

YR Physics Working Group meeting

April 15, 2020

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Agenda

- Review of the YR timeline
- Discussion on the charge for the Pavia meeting
- Input from subgroups on:
 - Pavia meeting agenda
 - Software and computing needs
 - Preferences on writing tools (eg. Word vs Latex, etc)
- Questions, comments from subgroups

YR Timeline (I)

From 01/23/2020 EICUG Remote Meeting, folding in lab/project planning

SC (Rolf's) slides at Temple

| | |
|-----------------|---|
| January 2020 | Software tutorials are given, all activities are underway |
| March 19-21 | First workshop at Temple University – Philadelphia <i>Goal: present progress for various groups and sub-groups, with much discussion and work time, initiate detector complementarity study based on detector technologies</i> |
| May 22-24 | Second workshop at U of Pavia – Pavia, Italy <i>Goal: present initial physics measurements and detector requirements following five chosen processes/tools (inclusive measurements, semi-inclusive measurements, jets and heavy quarks, exclusive measurements, diffractive measurements & tagging), present detector concepts and implications for physics measurements. Complete detector requirements table including segmentation needs.</i> |
| August 3-7 | Status reports at EICUGM @ FIU – Miami, FL <i>Goal: Conveners/sub-conveners inform community about status and progress. Conveners identify possible issues (if any) in meeting with EICUG Steering Committee.</i> |
| September 17-19 | Third workshop at CUA – Washington, DC <i>Goal: present mature studies of detector requirements from physics processes, balance detector concepts versus impact on physics measurements. Discuss possible systematics reduction among complementary detector choices. Complete final “to-do” list for YR(s).</i> |
| November 19-21 | Fourth workshop at UCB/LBL – Berkeley, CA or <u>Final Meeting (assembly of Yellow Report(s))</u> <i>Goal: distribute draft YR sections before meeting</i> |
| January 2021 | (optional) Final Meeting Completion of Yellow Report |

YR Timeline (II)

SC (Rolf's) slides
at Temple

2021 January

- After assembly of Yellow Report(s), in parallel:
 - ▶ Period of web-based EICUG community input.
 - ▶ Independent review team reads and comments.
- Final Yellow Report(s) to be released after folding in input. Goal is ~~April 2021 (or, expedited~~ January 2021).
- E.g., if fourth workshop at UCB/LBL is final meeting, a possible timeline could be:
 - ▶ November 22 – November 29
 - Editing by Conveners and Steering Committee.
 - ▶ November 29 – December 20
 - In parallel, period of web-based EICUG community input and independent review team reads and comments.
 - ▶ December 21 – January 11
 - Final editing of Yellow Report(s)

Charge for Pavia

Straw-man plan of attack:

a.- Review previous existing work related to your subgroup.

b.- Converge on a set of important and representative measurements for your subgroup.

} Presented at the
Temple meeting

c.- Break-down physics deliverables into “physics objects” (PO) [electron, hadron (ID/noID), muon, jet]; map out kinematics for each PO.

← Main goal for Pavia

d.- Cross-check PO maps across physics subgroups to determine the most challenging constraints in terms of detector design; resolve overlaps [decide who runs what].

e.- Focus on fast simulations for the most demanding measurements first; determine the optimal/acceptable detector performance; confirm/check resulting impact on the rest of the measurements

Simulation baseline parameters

Based on the current BNL design, we suggest, as a starting point for our physics simulations, to study one or several of the following beam energy combinations:

| | | | | |
|---------------------------------------|---------------|---------------|--------------|-------------|
| p-e | 275 on 18 GeV | 100 on 10 GeV | 100 on 5 GeV | 41 on 5 GeV |
| d/ ³ He/ ⁴ He-e | 110 on 18 GeV | 110 on 10 GeV | | 41 on 5 GeV |
| C/ ⁴⁰ Ca/Cu-e | 110 on 18 GeV | 110 on 10 GeV | | 41 on 5 GeV |
| Au-e | 110 on 18 GeV | 110 on 10 GeV | | 41 on 5 GeV |

(For nuclei the energy refers to the energy per nucleon)

