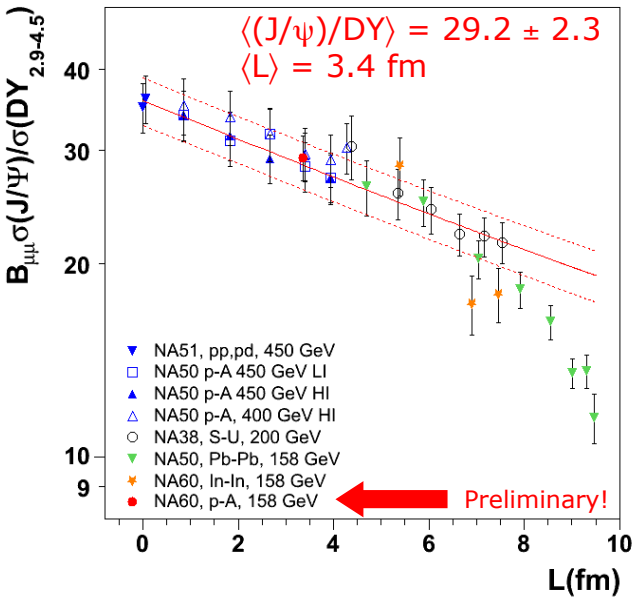
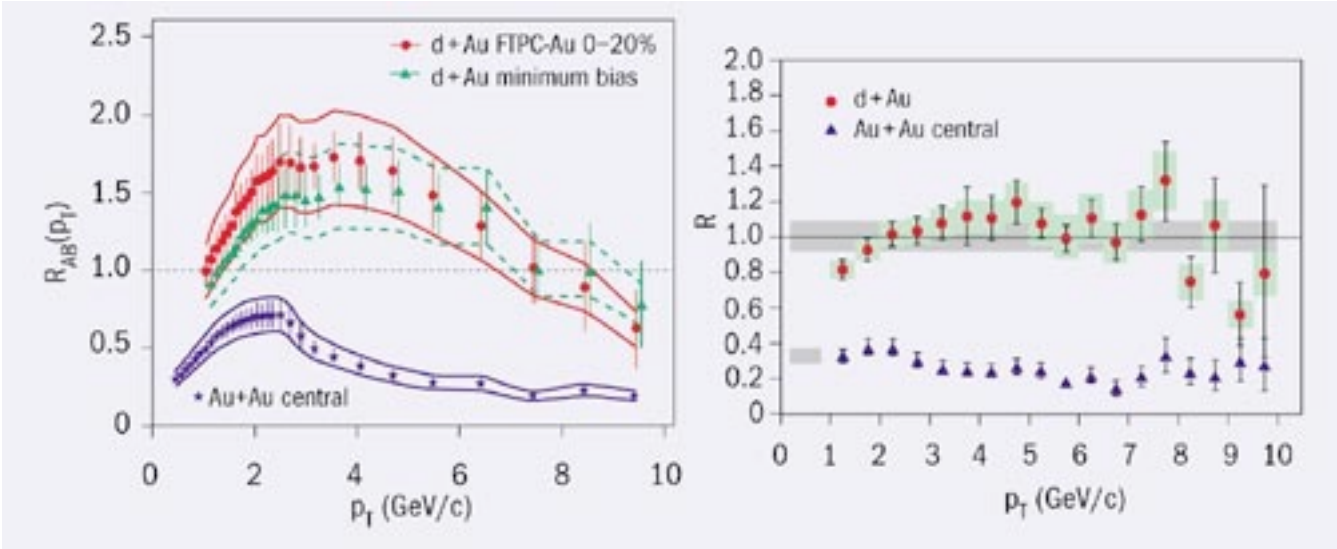
pA physics at the LHC

- ***LHC two-in-one magnet***
  - Equal rigidity :: $p_{\mathrm{Pb}} = Z\, p_{\mathrm{proton}}$
  - Center of mass shifted in rapidity $\Delta y = 0.46$
  - Top LHC energy for pPb: 8.8 TeV
- ***Estimated parameters for the 2012 pPb run***
  - Center of mass energy 5 TeV/A
  - Integrated luminosity ~25 nb^{-1}
  - Luminosity still **very uncertain**

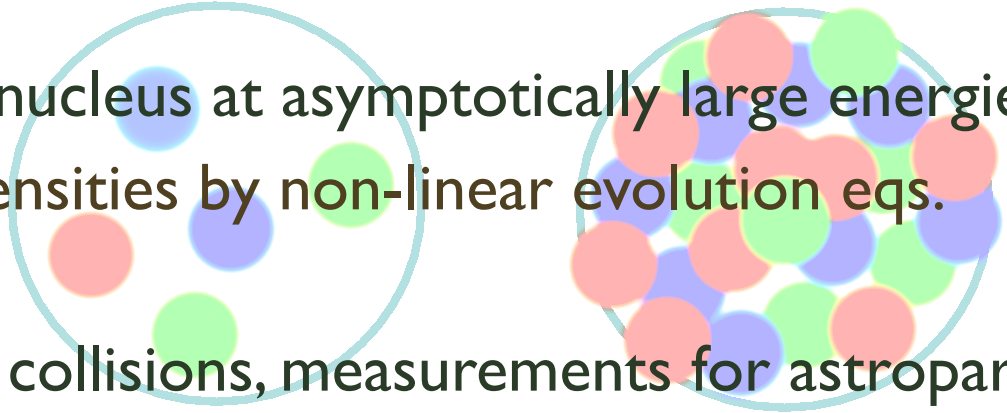
Dual role of pA/dA collisions

- **Benchmarking**: what are the cold nuclear matter effects?
  - Hard probes: nuclear PDFs and more

