A Fixed-Target ExpeRiment at the LHC (AFTER@LHC)

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Part I

Why a new fixed-target experiment for High-Energy Physics now ?

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- They exhibit 4 decisive features,
  - accessing the high Feynman x_F domain ($x_F \equiv \frac{p_z}{p_{z\,\mathrm{max}}}$)
  - achieving high luminosities with dense targets,
  - varying the atomic mass of the target almost at will,
  - polarising the target.

The European strategy for particle physics

Approved by the CERN council at the special Session held in Lisbon on July 14, 2006

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pg. 37 of the Strategy Brochure

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AFTER@LHC would definitely be a **unique** experiment

Part II

A fixed-target experiment using the LHC beam(s): AFTER@LHC

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- Good thing: small forward detector $\equiv$ large acceptance
- Bad thing: high multiplicity $\Rightarrow$ absorber $\Rightarrow$ physics limitation

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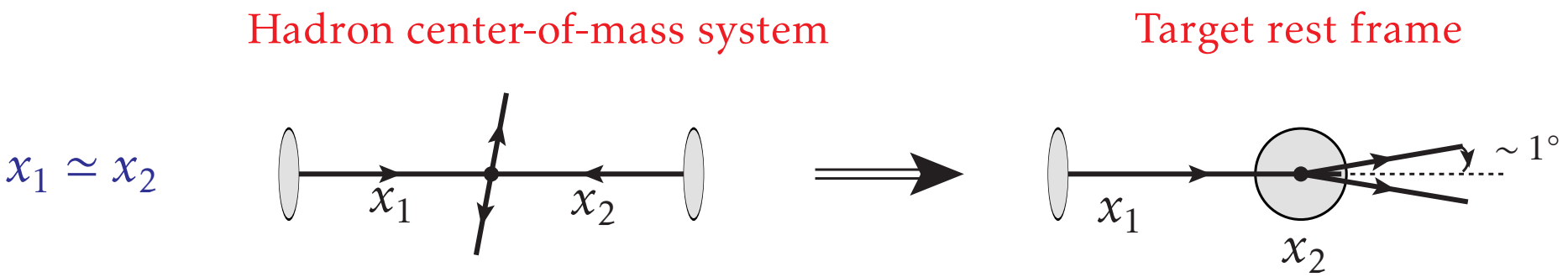

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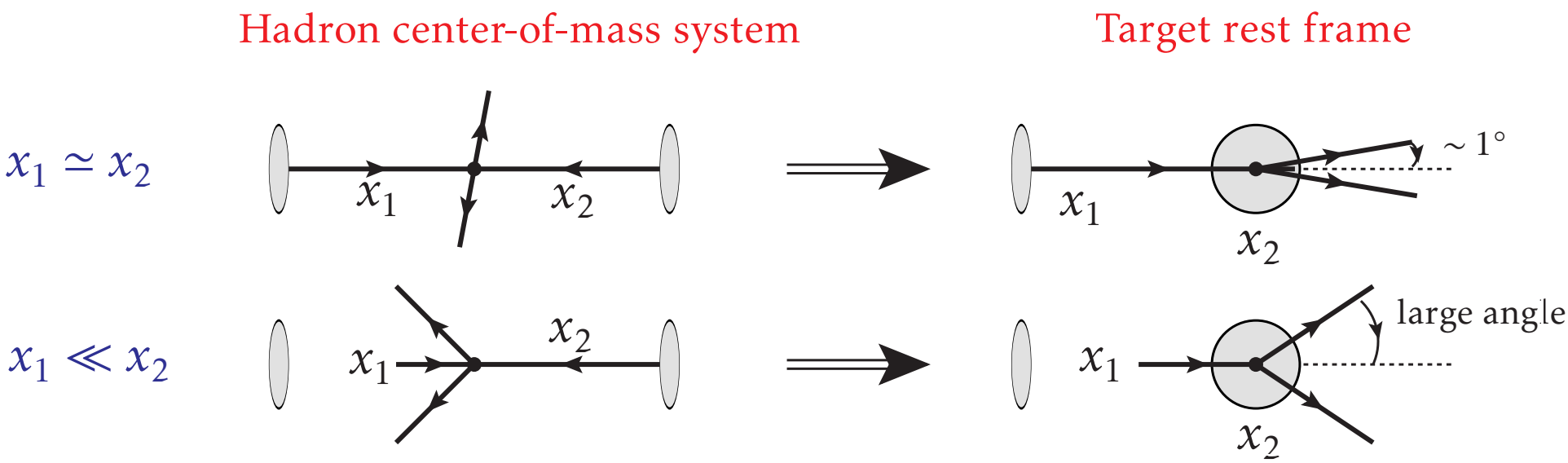

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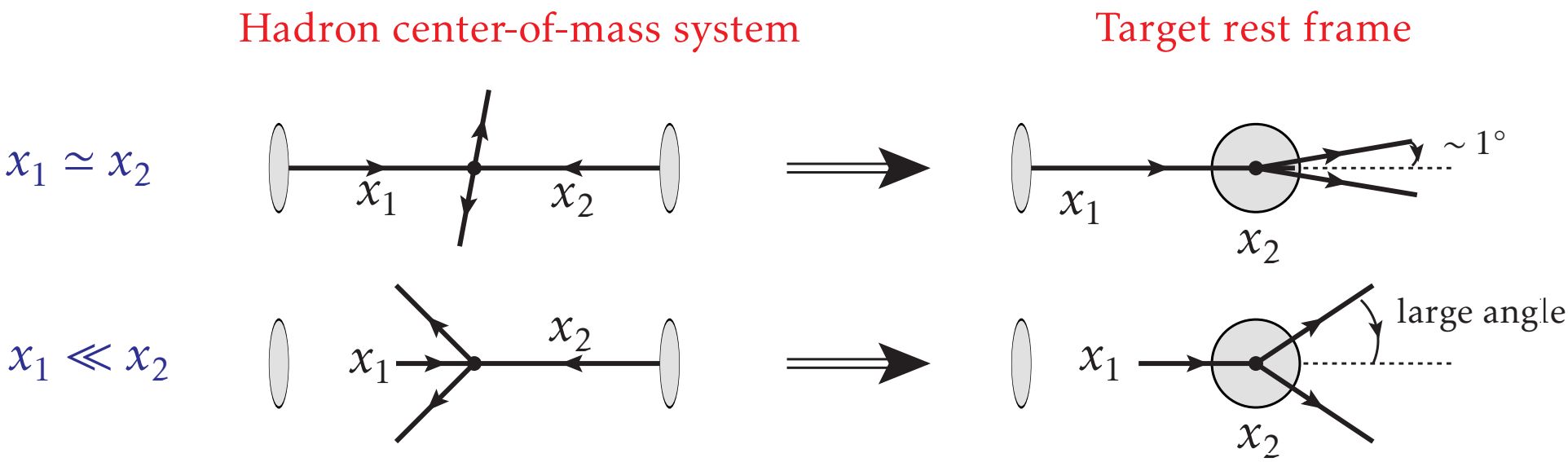

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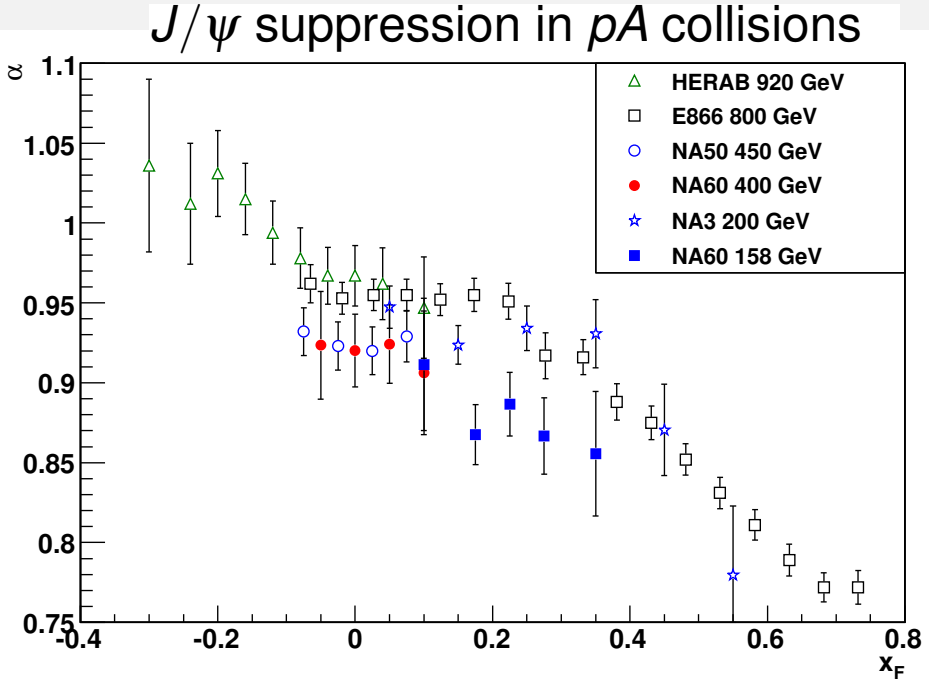

