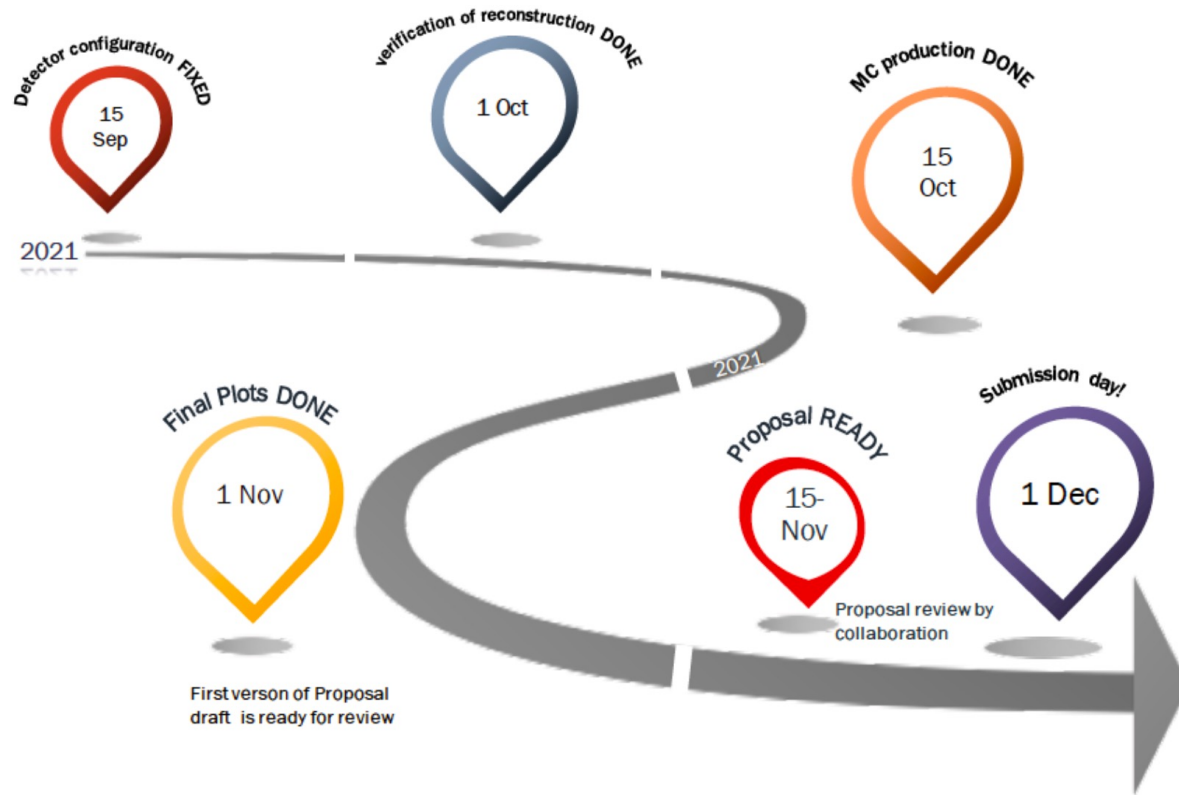


Discussion:

**Inclusive Group Plots
for Proposal**

**(see also previous discussion session
at meeting on 23 August)**

Timescales and Document Outline



Request for 1st draft input from working groups: 24 September

Currently planned document structure

- 1) Executive summary
- 2) Detector
- 3) EIC Science with ATHENA

(see eg Barbara Jacak at Bi-weekly meeting, 10 September² for full details)

