Outline of EIC Yellow Report (DRAFT)

January 31, 2020

Note: After some struggle and iterations on the outline of the YR, we came independently to the conclusion that a single-volume report is probably not the optimal choice. It is hard to get a coherent flow in a document that, on the one hand, tries to accommodate physics topics and processes, and on the other requirements and detector concepts. Below, we list drafts for an outline (subject to modifications by the conveners of course) for ***one*** *Yellow Report that could also be split as* ***four*** *separate volumes, YR/executive summary, YR/Physics, YR/Detector and YR/Accelerator Experiments. Here, we mostly leave out the details on the author list and the like which is discussed in a separate document. Of course, this draft outline is aimed to be a guide to the foreseen structure and not expected to be a rigid structure, as during the course of this year one expects changes and improvements to be made. It hopefully suffices to give people plenty of opportunity for contributions.*

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Volume I : Executive Summary

Short, may be 20 pages at most. Idea is that one can read the Yellow Report as one, or one can lift this volume out as standalone executive summary. Other Yellow Reports, like the one for ILC, have similarly used several volumes for their descriptions.

1. The Electron-Ion Collider

2. Physics Measurements and Requirements

3. Detector Concepts

4. Opportunities for Detector Technology & Computing

5. Opportunities for Accelerator Science & Technology

Volume II : Physics

6. Introduction

Includes intro/explanatory things related to physics only. Description of the effort and the methodology used. Define conventions, and maybe some sketches. Also discuss the relation of this YR, the White Paper, and the NAS report.

7. The EIC Physics Case

Start with a short summary outlining the overarching EIC physics goals, then defining various science topics and how they are intertwined through the processes and tools. Introduce the big matrix linking the science topics through measurements to the chosen five detector requirements processes. Explain why the focus on processes not on topics. May be also an overview what are new and recent science topics of interest. Here we have to watch out a bit since we are not writing a new WP. We are not rewriting the physics case here but simple broaden the range of physics that an EIC can address.

8. The EIC Measurements and Studies

Collected sub-group input goes here. The physics working group is organized according to processes but a matrix exists (or should exist) that maps physics topics to processes. In this chapter any contributions the EIC User Group is working on triggered by the Yellow Report are organized by physics topic. The idea here is not to repeat the White Paper but to leave the

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community opportunity for key measurements to be studied in more detail with focus on requirements. These studies should be described here. Physics motivation should be kept very short for WP topics. New topics can have a slightly more detailed text. The list of topics that defines the subsection was taken from the MIT meeting and will have to be adjusted to what studies were at the end actually done of course.

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7.5.6 Lattice QCD

9. Detector Requirements

Each chapter details what the requirements are and why. Summary puts it all together and identifies the driver. This is not a repetition of the previous section in that no details of the conducted studies are given (as in the previous section) but the results are emphasized, now mapped on processes that is a more suitable for the work towards detector concepts. Needs summary tables at the end.

9.1. Inclusive Measurements

9.2. Semi-Inclusive Measurements

9.3. Jets and Heavy Quarks

9.4. Exclusive Measurements

9.5. Diffractive Measurements & Tagging

9.6. Summary of Requirements

10. References

11. Appendices (can also absorb these as sidebars)

11.1. DIS Kinematics

Some kinematic plots (see Handbook and equivalent). May be reminder of some kinematic variables that are relevant for ep, eA etc. Sort of collection of sidebars. Short but helpful. Might be useful to have as reference. Include all the relations between W, x, Q2, xIP, beta, Mx, etc. Especially newcomers would appreciate to have this somewhere.

Volume III : Detectors

12. Introduction

Description of the effort and methodology used with the focus on detectors only. Define conventions (e.g. forward/backward). Maybe some sketches.

13. Detector Challenges and Performance Requirements

What was assumed in the report and what goes in the next sections. Sets important constraints on the machine requirement (lumi, energy, spin, etc) including the full integration detector and interaction region.

