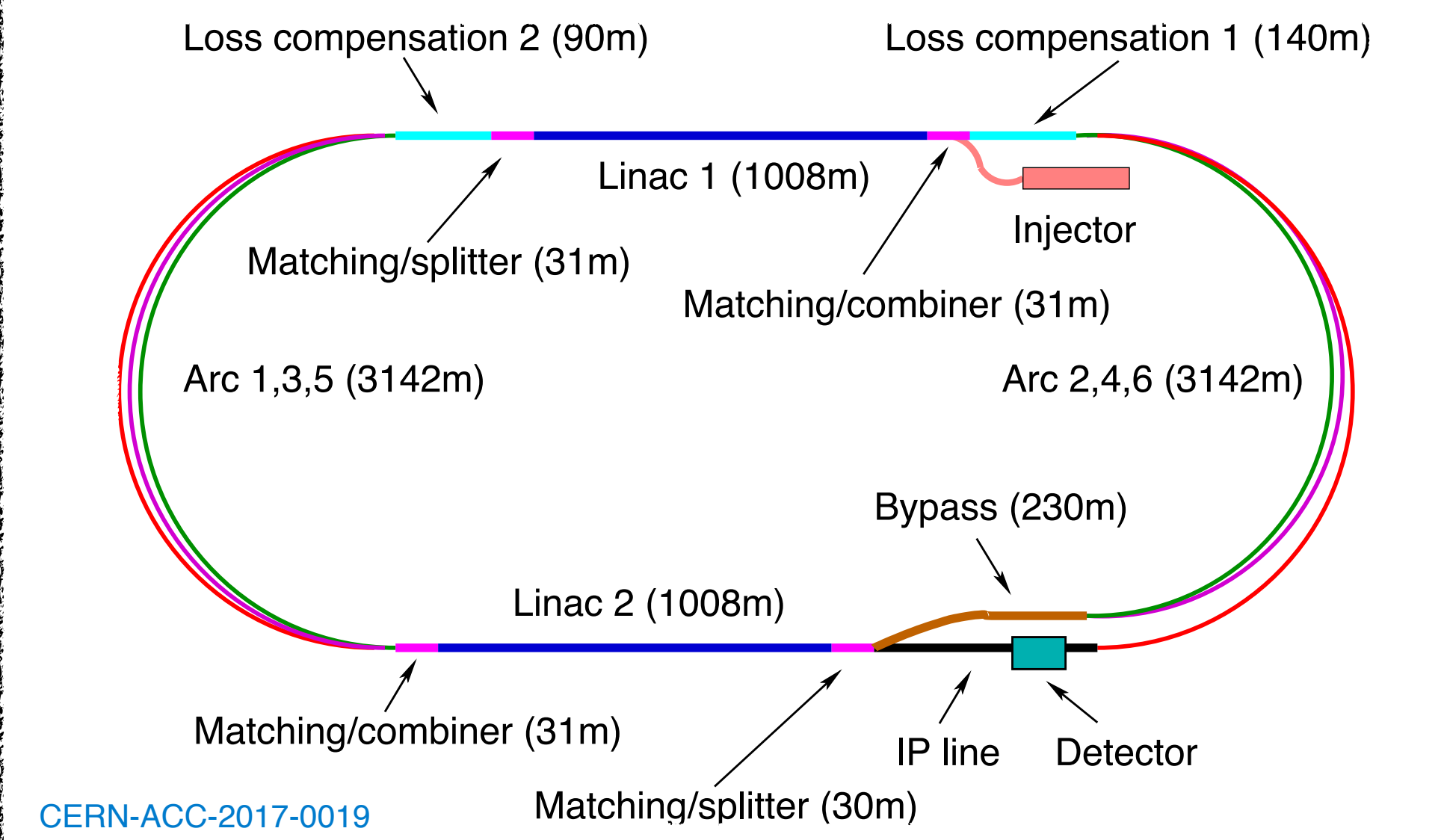


Energy frontier electron-ion physics with the LHeC and the FCC-eh

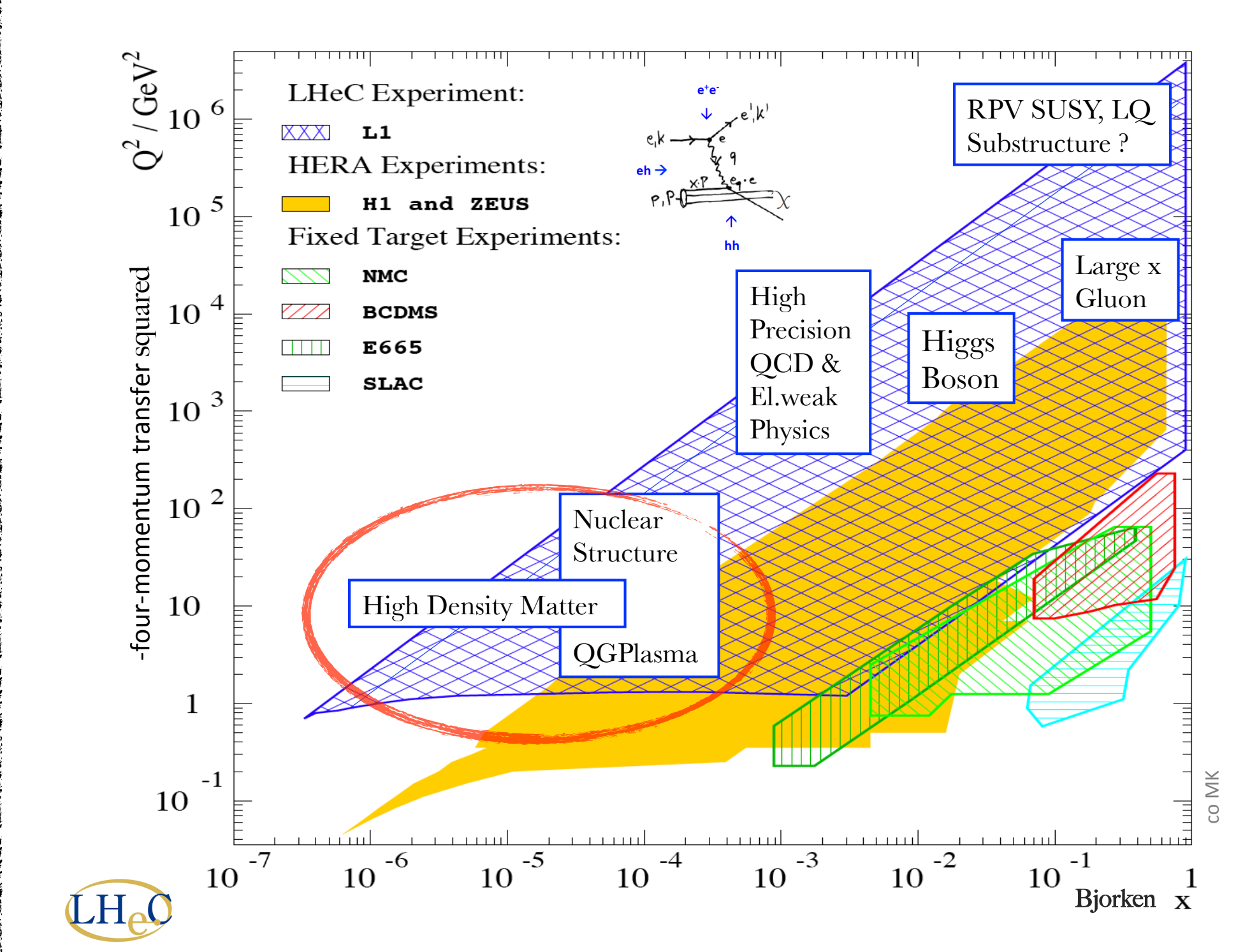
Néstor Armesto (Santiago de Compostela) for the LHeC/FCC-eh Study Group, <http://lhec.web.cern.ch/>

- **Large Hadron Electron Collider:** 60 GeV