Jets and Heavy Flavor WG Meeting

Sept 21, 2020

1. Presentation by M. Kelsey - EIC charm reconstruction studies in fast and full simulations

2. YR timeline and activities

- Timeline
- Structure and overleaf

Slides taken from A. Dumitru, A. Metz

Overall Timeline

January 2020	Software tutorials are given, all activities are underway
March 19-21	First workshop at Temple University – Philadelphia *Goal: present progress for various groups and sub-groups, with much discussion and work time, initiate detector complementarity study based on detector technologies*
May 22-24	Second workshop at U of Pavia – Pavia, Italy *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.*
August 3-7	Status reports at EICUGM @ FIU – Miami, FL *Goal: Conveners/sub-conveners inform community about status and progress. Conveners identify possible issues (if any) in meeting with EICUG Steering Committee.*
September 17-19	Third workshop at CUA – Washington, DC *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).*
November 19-21	Fourth workshop at UCB/LBL – Berkeley, CA or Final Meeting (assembly of Yellow Report(s)) *Goal: distribute draft YR sections before meeting*
January 2021	(optional) Final Meeting

Remains unchanged

Overall timing

Original Timeline (January 2020)

November 19-21, 2020 Fourth workshop at UCB/LBL – Berkeley, CA

Goal: distribute draft YR sections before meeting

Option A	Option B
2020 November Final Meeting	2020 November 4th Meeting
	2021 January Final Meeting
Final Yellow Report(s) to be released after folding in input	
January 2021	April 2021

Option A must be target - we are well on track!

- Stay in phase with present fast EIC project timeline
- Stay in phase with EoI input and call for Detector proposals
- Stay in phase with 2nd IR topical workshop of February and CFNS 2nd IR workshop series

Overall timing

Timeline - Option A

If 4th workshop at UCB/LBL is final meeting, the timeline is:

- November 1 - November 18
  - SC assembles independent review team (readers) with input from conveners
- November 22 – November 29
  - Editing by Conveners and Steering Committee
- November 29 – December 20
  - Period of web-based EICUG community input and independent review team reads and comments
- December 21 – January 11
  - Final editing of Yellow Report(s)
- January 15
  - Release Yellow Report(s)

Combined detector matrix

η	Nomenclature			Tracking				Electrons and Photons			π/K/p		HCAL		Muons
				Resolution	Allowed	minimum-pT	Si-Vertex	Resolution σ_E/E	PID	min E	p-Range	Separati	Resolution σ_E/E	Energy	
-6.9 to -5.8			low-Q2 tagger	σθ/θ < 1.5%; 10-6 < Q2 < 10-2 GeV2											
-5.0 to -4.5						300 MeV pions									
-4.5 to -4.0	↓ p/A	Auxiliary Detectors	Instrumentation to separate charged particles from photons			300 MeV pions		2%/√E(+1-3%)		50 MeV					
-4.0 to -3.5						<100MeV pions, 135MeV kaons				50 MeV			~50%/√E + 6%		muons useful for bkg, improve resolution
-3.5 to -3.0						<100MeV pions, 135MeV kaons				50 MeV					
-3.0 to -2.5			Backward Detector	σp/p ~ 0.1%⊕0.5%		<100MeV pions, 135MeV kaons	σ_xy ~ 30/pT μm + 40 μm			50 MeV	≤ 7 GeV/c		~45%/√E+6%		
-2.5 to -2.0				σp/p 0.1%⊕0.5%		<100MeV pions, 135MeV kaons	σ_xy ~ 30/pT μm + 20 μm	2%/√E(+1-3%)	π suppression up to 1:1E-4	50 MeV					
-2.0 to -1.5				σp/p 0.05%⊕0.5%		<100MeV pions, 135MeV kaons		7%/√E(+1-3%)		50 MeV					
-1.5 to -1.0						<100MeV pions, 135MeV kaons		7%/√E(+1-3%)		50 MeV					
-1.0 to -0.5		Central Detector	Barrel	σp/p ~0.05%×p+0.5%	~5% or less X	<100MeV pions, 135MeV kaons	σxyz ~ 20 μm, d0(z) ~d0(rΦ) ~ 20/pTGeV μm + 5 μm	(10-12)%/√E(+1-3%)		50 MeV	≤ 10 GeV/c	≥ 3 σ	~85%/√E+7%	~500 MeV	
-0.5 to 0.0						<100MeV pions, 135MeV kaons				50 MeV			~85%/√E+7%		
0.0 to 0.5						<100MeV pions, 135MeV kaons				50 MeV			~85%/√E+7%		
0.5 to 1.0						<100MeV pions, 135MeV kaons				50 MeV	≤ 15 GeV/c		~85%/√E+7%		
1.0 to 1.5			Forward Detectors	σp/p ~0.05%×p+1.0%		<100MeV pions, 135MeV kaons	σ_xy ~ 30/pT μm + 20 μm		3σ e/π	50 MeV	≤ 30 GeV/c		35%/√E		
1.5 to 2.0						<100MeV pions, 135MeV kaons				50 MeV	≤ 50 GeV/c				
2.0 to 2.5						<100MeV pions, 135MeV kaons				50 MeV					
2.5 to 3.0				σp/p ~ 0.1%×p+2.0%		<100MeV pions, 135MeV kaons	σ_xy ~ 30/pT μm + 40 μm			50 MeV	≤ 30 GeV/c				
3.0 to 3.5						<100MeV pions, 135MeV kaons	σ_xy ~ 30/pT μm + 60 μm			50 MeV	≤ 45 GeV/c				
3.5 to 4.0			Instrumentation to separate charged particles from photons			<100MeV pions, 135MeV kaons				50 MeV					
4.0 to 4.5	↑ e	Auxiliary Detectors				300 MeV pions				50 MeV			35%/√E (goal), <50%/√E (acceptable)*, 3mrad/√E (goal)		
4.5 to 5.0			Neutron Detection			300 MeV pions		4.5%/√E for photon energy > 20 GeV	<= 3 cm granularity	50 MeV					
> 6.2			Proton Spectrometer	σintrinsic(|t|)/|t| < 1%; Acceptance: 0.2 < pt < 1.2 GeV/c											