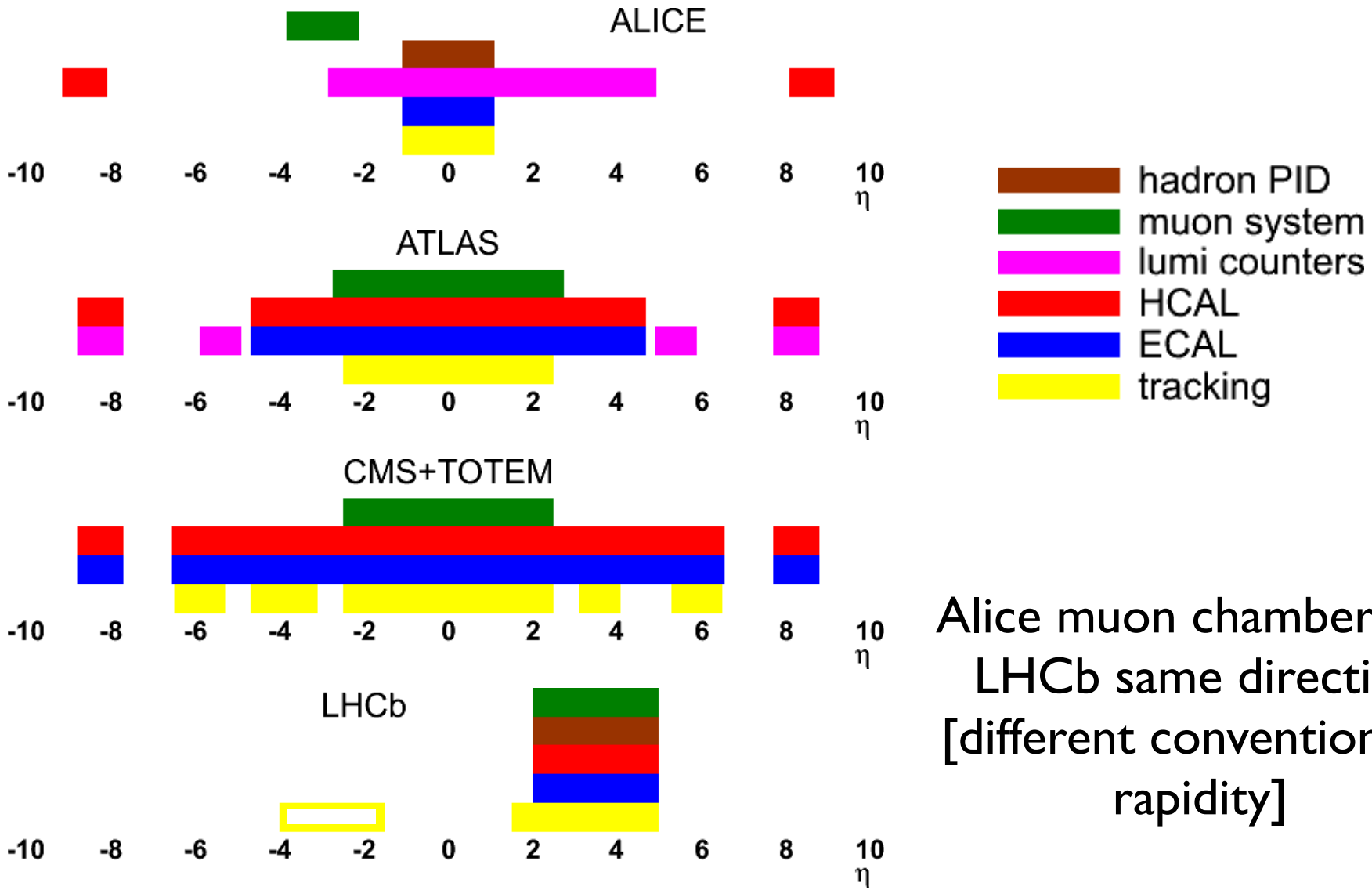




- **Small-x**: structure of the nucleus at asymptotically large energies
  - Saturation of partonic densities by non-linear evolution eqs.
  - Strong color fields
- and more... Ultraperipheral collisions, measurements for astropart...