electron accelerator (energy recovery racetrack) to provide ep/eA collisions at the HL-LHC/HE-LHC/FCC-eh.
- $\sqrt{s}=0.8\text{-}2.2$ TeV/nucleon in ePb.
- $\mathcal{L}_{eN}\sim 4/18/54\times 10^{32}$ cm²s⁻¹ in ePb.

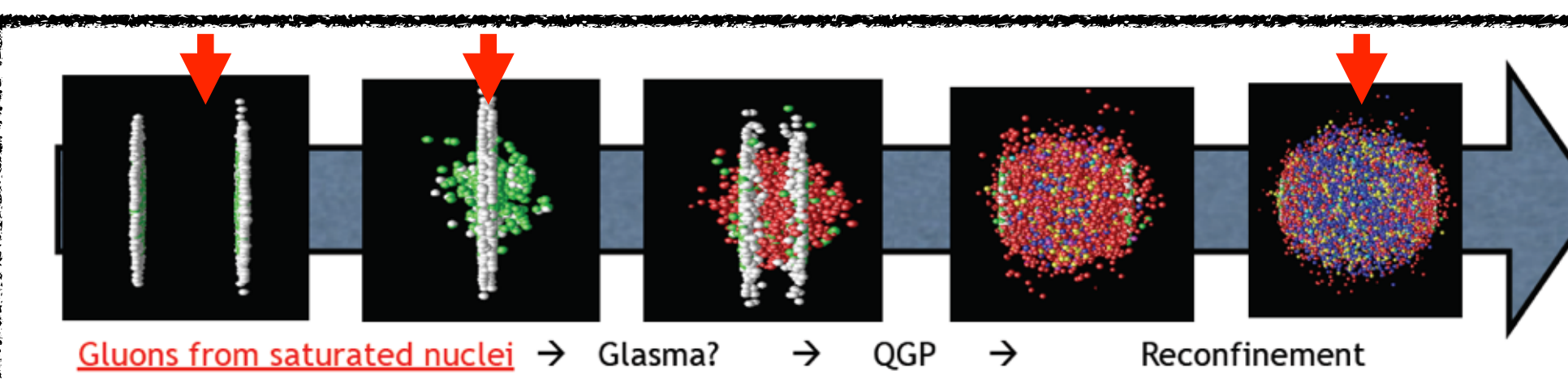
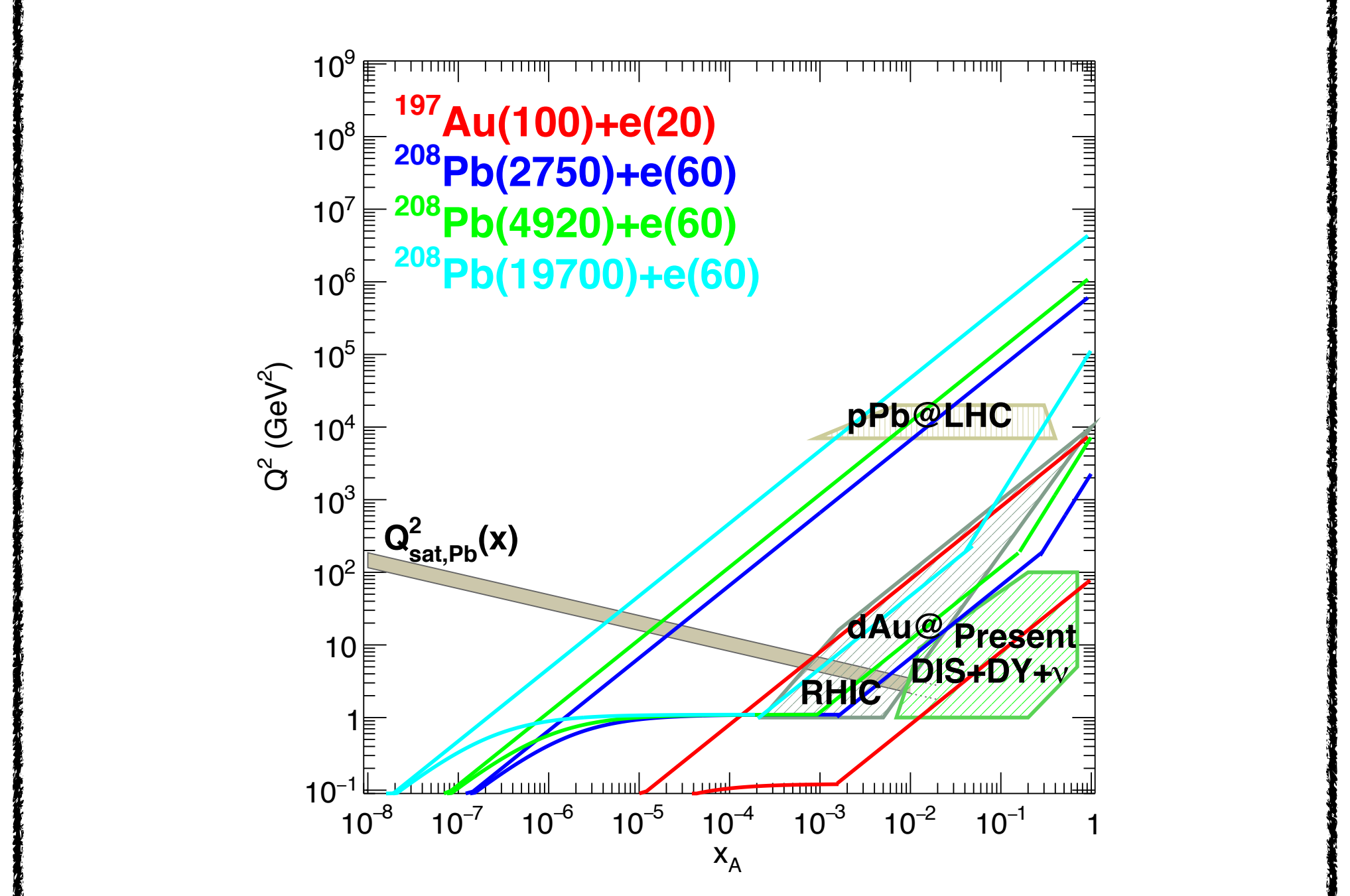