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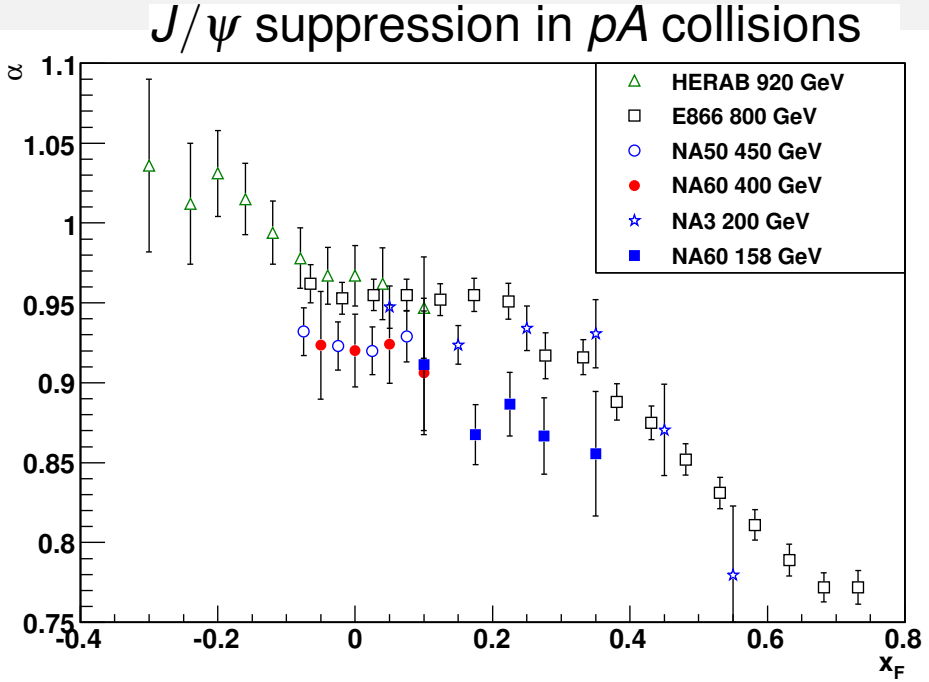

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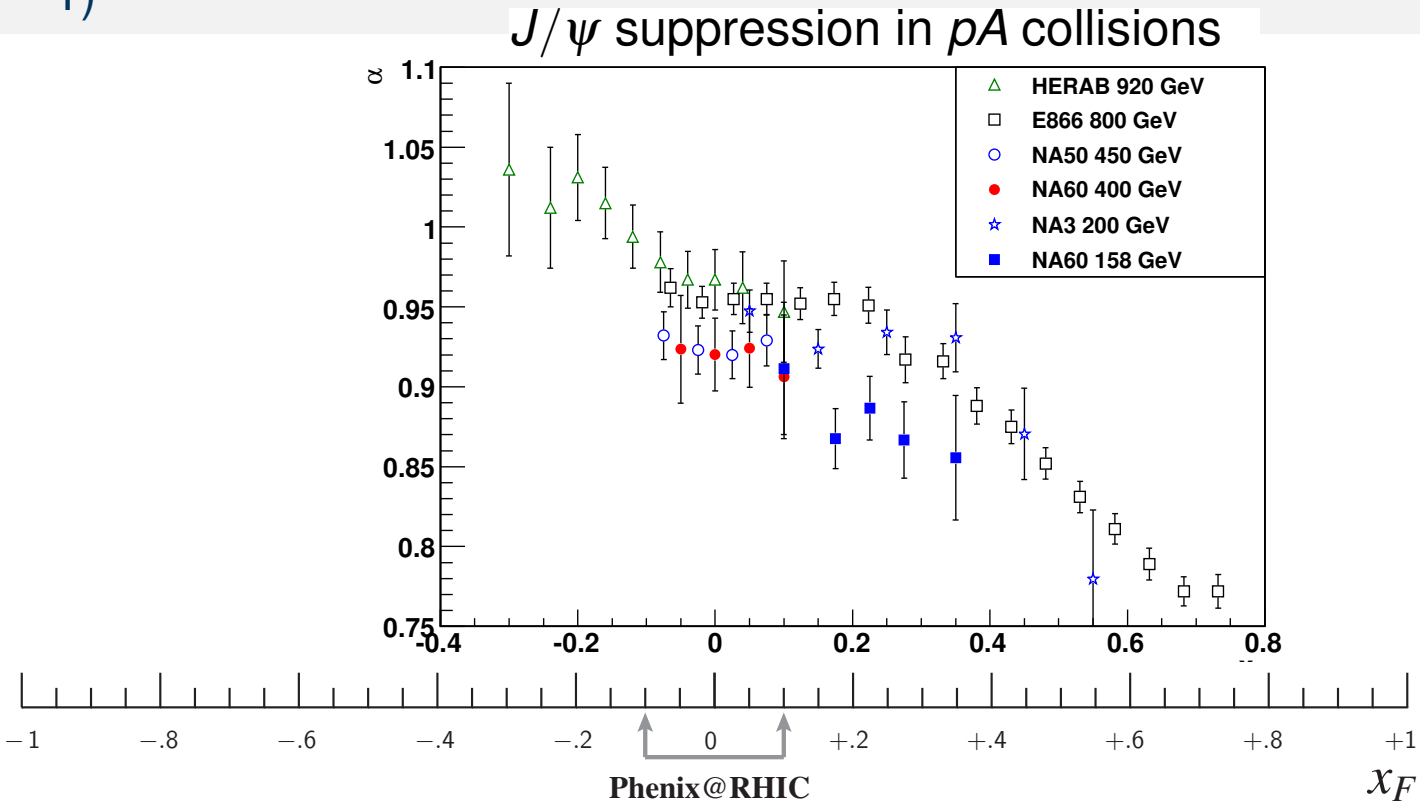

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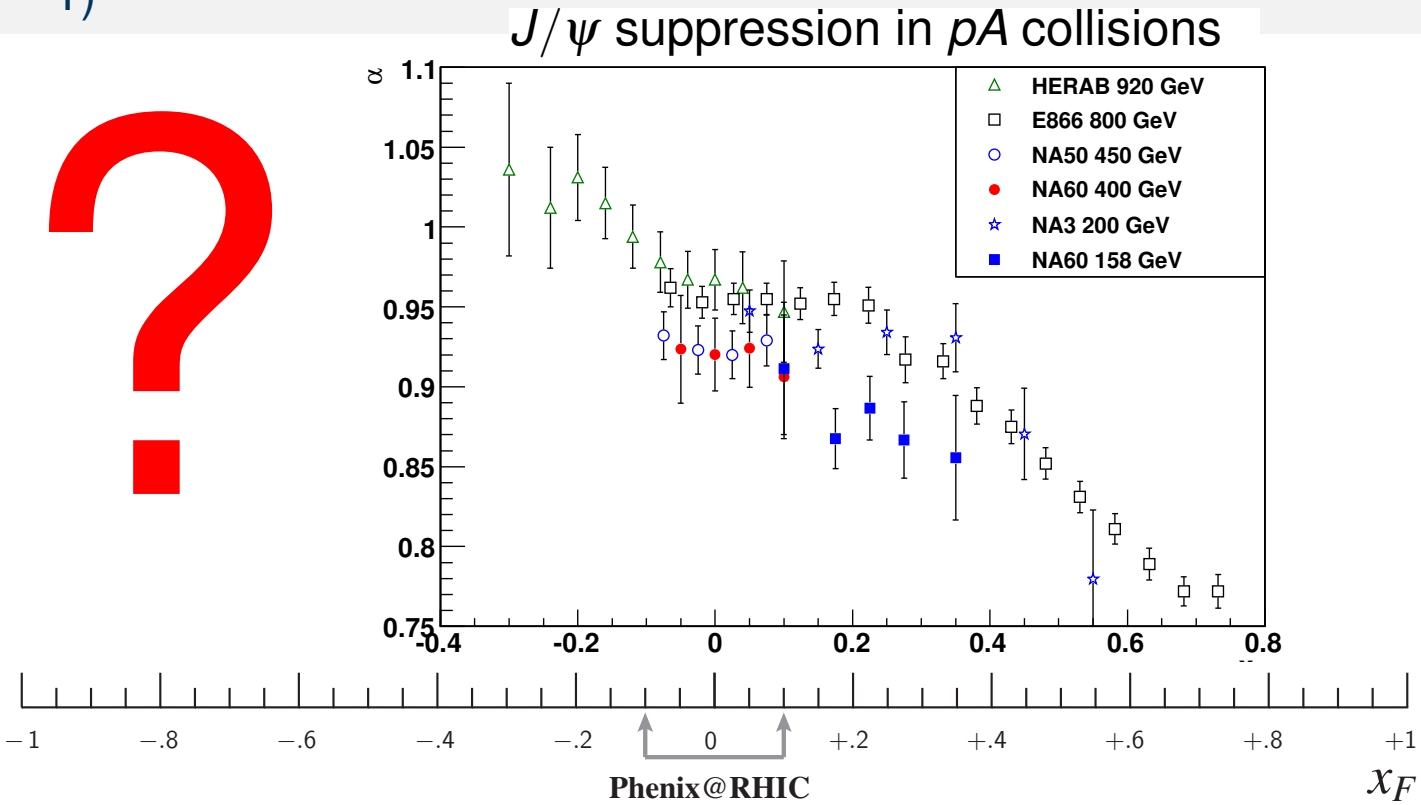

