

**Heavy Ions at the FCC
CERN, November 26th 2015**

FCC-AA: small-x in pA

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van Leeuwen (Nikhef)**

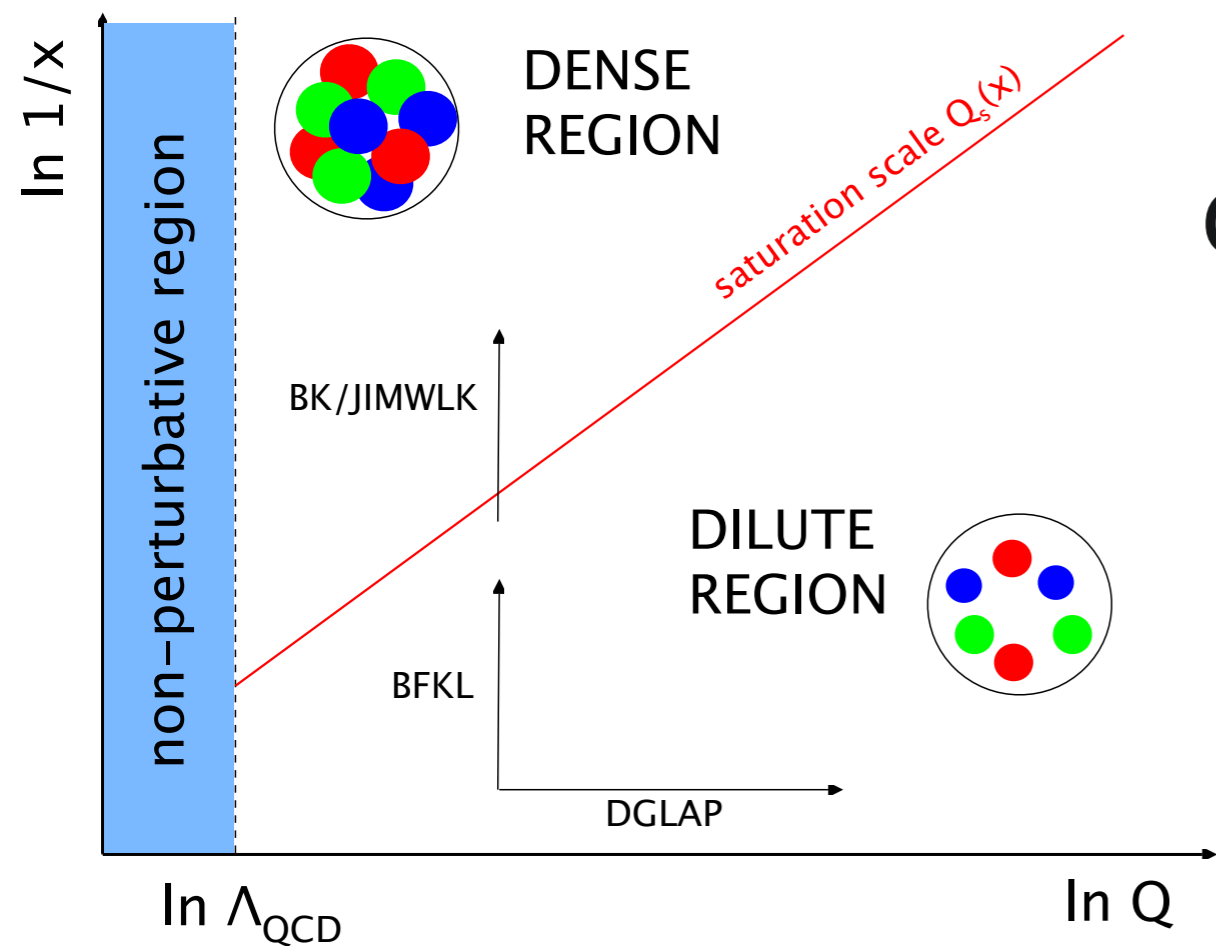
General structure:

1. Introduction: small-x and factorisation.
2. Inclusive spectra and R_{pA} .
3. Two-particle correlations and dijet measurements.
4. Constraining nPDFs. [David; should this be here?]
5. Relations with others.