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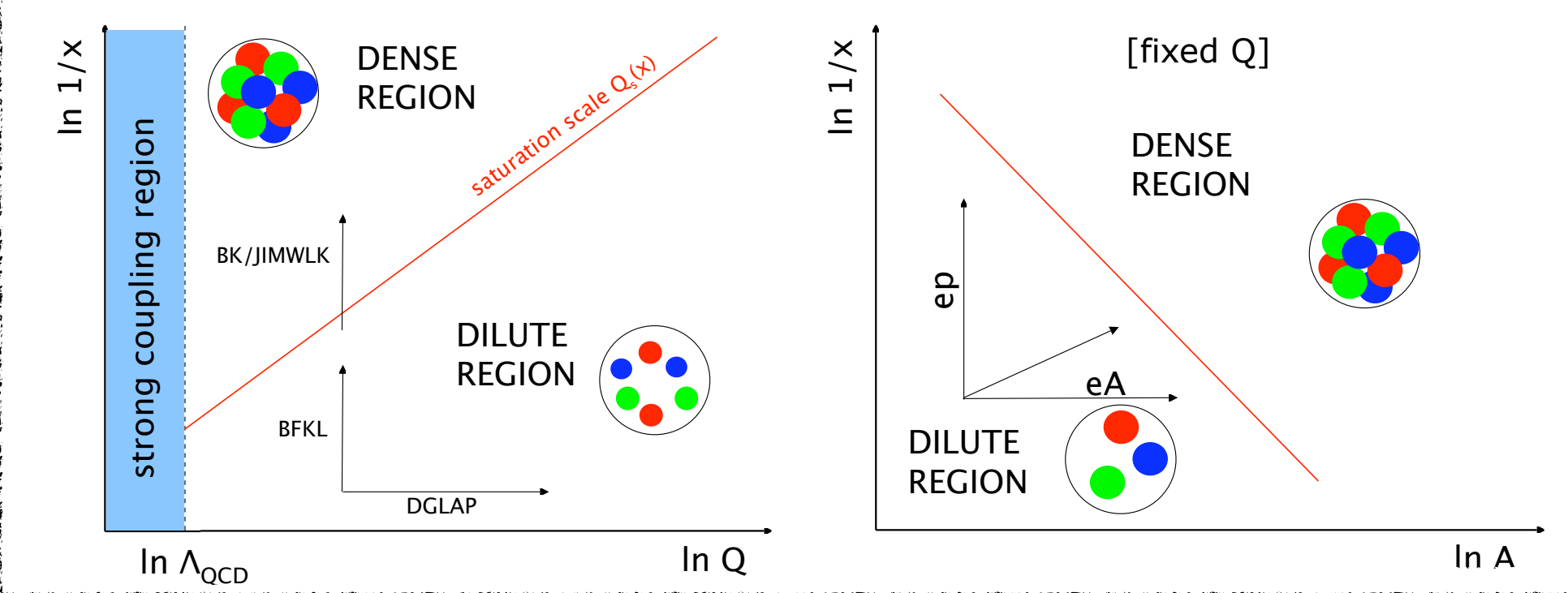
- **Unique physics program:** precision Higgs, searches complementing LHC, novel EW & BSM top physics, high mass diffraction, saturation,...