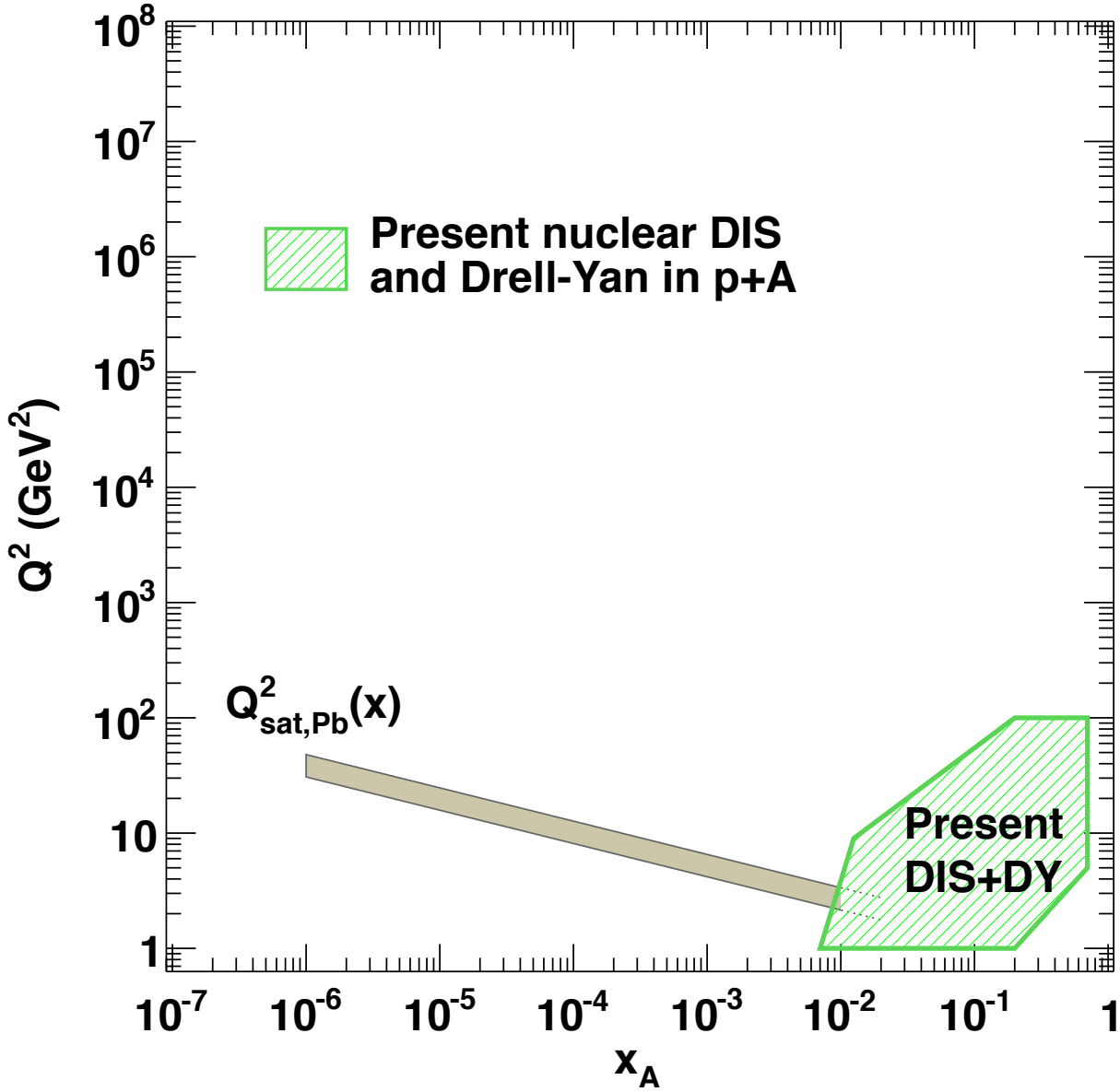


Comparison of angular coverage

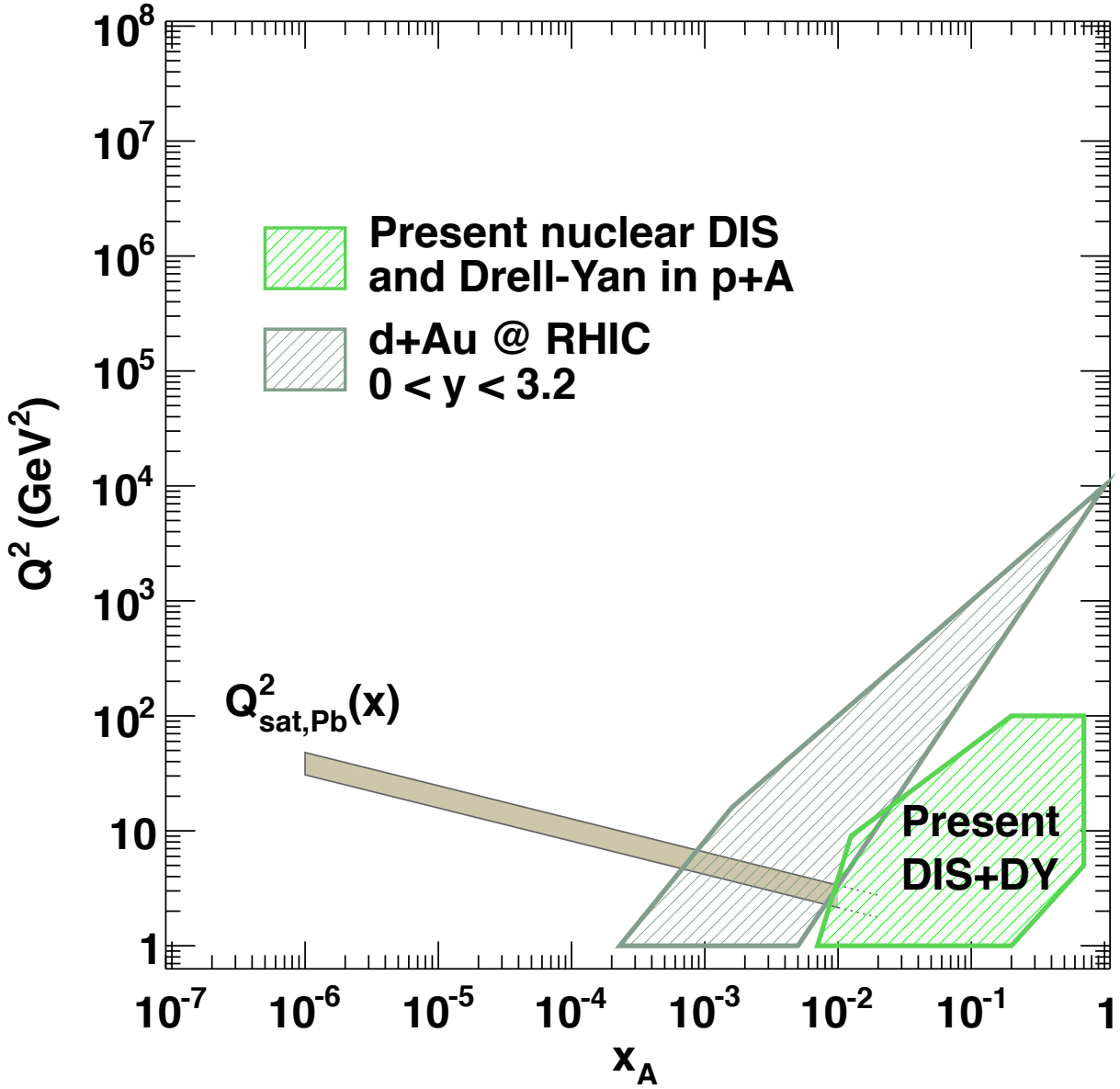


Alice muon chamber and LHCb same direction [different convention for rapidity]