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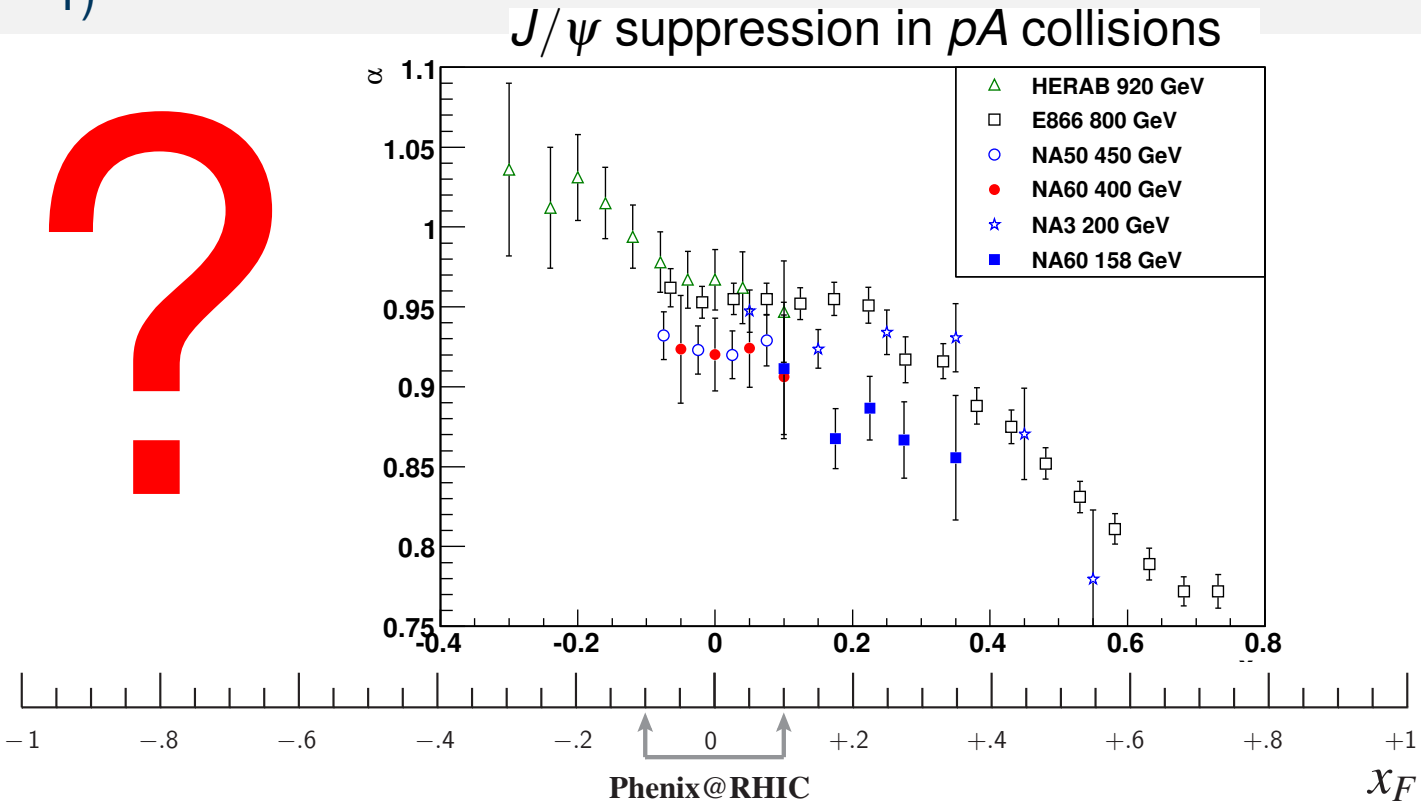

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- If we measure $\Upsilon(b\bar{b})$ at $y_{\rm cms} \simeq -2.5 \Rightarrow x_F \simeq \frac{2m_\Upsilon}{\sqrt{s}} \sinh(y_{\rm cms}) \simeq -1$

The beam extraction

★ The LHC beam may be extracted using “Strong crystalline field”
without any decrease in performance of the LHC !

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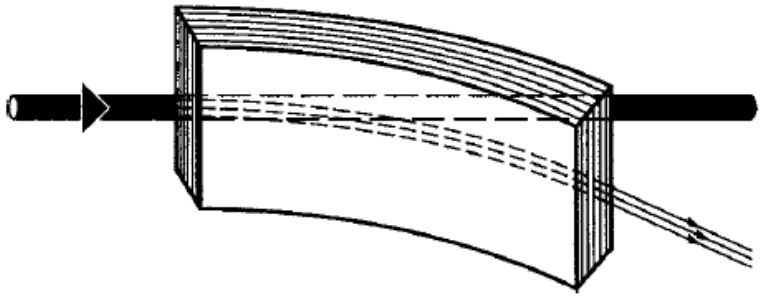

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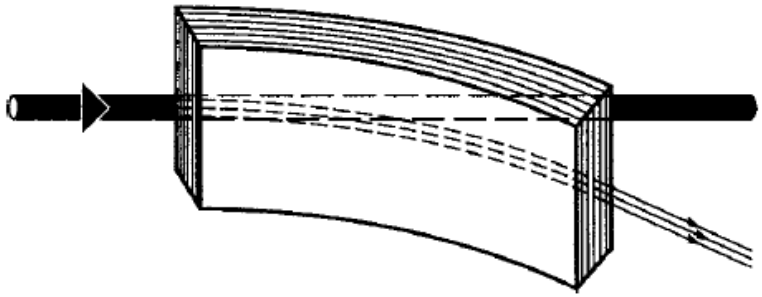

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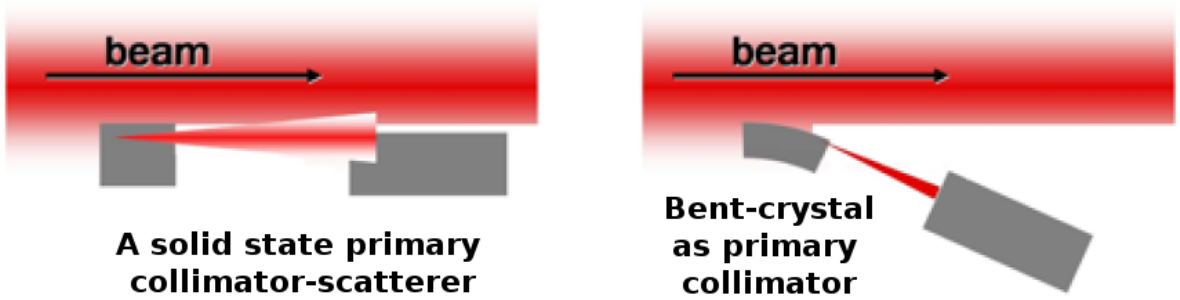

