Charge 3 of WG

“Utilize the extended design period for Detector 2 to identify groups that will focus on R&D for emerging technologies that could provide another aspect of complementarity to ePIC.”

Technology aspects have been discussed in many programs

- Regular WG Meetings
- Detector-II/IP8 Meeting @ EICUG Meeting 2023
- 1st International Workshop on a 2nd Detector for the EIC, 2023
- EICUG 2nd Detector Meeting, 2022
- Hot and Cold QCD Town Hall Meeting 2022
- EIC Yellow Report

Broader overview for the 2nd detector at Bill's talk at 11:30 AM, Friday, 8/4.
2ND DETECTOR AS A HOST FOR NEW DETECTORS

- Promoting new detector ideas for the 2nd Detector that
  1. Lead to the success of the physics programs
  2. Boost the advantages of IP8 secondary focus

- EIC-Related Generic Detector R&D
  - “This program will support advanced R&D on innovative detector concepts that either the one detector in the project scope or a second detector could incorporate.”, the official proposal guidelines

- Valuable design input from EICUG and EPIC on detector requirements
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# EIC PHYSICS PROGRAMS

## Golden Channels Strawman

<table>
<thead>
<tr>
<th>CHANNEL</th>
<th>PHYSICS</th>
<th>DETECTOR II OPPORTUNITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffractive dijet</td>
<td>Wigner Distribution</td>
<td>detection of forward scattered proton/nucleus + detection of low $p_T$ particles</td>
</tr>
<tr>
<td>DVCS on nuclei</td>
<td>Nuclear GPDs</td>
<td>High resolution photon + detection of forward scattered proton/nucleus</td>
</tr>
<tr>
<td>Baryon/Charge Stopping</td>
<td>Origin of Baryon $#$ in QCD</td>
<td>PID and detection for low $p_T$ $\pi/K/p$</td>
</tr>
<tr>
<td>$F_2$ at low $x$ and $Q^2$</td>
<td>Probes transition from partonic to color dipole regime</td>
<td>Maximize $Q^2$ tagger down to 0.1 GeV and integrate into IR.</td>
</tr>
<tr>
<td>Coherent VM Production</td>
<td>Nuclear shadowing and saturation</td>
<td>High resolution tracking for precision $t$ reconstruction</td>
</tr>
</tbody>
</table>

These channels are just a starting point, a way to initially focus activities within the group. Additional ideas and efforts are welcome!
CASE STUDY) MUON DETECTION

- The benefits of μ detection include
  - VM production
  - Gluon TMDs with mesons
  - TCS and DDVCS
  - Semi-leptonic decay channels and BSM studies

- Detector examples
  - MPGDs (ex) EICGENR&D2023 16
  - KLM-type detectors (ex) EICGENR&D2023 18
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IP8 SECONDARY FOCUS

- Ion detections in the far forward region

**Acceptance of the Far-Forward detectors** At low \( x_B \), the physical \( t_{\text{min}} \) for DVCS in \(^{4}\text{He}\) cannot be reached by the detectors, therefore detector acceptances directly define the minimal \( t \) which can be experimentally accessed, which

- IP8 secondary focus improves the detector acceptance for ion detection

---

**EIC far-forward acceptance with and without a 2\(^{\text{nd}}\) focus**

Without 2\(^{\text{nd}}\) focus: (EPIC @IR6)

\[ Z' \text{ vs } x_B \]

\[ p_\perp \text{ vs } x_\perp \]

With 2\(^{\text{nd}}\) focus: (Detector 2 @ IR8)

Order-of-magnitude improvement in forward acceptance

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\( p. 363, \) EIC YR

\( \text{Pawel Nadel-Turonski,} \)

\( \text{EICUG Annual meeting 2023} \)
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EIC-RELATED GENERIC DETECTOR R&D PROGRAM

- Committee chair: Dave Mack (JLab)
  - Annual proposal opportunity at https://www.jlab.org/research/eic_rd_prgm
  - 15 approved proposals out of 27 received proposals for the FY22 cycle
  - 20 proposal received for FY23 by July 14 2023
  - See Dave’s slides for his talk at the EICUG meeting, 2023

- Support for the 2nd detector is one of the main objectives of the EIC-related generic R&D program.