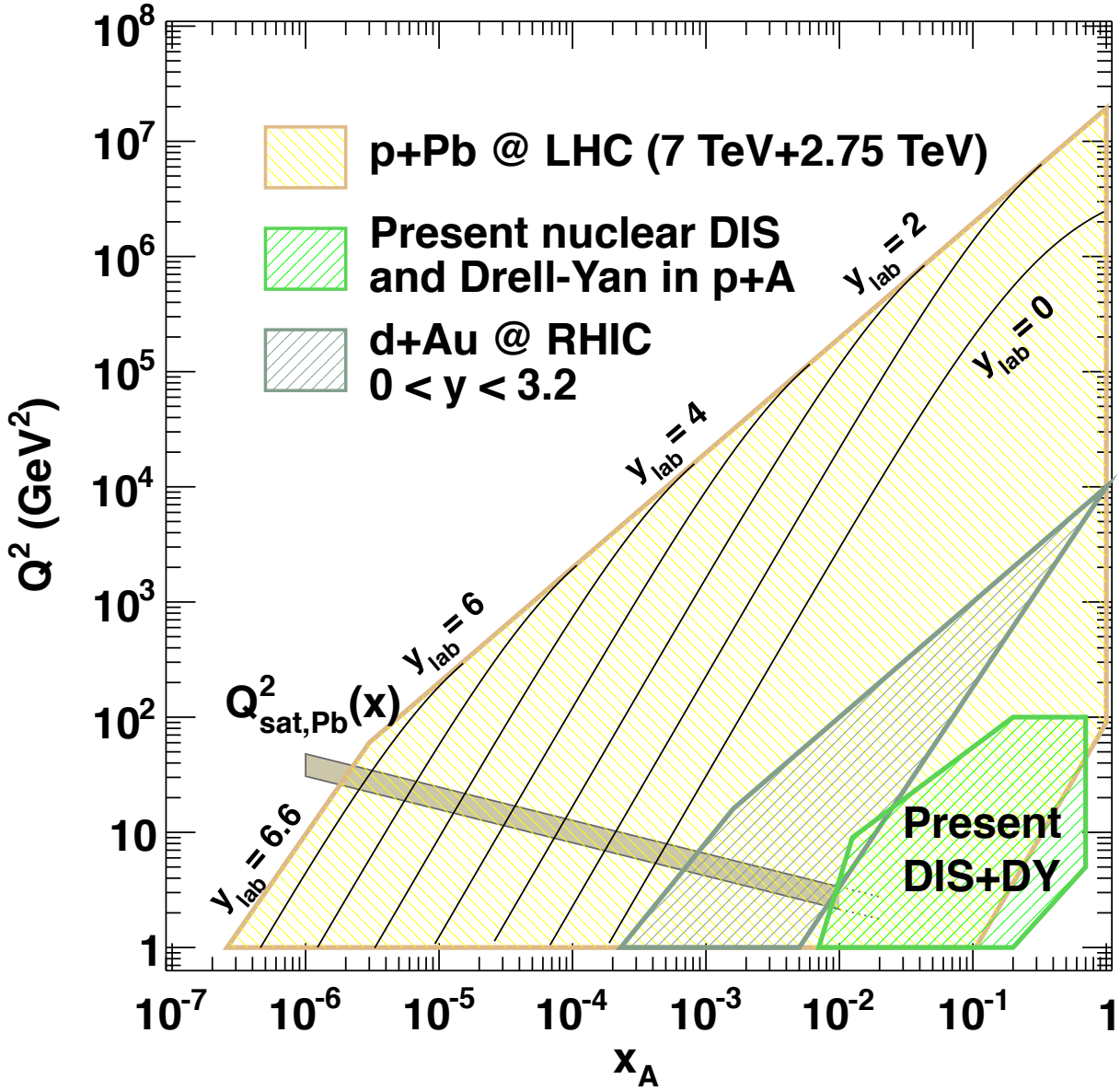
Kinematical reach in nuclear collisions



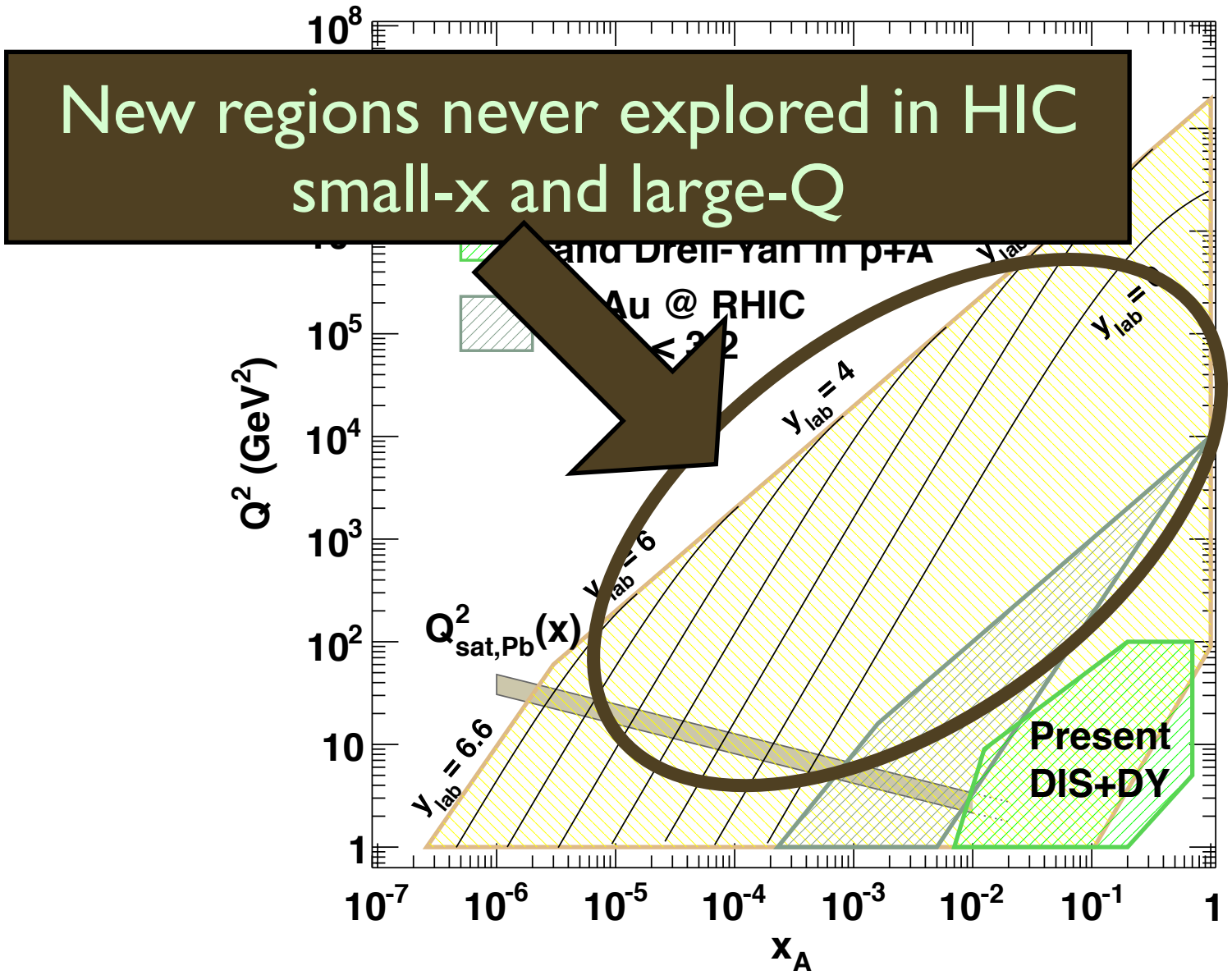
Kinematical reach in nuclear collisions



Kinematical reach in nuclear collisions

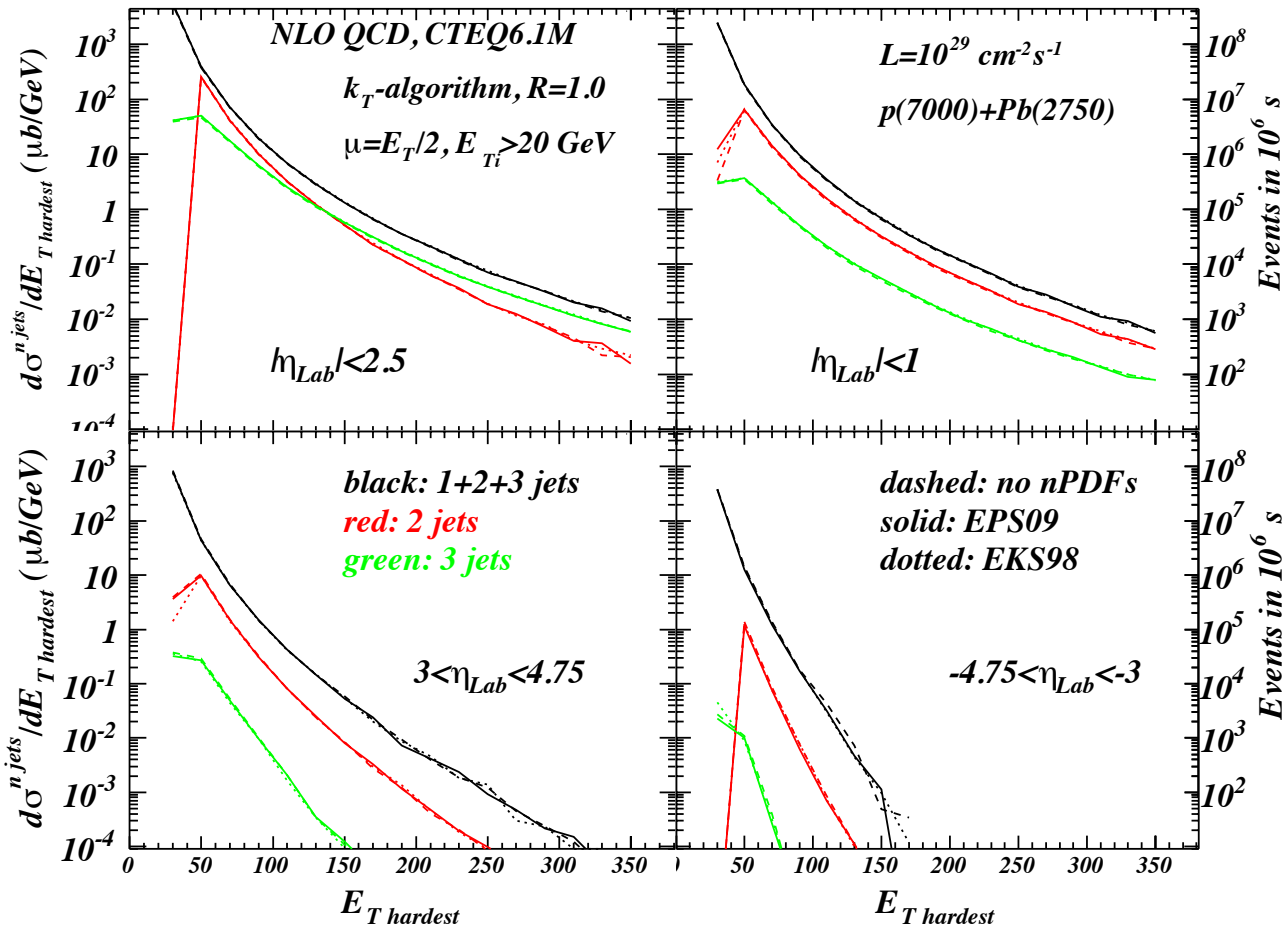


Kinematical reach in nuclear collisions



Yields of several processes

Calculations done at top LHC c.m. energy of 8.8 TeV
yields for 100 nb-1 [all taken from J. Phys. G: Nucl. Part. Phys. 39 (2012) 015010]