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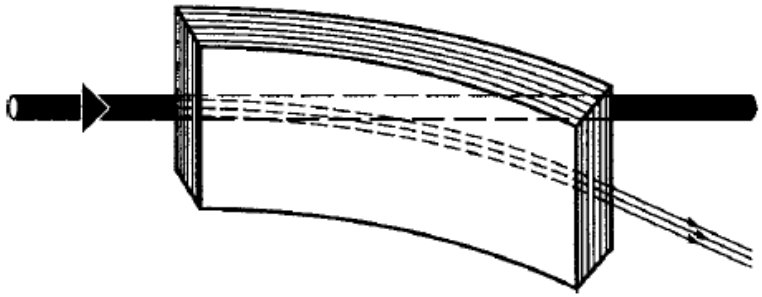

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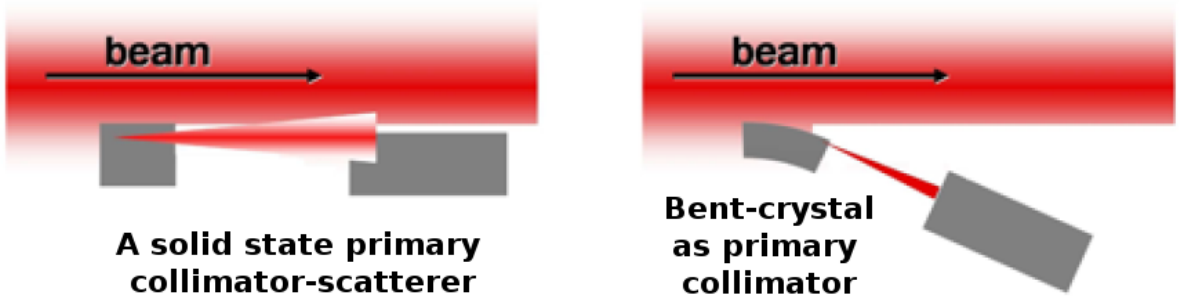

★ Tests will be performed on the LHC beam:

LUA9 proposal approved by the LHCC

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Target	ρ (g.cm^{-3})	A	$\mathscr{L}$ (μb^{-1}.s^{-1})	$\int \mathscr{L}$ (pb^{-1}.yr^{-1})
Sol. H_2	0.09	1	**26**	**260**
Liq. H_2	0.07	1	**20**	**200**
Liq. D_2	0.16	2	**24**	**240**
Be	1.85	9	**62**	**620**
Cu	8.96	64	**42**	**420**
W	19.1	185	**31**	**310**
Pb	11.35	207	**16**	**160**

Part III

AFTER: flagship measurements

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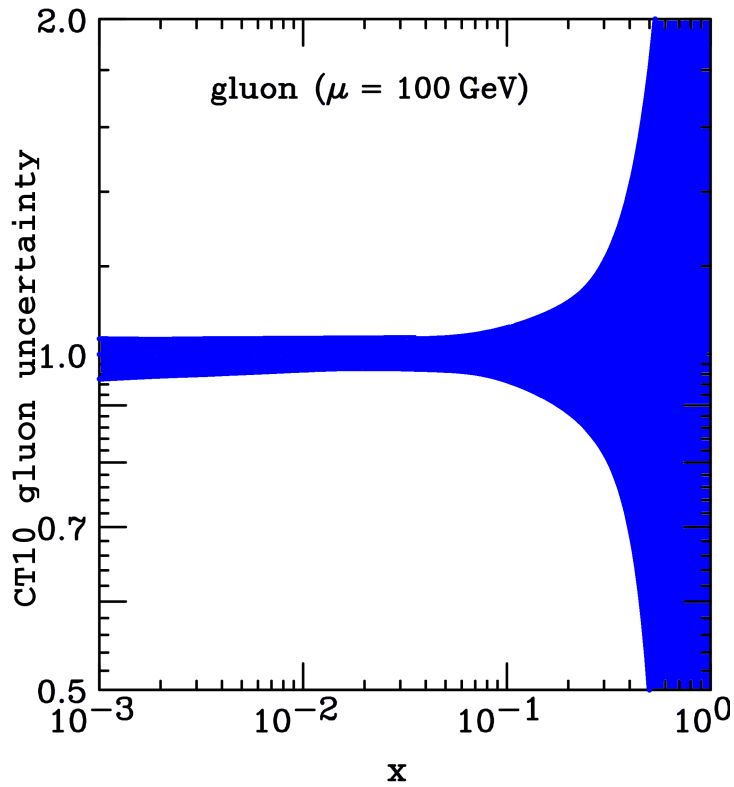

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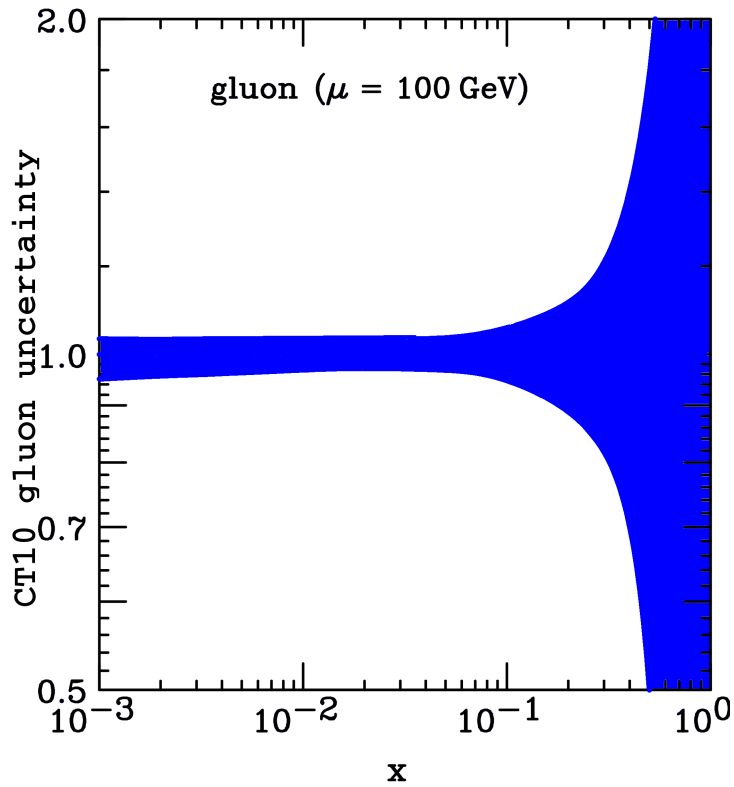

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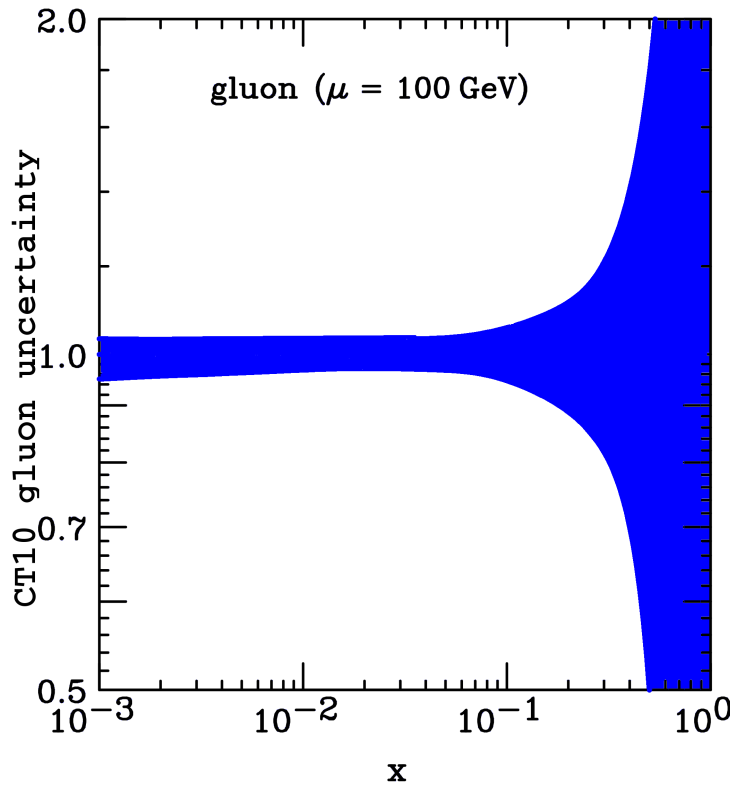
  see a recent study by D. Diakonov *et al.*, JHEP 1302 (2013) 069