Please assume integrated luminosities of 10 fb⁻¹ and 100 fb⁻¹

A polarization of 70% may be assumed for electrons and light ions

Exchanges with DWG

- ✓ Document studies/results in the wiki: <https://wiki.bnl.gov/eicug/index.php>
- ✓ Send information to the detector group in order to update the interactive detector matrix

| η | Nomenclature | | Tracking | | | Electrons | | $\pi/K/p$ | | HCAL | Muons | | | | | | | | |
|--------------|-------------------|---|--|---|-------------------|-------------------------|--|--|------------------------|-------------------------|-----------------|---------------|-----|---------------|---------------|--|------------------------|-----------------|-----|
| | | | Resolution | Allowed X/X ₀ | Si-Vertex | Resolution σ_E/E | PID | p-Range (GeV/c) | Separation | Resolution σ_E/E | | | | | | | | | |
| -6.9 to -5.8 | ↓ p/A | Auxiliary Detectors | low-Q2 tagger | $\sigma_{B/\theta} < 1.5\%$; $10^{-6} < Q^2 < 10^{-2} \text{ GeV}^2$ | | | | | | | | | | | | | | | |
| - | | | | | | | | | | | | | | | | | | | |
| -4.5 to -4.0 | | | Instrumentation to separate charged particles from photons | | | | | | | | | | | | | | | | |
| -4.0 to -3.5 | | | | | | | 2% ΔE | | | | | | | | | | | | |
| -3.5 to -3.0 | Central Detector | Backward Detector | $\sigma_{p/p} - 0.1\% \oplus 0.5\%$ | -5% or less X | TBD | 2% ΔE | 2% ΔE | π suppression up to $1 \cdot 10^4$ | $\leq 7 \text{ GeV/c}$ | $\geq 3 \sigma$ | -50% ΔE | | | | | | | | |
| -3.0 to -2.5 | | | $\sigma_{p/p} 0.1\% \oplus 0.5\%$ | | | | | | | | | | | | | | | | |
| -2.5 to -2.0 | | | $\sigma_{p/p} 0.05\% \oplus 0.5\%$ | | | | | | | | | | | | | | | | |
| -2.0 to -1.5 | | Barrel | $\sigma_{p/p}$ -0.05% \oplus +0.5% | | | | | | | | | -5% or less X | TBD | 2% ΔE | 2% ΔE | π suppression up to $1 \cdot 10^4$ | $\leq 5 \text{ GeV/c}$ | $\geq 3 \sigma$ | TBD |
| -1.5 to -1.0 | | | | | | | | | | | | | | | | | | | |
| -1.0 to -0.5 | | | | | | | | | | | | | | | | | | | |
| -0.5 to 0.0 | | | | | | | | | | | | | | | | | | | |
| 0.0 to 0.5 | | | | | | | | | | | | | | | | | | | |
| 0.5 to 1.0 | | | | | | | | | | | | | | | | | | | |
| 1.0 to 1.5 | | | | | | | | | | | | | | | | | | | |
| 1.5 to 2.0 | Forward Detectors | $\sigma_{p/p}$ -0.05% \oplus +1.0% | -5% or less X | TBD | 10-12% ΔE | 10-12% ΔE | π suppression up to $1 \cdot 10^4$ | $\leq 8 \text{ GeV/c}$ | $\geq 3 \sigma$ | -50% ΔE | | | | | | | | | |
| 2.0 to 2.5 | | | | | | | | | | | | | | | | | | | |
| 2.5 to 3.0 | | | | | | | | | | | | | | | | | | | |
| 3.0 to 3.5 | | | | | | | | | | | | | | | | | | | |
| 3.5 to 4.0 | ↑ e | Auxiliary Detectors | Instrumentation to separate charged particles from photons | | | | | | | | | | | | | | | | |
| 4.0 to 4.5 | | | Neutron Detection | | | | | | | | | | | | | | | | |
| - | | | | | | | | | | | | | | | | | | | |
| > 6.2 | | | Proton Spectrometer | $\sigma_{\text{intrinsic}}(\theta)/ \theta < 1\%$ Acceptance: $0.2 < p_{\perp} < 1.2 \text{ GeV/c}$ | | | | | | | | | | | | | | | |

YR Wikipages

← → ↻ wiki.bnl.gov/eicug/index.php/Main_Page

Visit the main page

Main page Discussion

Main Page

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- Yellow Report
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Help about MediaWiki

Yellow Report: Physics WGs
Common
Inclusive
Semi-Inclusive
Jets/HF
Exclusive
Diffraction/Tagging

Yellow Report: Detector WGs

Tools

About

Welcome to the [Electron-Ion Collider](#) [User Group Wiki Pages!](#)

These pages are in the very initial stages of construction. Please pardon our dust.

For comprehensive information about the Electron-Ion Collider User Group (EICUG), its organization

The purpose of this Wiki is different from the main EICUG site in that it serves as means to create the [Yellow Report](#).

This service is not intended to be used as a repository for papers and other comparable materials.