Needs cross check. Examples of unrealistic entries from the DWG identified

Tensions and correlations

Tensions with reference detector identified

- Primarily PID at high momenta

- Please add references to all studies
  - Many fields have not backup info linked, so it is not clear were things come from.
- Have MC been validated, e.g. can they reproduce world data?
  - How has the MC been tuned?
  - To jets/heavy flavors: what is multiplicity of jets? What is group's definition of a jet?
- What is the impact on physics if requirements are not fully met, e.g. PID not at 10 GeV/c in barrel or the minimum pT cut-off values? What is the tradeoff?
  - how much of the physics program is affected?
- Can phase space be compensated?
  - do we lose an entire physics program or a part of it? Is the loss acceptable?
  - Please, consider the phase space portion which is easier to access or the possibility to modulate the accessible phase space by varying the MC energy.
- Detection strategy - have boundary conditions and cross-correlations between detectors been taken into account?
  - some requirements may be mutually exclusive - but are they needed when considering an overall strategy?
- Next steps - how to achieve the optimization of physics and system integration
  - Can your analyses be shared with the DWG so that we can use them to evaluate the output of detector simulations? If so, you can you share them via the GitHub repository of the EICUG: https://eic.github.io

Yellow Report preparation

Discussion of different models of access to the YR

- One for all conveners or copies for different groups

- We will be using Overleaf for the EIC-YR
- We are using the BNL professional license
- PWG and DWG Convenors will have edit permission for the integrated document
- The structure of the document is based on the draft EIC YR outline (which has been discussed previously)
  - http://www.eicug.org/web/sites/default/files/YRs_Outline_v6_draft.pdf
- Copies of the template will be made for each subgroup and hosted at BNL; subgroup conveners will have edit permissions.
- Elke has set up the template based on the CDR
- View only version of integrated document:
  - https://www.overleaf.com/read/bbdqsmspmjdp

Yellow Report preparation

This is the heart of the format, which all sections will use.
It includes definitions for frequently used units, kinematic variables, particles, energies, colliding systems, etc. E.g

```
\newcommand{\gev}{\operatorname{GeV}}
\newcommand{\pT}{\mbox{$p_T$}}
\newcommand{\ep}{\textit{e}+\textit{p}}
```

Use common definitions
Do not deviate from labeling conventions for sections, figures, and citations.
Use Bibtex (and only Bibtex)

use INSPIRE standard where possible. (Search the publication on https://inspirehep.net, then click on "cite")

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8. 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 are more suitable for the work towards detector concepts. Needs summary tables at the end.

8.1. Inclusive measurements
8.2. Semi-inclusive measurements
8.3. Jets and Heavy Quarks (J&HF conveners)
8.4. Exclusive measurements
8.5. Inclusive diffractive measurements & Tagging
8.6. Summary of requirements

It is not yet clear whether some physics driver plots shouldn’t be included

Theory aspects

In-medium evolution and suppression of light and heavy flavor at EIC. Parton shower formation in nuclei (Z. Liu *et al.)*

Jets and jet substructure modification in DIS with nuclei (H. Li *et al.)*

Nuclear modification of jets and hadrons. Dijets and dihadrons and relation to TMD (X. Wang *et al.)*

Jets at moderate and small values of x. Improved TMD framework (ITMD) and forward jets. (K. Kutak *et al.)*

Nuclear PDFs from dijet distributions (M. Klasen *et al.)*

Higher order calculations at small x, photon+dijet, higher twist (Y. Mehtar-Tani *et al.)*

Models of color decoherence and relation to HI phenomenology (Y. Mehtar-Tani *et al.)*