Forward heavy-ion physics at the LHC

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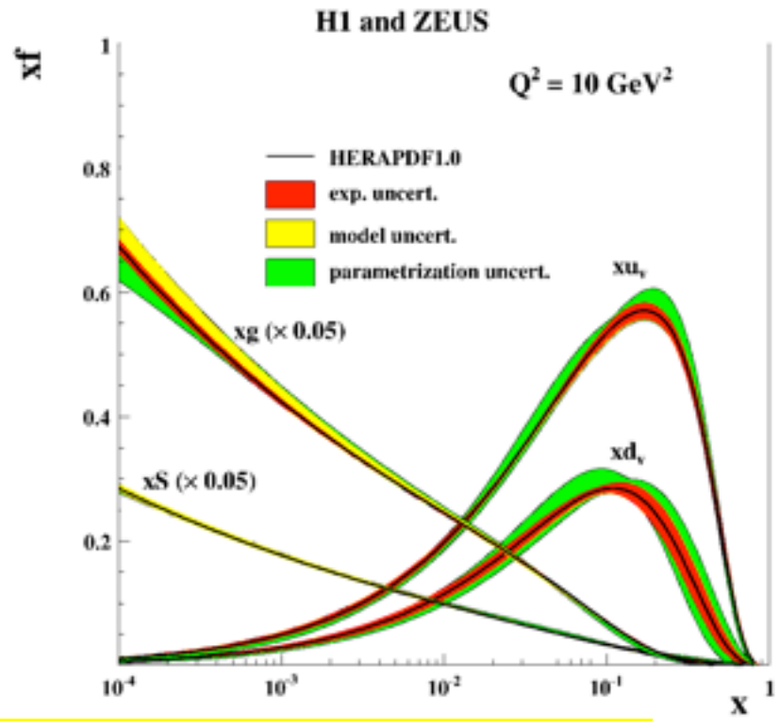
Forward HI physics

the nature of the initial state is one of the most important questions in relativistic heavy-ion physics.

Low-x regime dominated by gluons



UPCs are cleaner probes of nPDFs

UPC at LHC can be seen as the precursor of part of the EIC physics

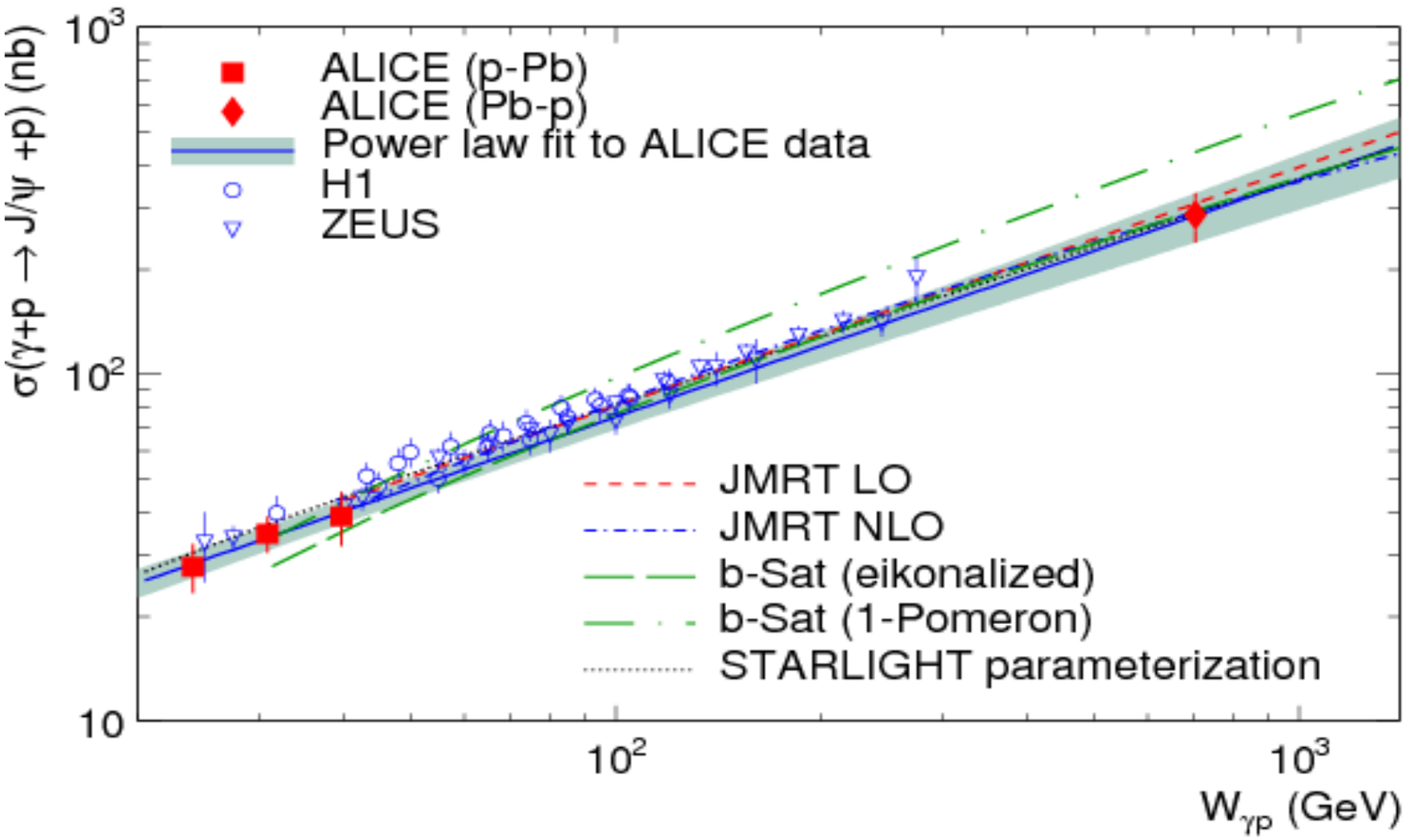
UPC described in the two recent White Papers:

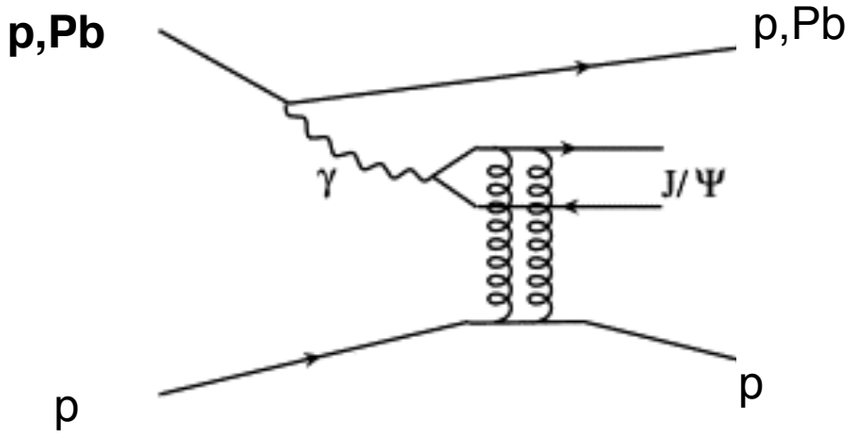
EIC white paper: *arXiv:1212.1701 [nucl-ex]*