~ 6 pages

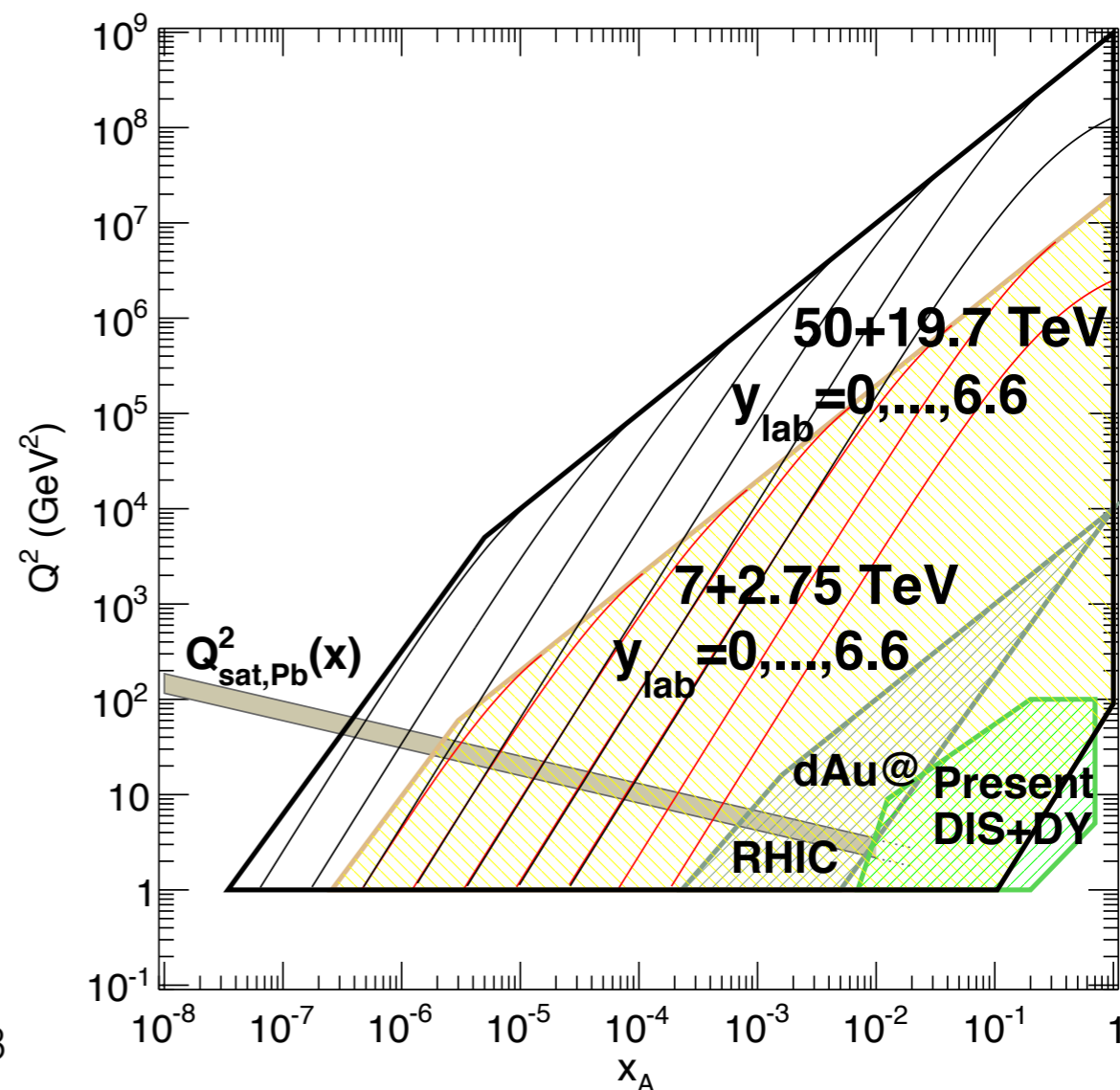
Introduction (I):

→ **Aim 1**: establish / study the existence of a new regime of QCD (CGC?), possibly no smoking gun.



→ Large enhancement in the kinematic plane: lever arm in $1/x$ for checking evolution.

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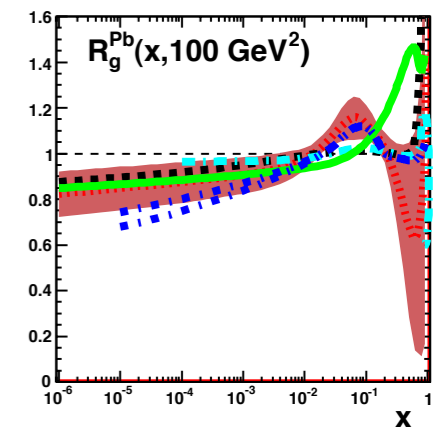
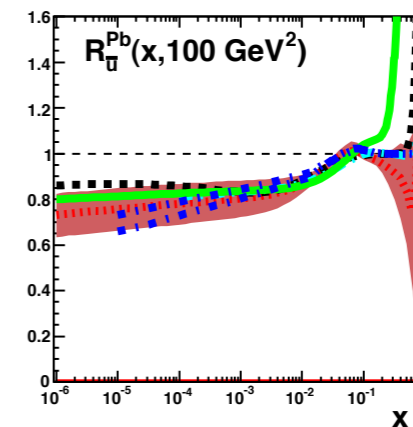
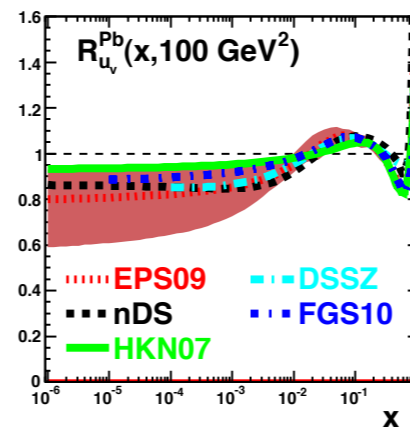
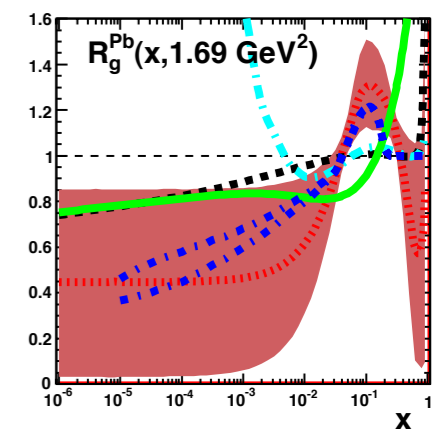
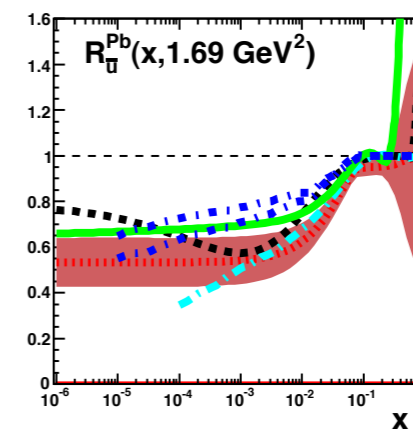
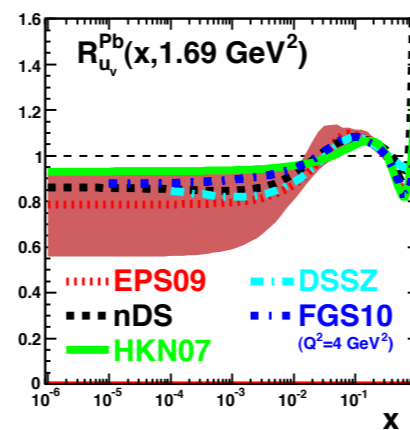
Introduction (II):