Plan for Physics Component

- Origin of Spin (~6.5 pages)
 - DIS at small x with unpolarized & polarized beams (2 pages)
 - 3D gluon momentum imaging through heavy flavor & jets (2 pages)
 - 3D quark momentum imaging through hadrons (1 page)
 - 3D spatial imaging via DVCS & TCS (1.5 page)
 - Origin of Mass (~3.5 pages)
 - Gluon form factors through DVMP on nucleons (1.5 pages)
 - 3D gluon spatial imaging/GPDs via J/ψ and Y (1 page)
 - threshold dependence of Y photo/electroproduction (1 page)
 - Gluons in Nuclei (~ 5 pages)
 - Nuclear PDFs & saturation
 - DIS & SIDIS (1 page)
 - Electro/photoproduction of ϕ (0.5 page)
 - Jet observables & correlations in CNM (1 page)
 - Jet substructure studies of CNM (0.75 page)
 - Heavy quark probes (0.75 page)
 - Energy loss and transport in dense matter
 - Precision probes via SIDIS (0.5 page)
 - Jet and jet substructure probes at small x (0.5 page)
 - Other opportunities (~1 pages)
 - How hadrons emerge from partons
- Organised by major topic based on NAS report (not by ATHENA working Group)
 - Not always obvious where our material fits ... we should think and be guided by this structure
 - Probably we should not yet suppress any of our material, but supply as planned and then discuss how best to incorporate?

What we're asked to supply per topic



9

Physics topic template

- State Big Question Addressed + 1 paragraph description of the measurement & importance. Refer to White Paper, NAS study, etc..
- Note advantages of Athena for making this measurement (e.g. precision, acceptance, PID, redundancy, etc)
- Species & polarization; are multiple beam energy/particle combinations needed?
- Which Athena detector elements are essential?
 - What are the requirements for resolutions, PID?
 - What integrated luminosity is needed for a significant measurement?
- Is this suitable for early (1st 3 years) physics program?

please draft 1 page per science goal including text and figures (!)

NB:

- We should assume 10 fb⁻¹ for Year 1, and 100 fb⁻¹ per year after ~2-3 years. This will be split among energy/species combinations run in a given year!
- Objective is to start with 1×10^{33} luminosity, and grow beyond that
- Objective is to start with 60%(50%) proton (electron) polarization; ultimate goal is 70% each

ATHENA Proposal discussion

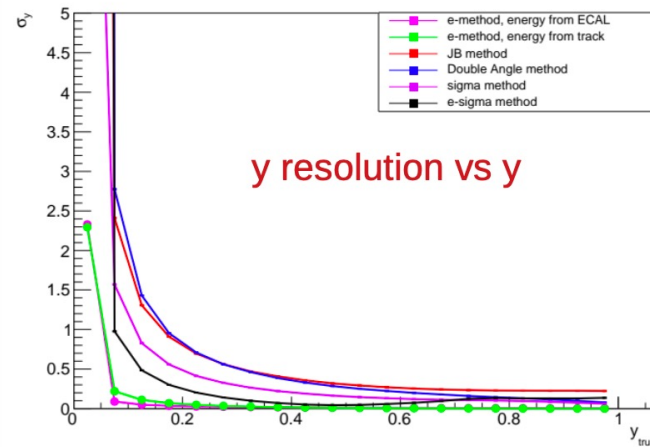
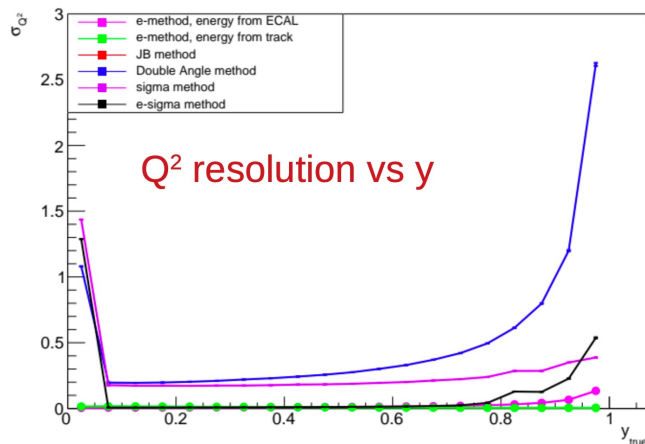
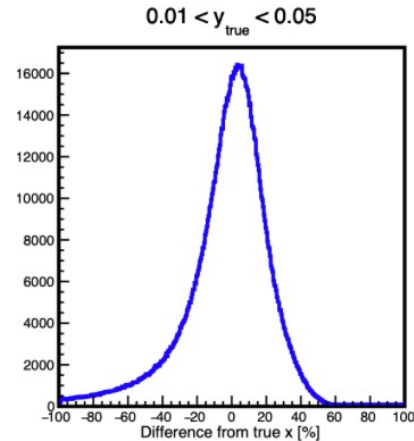
9/16/2021