- **eA:** fully determined kinematics (not in pp/AA), large lever arm in Q (even below Q_s if there) ⇒ nPDFs, factorisation, saturation, nGPDs, in-medium radiation/hadronisation,...

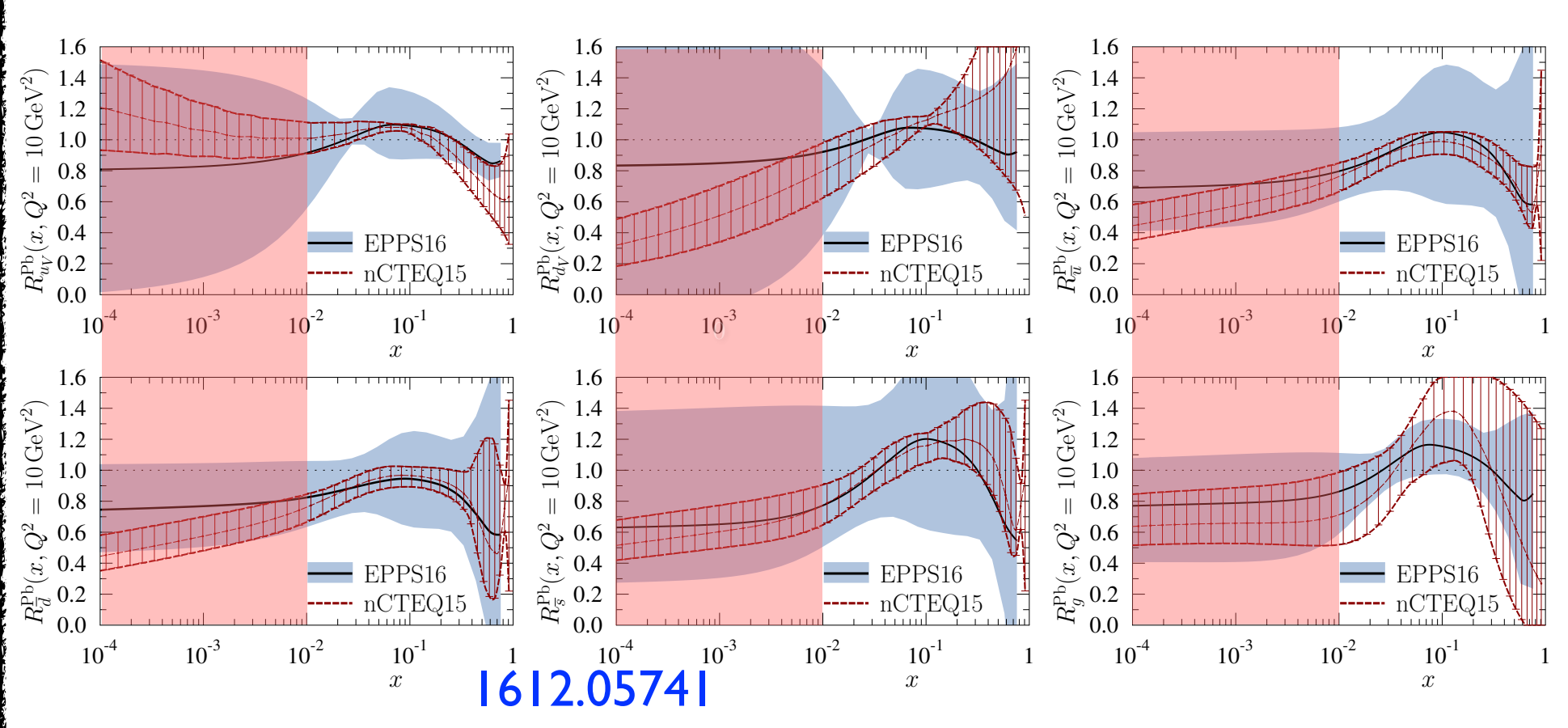


- **Information on most stages of a heavy-ion collision:** initial, particle production, in-medium radiation/hadronisation, can be obtained from eA.
- **Establishing saturation** (non-linear dynamics at small x) requires a **two-pronged approach:** decrease x & increase A.