HI White paper: *arXiv:1502.02730 [nucl-ex]*

Gluon saturation

Phys.Rev.Lett. 113 (2014) 23, 232504





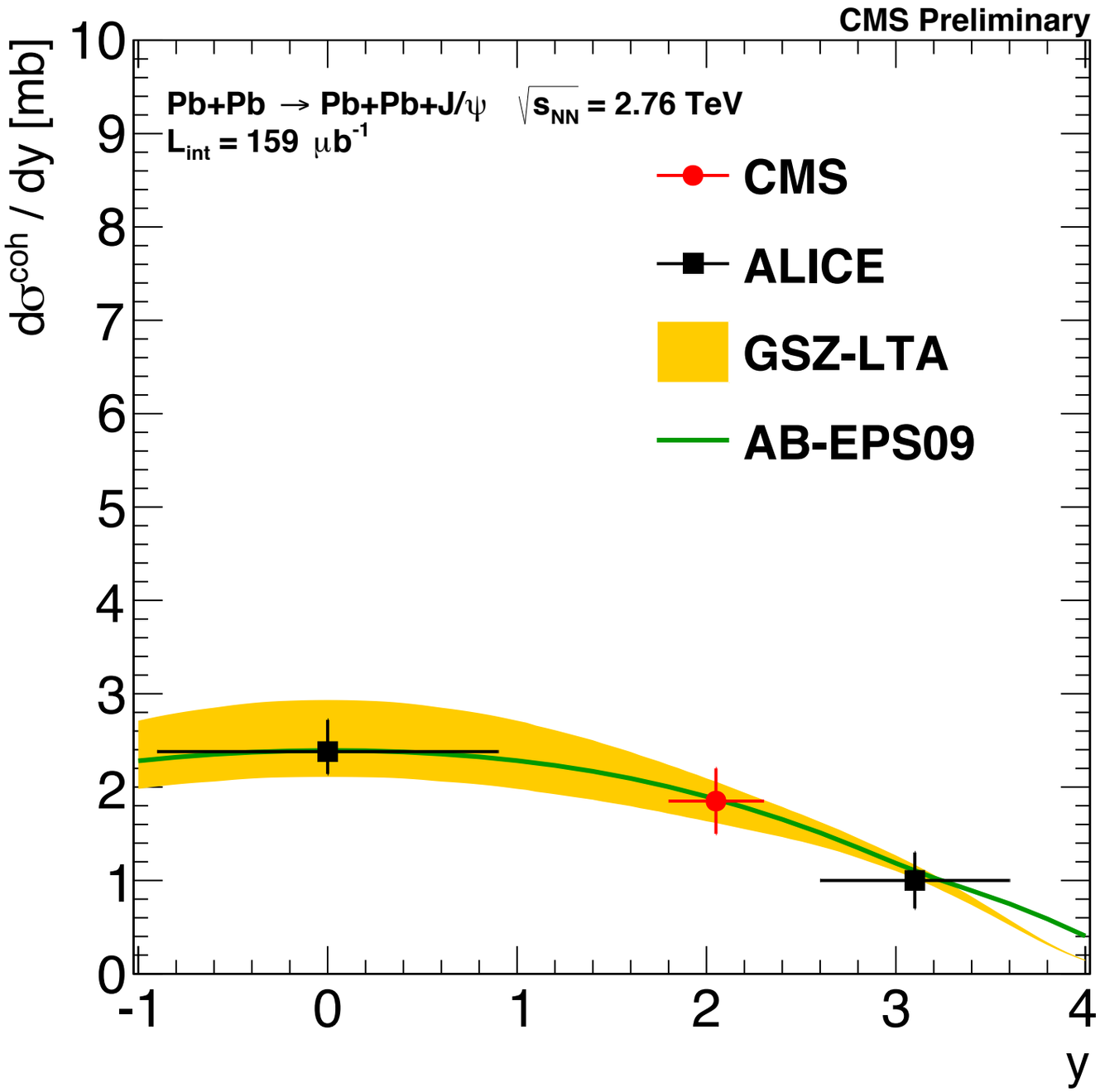
$$\frac{d\sigma_{\gamma \mathrm{Pb} \to J/\psi \mathrm{Pb}}(t=0)}{dt} = \frac{16\,\Gamma_{ee}\pi^3}{3\alpha_{em}M_{J/\psi}^5}\left[\alpha_s(Q^2)xG_{\mathrm{Pb}}(x,Q^2)\right]^2$$

