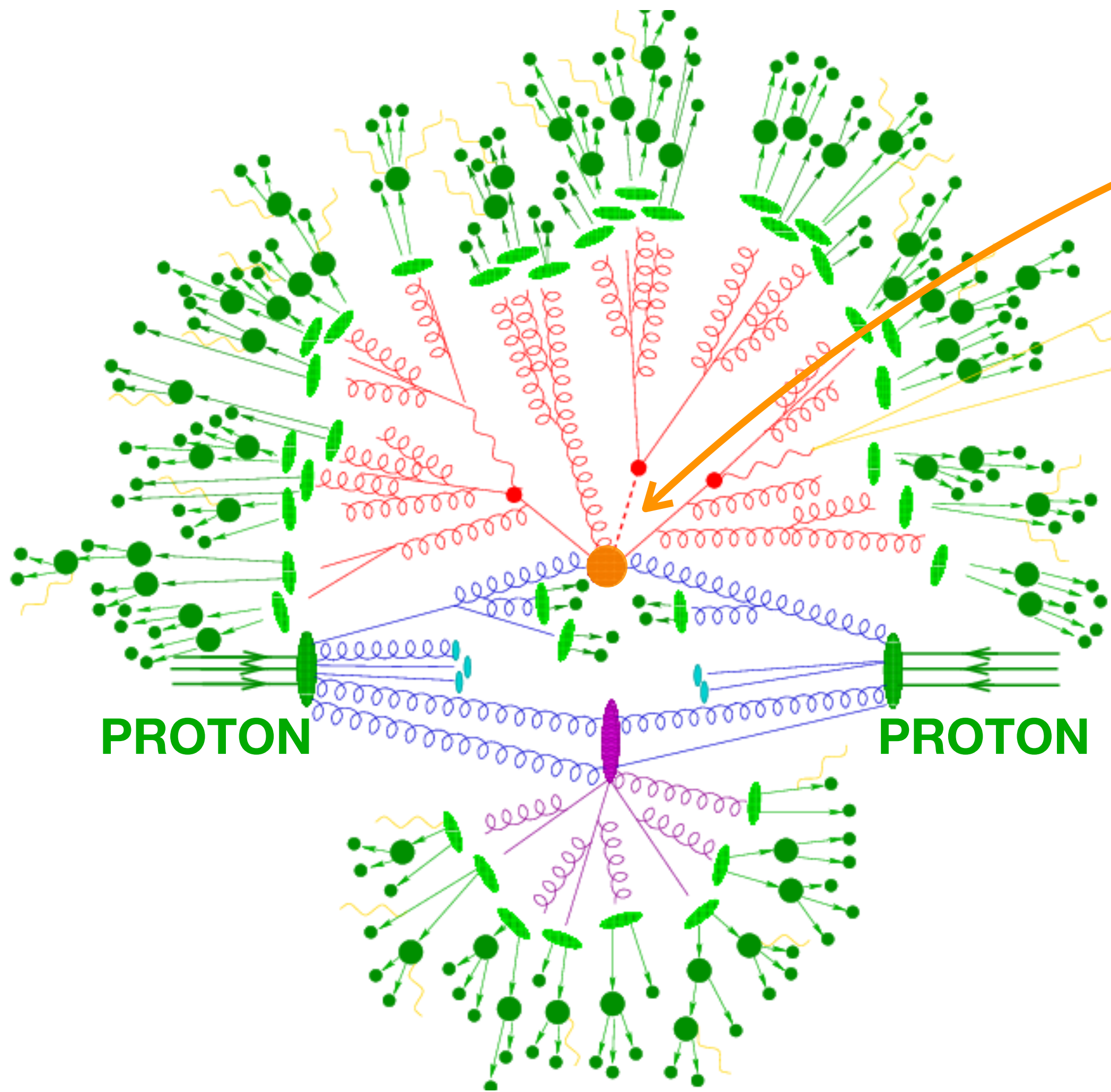
# LHC EVENT



ENERGY  
SCALE



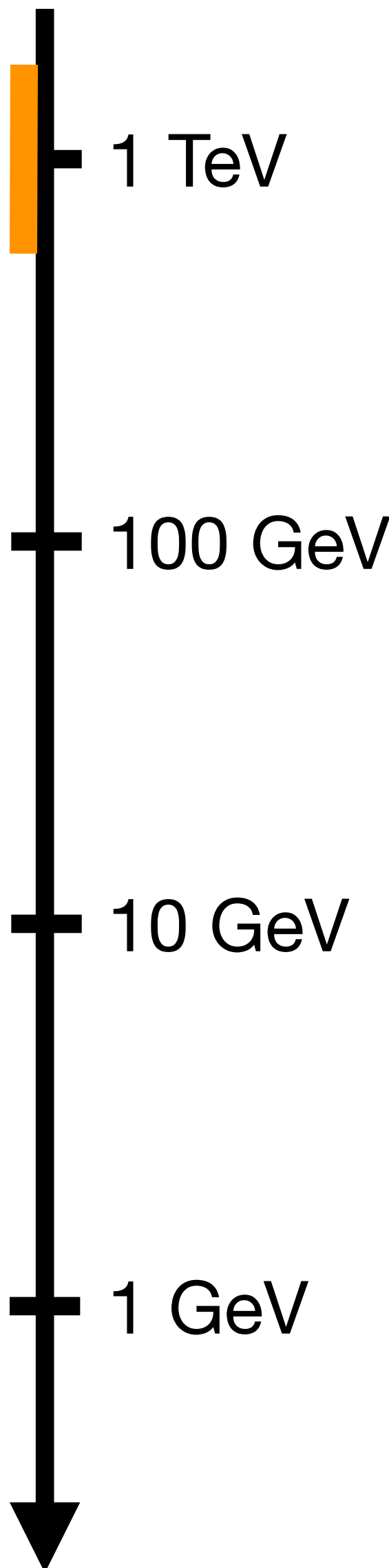