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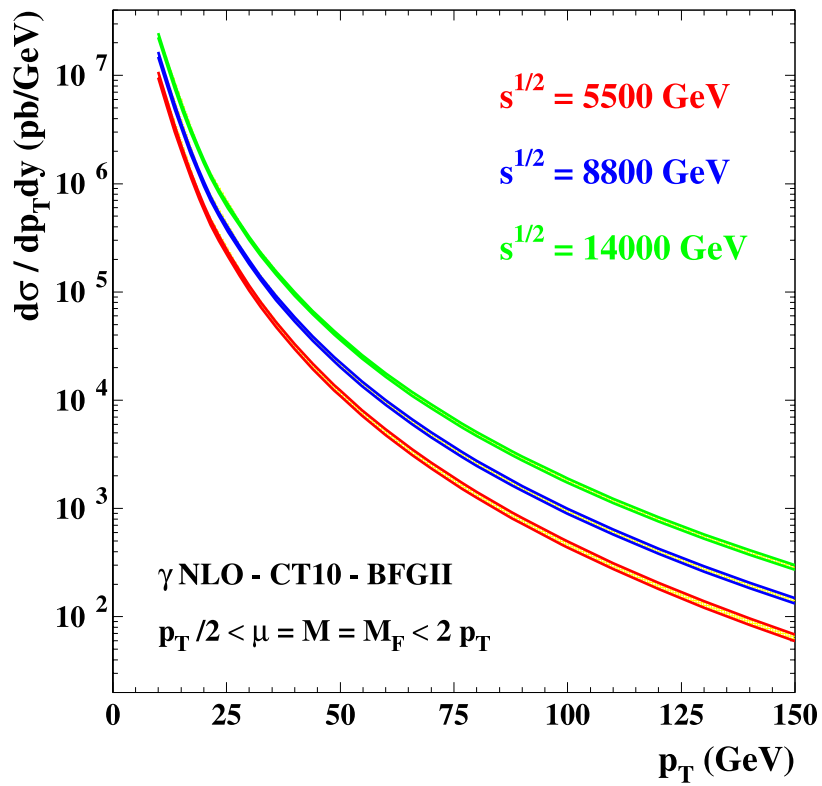
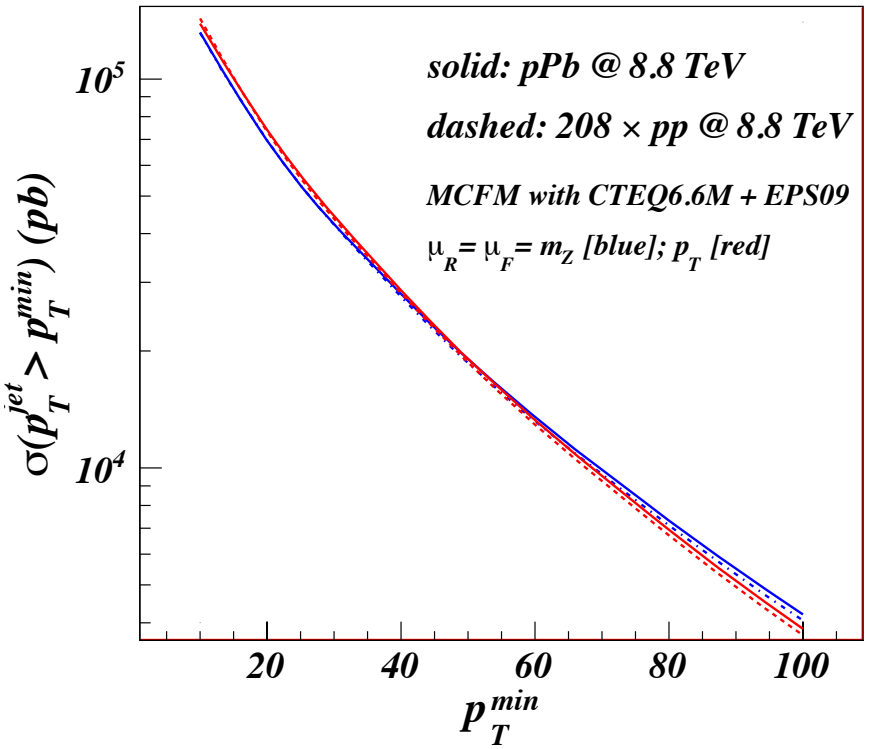


$(Z \to \mu^+\mu^-) + jet$



Order 4000 Z to dimuons at central rapidity

Yields of several processes

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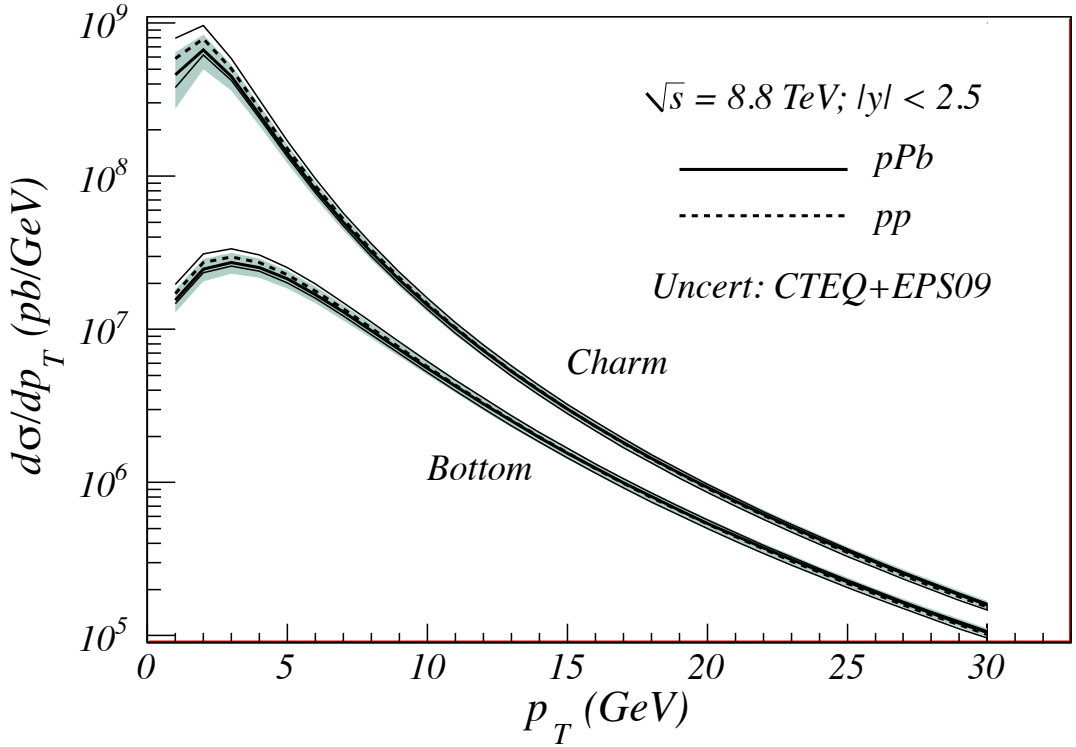
yields for 100 nb-1 [all taken from J. Phys. G: Nucl. Part. Phys. 39 (2012) 015010]