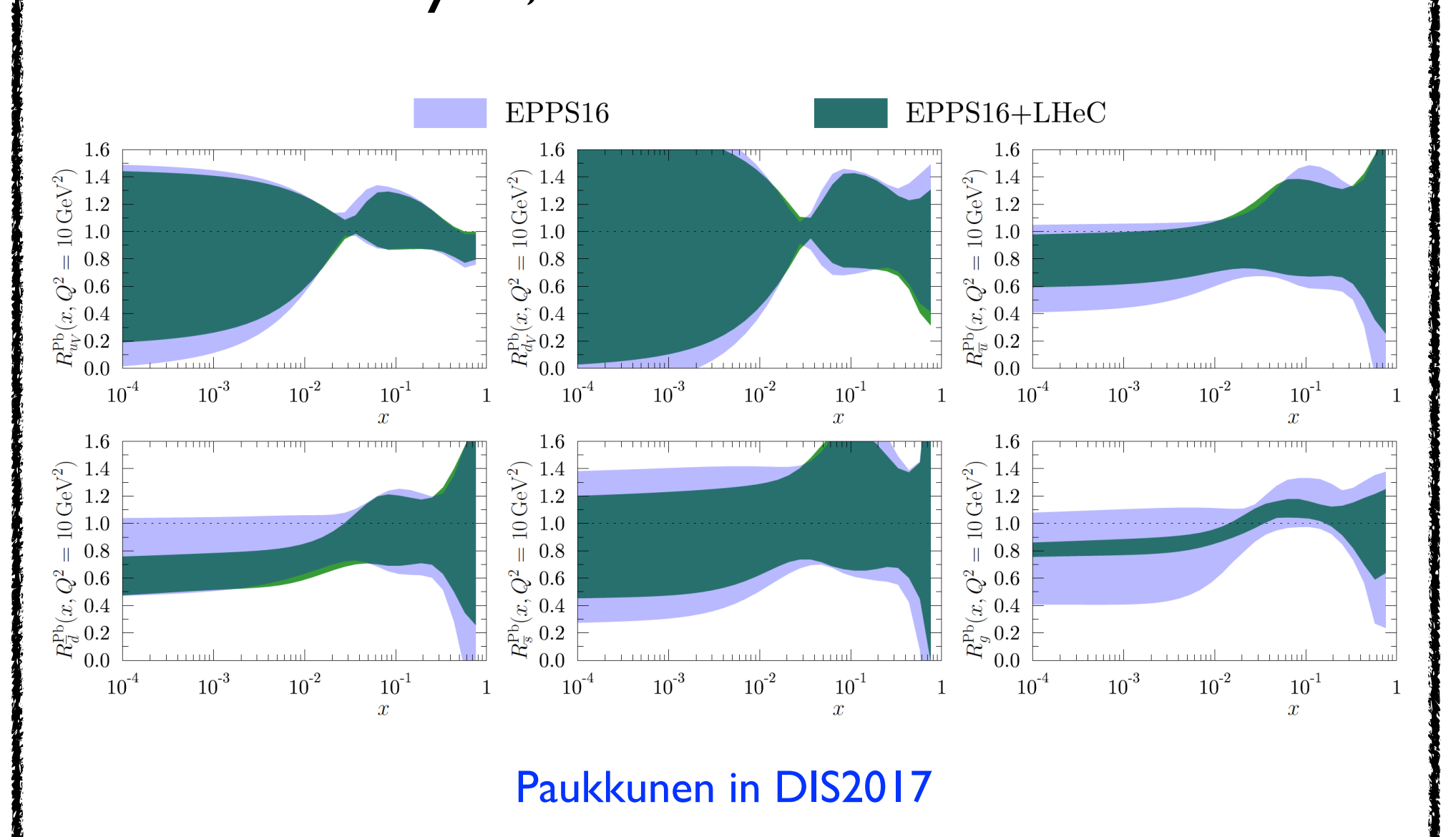


- **Inconsistencies in existing nPDFs:** different sets of fitted data (V's, π⁰'s, LHC pPb W, Z and dijets,...), assumptions (e.g. R_{uV}=R_{dV}), non-suitable data used for lack of better ones, pPDFs as questionable base, no flavour separation of sea and valence.

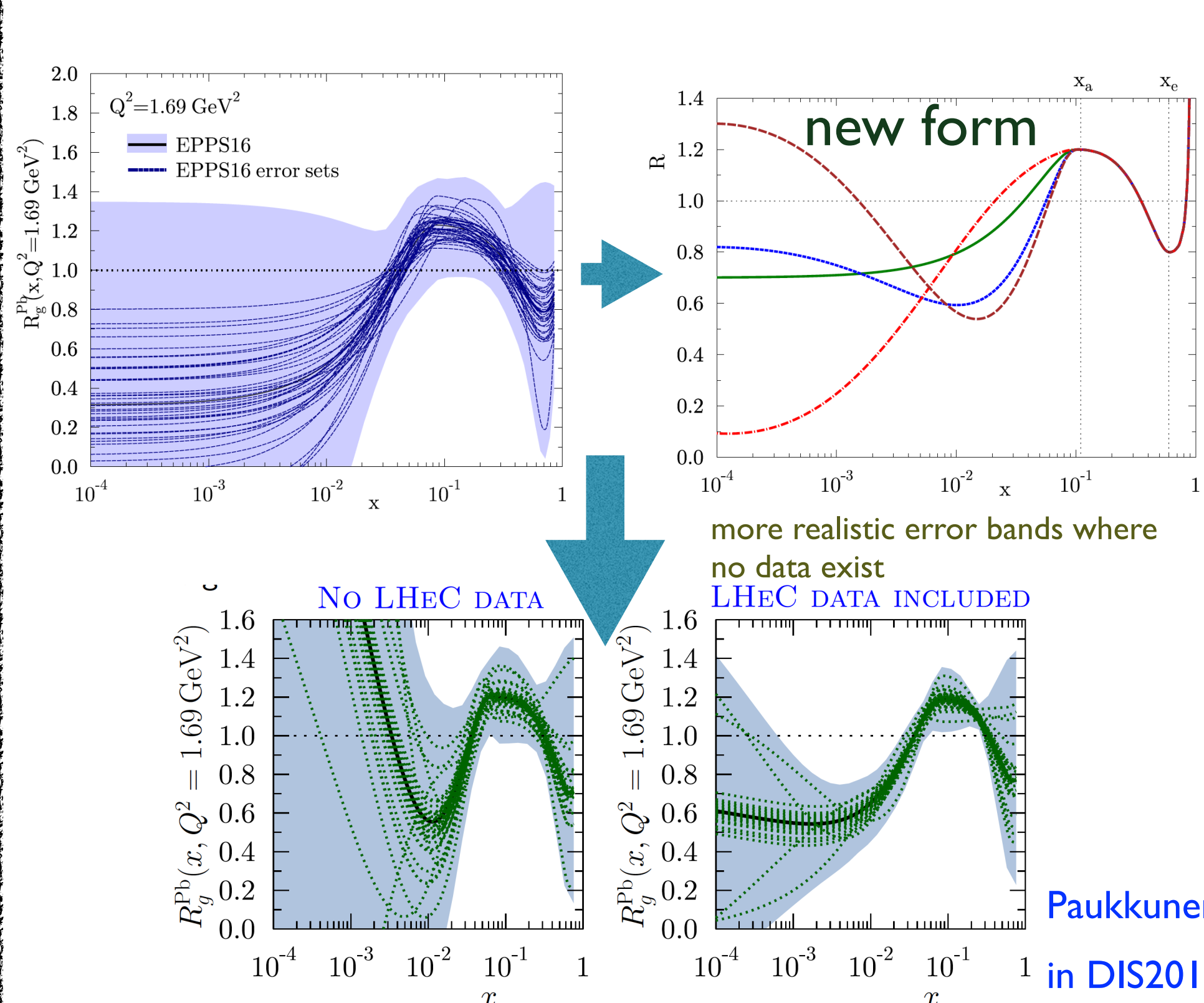
⇒ **eA@LHeC to fully determine PDFs of a single nucleus** for the first time.