UPC VM in pp, p-Pb is a direct tool to measure saturation

Bjorken $x \sim 10^{-2} - 10^{-5}$

accessible at LHC

Coherent J/Ψ photoproduction

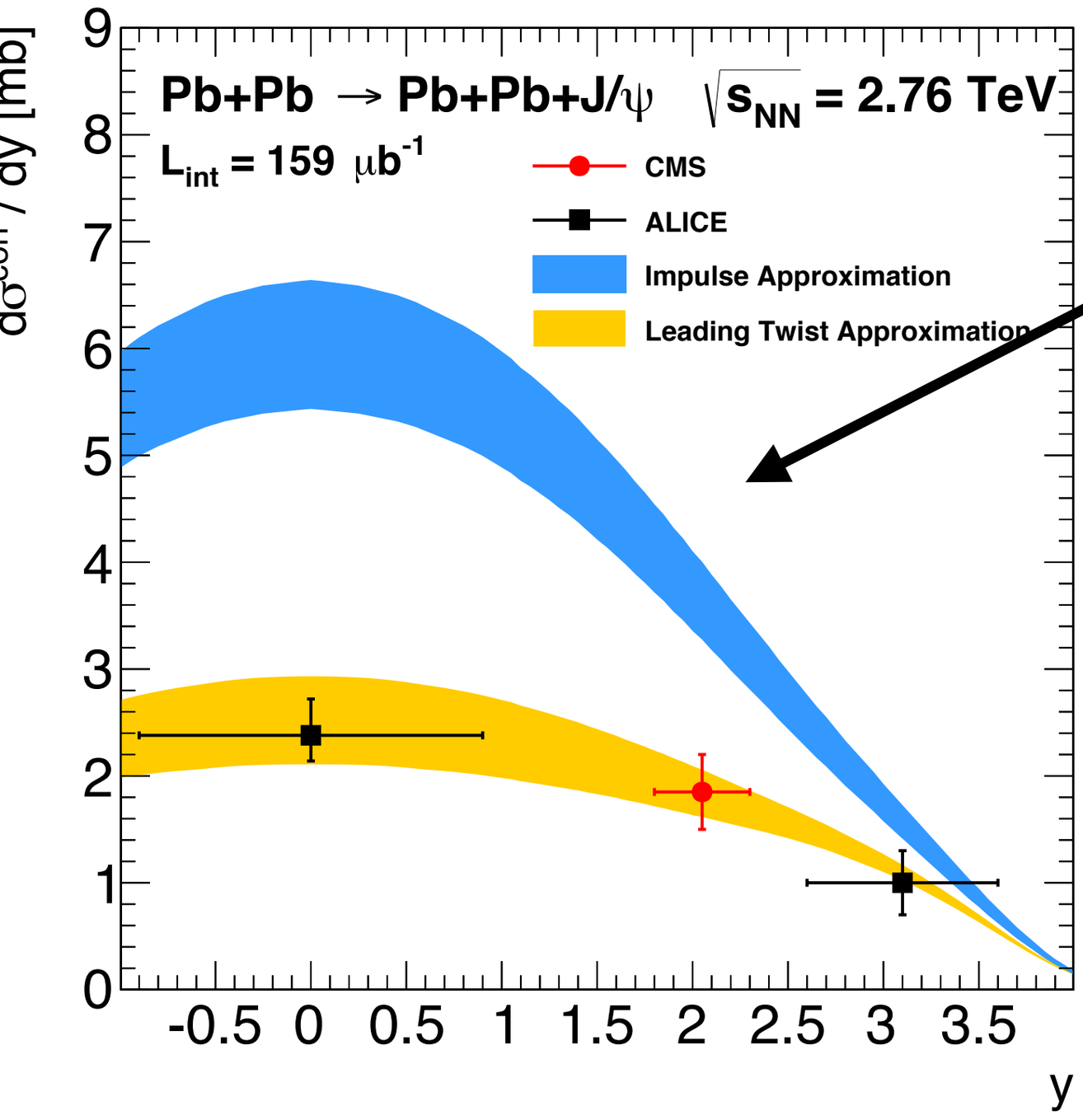


Phys. Lett. B718 (2013) 1273-1283

Eur. J. Phys. C73, 2617 (2013)

CMS-PAS-HIN-12-009 (2014)