Yields of several processes

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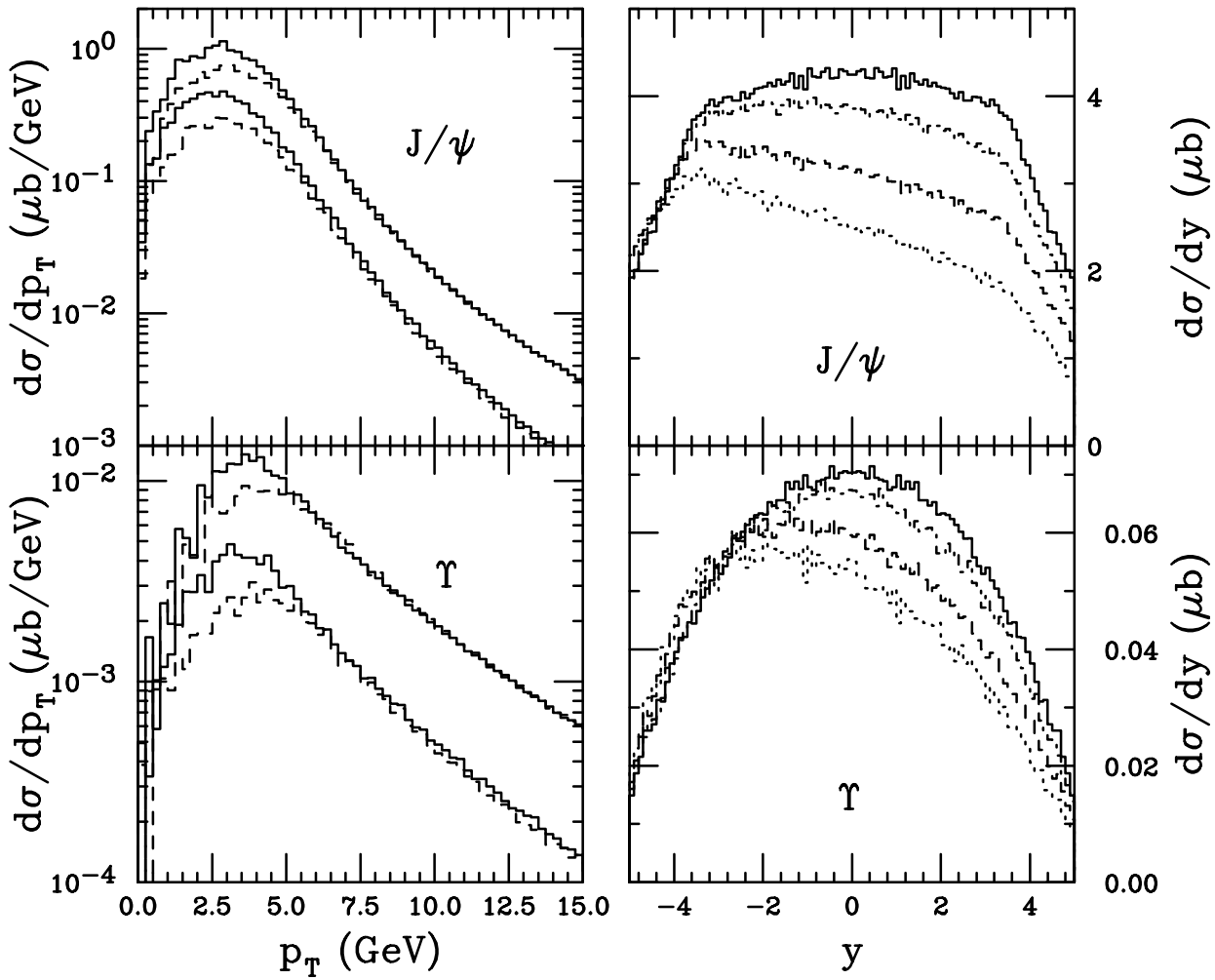
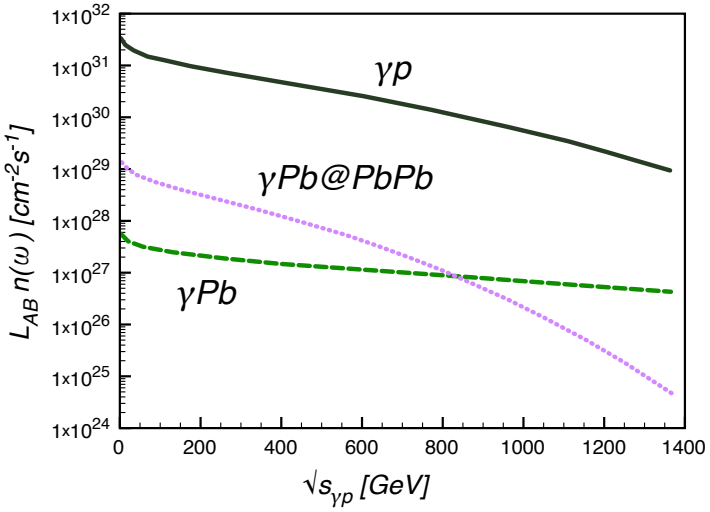
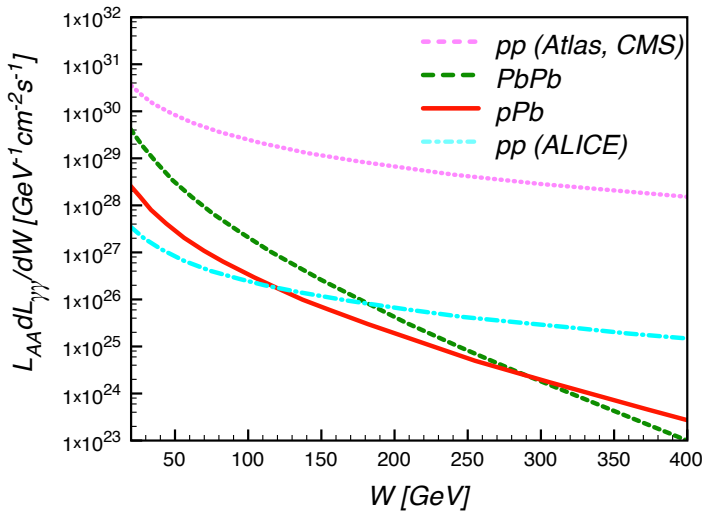
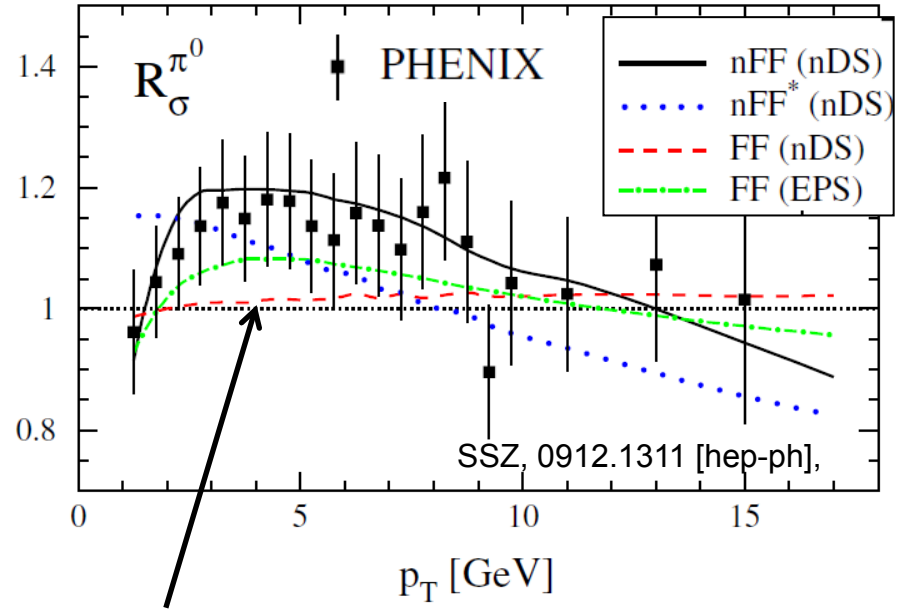