- The program also helps to identify the detector expertise within the community
The WG has invited the detector experts to discuss the technology concepts.

For the full technology inventory, see Thomas Ullrich's slides: https://indico.bnl.gov/event/18414/contributions/76157/attachments/47563/80668/EIC_Technology_Inventory_Temple.pdf
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CONCLUSION

- EIC Detector 2 is a perfect place where the new detectors can benefit the EIC physics programs. I have curated some examples from the past meetings, but there are many more not discussed here.

- EIC Generic R&D has played important role.

- The WG always welcomes more input on the detector requirements! In particular, the input from RHIC/AGS users and the New detectors and Technology enthusiasts is extremely valuable! Please contact us at eic-det2-conveners-l@lists.bnl.gov or one of the conveners ▶

- Stay tuned for our upcoming events!

Sangbaek Lee (ANL)
Anselm Vossen (Duke/JLAB)
Thomas Ulrich (BNL/Yale)
Pawel Nadel-Turonski (CFNS/SBU)
Simonetta Liuti (UVA)

Detector WG
- Klaus Dehmelt (CFNS/SBU)
- Ernst Sichtermann (LBNL)

Physics WG
- Charles Hyde (ODU)
- Bjoern Schenke (BNL)
EXAMPLE OF EFFORTS TO IDENTIFY THE DETECTOR EXPERTISE OUTSIDE THE COMMUNITY

- Ex)

Magnet

Examples of magnets for future experiments that represent the engineering and R&D challenges:

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
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</tr>
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<tbody>
<tr>
<td>LHC</td>
<td>CMS</td>
<td>ATLAS solenoid</td>
<td>4</td>
<td>3</td>
<td>13</td>
<td>29</td>
<td>2.7</td>
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<tr>
<td>LHC</td>
<td>CMS</td>
<td>ATLAS solenoid</td>
<td>2</td>
<td>1.2</td>
<td>5.3</td>
<td>7.8</td>
<td>0.04</td>
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<tr>
<td>FCC-sc</td>
<td>CLIC</td>
<td>CLIC detector</td>
<td>2</td>
<td>3.7</td>
<td>7.4</td>
<td>29-30</td>
<td>0.6</td>
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<tr>
<td>FCC-sc</td>
<td>CLIC</td>
<td>CLIC detector</td>
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<td>2.1</td>
<td>6</td>
<td>20</td>
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<tr>
<td>FCC-hh</td>
<td>CLIC</td>
<td>CLIC detector</td>
<td>4</td>
<td>3.5</td>
<td>7.8</td>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td>FCC-hh</td>
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<td>CLIC detector</td>
<td>2</td>
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<td>19</td>
<td>30</td>
<td>12.5</td>
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<tr>
<td>FCC-hh</td>
<td>CLIC</td>
<td>CLIC detector</td>
<td>4</td>
<td>2.6</td>
<td>3.4</td>
<td>30</td>
<td>0.4</td>
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<tr>
<td>JAXO</td>
<td>CMS-E</td>
<td>CMS-E</td>
<td>8 coil toroid forward solenoid</td>
<td>2.5</td>
<td>8x9.0</td>
<td>22</td>
<td>10</td>
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<tr>
<td>JAXO</td>
<td>CMS-A</td>
<td>CMS-A</td>
<td>dipole</td>
<td>9</td>
<td>1.3</td>
<td>6.9</td>
<td>25</td>
</tr>
</tbody>
</table>

CERN: Magnet R&D (WP 8) on advanced powering, 4-T facility, instrumentation

Reality check: anything but low $X/X_0$ coils is probably beyond a 2nd EIC detector’s timeframe - expect no miracles.

Thomas Ullrich, Detector-II Workshop, May 2023