Coherent J/Ψ photoproduction

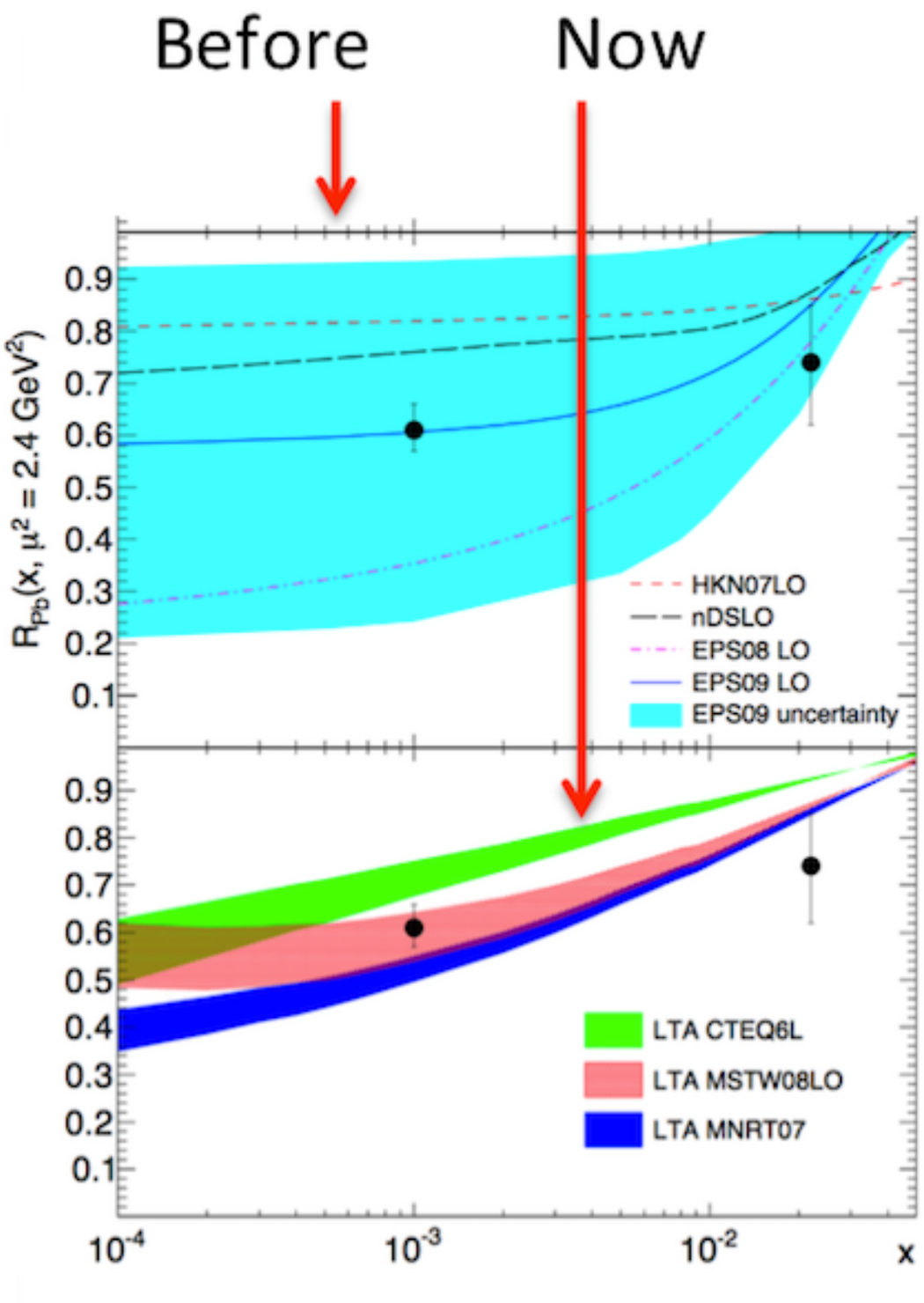


Model independent. Parametrization of exclusive J/Ψ data in gamma-proton

i.e. No nuclear effects

Experimental evidence of nuclear gluon shadowing

Nuclear gluon density

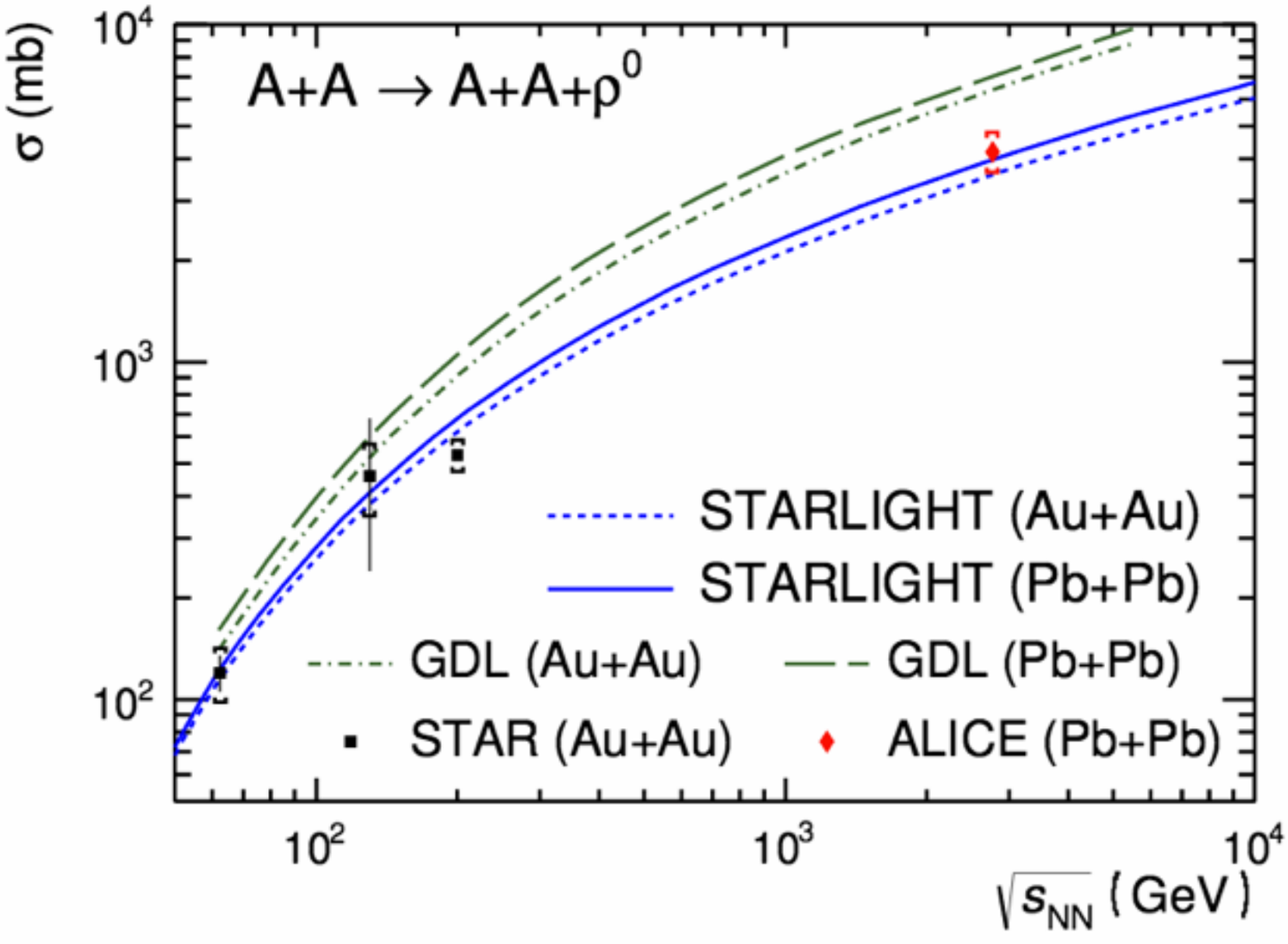


$$S_A(W_{\gamma p}) = \frac{G_A(x, \mu^2)}{AG_N(x, \mu^2)} = \mathbf{0.61}$$