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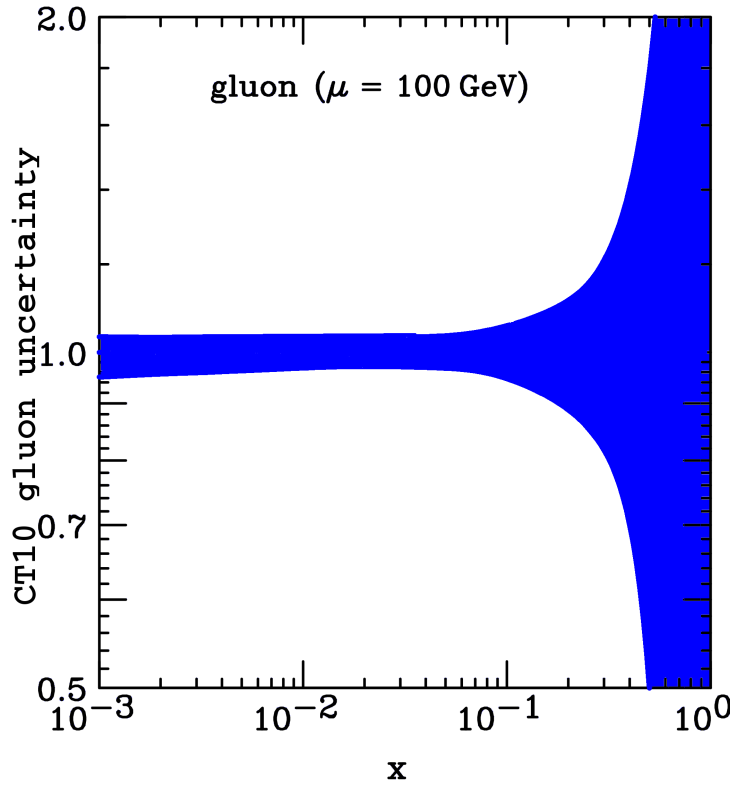

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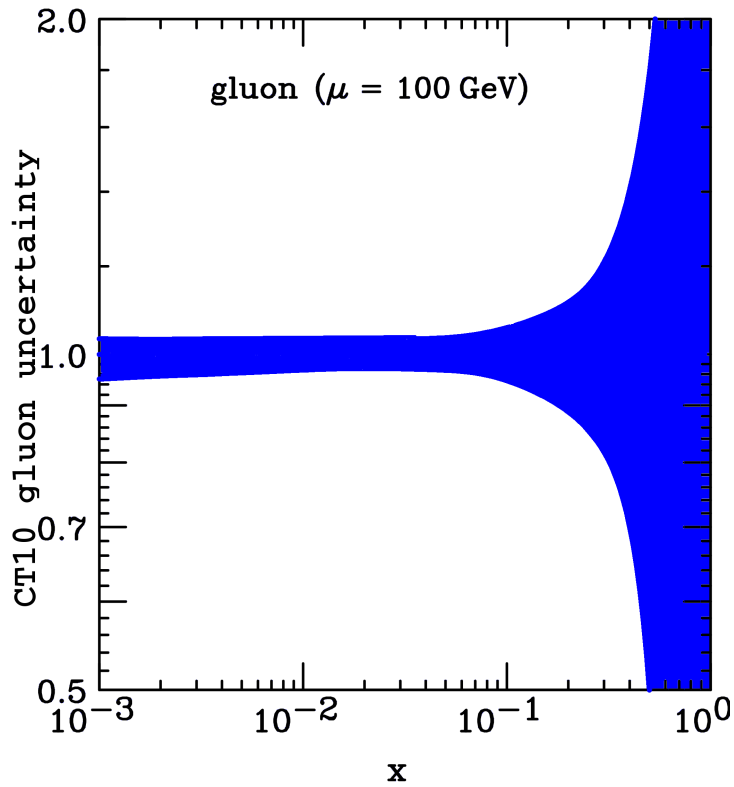

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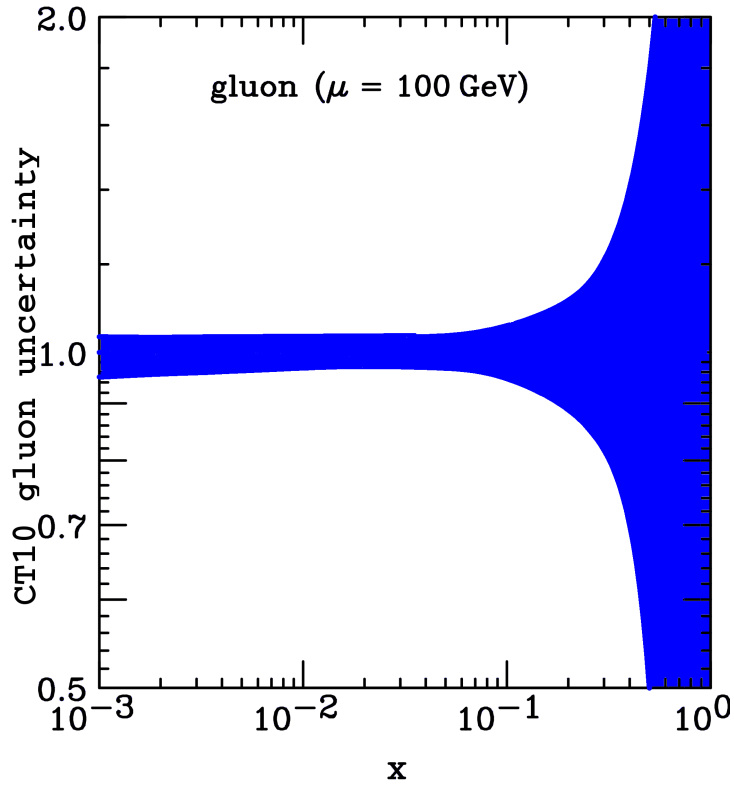

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Multiple probes needed to **check factorisation**

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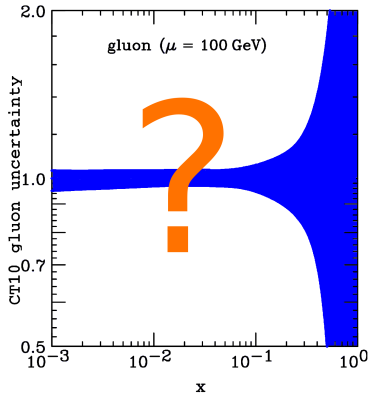

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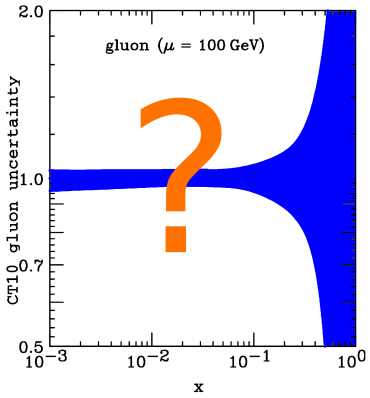

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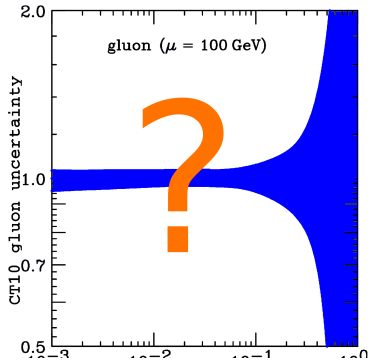

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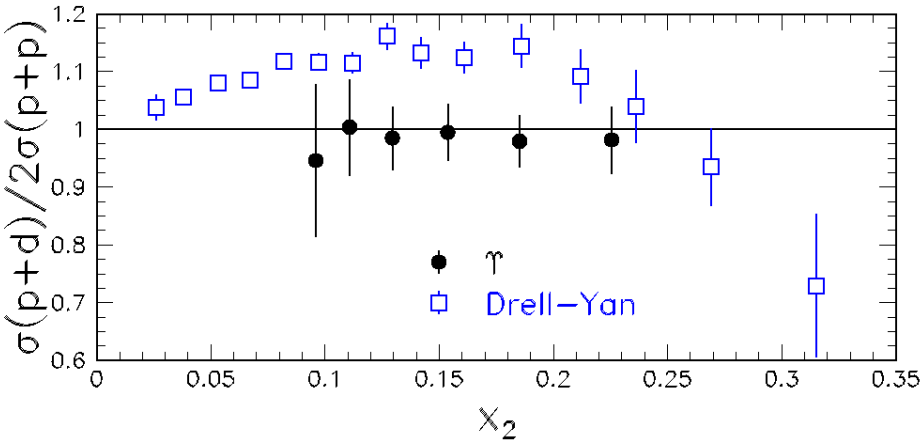