→ **Aim 2**: clarify the initial conditions for AA collisions (**Urs**), thus reducing the uncertainties in the determination of medium properties.

→ **Factorisation**: to be tested in pA, different at low and high scales.

→ At high scales:
nPDFs. nCTEQ15?

→ Link with other FCC-hh chapters.



Introduction (III):

- **Theory status on non-linear formalism:**
- Full NLO JIMWLK evolution kernel [not yet used, rcBK].
 - Resummed kernels.
 - NLO DIS impact factors [not yet used, LO].
 - NLO hybrid formalism for forward production.
 - Partial NLO k_T factorisation [not yet used].
 - LO correlations among hadrons, jets, photons, dileptons, ...
 - Azimuthal asymmetries [under study].
 - ...
- **Experimental status of the small-x regime:**
HERA; multiplicities, R_{pPb} , correlations, ridge, quarkonia; perspectives on jets, photons, Run I impact on nPDFs studies available for draft.

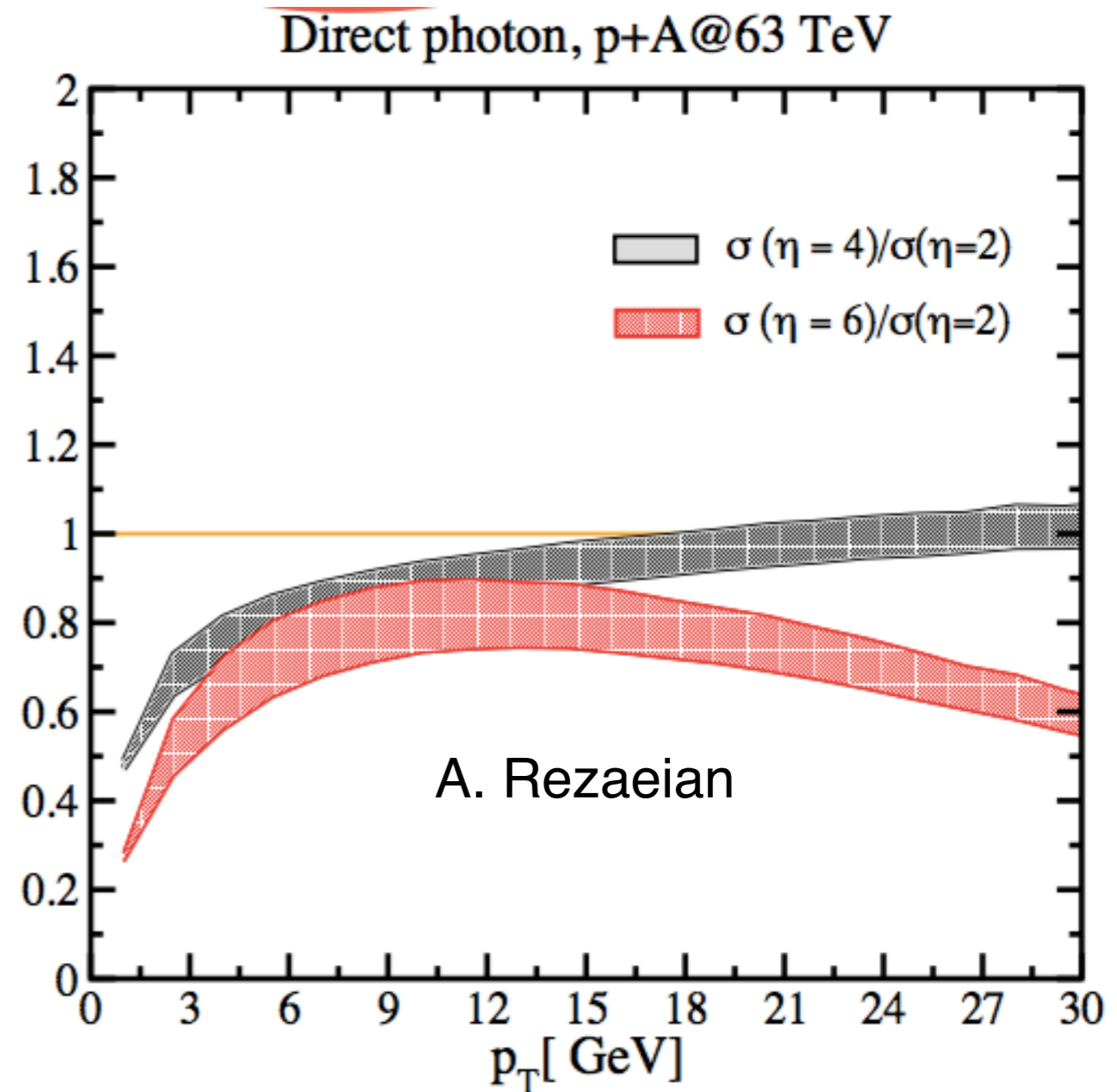
Inclusive spectra, R_{pPb}

→ Inclusive production reaches $x \sim 10^{-6}$ at $y = 5$, Q_s could be up to a few GeV.

