Inclusive Group Report

ATHENA Bi-weekly meeting
10 June 2021

Paul Newman (Birmingham)
Barak Schmookler (Stonybrook)
Qinghua Xu (Shandong)

EIC@IP6 Inclusive Group Kick-off meeting

Monday 24 May 2021, 09:30 → 11:30 US/Eastern

Description Zoom link

09:30 → 09:40 **Introduction: goals and timelines**
Speakers: Barak Schmookler (Stony Brook University) , Paul Newman (University of Birmingham, UK) , Qinghua Xu (SDI
InclusiveDIS-1stmtg-...

09:40 → 10:10 **Summary of Inclusive Physics content in Yellow Report** ¶
Speaker: Barak Schmookler (Stony Brook University)
YR_Summary_05242...

10:10 → 10:30 **Inclusive variable reconstruction at HERA**
Speaker: Paul Newman (University of Birmingham, UK)
HERA-kinematics.pdf

10:30 → 10:50 **Discussion / plans for next meetings**

[17 attendees]

ATHENA@EIC Inclusive Group Meeting

Monday 7 Jun 2021, 09:30 → 11:30 US/Eastern

Description Zoom Link

09:30 → 10:00 **Introduction of task list**
Speakers: Barak Schmookler, Paul Newman , Qinghua Xu
InclusiveDIS-mtg-06...

10:00 → 10:30 **Simulation studies in NC and CC at EIC**
Speaker: Xiaoxuan Chu (BNL)
ATHENA_inclusive.pdf

10:30 → 10:50 **Discussion on estimation of full/fast computing resources**
Software group request such information by next week Thursday, June 10.

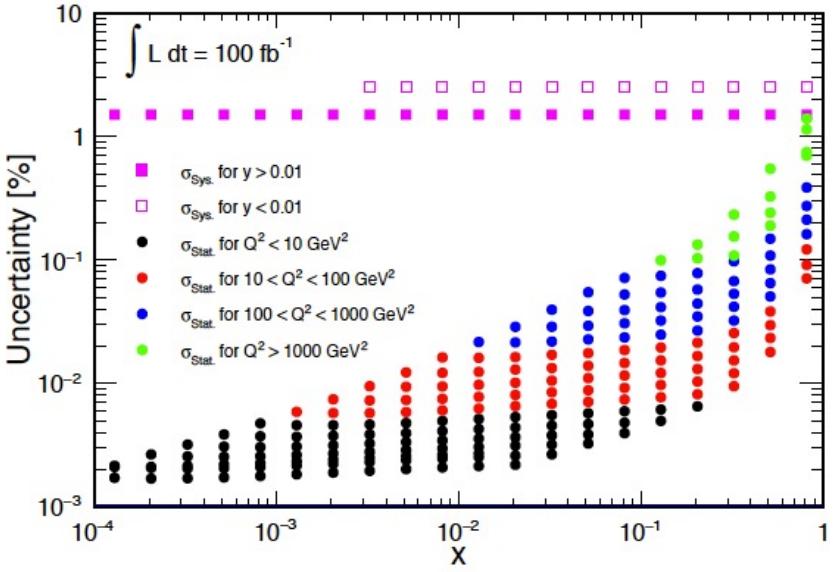
[11 attendees]

Channels of Interest / Challenge to Detector

- Inclusive NC DIS, leading to
  - → inclusive structure functions (p, A)
  - → polarization asymmetries
  - → quark density and helicity distributions
  - → sensitivity to non-linear effects …

- Inclusive CC DIS

- Total cross section in photoproduction ($Q^2 \to 0$) limit



Challenge to detector:
- Widest possible kinematic acceptance
- Optimised resolution, background suppression and other systematics

Plot from YR based on 100 fb^{-1} NC with 5 bins per decade in x, Q^2

… Everything is limited by systematics.

Systematic Sources and Detector Challenges

We don't only care about the scattered electron.

- Hadronic response is crucial for best reconstruction of NC at low y and for CC, and also for background suppression.
- Essential variables are total hadronic final state p_T and $E\text{-}p_z$ (to be calibrated against scattered electron in NC events)

In addition to ECAL (& tracker) to reconstruct E_e, θ_e, systematics depend on

- Global hadronic final state rec^n (HCAL + tracker + ECAL)
- PID detector performance for π suppression
- Beamline photon tagging (luminosity, QED radiative corrections)
- Understanding beam effects (crossing angle, crabbing, beam angular divergence and energy spread
- …