- **Expected impact of the LHeC:** pseudodata generated with EPS09, ($\int \mathcal{L}_{eN}=1/10$ fb⁻¹ in ePb/ep, NC+CC only, no flavour decomposition), F_L>0; uncorrelated and normalisation uncertainties considered.
- EPPS16 analysis, same method and tolerance.

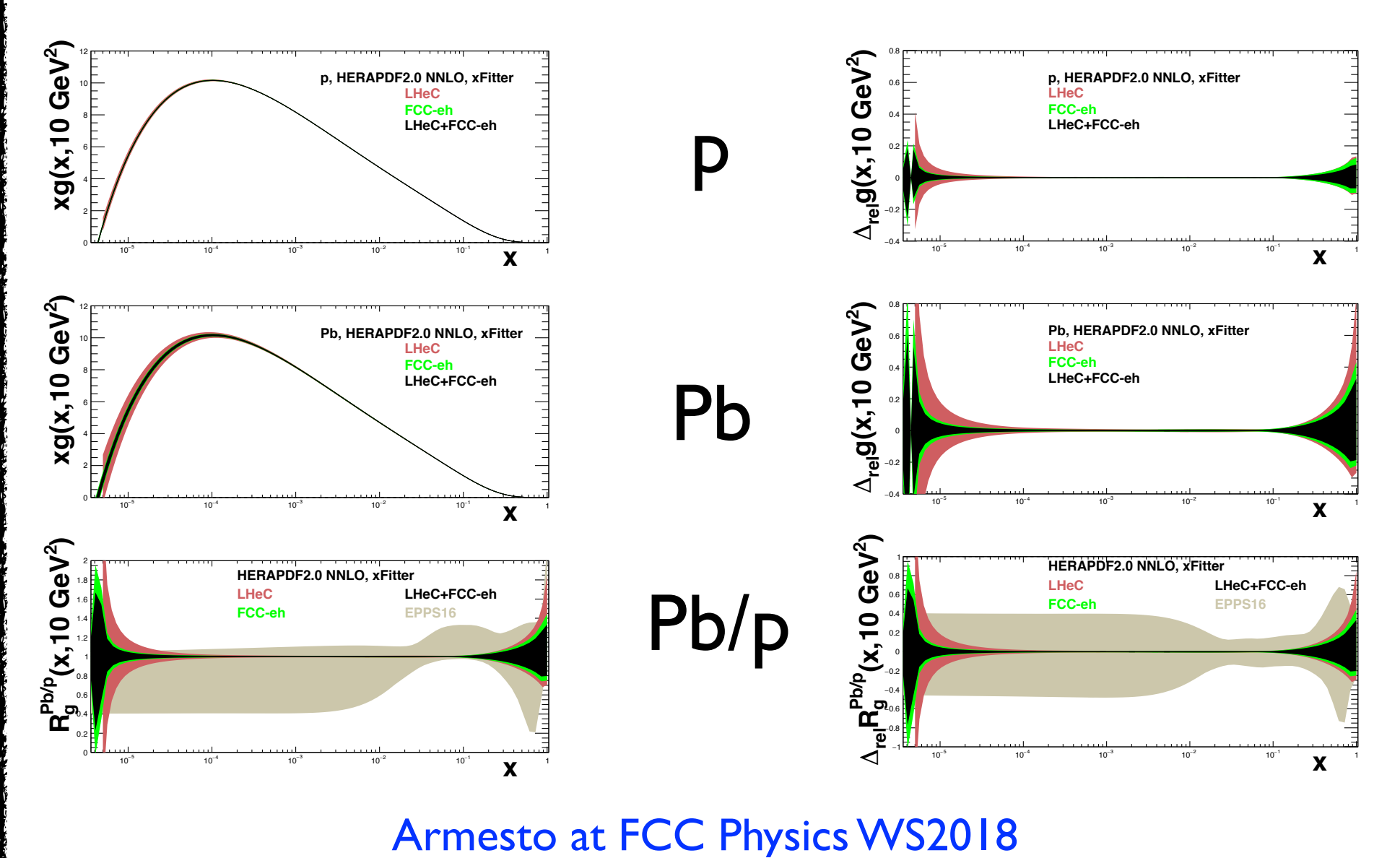


- **Small-x extrapolation** driven by shape of initial conditions ⇒ use a more flexible one:

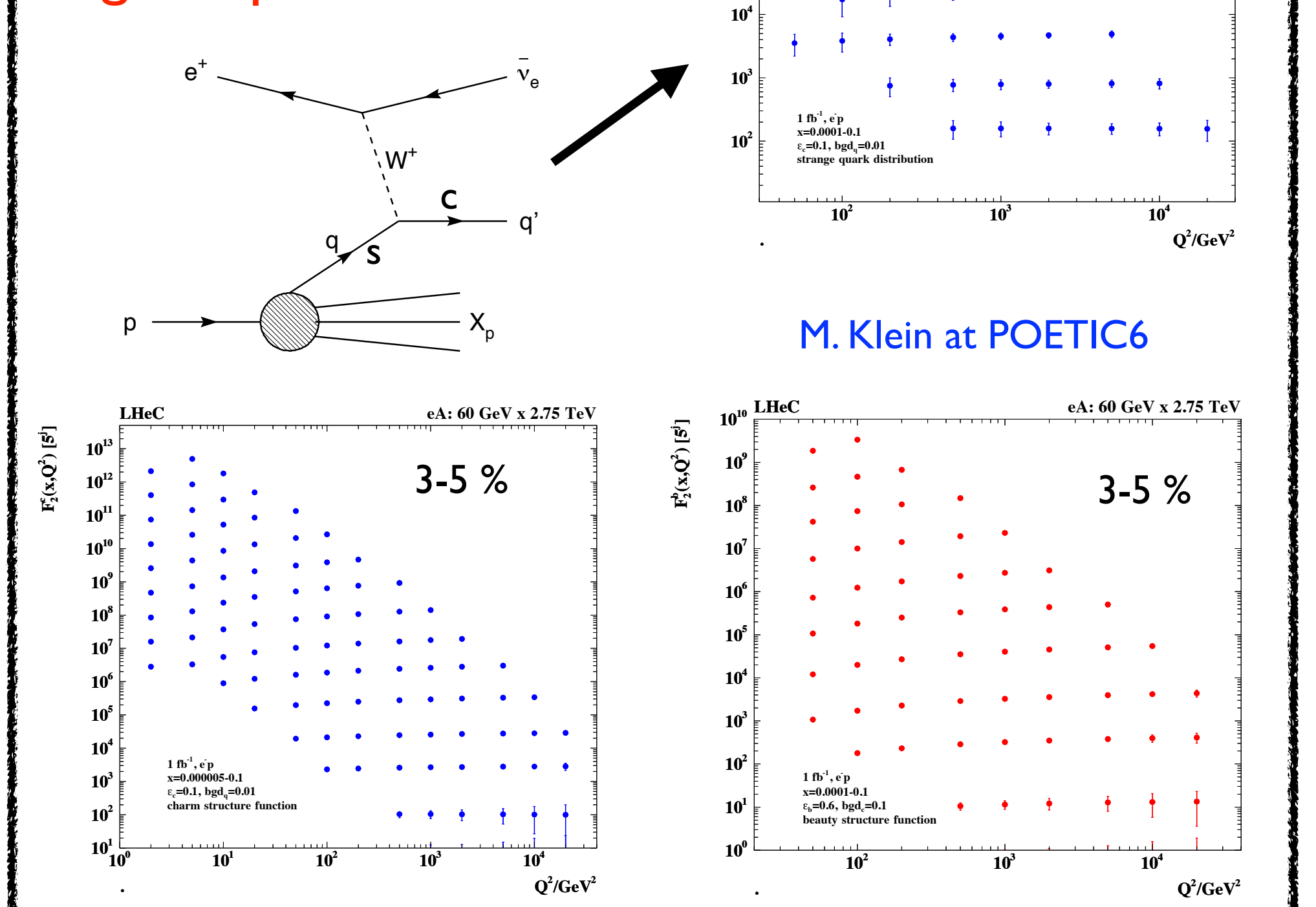


- **Extraction of Pb-only PDFs** by fitting pseudodata, using xFitter to estimate the 'ultimate' precision that could be achieved:

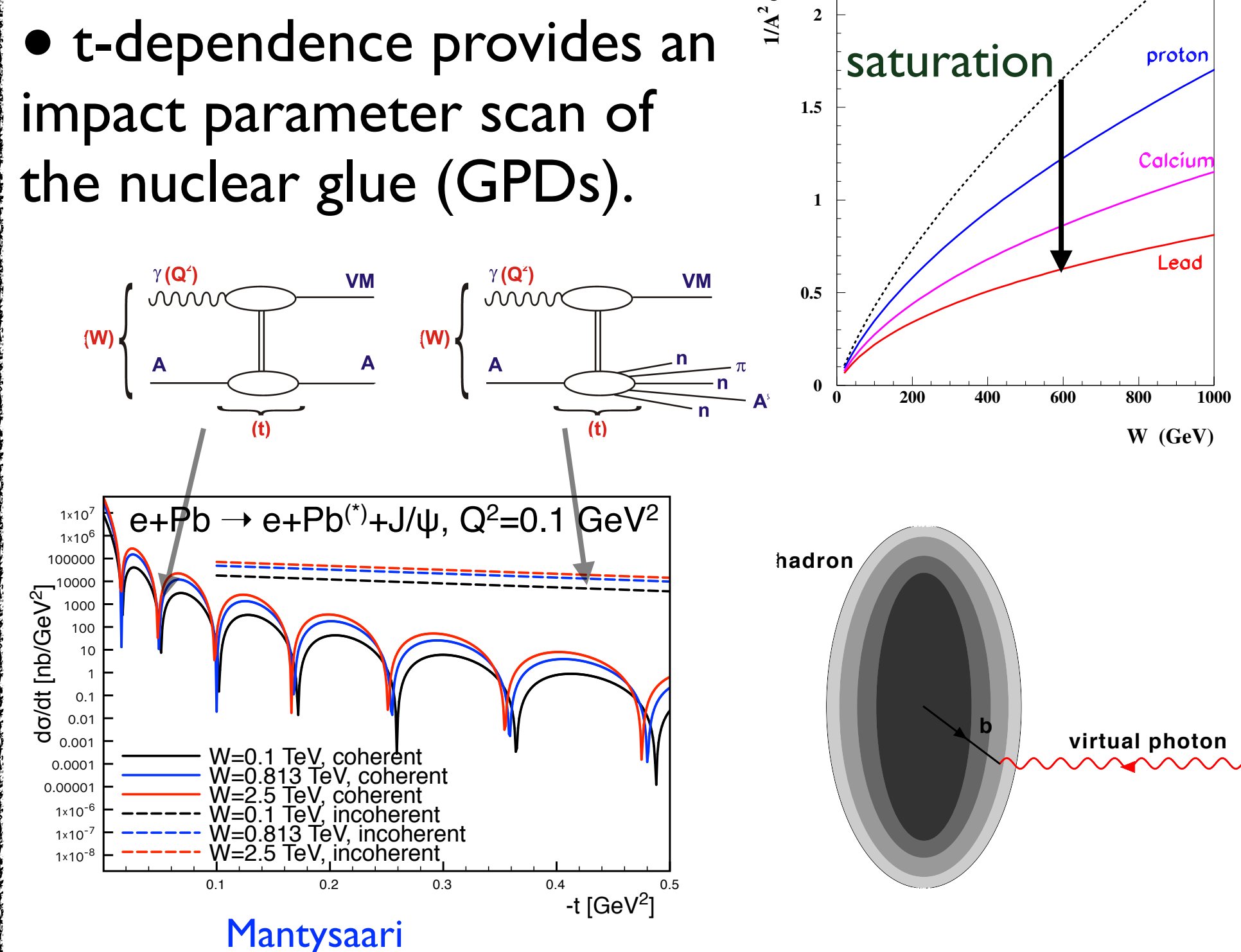
→ HERAPDF2.0-type parametrisation, NNLO, RTOPT mass scheme, α_s=0.118; only data with Q²≥3.5 GeV², initial evolution scale 1.9 GeV².
→ Central values from HERAPDF2.0: no parametrisation bias.
→ Standard xFitter/HERAPDF treatment of systematics.