→ Currently only one prediction: photons at fwd. rap., suppression not much larger than at LHC?

→ Ratios large/small rap. probe x evolution, should we ask for R_{pPb} plot?
Hybrid at NLO?

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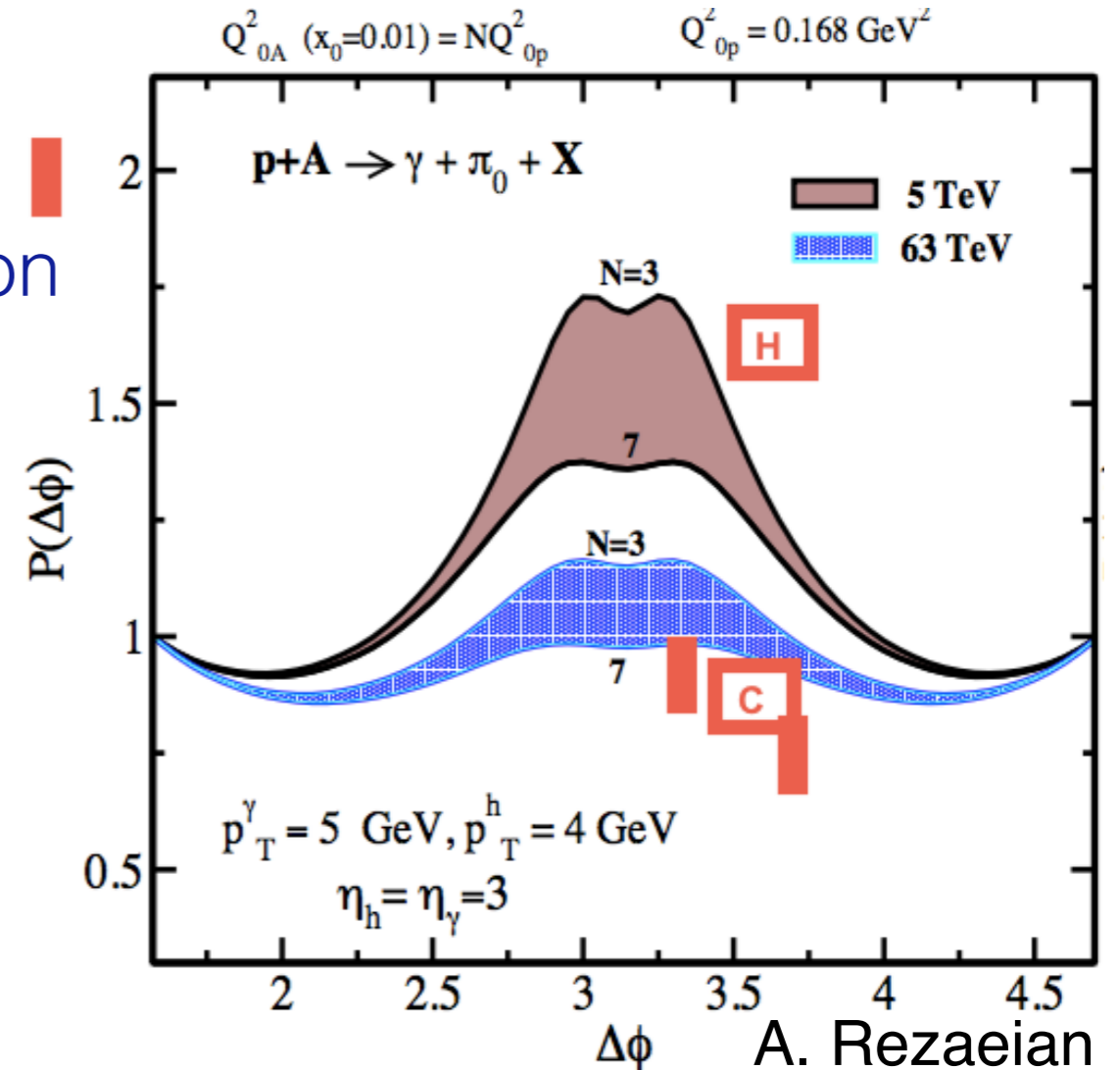


2-particle correlations

→ Fwd-fwd correlations probe low x ,
fwd-mid correlations probe evolution in x .

Example: γ - π^0 correlation

→ Recoil broadened and suppressed due to multi-gluon recoil (CGC).