(slide from Barbara's 10 September talk)

... the following slides review our planned contributions, starting from discussions in our previous meetings

1) Resolution on Kinematic Variables

- Basic performance metrics for a DIS experiment
- Essential input before discussion of DIS (i.e. likely to appear at beginning of physics section)
- Likely presentation
 - width of rec/true dist'n in y , Q^2 , x versus y , Q^2 , x .
 - Include electron, hadron, mixed methods
 - Showing versus HFS angle or η would make more direct connection with detector.
- Multiple groups working on this
- We have (lots of) placeholder plots, but need to decide on choices of what to show
- Results will depend on overall HFS reconstruction decisions and software



2) Electron ID performance

- As for resolutions, likely to appear at start of physics section (if not already present in detector section)

- **Electron acceptance as function of Q^2 ?**

→ Should extend to(wards) $Q^2 \rightarrow 0$ limit

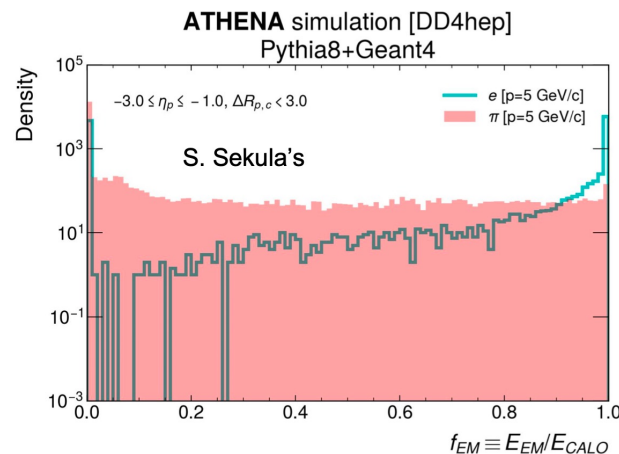
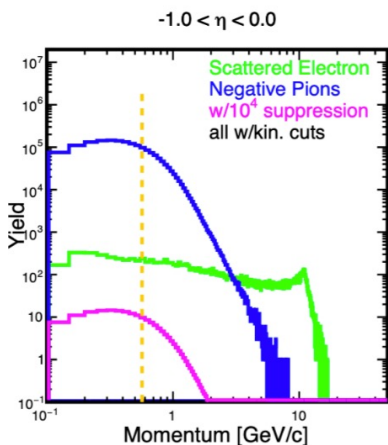
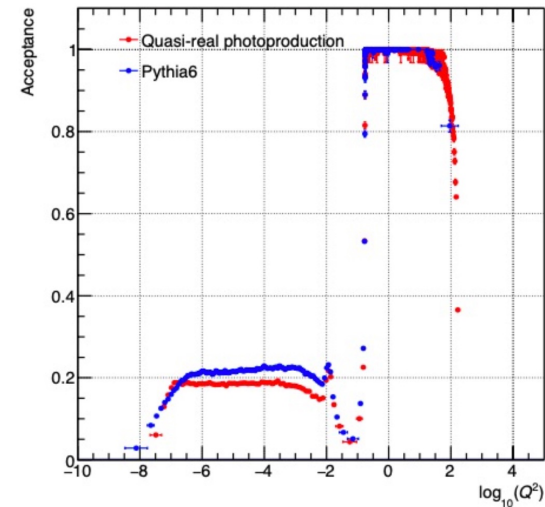
→ Needs Fullsim ... do plots exist?

