

# Inclusive Group Report

**ATHENA Bi-weekly meeting  
8 July 2021**

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# Golden Channels

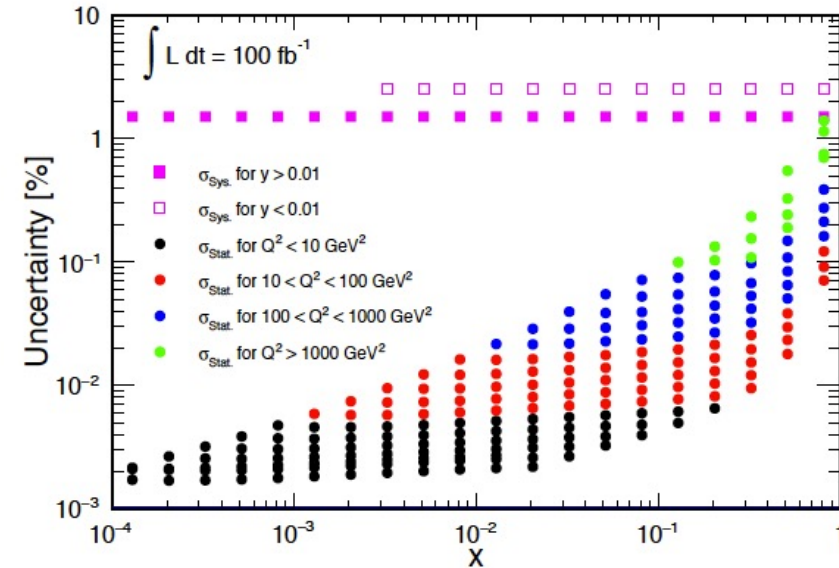
- Most important observable to study is inclusive NC DIS cross section at Large  $Q^2$   
→ leading to several headline physics results

Golden channels	Physics Topic/goal
Unpolarized inclusive ep/d: $\sigma(x, Q^2) \rightarrow F_2, F_L$	Proton PDFs $q(x, Q^2), g(x, Q^2)$
Unpolarized inclusive eA: $\sigma(x, Q^2) \rightarrow F_2, F_L$	Nuclear PDFs $q(x, Q^2), g(x, Q^2)$
Polarized inclusive ep/d, $A_{LL} \rightarrow A_1(x, Q^2) \rightarrow g_1$	Proton spin structure Gluon & Quark Helicity $\Delta g(x, Q^2), \Delta u^+, \Delta d^+$
Parity-violating DIS	Polarized/unpolarized PDF (strange)

- Also probably ... Inclusive CC DIS
- Also possibly ... Total cross section in photoproduction ( $Q^2 \rightarrow 0$ ) limit

[Further details to emerge following next meeting on Monday 12 July]<sub>2</sub>

# Neutral Current Cross Sections



N.C. systematic uncertainties

	Point-to-Point (%)	Normalization (%)
Statistics (10 fb <sup>-1</sup> )	0.01-0.35	-
Luminosity	-	~1
Electron Purity	-	~1 (for 90% purity)
Bin-Centering	<0.5	<0.5
Radiative Corrections ( <i>HERA</i> )	1	-
Acceptance / Bin-Migration + Trigger & Tracking Eff. + Charge- Symmetric Background	1-2	2-4
Additional uncertainty for y<0.01 bins	2	-
Total	1.5-2.3 (2.5-3 for y<0.01)	2.5-4.3

Plot from YR based on 100 fb<sup>-1</sup> NC with 5 bins per decade in x, Q<sup>2</sup>

... Everything is limited by systematics.

