GEn Charge Exchange Polarimeter

GMn Preparation Review

David Hamilton

for the E12-17-004 collaboration

30th October 2018
E12-17-004 GEn-Recoil

- E12-17-004 experiment proposed to:
  
  Measure $G_{En}/G_{Mn}$ at $Q^2 = 4.5 \text{ (GeV/c)}^2$ using Recoil Polarization technique

  Compare standard np→ np and charge-exchange np→ pn scattering as analyzers of the neutron polarization at several GeV neutron energy

- Approved for 5 days of beam

- Proposed to “piggy-back” the $G_{En}/G_{Mn}$ measurement on the $G_{Mn}/G_{Mp}$ experiment at the 4.5 (GeV/c)$^2$ kinematic point (identical kinematics)

- Most of the apparatus is common to the two experiments

- Piggy-back operation results in major saving of $G_{En}/G_{Mn}$ setup time but must not cause significant down time for $G_{Mn}/G_{Mp}$

- Additional to the $G_{Mn}/G_{Mp}$ apparatus (E12-09-019), $G_{En}/G_{Mn}$ requires the neutron polarimeter: neutron-scattering analyzer blocks, proton trackers and the associated electronics, readout etc.

- More on this in later talk (at 4.45pm)
Two Neutron Polarimeters for GEn-Recoil

Charge Exchange (CE) Polarimeter
- High-momentum forward protons (into HCAL) after CE \( np \rightarrow pn \)
- 2 INFN GEM planes
- 6 UVa GEM planes
- 1 Cu analyzer
- Provision to mount CH analyser for PR Polarimeter

Proton Recoil (PR) Polarimeter
- Low-momentum large-angle recoiling protons after \( np \rightarrow np \)
- 2 sections, one each side of CE Polarimeter
- Each section has
  - 2 UVA GEM planes
  - 1 Plastic scintillator plane

(see talk by Michael and Brad)
CE Polarimeter Components

- Polarimeter components sit on 48D48 counterweight.
- GEM electronics hut located on large-angle side of counterweight.
- Will need shielding between beamline and detectors.

Infrastructure (see Robin's talk):
- Main frame and GEM subframes
- Copper analyzer and frame
- Active analyzer and frame (for RP polarimeter)

GEM gas supply (see Jack's talk)

Detectors (see Kondo's talk):
- 2 INFN GEM planes
- 6 UVa GEM planes

Readout Electronics (Alex’s talk, July):
- 2 VME crates, 1 VXS crate
- 40 MPDs
- 1 SSP
Infrastructure Cost Estimates and Timeline

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost ($)</th>
<th>Status</th>
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<tbody>
<tr>
<td><strong>CE Polarimeter</strong></td>
<td></td>
<td></td>
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<tr>
<td>Glasgow can cover the costs, but it would make sense to procure other SBS equipment &quot;in kind&quot;.</td>
<td></td>
<td></td>
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<tr>
<td>Copper Analyzer</td>
<td>16k</td>
<td>Spring 2019?</td>
</tr>
<tr>
<td>Analyzer frame</td>
<td>4.1k</td>
<td>Spring 2019?</td>
</tr>
<tr>
<td>4 GEM subframes</td>
<td>3.4k</td>
<td>Spring 2019?</td>
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<tr>
<td>Main frame</td>
<td>5.6k</td>
<td>Spring 2019?</td>
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<tr>
<td><strong>PR polarimeter</strong></td>
<td>12.2k</td>
<td>JLab budget, spring 2019?</td>
</tr>
<tr>
<td><strong>GEM electronics hut</strong></td>
<td>4.2k</td>
<td>JLab budget, spring 2019?</td>
</tr>
<tr>
<td><strong>Shielding around beamline</strong></td>
<td>15k</td>
<td>JLab budget, fall 2019? Shielding needs work</td>
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Total of $60k (cost estimates from Robin)

Active plastic scintillator analyzer (32 channels) for RP polarimeter already built and tested in Glasgow. Ready for shipping to JLab.
Outlook and Manpower

- The detectors for the CE polarimeter have been identified
  - 2 INFN GEM planes, 6 UVa GEM planes
- Kondo leading efforts here, with a plan to have detectors in the polarimeter frame by late 2019.
- Budget and timeline for acquiring MPD modules, VME/VXS crates and SSP need to be finalised.
- Infrastructure design work led by Robin will be complete by spring/summer 2019.
- Additional simulation effort needed in optimizing beamline shielding, also important for RP polarimeter (Glasgow, early 2019?).
- Glasgow has a fraction of 1 PDRA (R. Montgomery), 1 technician (A. Clarkson) and 1 academic (D. Hamilton); expecting 1 PhD student starting Fall 2019, w/ long-term (6-month) stay at JLab.