Ultraperipheral collisions

Calculations done at top LHC c.m. energy of 8.8 TeV
yields for 100 nb-1 [all taken from J. Phys. G: Nucl. Part. Phys. 39 (2012) 015010]







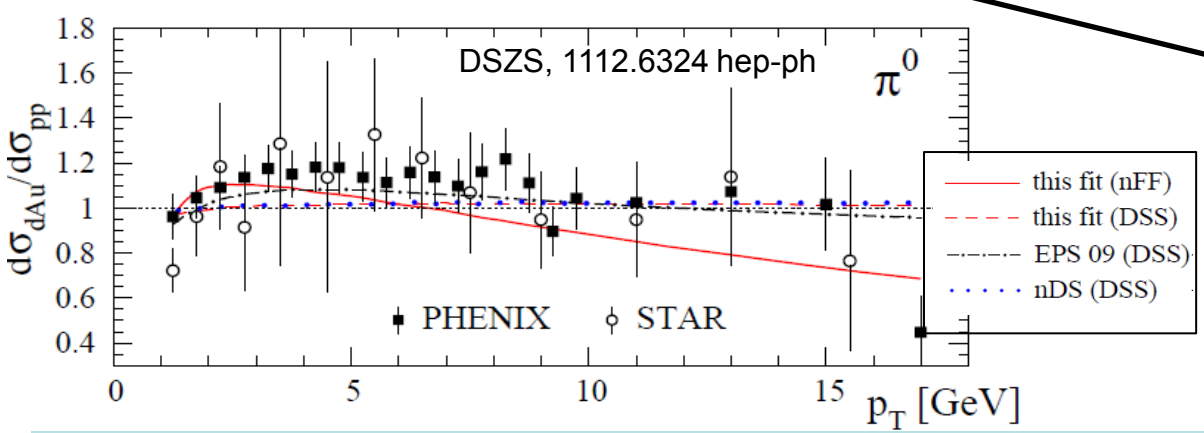
Nuclear FFs:

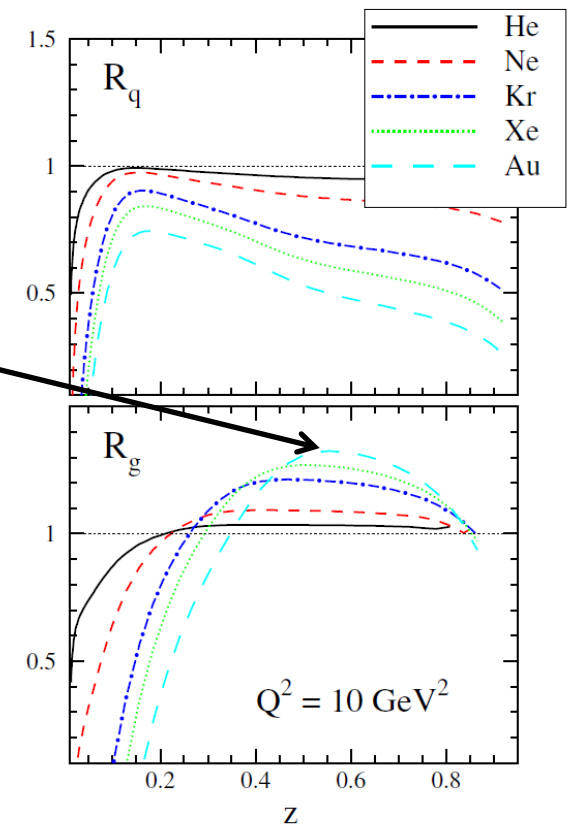
Sassot, Stratmann, Zurita
0912.1311 hep-ph, PRD81 (2010)

Kari Eskola

- HERMES SIDIS data
  → suppression for the nuclear quark D(z)
- PHENIX data on RdAu(pi0)
  STAR data on RdAu(pi)
  → **nuclear modifications for the gluon D(z)**

~No gluon antishadowing in the old nDS nPDFs used here
→The ~**entire** enhancement in R_{dAu} is translated into an **enhancement of nuclear $D_g(z)$**

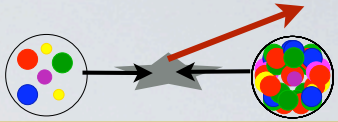




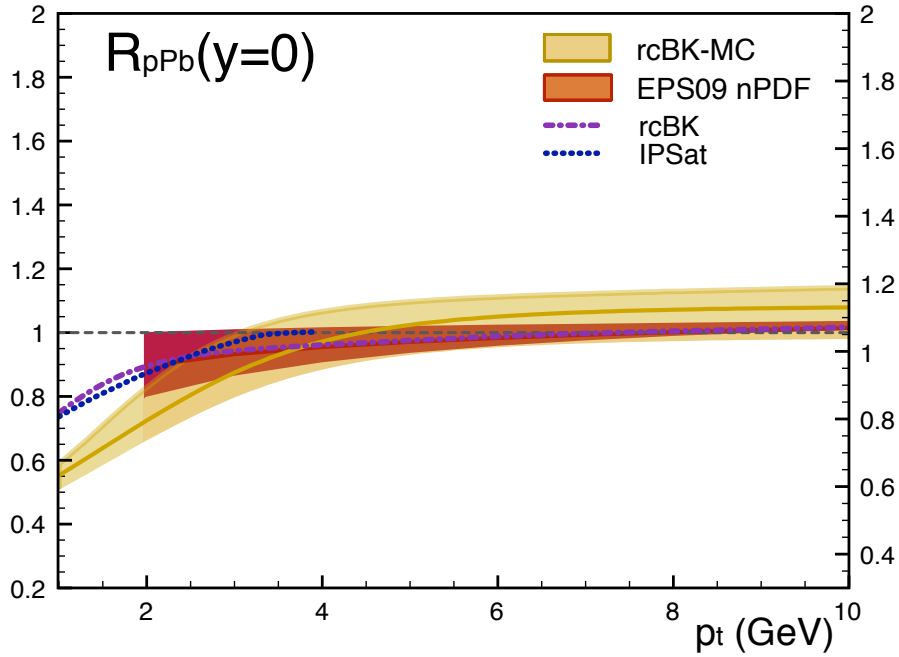
SSZ, 0912.1311 [hep-ph]