For x ~10^-3 and Q2 = 3 GeV2

Coherent Rho0

JHEP 1509 (2015) 095

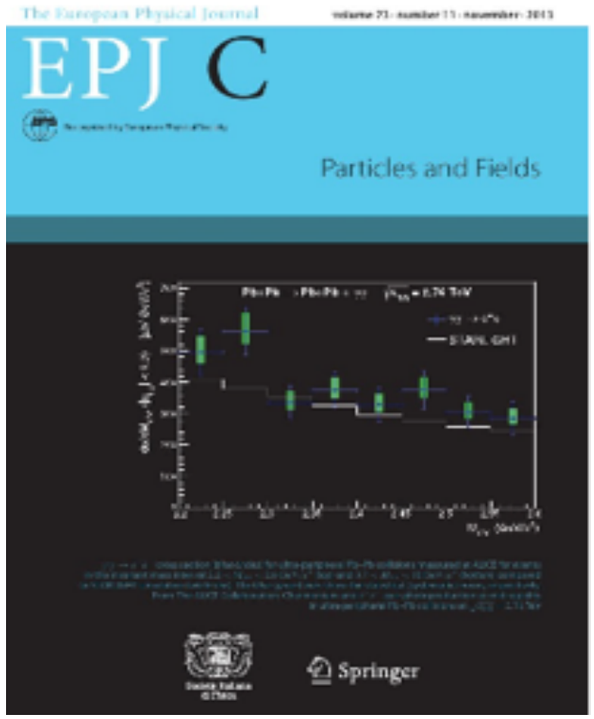


Both ALICE and STAR find measured cross section ~40% lower than predicted by Quantum Glauber, ….although works fine at fixed-target experiments

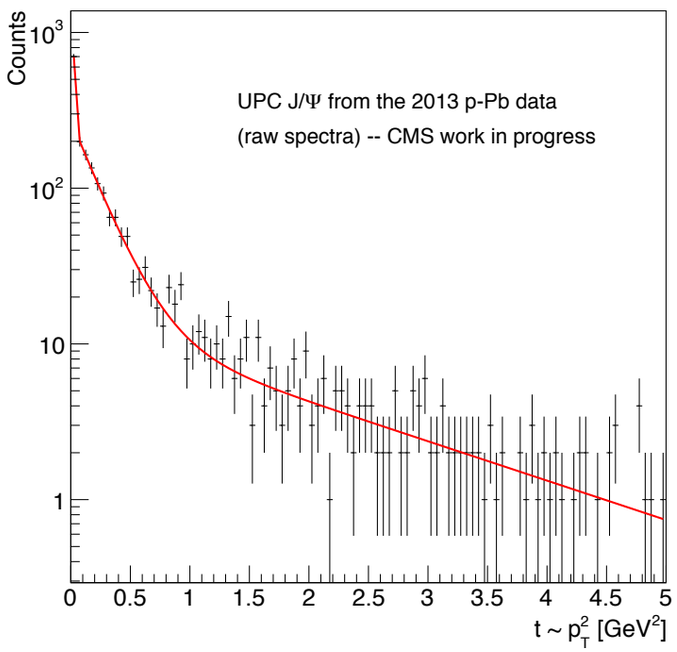
Nuclei does not behave like individual nucleons?