Details about the EICUG collaborative tools are presented here: <http://www.eicug.org/web/content>

Yellow Report

EUCUG main site links:

- Yellow Report
- Yellow Report Physics Working Group
- Yellow Report Detector Working Group

← → ↻ wiki.bnl.gov/eicug/index.php/Yellow_Report_Physics_Inclusive_Reactions

Page Discussion

Yellow Report Physics Inclusive Reactions

Welcome to the inclusive reactions group! Our charge is to "advance the state of documented (i) physics studies and (ii) detector concepts in preparation for Inclusive Reactions section of the Yellow Report will be approximately 15 pages total and is due by the end of calendar year 2020. For details and a list of

Contents [hide]

- Focus Areas & Workflow
- Theoretical Interpolation Tables
- Vertex Level Monte Carlo Simulation Generation
 - 3.1 File Storage
- Fast Simulation Detector Effects
- Reconstruction and Correction Techniques
- Global Analysis and Impact Plots

Focus Areas & Workflow

| Measurement | Main Detector Requirements | Anticipated Plot | Physics Topic/good | Responsible persons | Additional Comment |
|--|----------------------------------|---|-----------------------------------|---------------------|---|
| A_1, A_2 for p, d | Standard inclusive | $A_1, A_2, \theta_{rel}, \Delta\phi$ | Glom & Quark Helicity and HT | TBA | Global fit with SEDS? |
| $A_{\nu}, A_{\bar{\nu}}$ for p, d | Standard inclusive | $A_{\nu}, A_{\bar{\nu}}, F_{2,3}^{\nu}, \theta_{rel}, \Delta\phi$ | Pol. & Unpol. strange | TBA | Will SEDS do the Kaon tagging, charm? |
| $d_{eN}^{(2)}$ d_{eN} (inc. HQ) for p, d | Standard inclusive + heavy quark | $d_{eN}^{(2)}, F_{2,3}^{\nu}, \theta_{rel}, \Delta\phi$ | Proton PDFs | TBA | Global fit with SEDS? |
| $d_{eN}^{(2)}$ d_{eN} (inc. HQ) for A | Standard inclusive + heavy quark | $d_{eN}^{(2)}, F_{2,3}^{\nu}, \theta_{rel}, \Delta\phi$ | Nuclear PDFs | TBA | |
| $d_{eN}^{(2)}$ d_{eN} (inc) for p, A | Standard inclusive | $d_{eN}^{(2)}, F_{2,3}^{\nu}, \theta_{rel}, \Delta\phi$ | Non-linear QCD dynamics | TBA | Global fit with SEDS? |
| A_{ν} for d | Standard inclusive | $\sin^2(\theta_{rel})$ | ERM & precision EW physics | TBA | Need ~ 100 fb $^{-1}$ CLFV via $e \rightarrow e\gamma$ |
| $d_{eN}^{(2)}$ d_{eN} $d_{eN}^{(3)}$ | Standard inclusive | Updated Fig.6 in Physics-08.115018 for CM energies covering | Lorentz and CPT Violating Effects | Lammi and Shrivell | |

The inclusive reactions group covers a wide range of physics chs Standard model and CPT and Lorentz violating measurements. The general workflow is illustrated on the right. Theory groups pass through a fast-simulation detector package that will provide and passed back to the theoretical groups for global fitting and fit

Theoretical Interpolation Tables

A git repository has been set up to store the theoretical input table

Vertex Level Monte Carlo Simulation

The IRG has identified three possible paths for vertex level simulation/pion discrimination or the reconstruction of kinematic variables existing resources so it will be the initial focus of the IRG. The work path is to generate full-final-state simulations for each set of theoretical input. While this path is uncovered.

A complete list of the available generators is compiled on the [EIC simulations page](#).

File Storage

```

    graph TD
      A[Theoretical cross sections] --> B[Interpolation tables for  $\sigma(s, Q^2)$ ]
      B --> C[Unweighted vertex level MC events]
      B --> D[Weighted vertex level MC events]
      B --> E[Unweighted vertex level MC events]
  
```

Pavia agenda

Current (and very preliminary) plan:

- Day 1 - Plenary
 - Project, accelerator design reports
 - Physics and detector WG overviews
 - Complementarity/EoI discussion
 - Possibly software Q&A
- Day 2 - Parallel/Semi-parallel
 - WG parallel sessions
 - PWG & DWG joint sessions
- Day 3 - Plenary
 - WG summaries
 - Discussion on next steps

Input from subgroups

- Software needs
 - tools: event generators, simulation software
 - computing resources: storage, cpu...
- YR writing tools (Latex vs Word)
- Other general input/questions

Next meeting: May 6 at 11AM EST