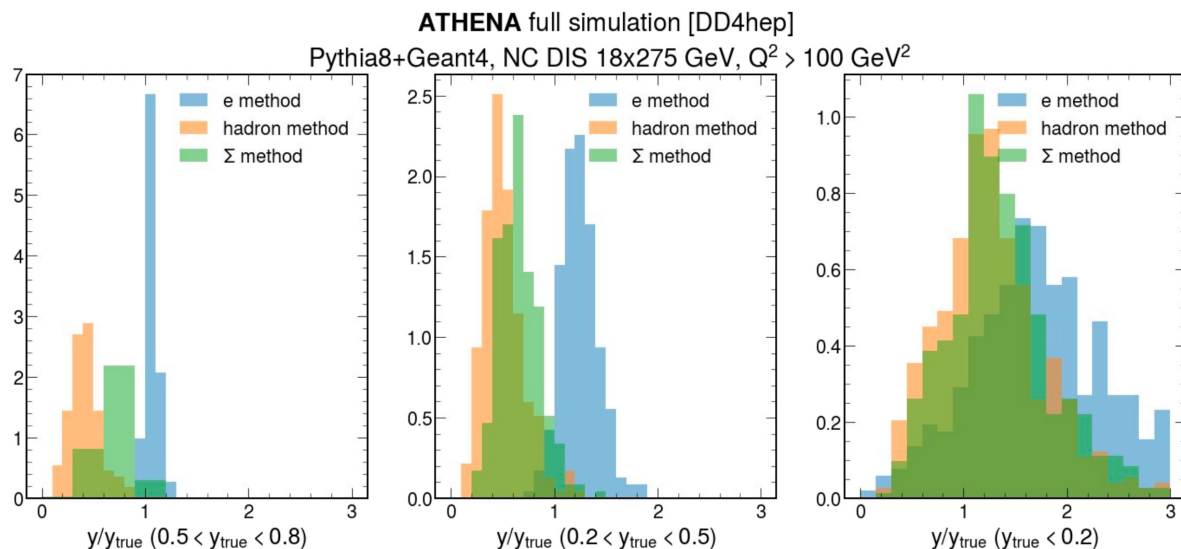
- Assumptions on systematic sources and sizes from yellow report being revisited

→ Updating overall approach and adding more (eg calo energy scales)

→ Preparing code to evaluate dependence on ATHENA detector configuration.

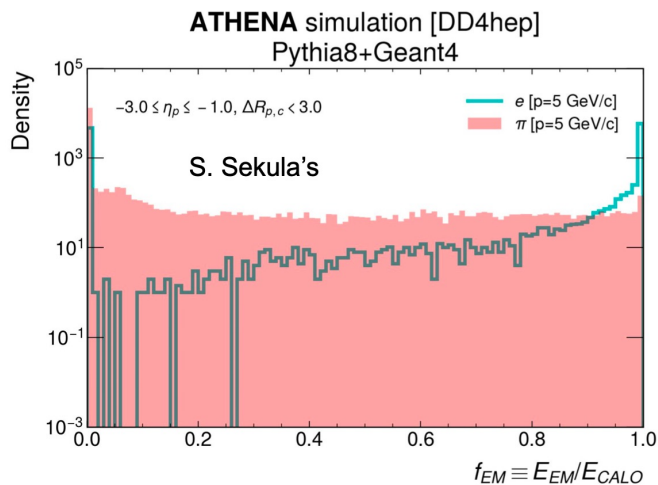
# First Results with Full Simulation

... based on DD4HEP implementation of calorimeter hadronic response



First step in kinematic resolution studies using Different methods

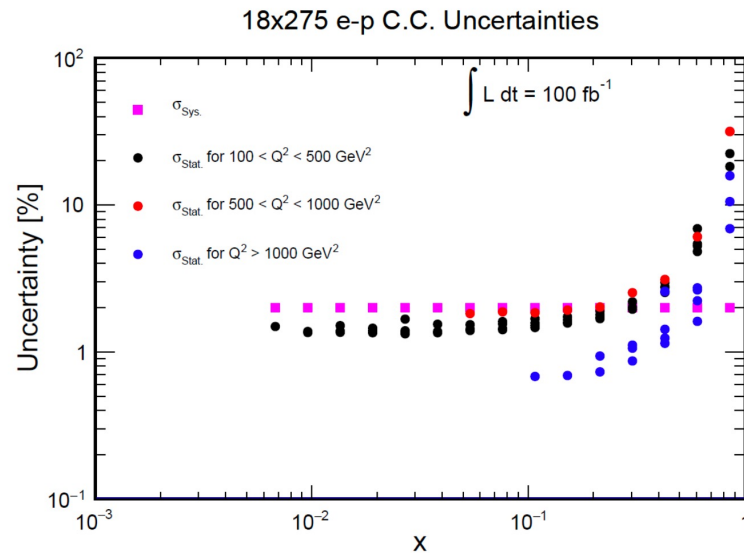
[Migel Arratia]