- **Electron ID - background suppression**

→ Derived from e/π ratios (MC), estimated

PID suppression factor (Detector section) and

(ideally?) isolation / calorimeter shower shape selection



- Can a full 'electron finder' be developed on required timescale?

- Is this within our remit?... we should at least contribute!

3) Basic Inclusive Cross Sections

Our previous thinking (following procedure in Yellow Report and elsewhere ..

→ Estimate precision on unpolarised ep cross section based on systematics derived from basic ATHENA performance studies and experience at previous colliders

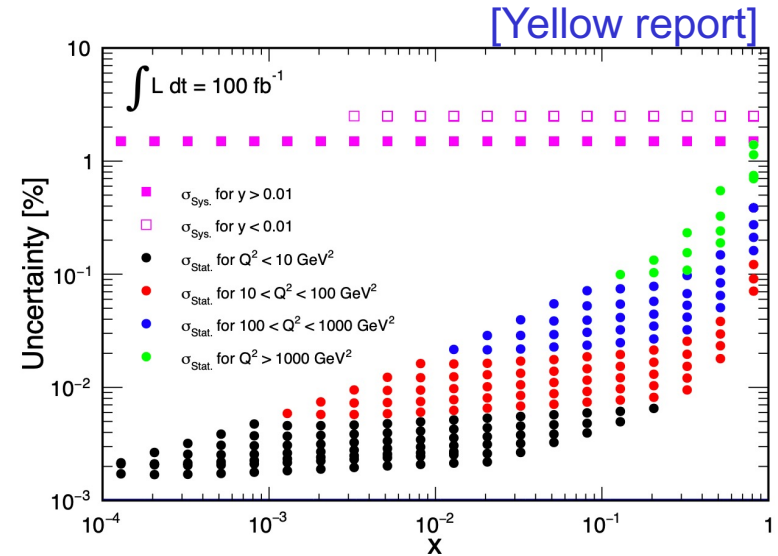
→ Fold in acceptances

→ Use predicted x-sections eg from PYTHIA to obtain NC, CC ‘pseudodata’

Some outstanding points ...

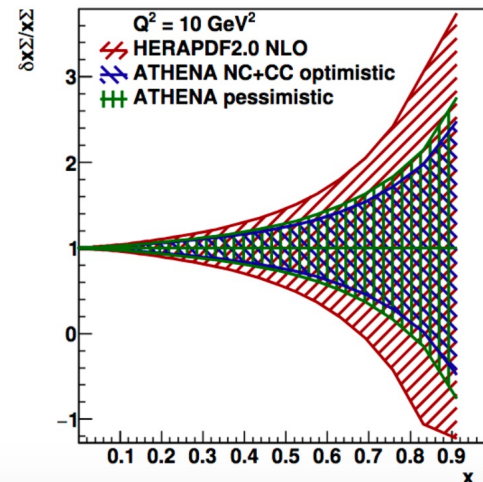
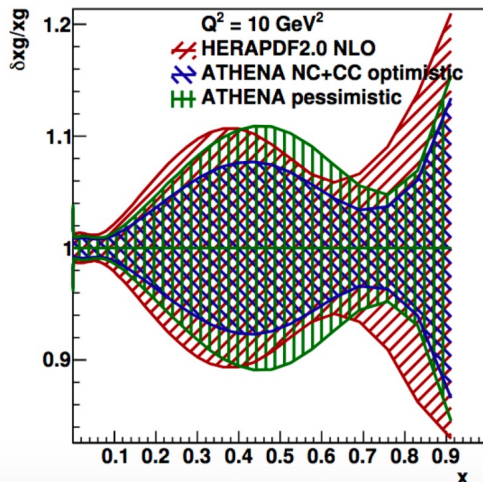
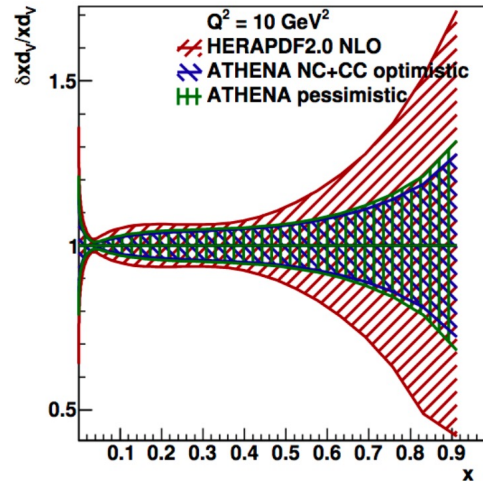
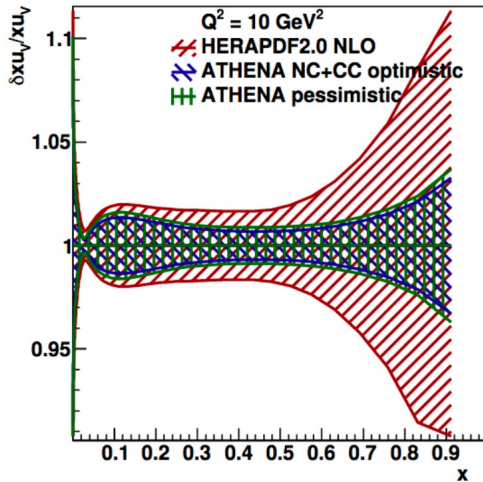
→ Proposal emphasizes spin and nuclei. Need to extrapolate to estimate precision on polarisation asymmetries and on eA cross sections, to be compared with sizes of asymmetries and of nuclear modification ratios