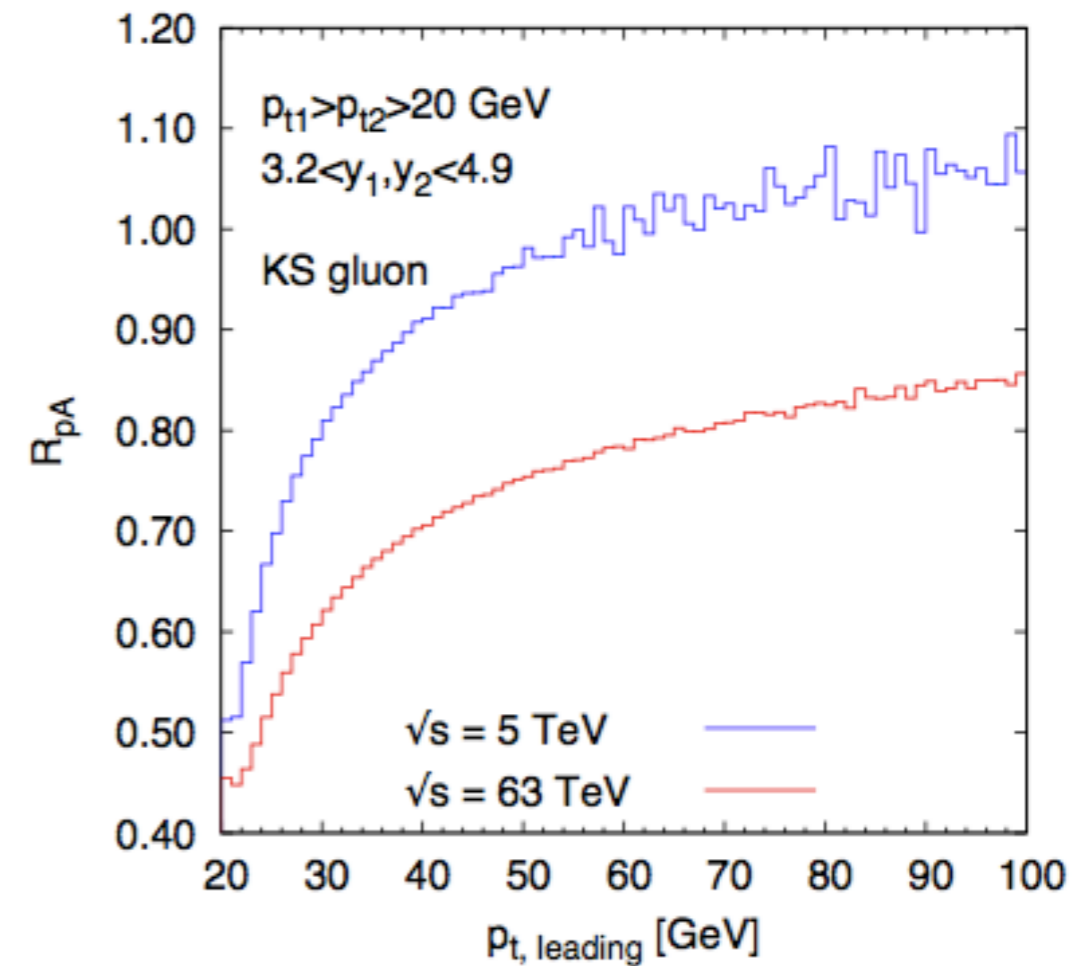
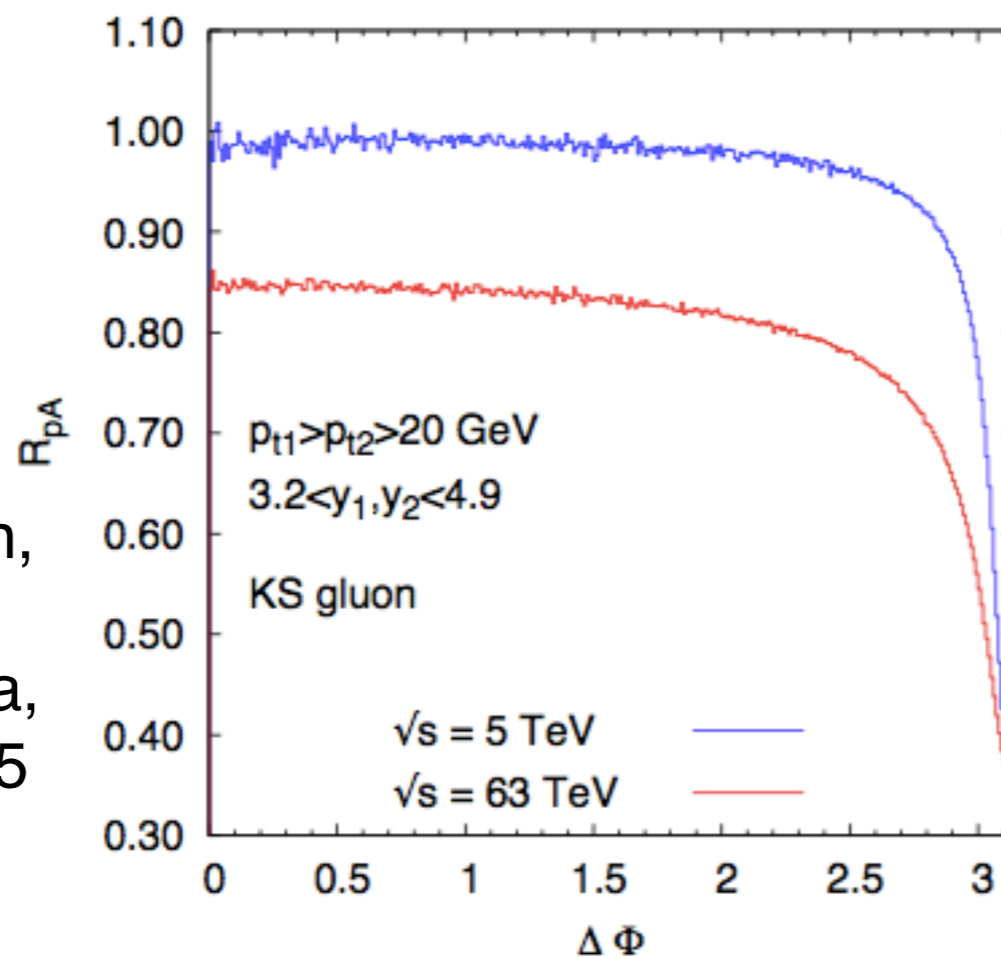
→ Effect stronger at FCC; check pp reference for kinematic effects.

Di-jets

→ Motivation very similar to two-particle measurements.

→ Clear suppression of recoil yield expected.