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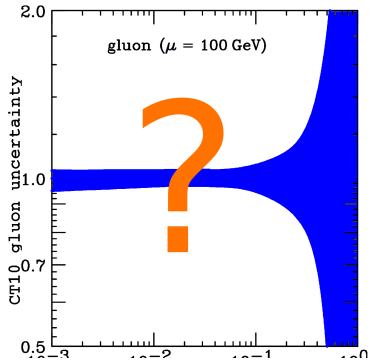

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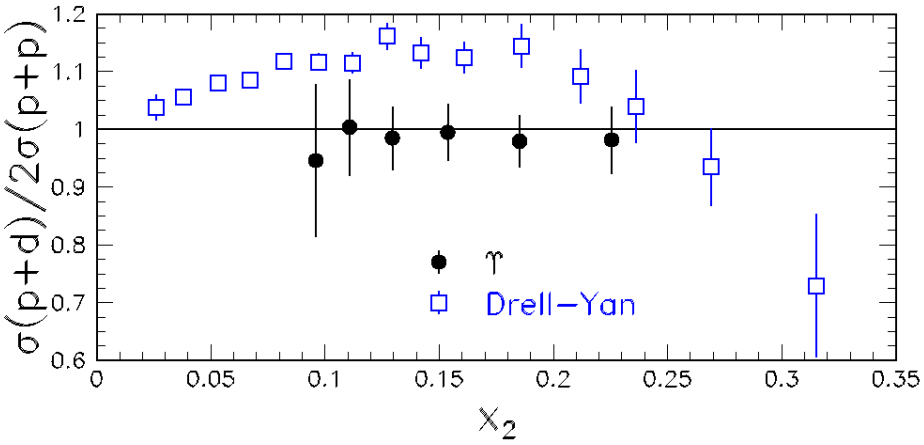

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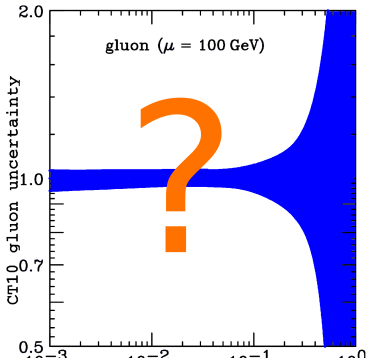

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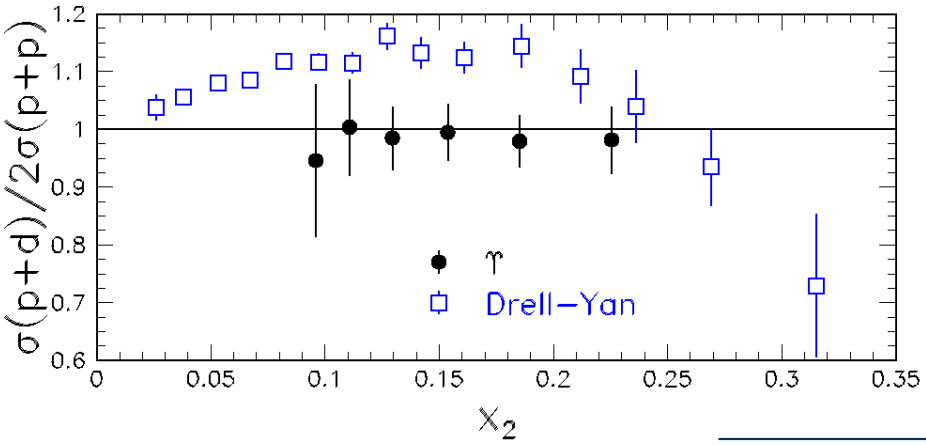

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target	yearly lumi	$\mathscr{B}\frac{dN_{J/\psi}}{dy}$	$\mathscr{B}\frac{dN_{\Upsilon}}{dy}$
1m Liq. H_2	20 fb^{-1}	4.0×10^8	9.0×10^5
1m Liq. D_2	24 fb^{-1}	9.6×10^8	1.9×10^6

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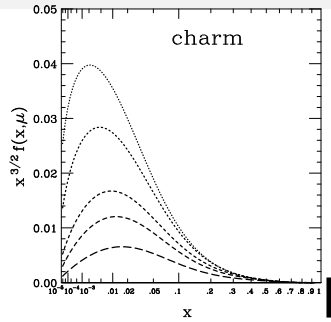

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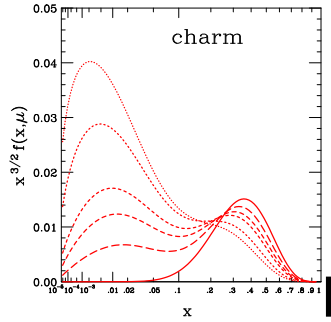

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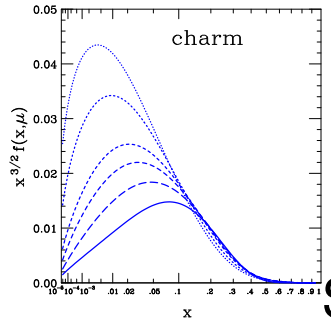

Sea-like

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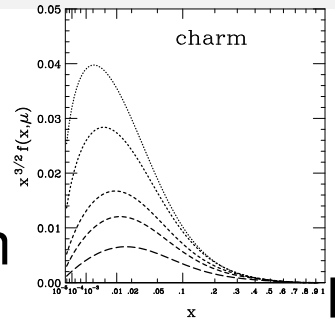

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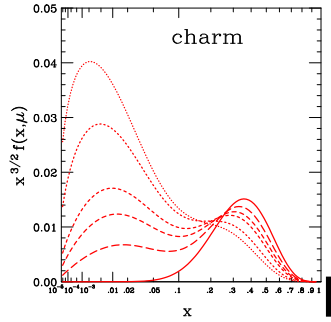

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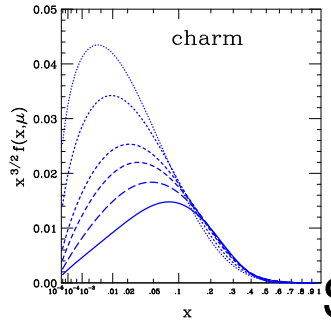

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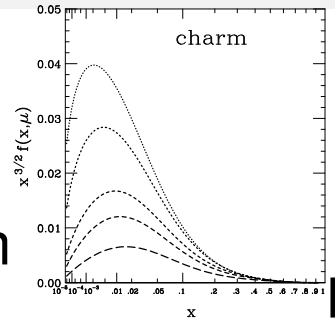

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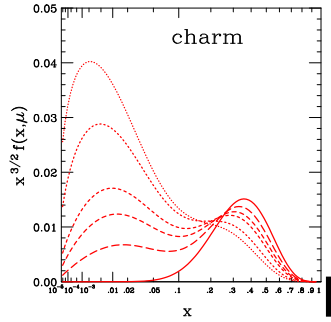

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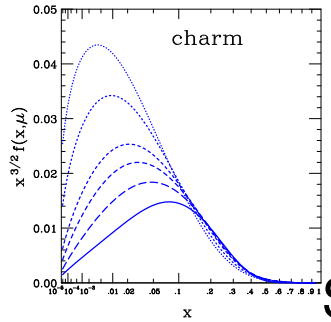

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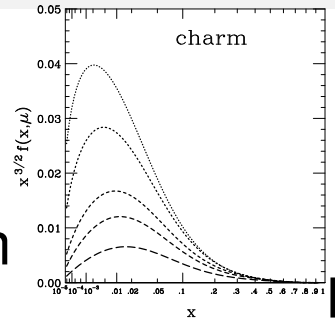

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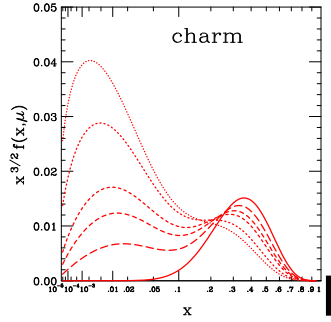

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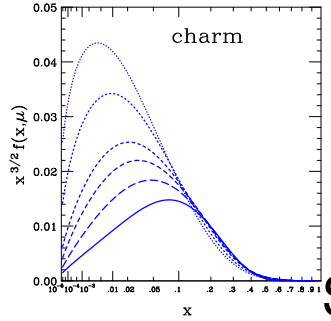