Many new channels will be available with innovative triggers in Run 2 and Run 3

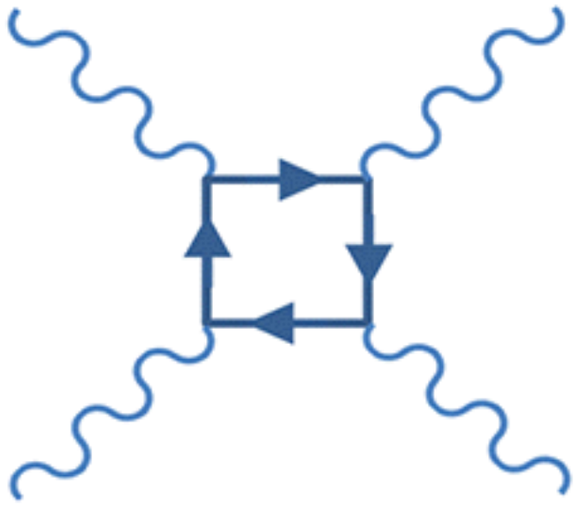
Two-photon process



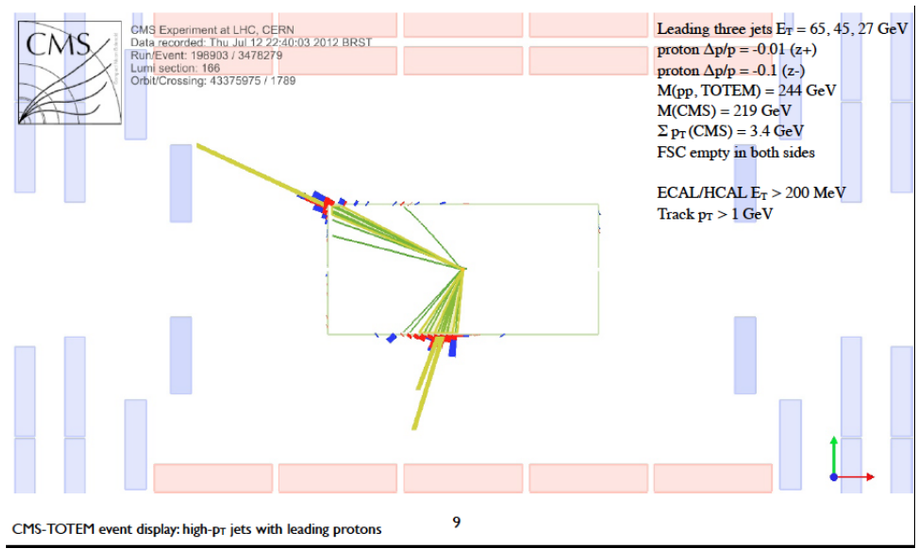
t-dependance



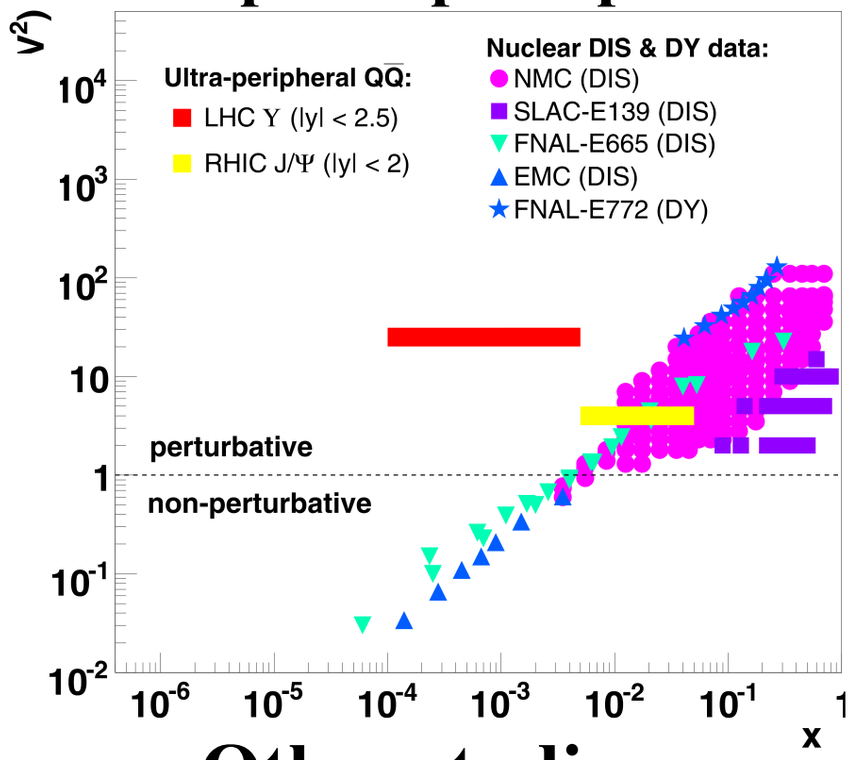
Light-by-light



UPC Jet



Upsilon photoproduction

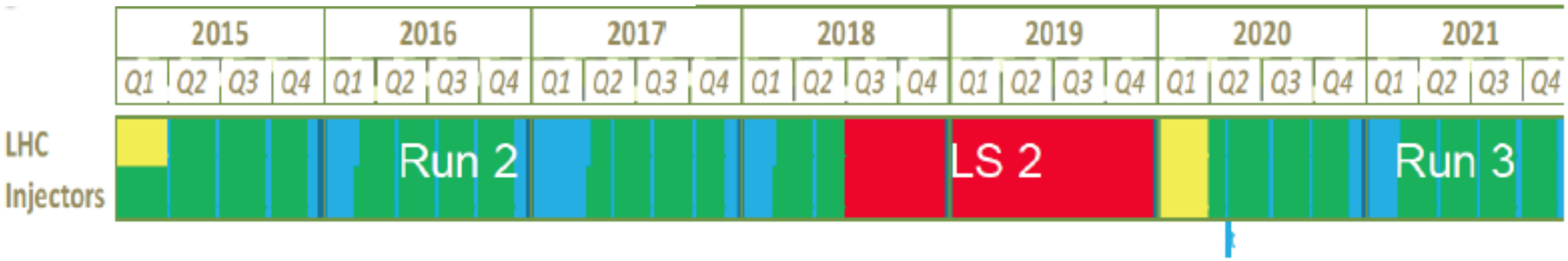


Other studies also possible …

- UPC Phi meson
- Exotic quarkonia
- Glueballs
- Dark photons
- Z/W photoproduction
- Higgs production