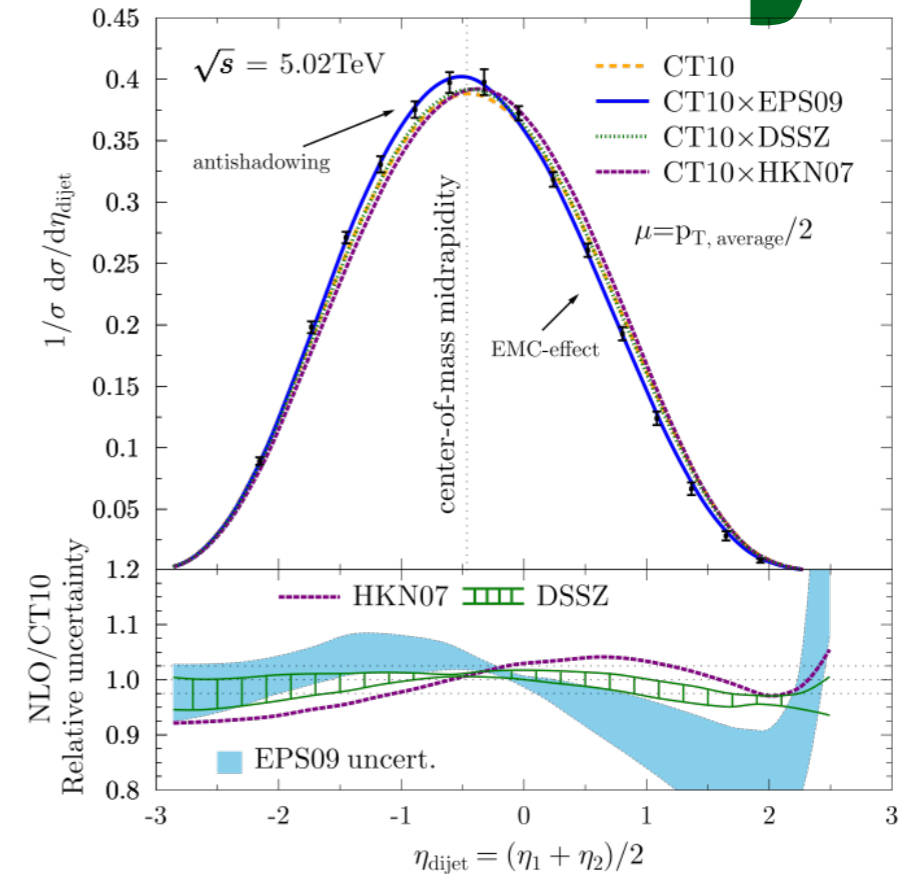
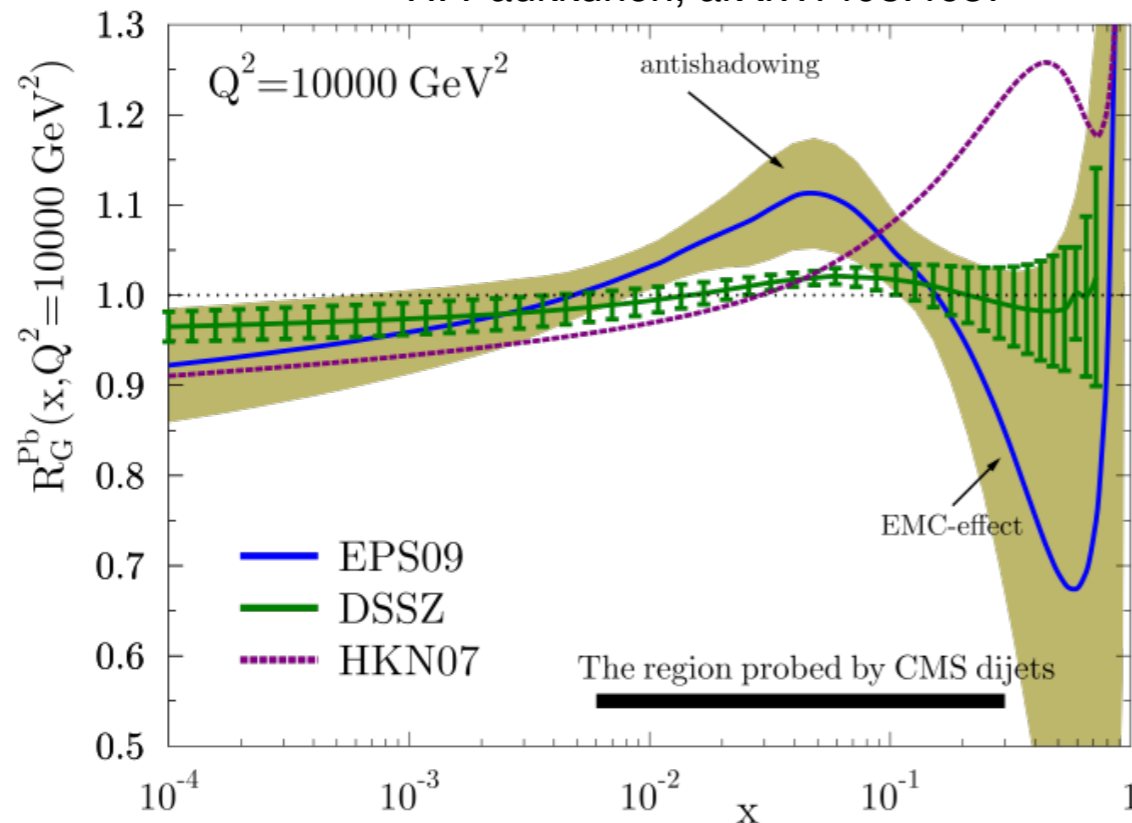
A. van Hameren,
Kotko, Kutak,
Marquet, Sapeta,
arXiv:1402.5065



→ FCC calculation to be updated for January.

