

Report

Proton Radius (PRad) Experiment Readiness Review

2015 November 12

Reviewers: E.Chudakov (chair), P.Degtiarenko, D.Higinbotham, B.Manzlak, E.Sun, M.Tiefenback, G.Young

The PRad team provided well-prepared and comprehensive presentations and other requested information. The questions of the charge along with the answers are listed below.

Charge:

- 1) Has the target and detector configuration been defined (including ownership, maintenance and control during beam operations)? Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?*

Findings: The target and the detector configuration have been defined. There are modifications with respect to the proposal: a) the veto counter is replaced with a large GEM detector, b) the target chamber has a different geometry. The ownership and responsibilities have been defined. The Hybrid Calorimeter (HyCal) has been installed at a movable rack, connected, tested and is ready for operations. No other equipment has been installed. The vacuum chamber and the GEM chamber are being manufactured. An installation plan and schedule is in place.

Comments: The new design of the target chamber appears to be superior to the original design in all respects. The GEM chamber provides a superior spatial resolution than the original design. However, it inserts a considerable amount of material in front of the calorimeter (2 chamber frames). The large vacuum chamber has a relatively thin window. A vacuum pipe, fastened to other beam elements, is attached to the center of the window via a bellows. The reviewers are concerned that an accidental motion of the long beam pipe could damage the window.

Recommendations:

- 1.1 Demonstrate that the final configuration of the experiment, including the new GEM detectors with their frames and the gas outside of the target cell, will deliver the proposed results.

Charge:

- 2) Have all the jobs that need to be done to mount and run the experiment/s been identified and defined adequately?*

Findings: A reasonably detailed plans for installation and running are in place. The running plan assumes that the accelerator would be able to retune the beam energy from 1 to 2 GeV and back easily.

Comments: Accordingly to the recently published schedule for the PRad running period, the accelerator will run at 1 GeV per pass. The planned energy changes for PRad will involve switching between 1 and 2 passes.

Recommendations:

2.1 Plan for testing of the integrity of the Vacuum system before the installation of the detectors downstream of the vacuum volume.

2.2 Optimize the running plan taking into account the time spent for the energy changes.

Charge:

3) *Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?*

Findings: Installation work: the responsibilities and the manpower are identified. Running: the collaboration will provide about 17 shift workers, the Hall staff is expected to contribute. Data analysis: the collaboration will provide 3.5 FTE of postdocs and graduate students.

Comments: The manpower appears to be on the short side and the committee would encourage the collaboration to seek additional collaborators, in particular for simulation and data analysis.

Recommendations: none

Charge:

4) *Is the plan for the installation and operation of the experiment well integrated with the 12 GeV construction? Have potential conflicts with the 12 GeV Upgrade in Hall B been examined and resolved?*

Findings: It appears that the PRad installation plan has been well coordinated with the 12 GeV installation schedule.

Comments: none

Recommendations:

4.1 Establish a formal line of communication with the 12 GeV team using the HPS experience.

Charge:

5) *Are the changes in the beam line to run the experiment as compared to the Hall B 6 GeV situation compatible with safe and efficient beam operations?*

Findings: There are no significant changes in the beamline upstream of the PRad target in comparison with the HPS experiment which ran recently. However, PRad is using a much thinner target and has stated a very stringent halo requirement. It is not so stated, but it appears that PRad is potentially more sensitive to the gas in the beam pipe upstream of the target, than the HPS experiment.

Comments: none.

Recommendations:

5.1 Define the requirements for the vacuum level in the beam pipe upstream of the target and any needed hardware to meet them.

Charge:

6) *Are the radiation levels expected to be generated in the hall acceptable?*

Findings: The experiment is planning to run at about 10nA – a typical beam current for Hall B, and a very thin, windowless target of about 1 μ g/cm². The material, close to the beam in the target area is also thin: <50mg/cm². The radiation levels are expected to be acceptable.

Comments: none

Recommendations: none

Charge:

7) *Are the PRad specific equipment, documentation and procedures to run the experiment in place and adequate? This includes demonstrated readiness for expedient analysis of the data.*

Findings: The specific equipment include: the target, the vacuum system, the GEM chamber, the HyCal calorimeter, the front-end electronics, and the DAQ system. The HyCal is in place, the other components are still at the construction or testing stage. The GEM chamber with its readout electronics is a new equipment at JLab. At the moment of the review, the DAQ achieved the GEM readout rate an order of magnitude shorter than the goal of 2-3kHz. The plan is to reach the specs by Feb 2016. The documentation question is addressed in the recommendations for the next point.

Comments: none

Recommendations:

- 7.1 Define the requirements for the GEM performance and demonstrate that these requirements are met.
- 7.2 Demonstrate by the end of January that the DAQ with the GEM and HyCal can operate at the required rate. Consider requesting the experts's help from JLab.
- 7.3 Demonstrate the data analysis procedures by March.

Charge:

8) *Are the formal documentation requirements and reporting (run coordinator → shift leaders) procedures for running the experiment adequate, appropriate and complete (COO, ESAD, RSAD, ERG, OSP's, general equipment operation manuals, etc.)?*

Findings: The formal documentation is mostly in place. For example, design, review and factory testing documents for vacuum vessels are adequately prepared.

Comments: Formal OSP documentation must be provided for all new equipment. Procedures for running the experiment should be complete (COO, ESAD, RSAD, ERG, OSP's, general equipment operation manuals, etc.) and submitted with a cover letter by the hall leader to the division safety officer, *a minimum, ten days prior to the scheduled run date.*

Recommendations:

- 8.1 Provide OSPs for: GEM, Vacuum system, Target, and HyCal.
- 8.2 Update the ERG document, namely the section on the Vacuum protection areas.
- 8.3 Provide a pre-run checklist. Submit a reference to this list along with the COO, ESAD and other documents.