CERN Yellow Report

Many new channels will be available with innovative triggers in Run 2 and Run 3

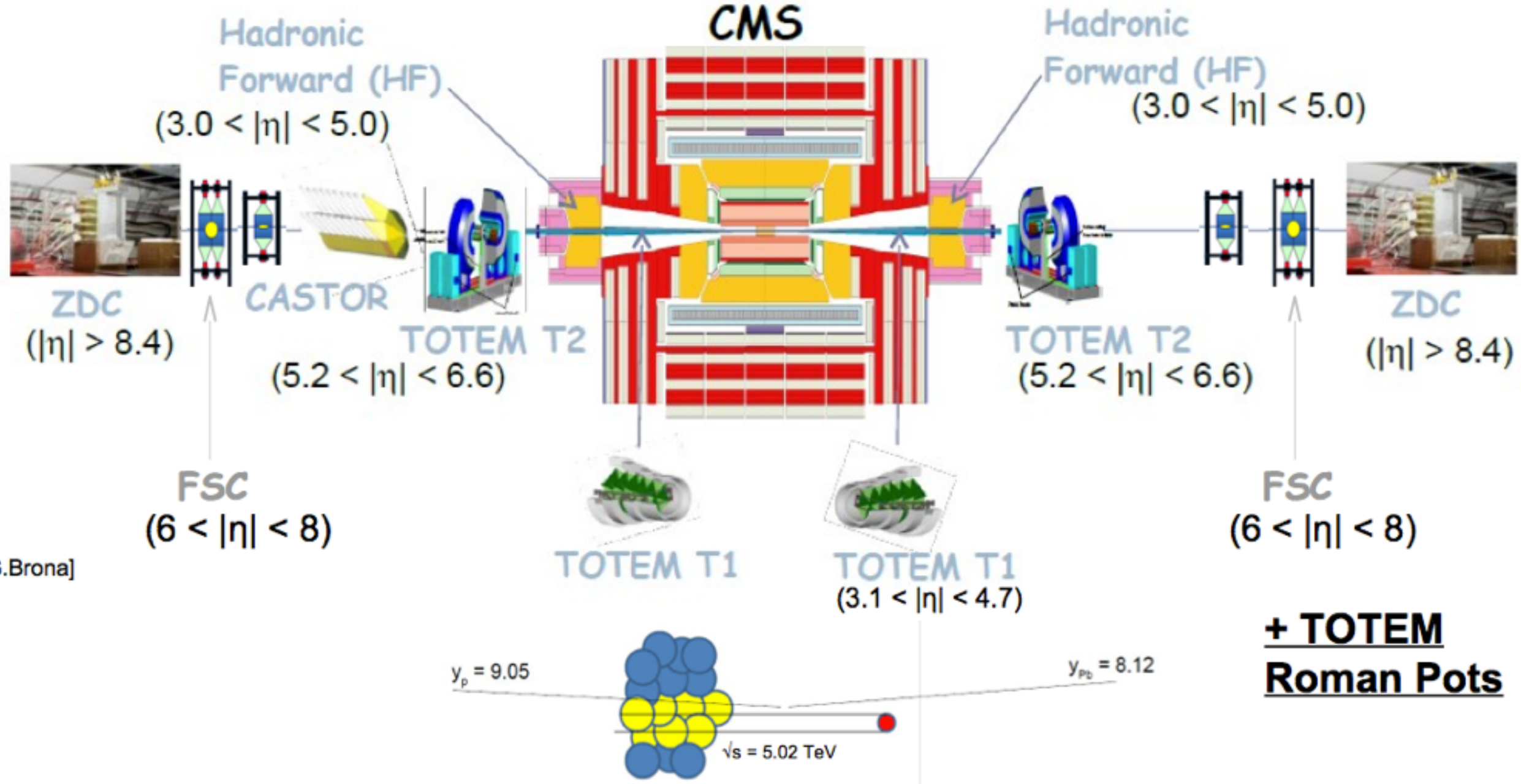


News: CERN Yellow Report on the **LHC Forward Physics** submitted to the LHCC in Summer 2015

At the very least, UPC physics at the LHC is a good testbed of EIC physics

Forward Heavy-Ion PhysicsWorkshop
Lawrence, KS - September 2014
http://cern.ch/lawrence2014

Additional slides



[G.Brona]

+ TOTEM Roman Pots