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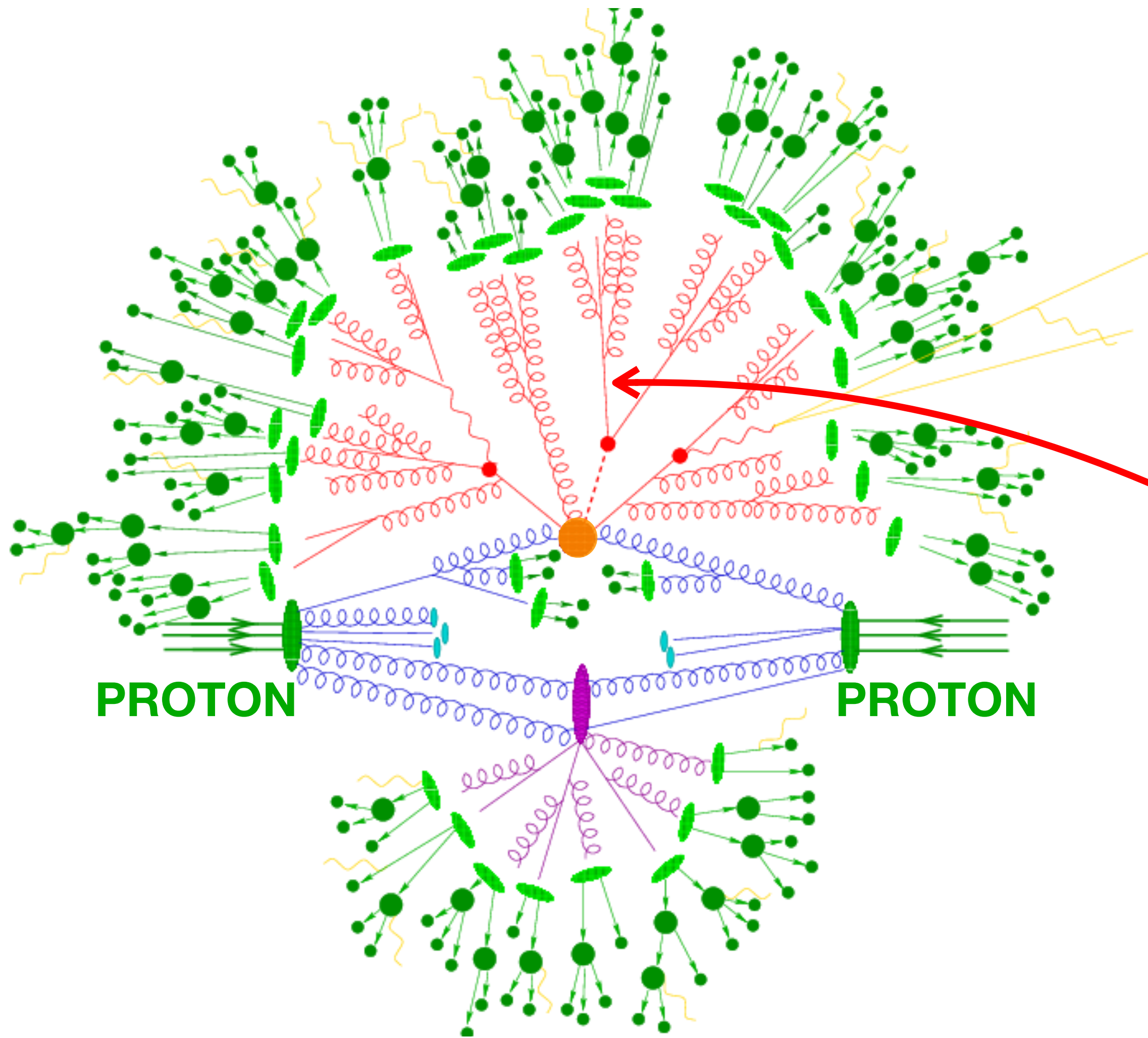
## Hard Scattering