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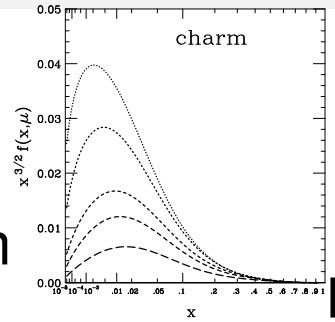

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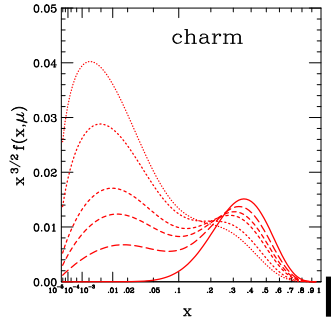

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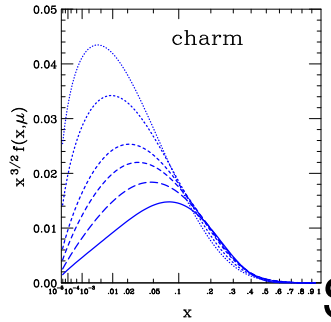

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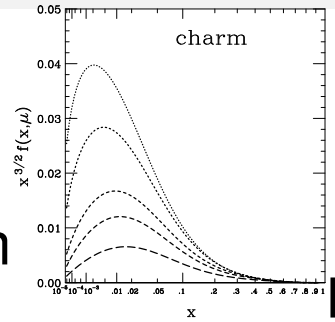

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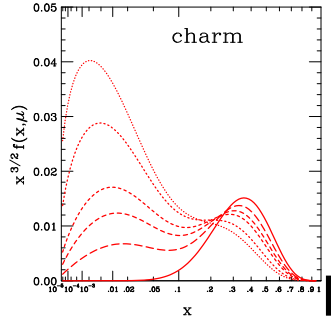

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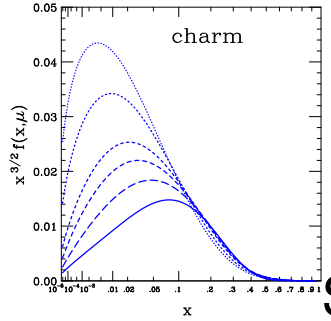

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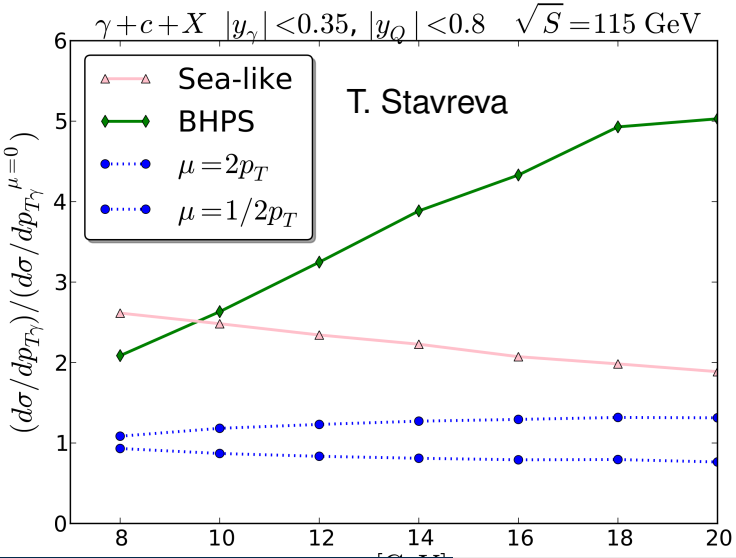

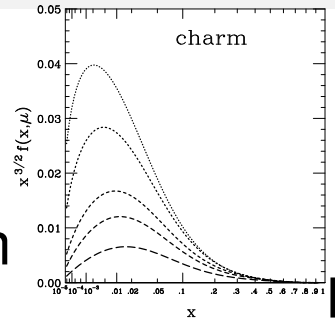

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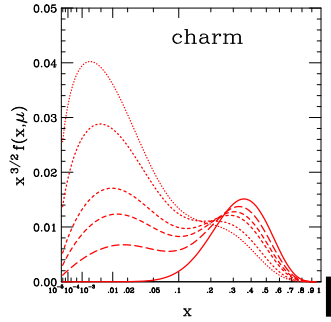

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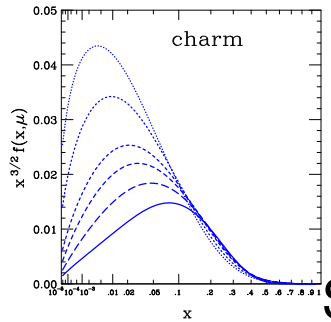

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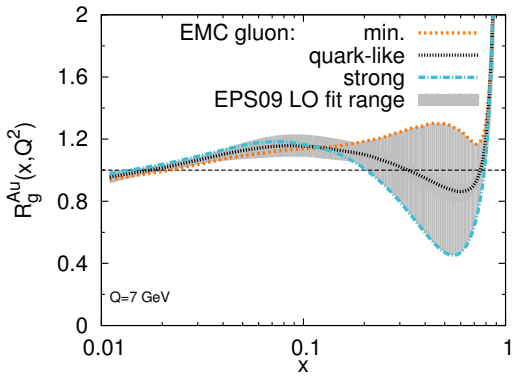

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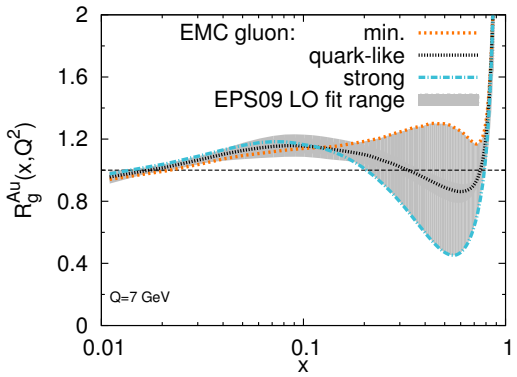

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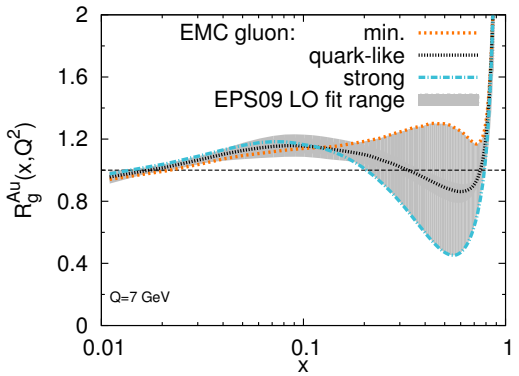

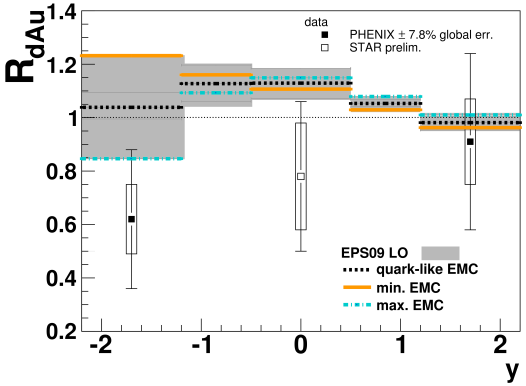

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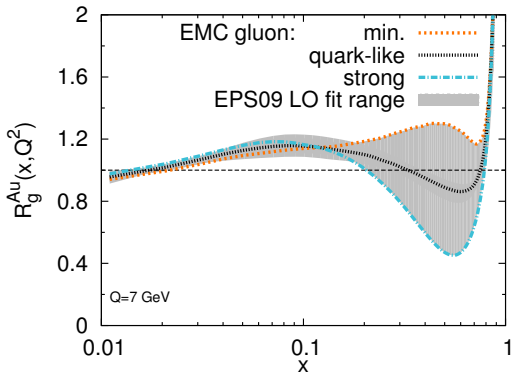