Di-jet eta asymmetry

H. Paukkunen, arXiv:1408.4657



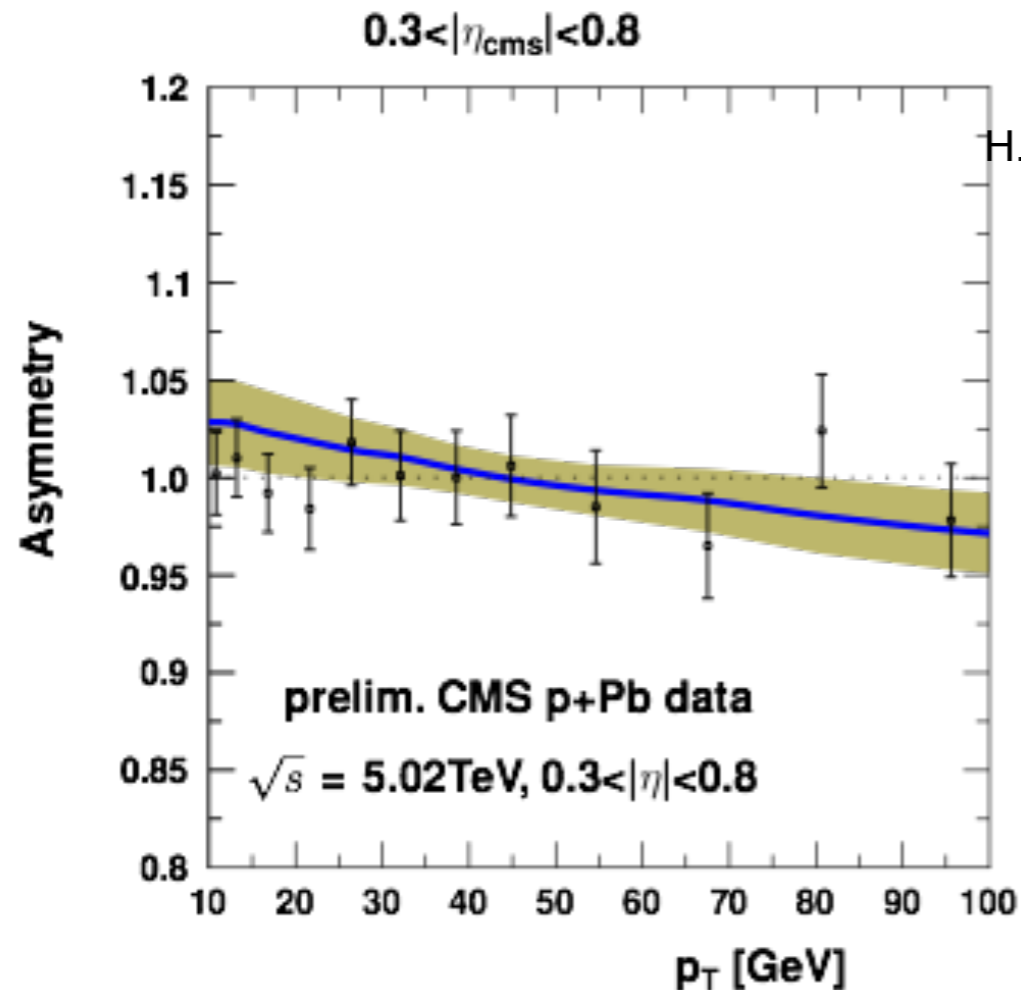
→ At LHC: very precise measurement, sensitive to anti-shadowing (intermediate x) at high Q (more nPDF than CGC, but think of HERA II).

→ Question: do we also hit the sweet spot in x at FHC? It should become small x .

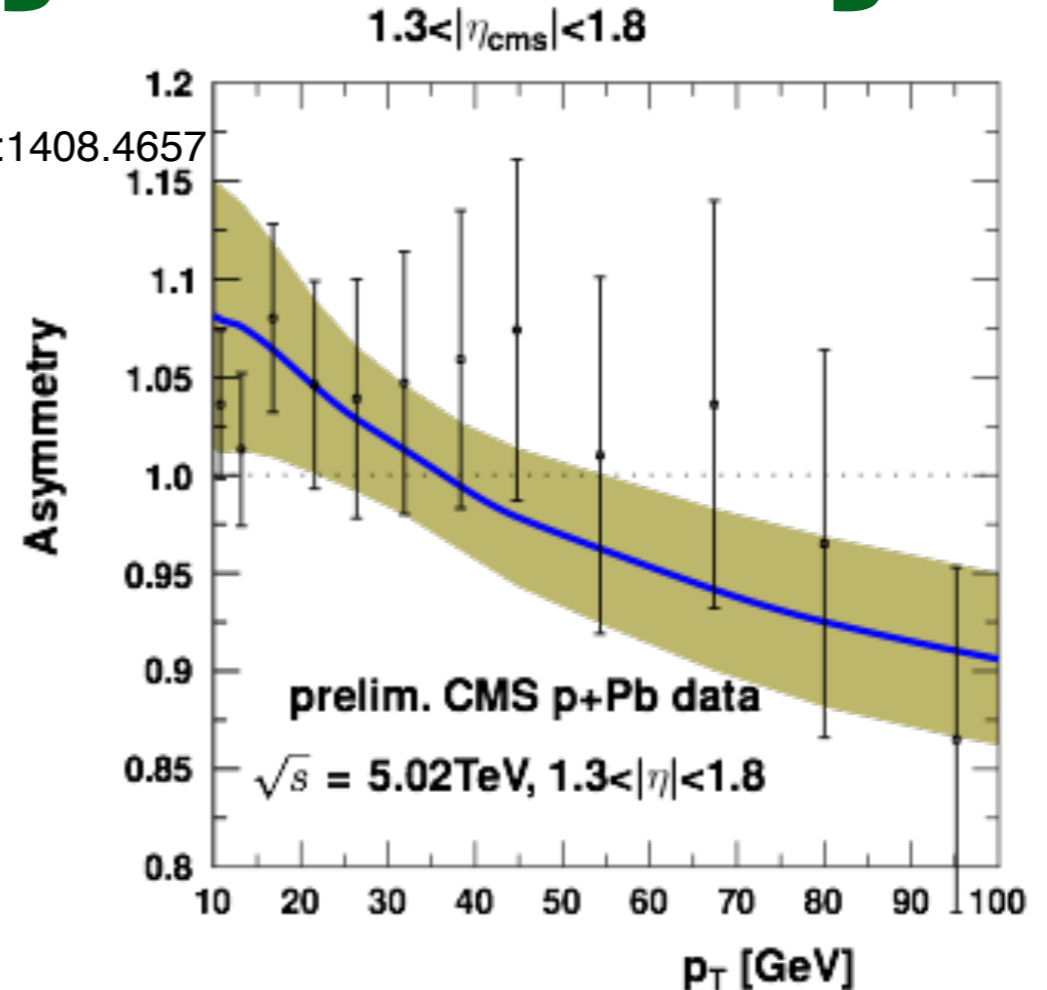
→ Caveat: centrality dependence.