Studied with fixed-order perturbation theory. State-of-the-art: NNLO corrections in QCD,  $\mathcal{O}(\alpha_s^2)$ .

ENERGY SCALE



# LHC EVENT



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## Parton Shower

Cascade of particles enhanced in the soft and collinear regions. It represents a degradation of energy till  $\Lambda_{\text{QCD}}$ .

ENERGY  
SCALE

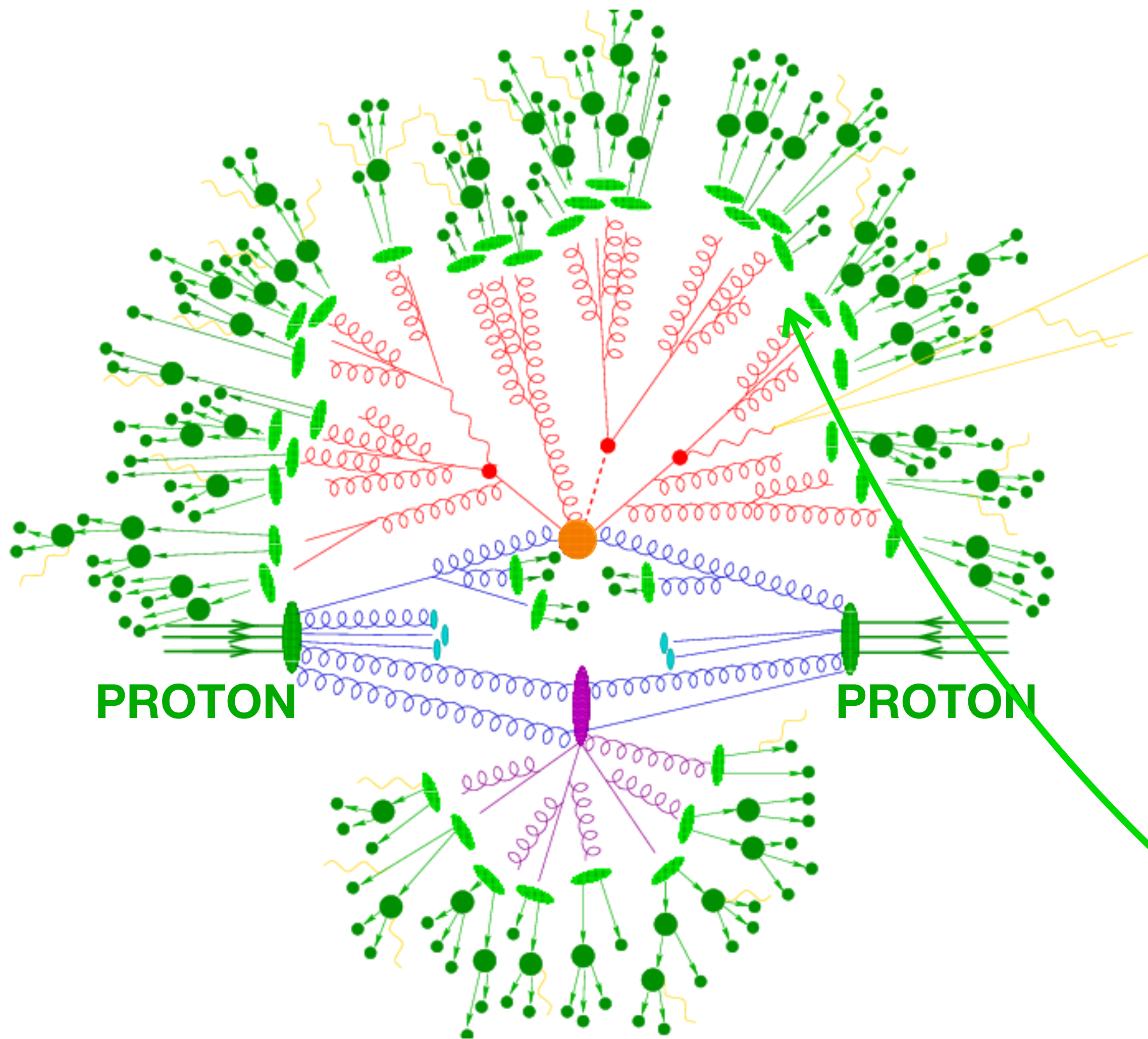
1 TeV

100 GeV

10 GeV

1 GeV

# LHC EVENT



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## Hadronization

Non-perturbative effects tuned to data.

ENERGY  
SCALE

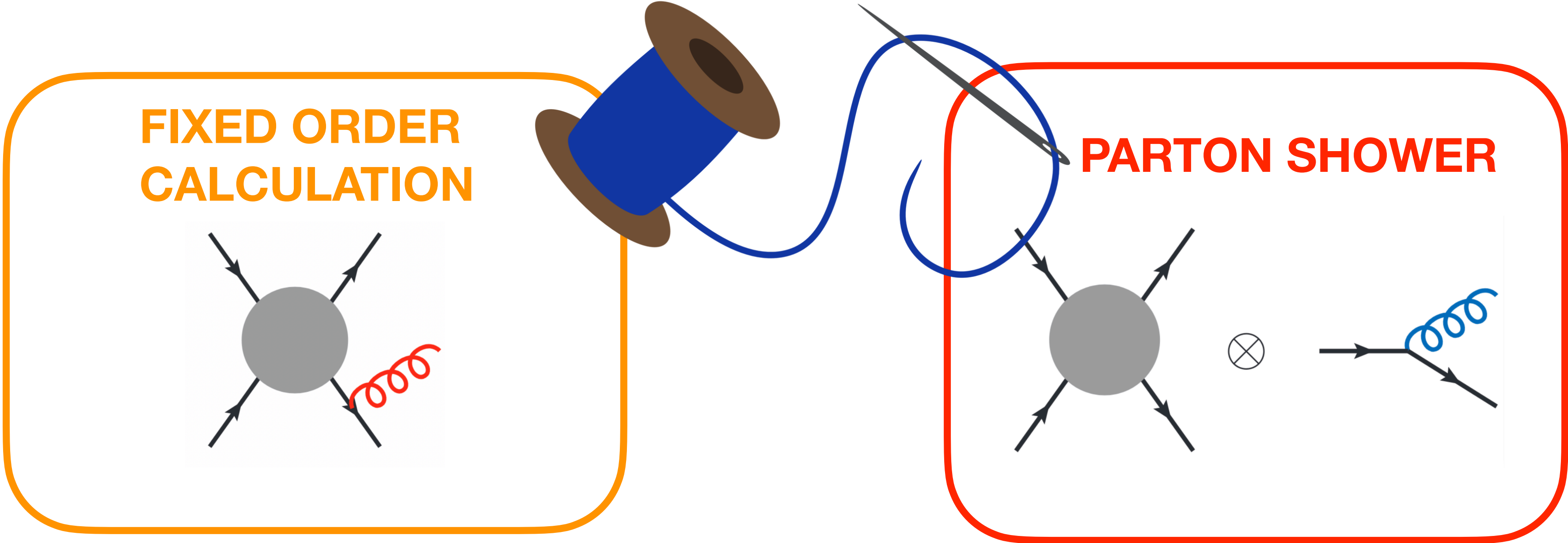
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# MATCHING