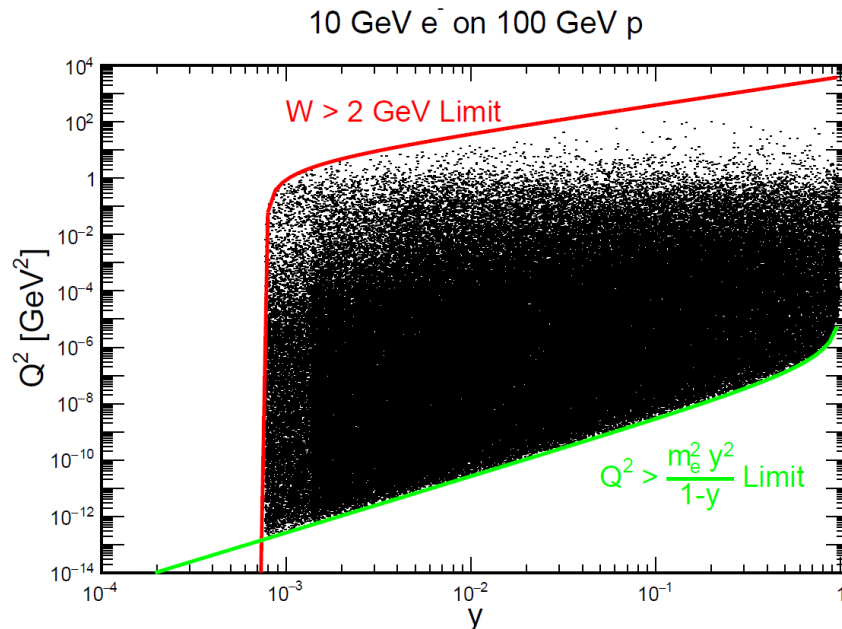
Electromagnetic fraction of calorimeter energies ... distinguishing electrons from charged pions

# Other possible studies (manpower dependent)

Estimated uncertainties for C.C. Cross sections



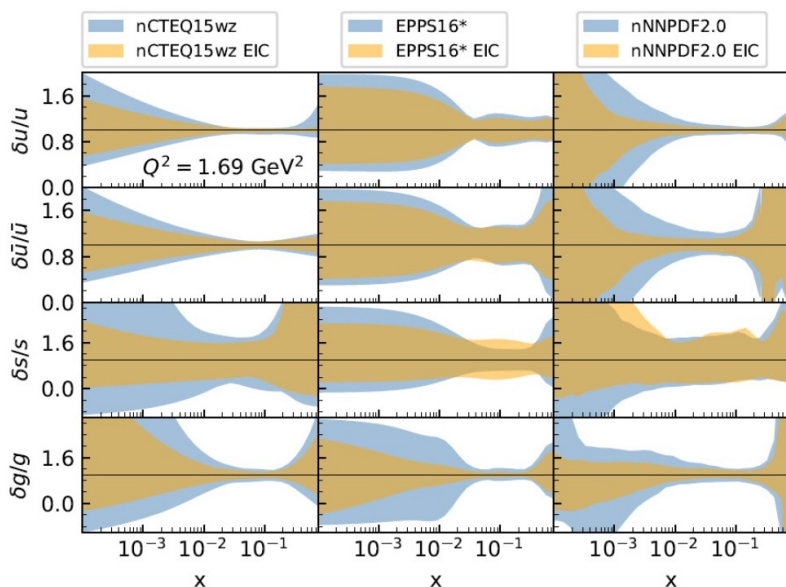
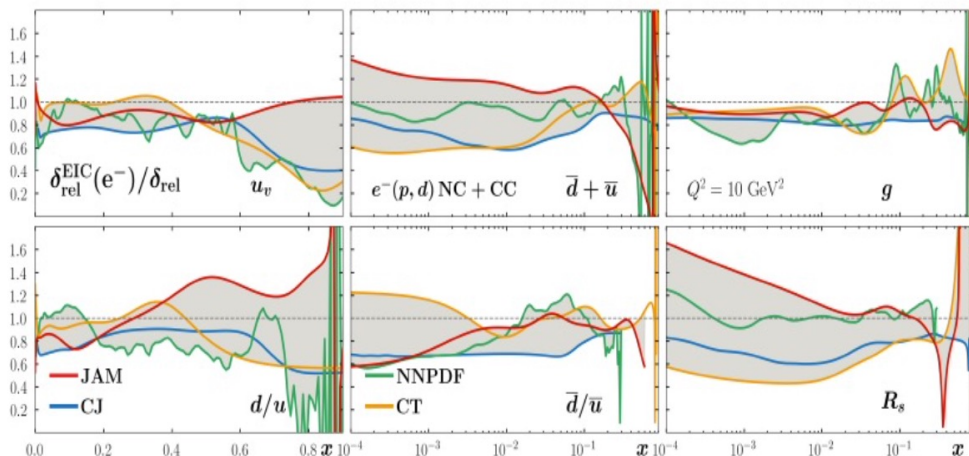
... preparing to revisit Yellow report results on CC cross section precision with ATHENA detectors



... ensuring that MC simulations extend to kinematic limit at low  $Q^2$  to enable evaluation of instrumentation in outgoing electron direction.

