

Questions & thoughts on pC polarimetry

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08.12.2021

Questions

1. How much time is needed for ToF recoil measurements to avoid pile-up?
2. What are the limitations on target thickness to ensure useful carbon ($^{12}_6\text{C}$) recoil energy measurement?
3. How long can a C target remain in the (RHIC and EIC) beams while avoiding disintegration?
4. Is an average polarization over a number of bunches sufficient in evaluating asymmetries?
 - Is bunch-by-bunch polarization measurement needed?
5. How accurately should the profiles of beam and polarization be measured?
 - Are polarization profiles along x , y and z coordinates equally important?
6. Are HJET, $p + \text{C}$ recoil polarimeter and physics detectors operated simultaneously?
 - What are the fractional losses, also from beam life time?
7. What is the needed C target density (atoms/cm²) for beam polarimetry?

Thoughts I

1. Solid carbon target

- Thin fibers burn quickly at EIC beam intensities.
- Diamond pellets?
 - What is the admissible size to get $^{12}_6\text{C}$ out?
 - How would one inject and track such a tiny pellet?
 - Can the discontinuous rate from be handled?

2. Cluster jet targets (quasi-continous rate) [1]

- Experience with H_2 and D_2 targets at $d_t \approx 10^{14}$ to 10^{15} atoms/cm².
- Development actually started with heavier gases.
- Would CO_2 or CH_4 work, or O_2 ?
- Cluster size may be a problem: 0.3 to 2 μm (see e.g. [2]).
- No container walls!
- Can pure gas jet targets make d_t up to 10^{15} atoms/cm²?
- Vertex determination?

3. Storage cell (like planned for LHCb spin)

- cheaper than 2.
- Dwell time typically 2 ms after gas flow is switched off.
- Cell needs to have ultra-thin container walls to get C out.

Thoughts II

4. Shoot 10 MeV C ions at angle of 10° against p beam
 - Would allow one to detect recoil C and scattered $p \rightarrow$ vertex.
5. Would a more sophisticated detector system help?
 - Are there polarimeter reactions available that were up to now overlooked?
 - Measure low-energy spectator protons from $^{12}_6\text{C}$ together with fragment of $^{11}_5\text{B}$ recoil (see [3, 4])?

References

- [1] A. Taschner, E. Kohler, H. W. Ortjohann, and A. Khoukaz, Nucl. Instrum. Meth. A **660**, 22 (2011).
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- [4] C. Wilkin, Eur. Phys. J. A **53**, 114 (2017).