Independent TAC Report on PR12-23-011

Jay Benesch, Daniel Carman, Douglas Higinbotham, Holly Szumila-Vance, and Benedikt Zihlmann

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PR12-23-011: Precision Deuteron Charge Radius Measurement with Elastic (e,e'd) Scattering

This experiment is proposing a special experimental setup to make a precision measurement of the deuteron charge radius and charge form factor. The setup is comprised of the *standard* PRad setup augmented with a new Si-based recoil detector. The required beam parameters do not pose a technical challenge, though the non-standard 1.1 GeV energy could be a scheduling challenge.

Primary Comments

- 1. The quoted target density (page 18 of the proposal) is wrong by a factor of 1000. It should be 1.67e-3 mg/cm³ in the case of a cold deuterium gas target.
- 2. Making use of the Bethe-Bloch calculator and the correct target thickness, it was clear that deuterons with $Q^2 < 0.01 \text{ GeV}^2$ cannot reach the second layer of silicon. It was also noted that the NIKHEF internal target recoil detector used much thinner Si layers and that deuterons had to reach the second layer of Si to cleanly separate deuterons from protons. See https://doi.org/10.1016/S0168-9002(99)01176-6.
- 3. No discussion is provided on how the Si-strips will work in close proximity to 20 K, a temperature that is so low that it is not clear if Si detectors can operate.

Secondary Comments

- 1. What is the status of the required crates and modules for HyCal? Will there be enough FADC modules for the entire detector or just the inner $PbWO_4$ part?
- 2. It was not clear how the high precision of the HyCal system was going to be achieved and if the experiment would require the non-trivial re-installation of the Hall B tagger system.
- 3. It was not clear exactly who is taking responsibility for the design and construction of the complicated recoil detector. It is clear that this detector needs to be designed in close collaboration with the Target Group.
- 4. The target/scattering chamber system will require significant work including two additional turbo-pumps and design work to accommodate the new recoil detector system.
- 5. The upgraded Hall B beam dump will allow powers of 1 kW instead of the 0.16 kW assumed in the proposal. Does this change affect the beam time request?

- 6. The proposal states that the GEM trackers will be read out using APV25 ASICs. It is possible that replacing these with a newer generation chip (VMM?) in conjunction with an appropriate backend will allow for higher GEM readout rates, allowing for a reduced beam time request.
- 7. The timing resolution of the Si recoil detector is assumed to be 1 ns (Fig. 46). Given the typical signal rise time and decay time of silicon detectors with an expected amplifier shaping time of at least 50 ns, a more realistic timing resolution of several ns should be assumed and its impact on the signal-to-noise ratio of selecting elastic events should be investigated.