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13.1. Beam Energies, Polarization, Versatility, Luminosities

13.2. Rates and Multiplicities

13.3. Integrated Detector and Interaction Region

13.4. Backgrounds

13.5. Systematics and Ancillary Detectors

13.5.1. Luminosity

13.5.2. Polarimetry

13.6. Physics Requirements

Summary of requirement as derived from “Volume II”, but only the hard numbers w/o any physics motivation. Mainly tables.

14. Detector Aspects

14.1. Magnet

14.2. Tracking

14.2.1. Central

14.2.2. Forward

14.2.3. Backward

14.3. Particle Identification

14.3.1. Central

14.3.2. Forward

14.3.3. Backward

14.4. Electromagnetic Calorimetry

14.4.1. Central

14.4.2. Forward

14.4.3. Backward

14.5. Hadronic Calorimetry

14.5.1. Central

14.5.2. Forward

14.6. Far-Forward Detectors

14.6.1. Low Q2 Tagger

14.6.2. Forward Taggers

14.6.3. Roman Pots

14.6.4. ZDC

14.7. Electronics

14.8. Data Acquisition

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14.9. Software, Data Analysis and Data Preservation

15. The Case for Two Detectors

The whole complementary discussion should go here. With the physics case and requirements outlined, and the various individual and common detector technologies outlined, this may be the most logical place for the arguments for two complementary detectors. We can decide later to re-order this and the next section as needed.

16. Integrated EIC Detector Concepts

Here we are putting all the above "aspects" together in possible detectors. One proto-detector as "standard" (whatever that means) and then possible alterations with pros and cons. Some might give a better detector than the standard but might be very costly etc.

16.1. General Purpose Detector Concept

16.1.1. Standard Layout

16.1.2. Detector technology description

16.1.3. Electronics, Data Acquisition and Computing technology description

16.1.4. Detector Integration

16.1.4.1.Central Detector

16.1.4.2.Forward/Backward Detector

16.1.5. Systematics Discussion

16.2. Second General Purpose Detector Concept

16.2.1. Standard Layout

16.2.2. Detector technology description

16.2.3. Electronics, Data Acquisition and Computing technology description

16.2.4. Detector Integration

16.2.4.1.Central Detector

16.2.4.2.Forward/Backward Detector

16.2.5. Systematics Discussion

16.3. Specialized Purpose Detector Concept

16.4. Alternative Concepts

17. Detector Technology

17.1. Areas of Targeted R&D

This is a bit a delicate part. We need to identify areas where targeted R&D is needed but we do not want to give the impression this is an open-ended R&D pit.

17.2. Generic Detector R&D

The generic detector R&D program to address the scientific requirements for measurements at a future Electron Ion Collider (EIC) has served to also consider more forward-looking detector concepts and technologies, and associated software and computing ideas. Here we can list opportunities for future computing and detector technologies that can enhance computing and detector technologies in general and possibly enhance the scope of EIC science in the outyears.

18. References

19. Appendices

Volume IV : Accelerator Physics Experiments

20. Introduction

The EIC, once built, will be a unique facility to push the frontiers of accelerator science and technology. It will be one of the most complex and sophisticated collider accelerators ever built, with machine requirements to push the state-of-the-art on many fronts including the high degree of beam polarization, high luminosity, beam cooling, beam dynamics, crab cavities for both beams, and an interaction region with complex magnets. Here we outline opportunities for accelerator physics experiments at a future EIC

21. Experiments that can advance accelerator science in general

22. Accelerator design modifications that could enhance EIC science reach

22.1. Positron Beams

22.2. EIC Improvements in the out-years

23. Experiments that can feed to design/operations of future machines

24. References

25. Appendices

26. Acknowledgements

People outside the EICUG that helped substantially w/o being in a WG. Like theoreticians that do fits for us or detector experts from outside collaborations.

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