→ Extension towards $Q^2 \rightarrow 0$



4) Impact on Proton Parton Densities

DGLAP-based QCD fits in x-fitter framework with / without ATHENA data already set up and waiting for our pseudodata (K Wichmann)



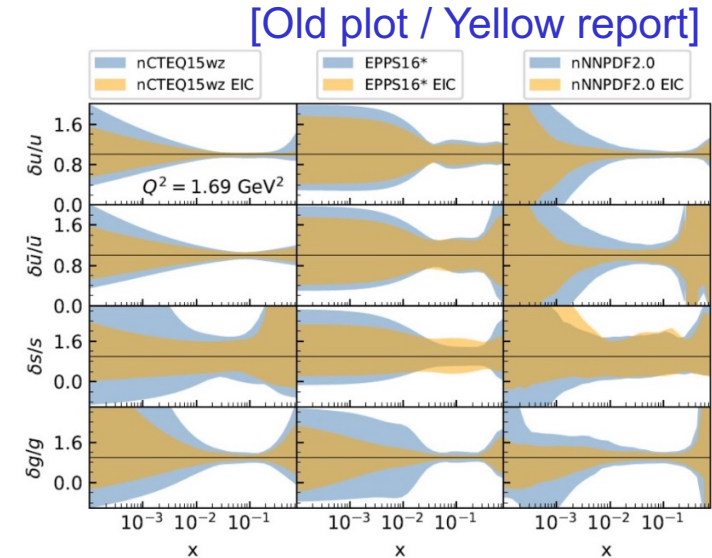
- Placeholder plots already in place based on data from Yellow Report

- Still need to define different ‘optimistic’ and ‘pessimistic’ scenarios that emphasise strengths of ATHENA

- Proton collinear PDFs not explicitly included in current plan for proposal (but we should probably still propose them)

5) Impact on Nuclear Parton Densities

- Continuation of proton parton density studies
- Colleagues from fitting / phenomenology community are keen to engage (Nestor Armesto and Katarzyna Wichmann)
- PN and BS are arranging a meeting with them to understand what input information is needed from us



6) Impact on Polarised Parton Densities

- Quite fundamental, especially in currently planned proposal layout
- No plans in place yet?
- Providing suitable input data to fitting colleagues should be possible
- Who to contact?