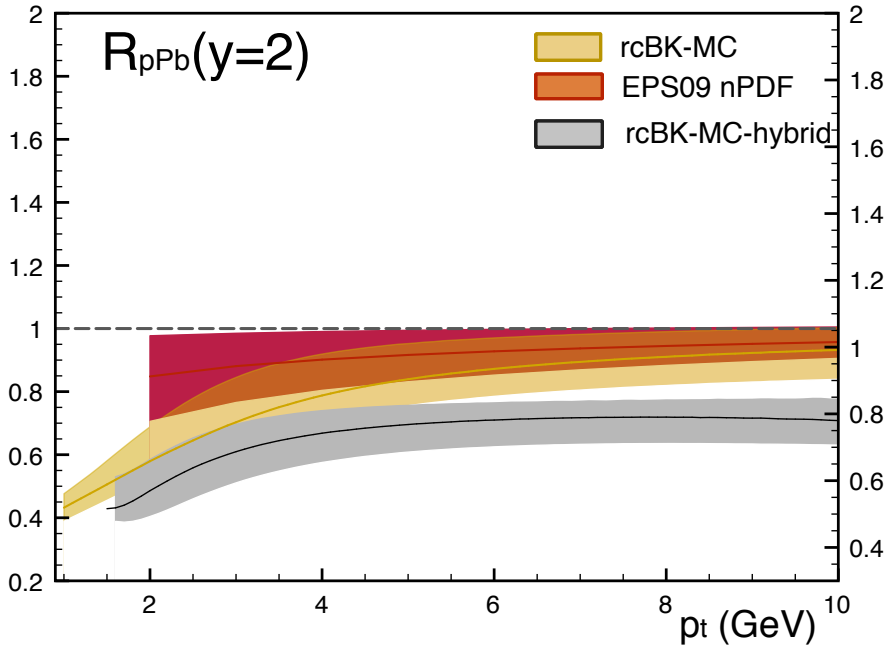
Same data are used in DSZS global nPDF fit
→**by construction, with nFF (or w. FF w/o data weights) no antishadowing for DSZS gluons**

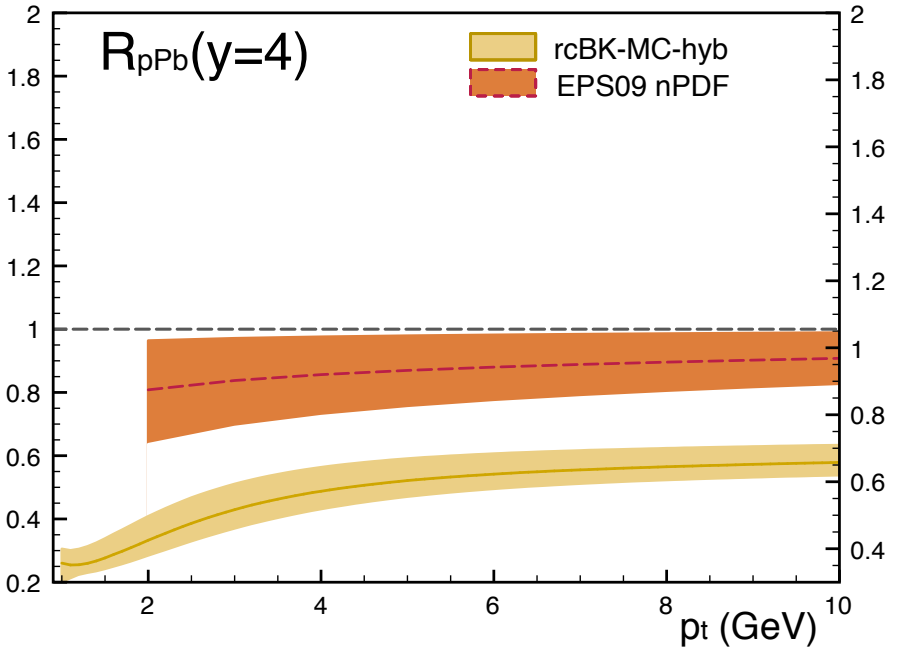
Moving forward: Testing the evolution

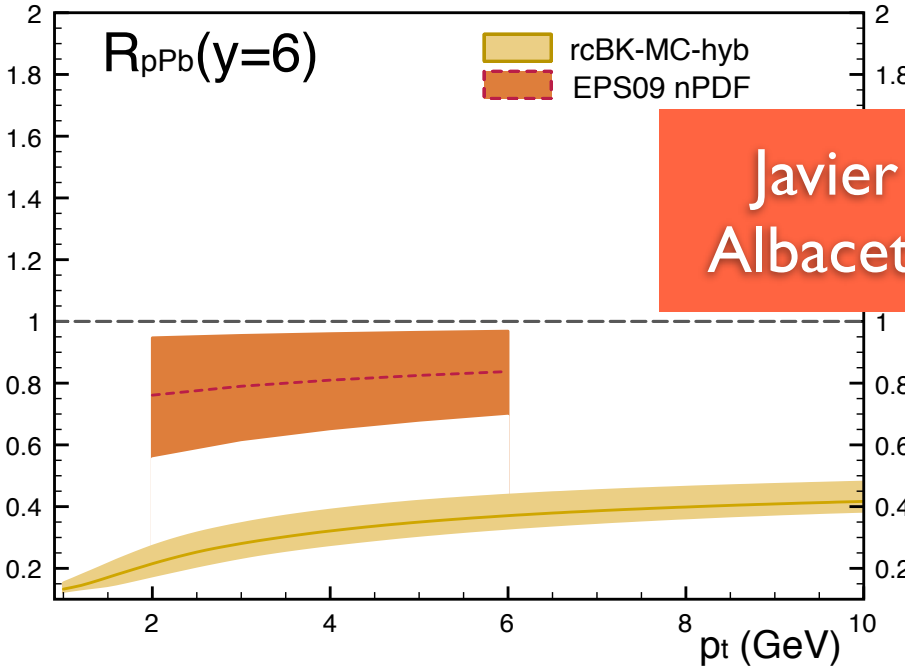


(p_t, y_h>>0)









Javier Albacete

Some questions

Where are benchmarking measurements essential?

- Quarkonia
- Jets, heavy-flavor
- Bulk - if CGC approaches used
- What is needed in terms of luminosity / measurements

What can be learnt about small-x physics/saturation?

- What are the best observables?
- Would measurements provide unambiguous answer?
- Strategy needed - how to fully exploit the LHC capabilities?

Is more pp reference data needed? at pPb/PbPb energy