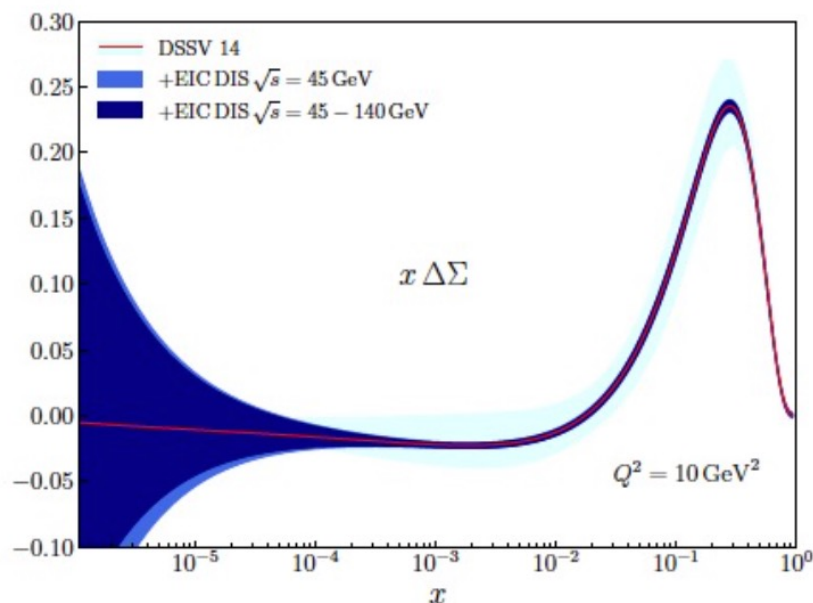
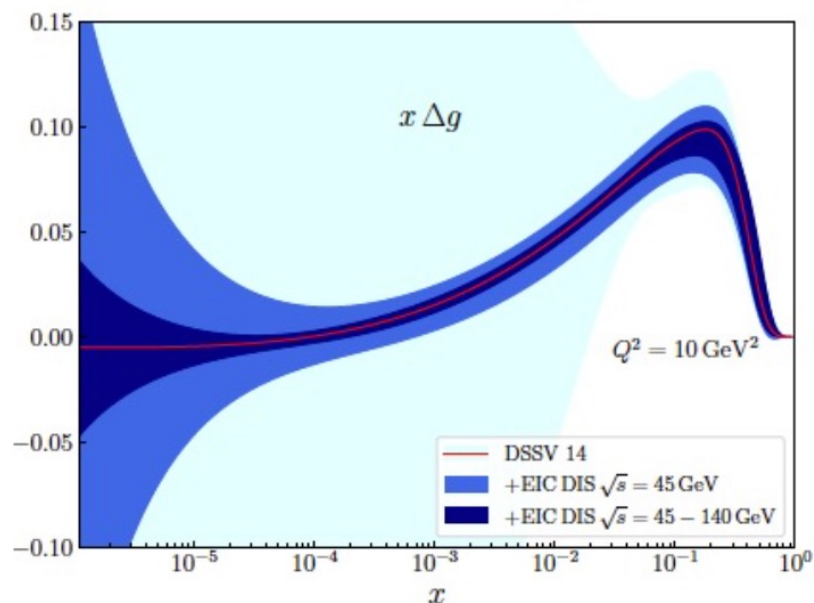
# Possible Derived Results (examples from YR)

Impact on proton PDF uncertainties from adding NC and CC EIC ep and eD pseudo-data in global fits



Impact on Gold PDF uncertainties from adding EIC eA pseudo-data in global fits

# Possible Derived Results (examples from YR)



Impact on gluon and singlet quark helicity distributions from adding EIC inclusive double spin asymmetry ( $A_{LL}$ ) pseudodata

- Most effort will be in basic cross section simulations and benchmarking detector proposals, including full detector, background and beam effects
- Discussions ongoing about practicality and needs for further fitting step to extract PDFs etc.