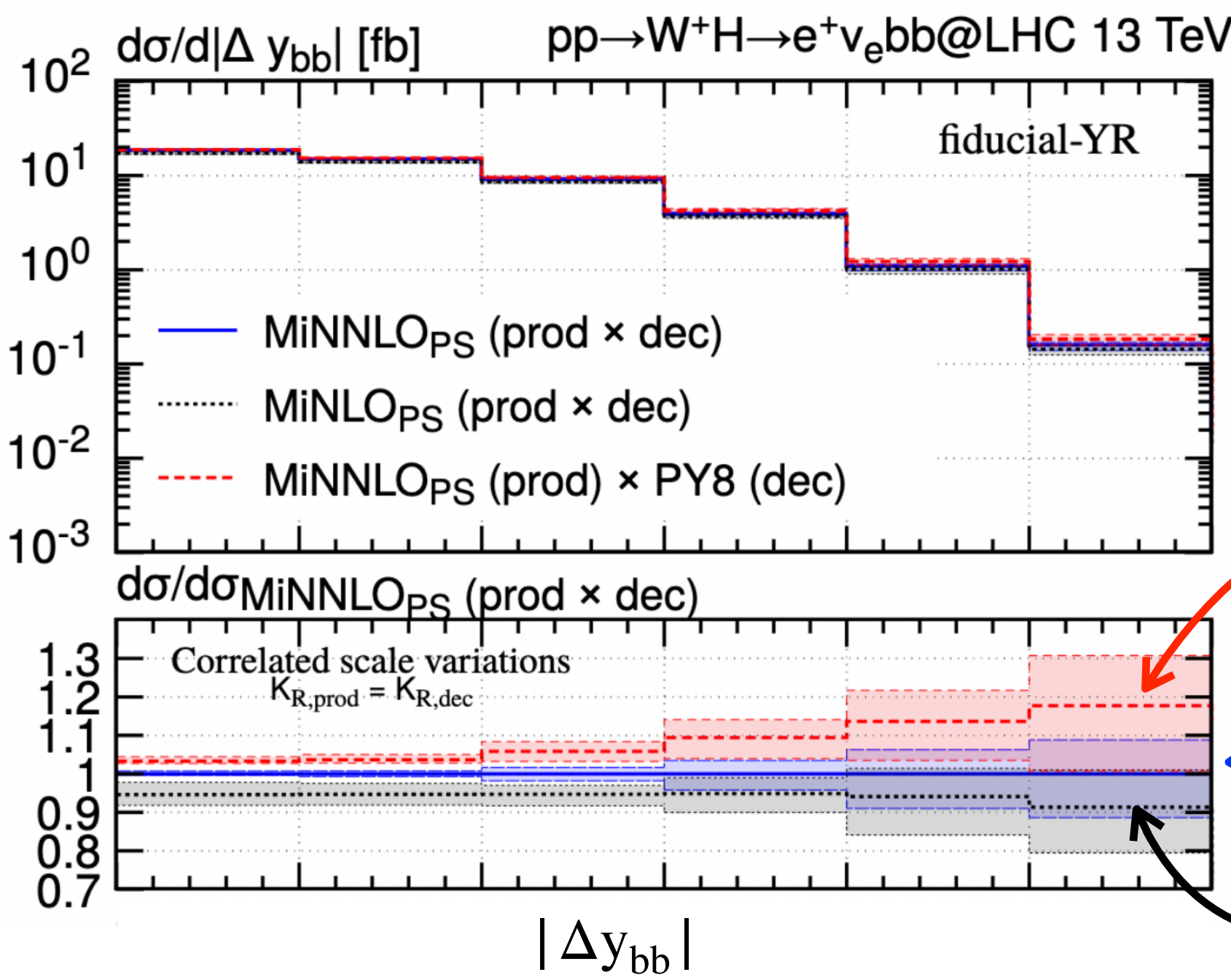


# MATCHING

$$pp \rightarrow W^+H \rightarrow e^+\nu_e b\bar{b}$$

- **MiNNLO<sub>PS</sub>** : NNLO + PS (LL)

Monni, Nason, Re, Wiesemann, Zanderighi (1908.06987)



**PREVIOUS RESULT**

**MiNNLO<sub>PS</sub> RESULT**

**PREVIOUS RESULT**

Zanoli, Chiesa, Re, Wiesemann, Zanderighi (2112.04168)

# MATCHING

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*ongoing!*

- **PanScales**: NLO + PS (NLL)

Dasgupta, Dreyer, Hamilton, Monni, Salam, Soyez (2002.11114)



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*Thank you!*