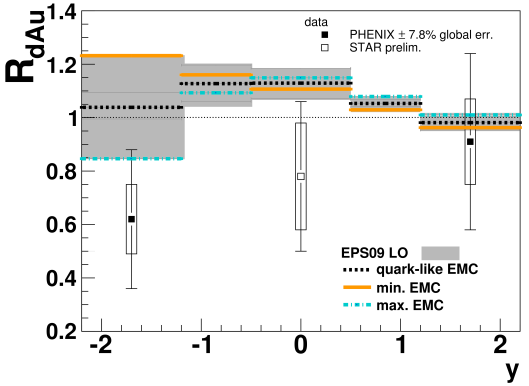

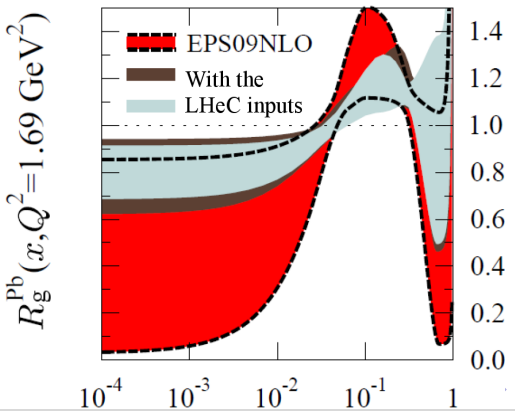

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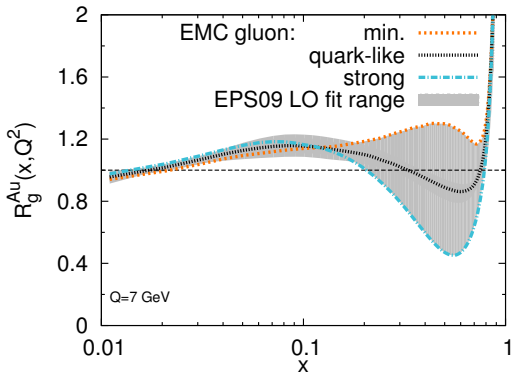

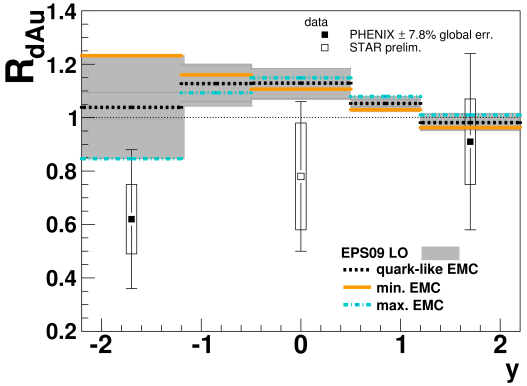

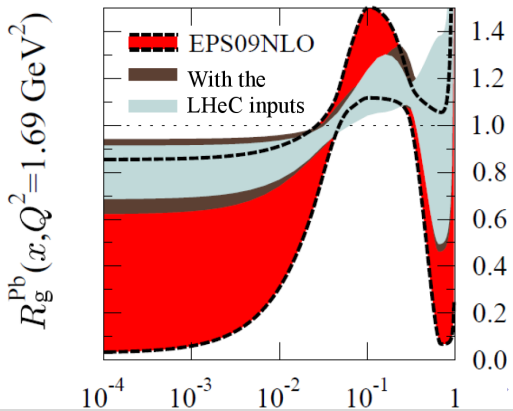

More with AFTER: photoproduction and "beyond" DY

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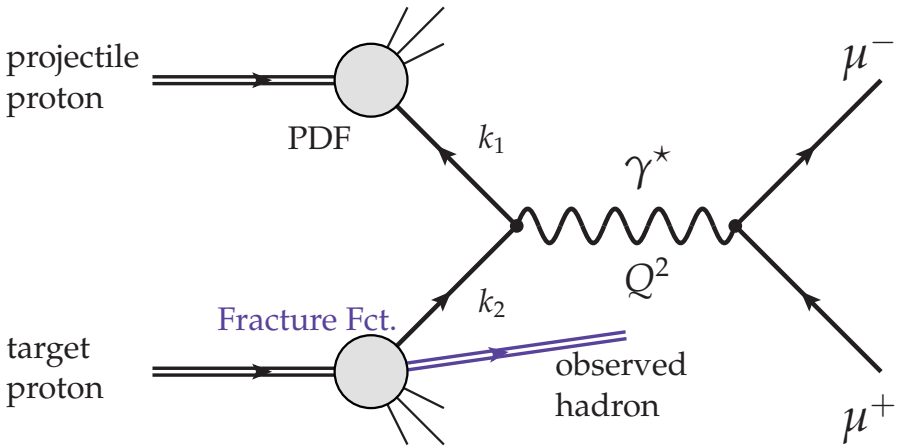

L. Trentadue, G. Veneziano, PLB 323 (1994) 201
F. Ceccopieri, L. Trentadue, PLB 668 (2008) 319

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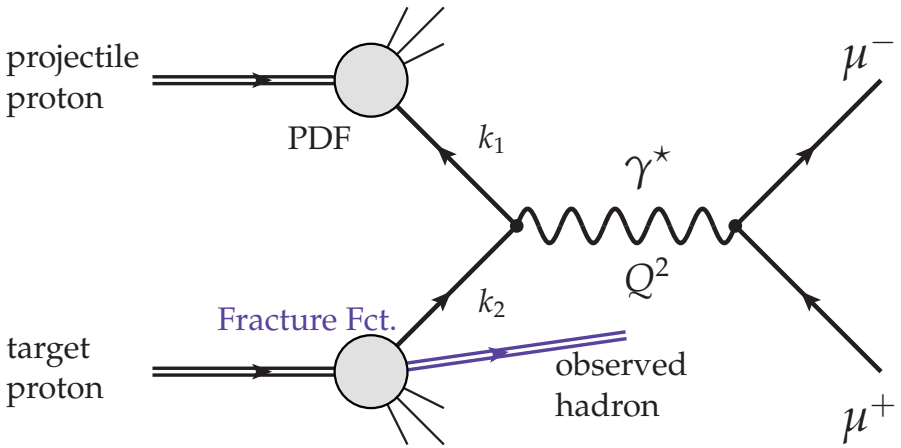

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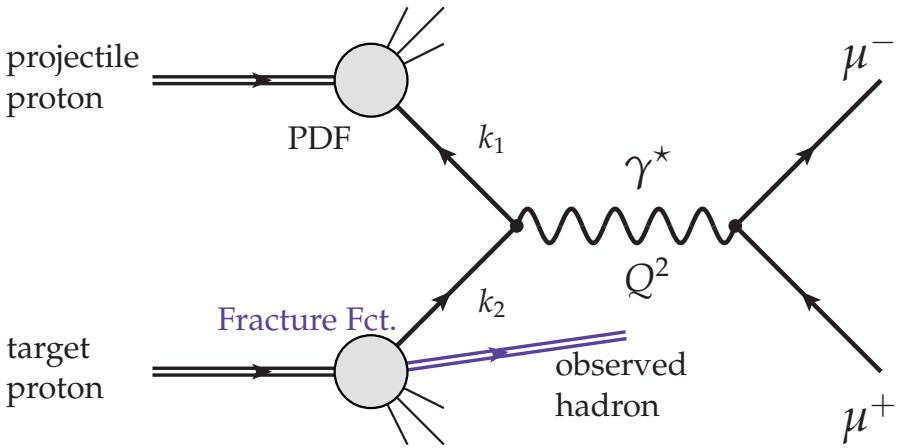

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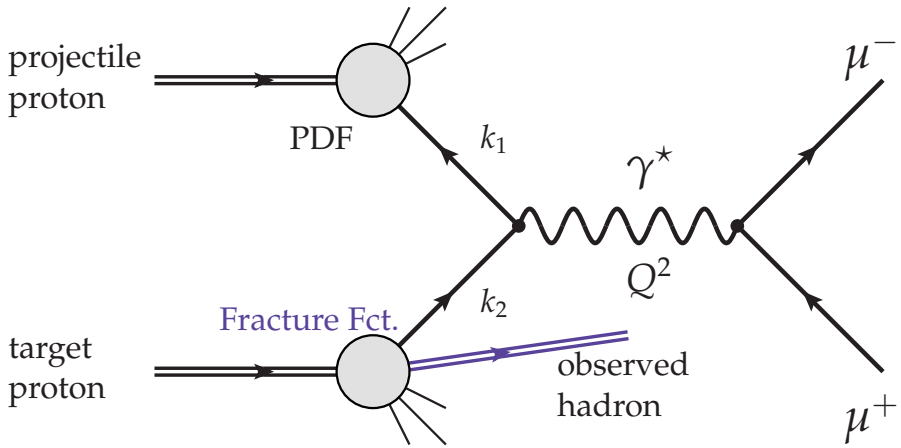

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Part IV

Conclusion and outlooks

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