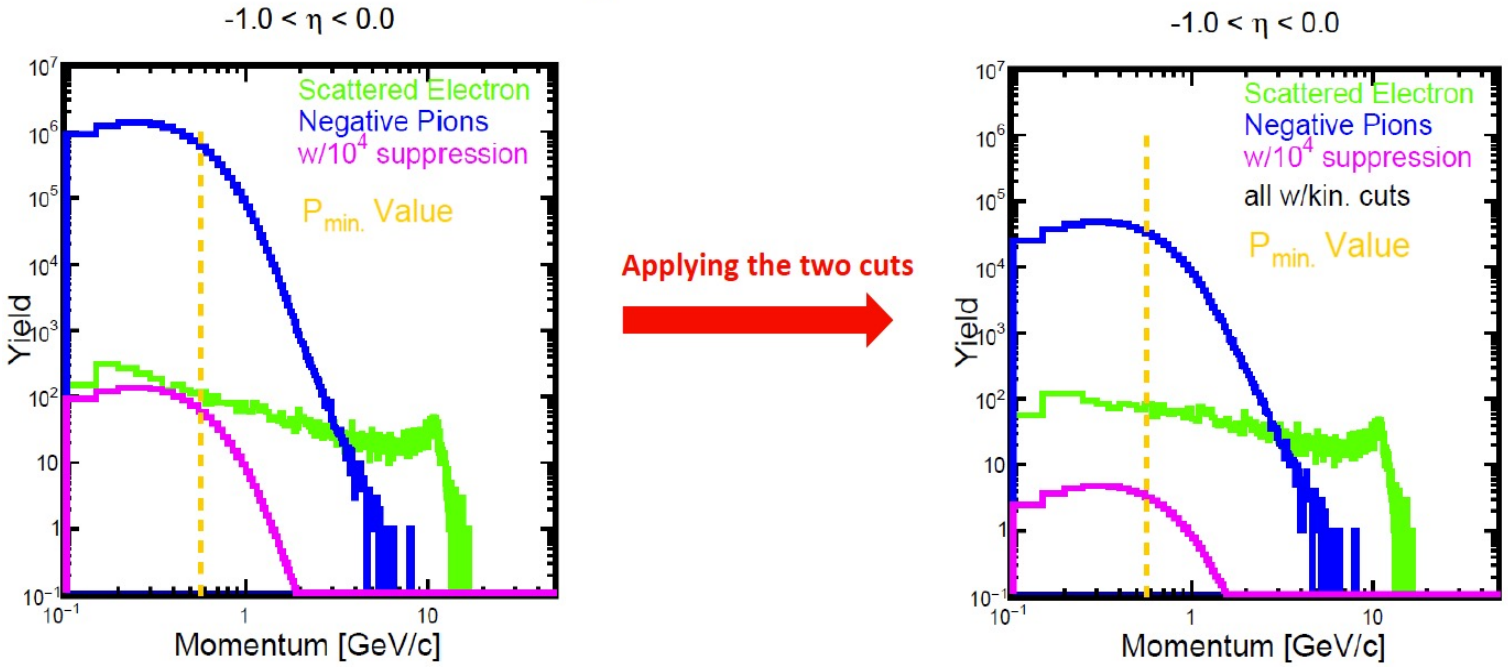
Determining optimal configurations requires simulation studies of multiple detector components simultaneously.

Much of the relevant code (and MC generator files) are in place from YR and can be recycled.

First Look at Background Suppression Methods

- π suppression from:
  - PID detectors
  - Electron selection (cluster characteristics and isolation)
  - Event Kinematics / topology

Influence near mid-rapidity of requirements on total event E-pz and azimuthal correlation between scattered electron and hadronic final state … factor ~20 in background with minimal affect on signal ($Q^2 > 1$ GeV^2)

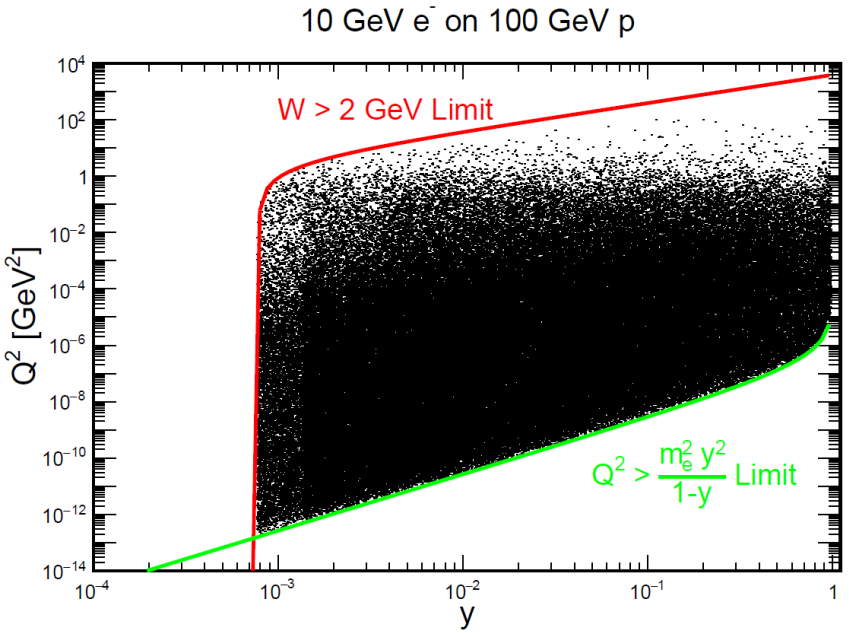


[B Schmookler]

Further Points Investigated so Far

- Different Kinematic Rec'n methods & associated resolutions / purities
- Influence of QED radiative effects
- Influence of crossing angle (hadron acceptance, hotspot …)
- Simulation statistics needs …

… Given basic $1/Q^4$ cross section dependence, generate in Q^2 slices to have sufficient MC statistics to evaluate resolutions / systematics in all measurement bins.



- Minimal cuts apart from W > 2 GeV
- Strongest focus on $Q^2 > 1$ GeV^2. Some events down to kinematic limit
- Significant overlap with needs of other groups (SIDIS, Jets…)