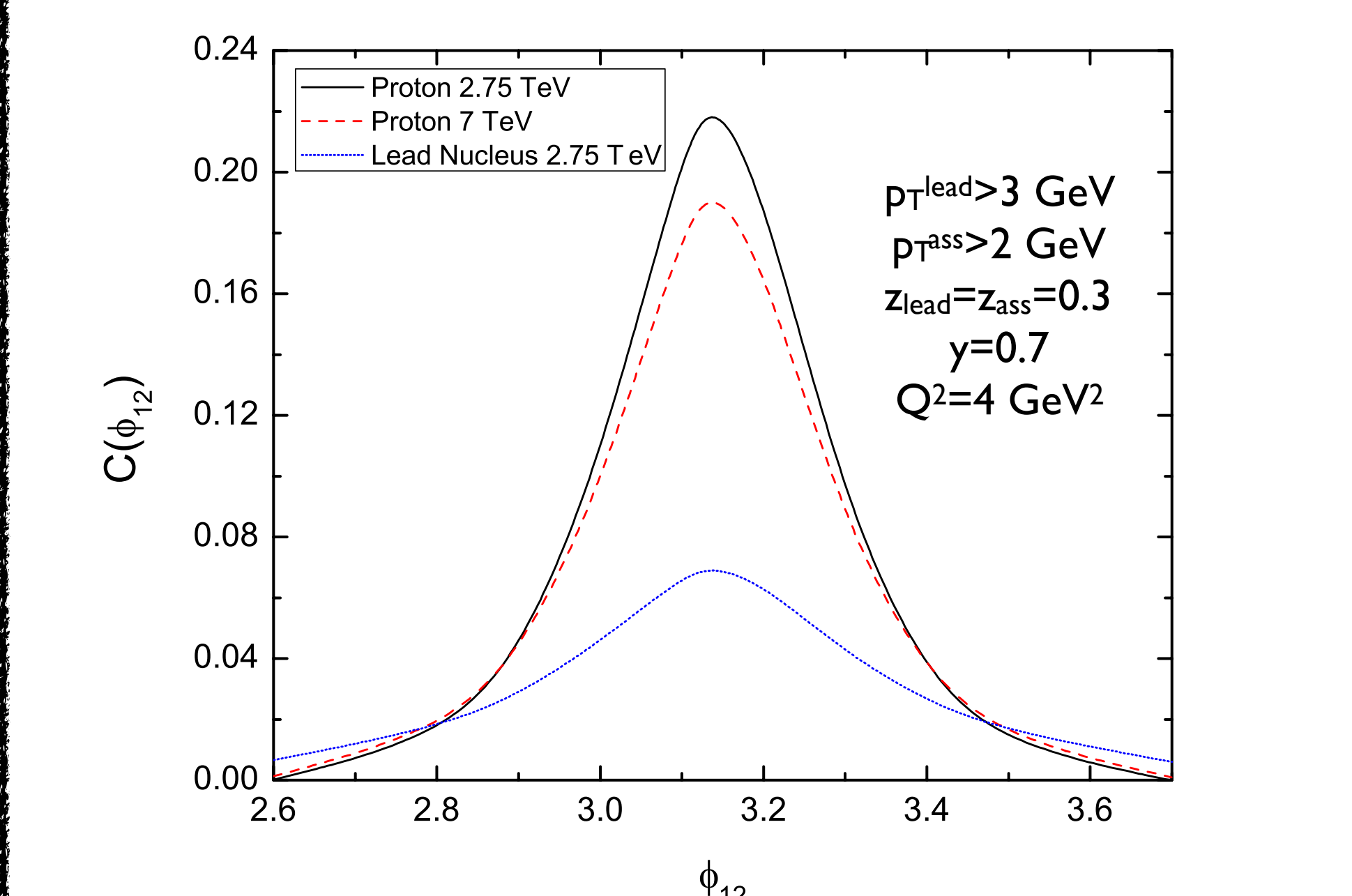
- **Full flavour decomposition** s, c, b possible in a single experiment:



- **Elastic vector meson (J/ψ, γ) production sensitive to saturation.**



- **Dihadron azimuthal decorrelation** as a signal of saturation:



- **In-medium radiation/hadronisation.**