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Hadron asymmetry



H. Paukkunen, arXiv:1408.4657

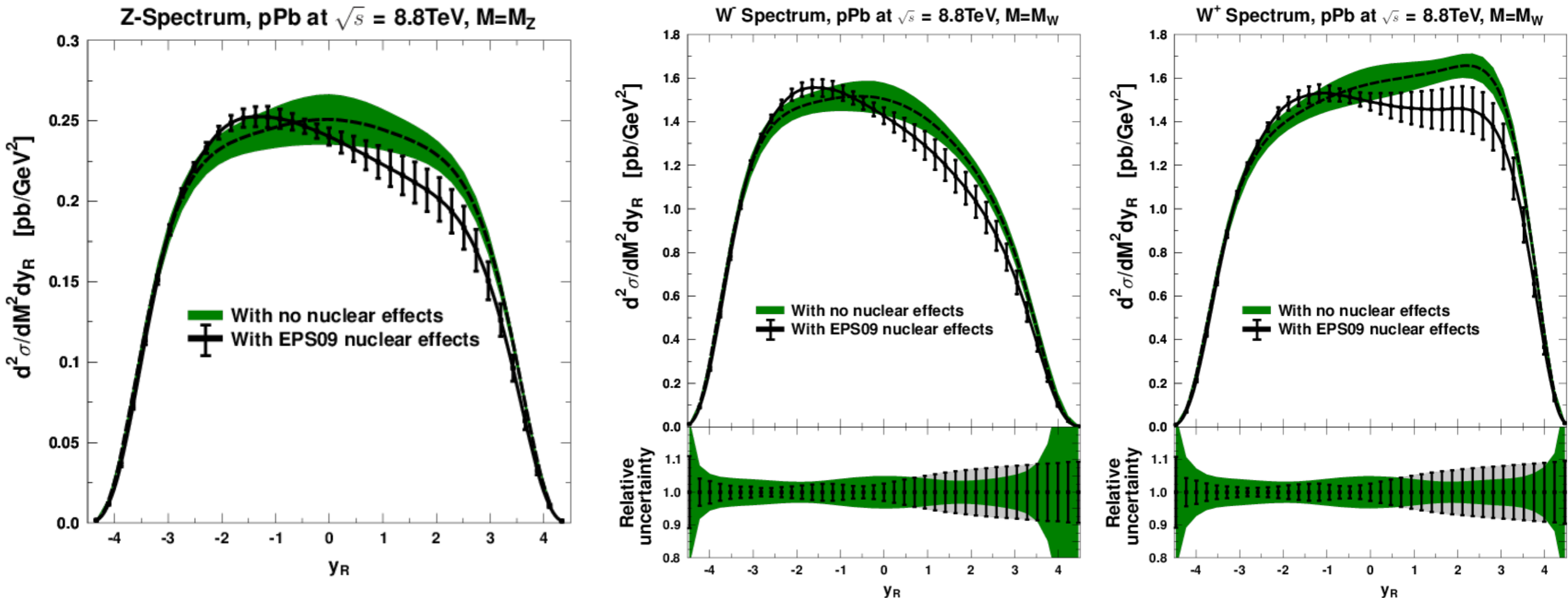


→ Advantage: compare fwd/bkwd, so no pp reference needed and some experimental uncertainties drop out.

→ Also sensitive to (anti-)shadowing; effects small; need high precision ($< 5\%$).

Electroweak probes

H. Paukkunen, C. Salgado, arXiv:1010.5392; H. Paukkunen, arXiv:1408.4657



→ Clear (anti-)shadowing effects expected at fwd/bkw rapidity; $\sim 5\%$ precision needed at LHC.

→ May be the 'best' (most QCD-independent) probe of nPDFs in hadron collisions? Ask?

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Relations:

→ **LHeC/FCC-he** should play the role that HERA played for protons @ LHC: provide parton densities, test factorisations from ep-eA to pp, pA and AA.
→ EIC?: probably little relevance.

→ FCC-ee: $\gamma\gamma$ to test small-x QCD evolution.

→ UPCs (David).

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