PRad-II Review Committee:
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The Review Committee met with the PRad-II collaboration on March 12, 2021. PRad-II is an experiment designed to measure the proton charge radius with unprecedented statistical and systematic precision, leading to an extracted charge radius at the level of ~0.004 fm, over a factor of 2 better than any previous scattering measurement. The agenda included:

- Update on the PRad-II Proposal: Haiyan Gao
- Plans for the Radiative Corrections: Haiyan Gao
- Plans for the HyCal Upgrade: Ashot Gasparian
- Plans for the fADC based DAQ: Dipangkar Dutta
- Plans for the Tracking Detectors: Nilanga Liyanage
- PAC48 Issues and Answers: Ashot Gasparian

The review concerned the three issues identified by the Jefferson Lab PAC that led to conditional approval of the experiment. We first repeat the three issues, each followed by the judgment of the Review committee concerning the response of the PRad-II collaboration.

``*The μRWell technology (point 1 above) has never been used in a running experiment, and its reliability and radiation hardness have not been fully demonstrated. Since the main reduction on the total uncertainty arises from the addition of a second tracking station, the PAC recommends considering a second GEM station instead, further relying on the present GEM technology to reduce the risks of jeopardizing the final physics goal.*"

The PRad-II collaboration has changed plans to reduce risk, by following the PAC recommendation and using two GEMs. The Review Committee supports this change.

``*The upgrade of HyCal (point 3 above) implies 1500*[1] *additional PbWO4 crystals and a new electronic readout. The cost estimate is about $5M. While it is clear that the new readout based on FADC will strongly increase the rate of data taking (and thus reduce the statistical uncertainty), the PAC could not be convinced on the necessity of the costly replacement of the crystals for reaching the final uncertainty on the proton radius*."

The planned electronics and data acquisition upgrades for PRad-II, leading to a higher data rate, are entirely justified.

The Review Committee fully understands the viewpoint of the collaboration, that, to achieve the best possible uncertainties, the experiment is best run with a fully

[1] 1500 is a typo; 2500 crystal are needed.

upgraded HyCal, covering the proposed Q^2 range with a minimal number of beam energies. Such a project has to rely on external financing. The Review Committee sees that, if necessary, the experiment can potentially cover the proposed Q^2 range using only the the existing PbWO4 crystal part of HyCal by adding a higher beam energy (such as 3.5 GeV) measurement to the 3 requested energies, along with additional beam time. However, at 3.5 GeV the inelastic background is expected to be nearly two orders of magnitude higher than at 2.1 GeV, increasing the uncertainties, and the radiative corrections are expected to be different, which may introduce an additional uncertainty.

``*The PAC strongly suggests the planning of a blind analysis to convincingly reduce possible bias stemming from the normalization and the Q^2-dependence of the form factor. In particular, all radiative correction calculations and their implementation in the Monte Carlo simulation should be fixed before the fit for the proton radius.*''

The PRad-II collaboration presented a plausible plan for blind analysis that involves masking either the HyCal trigger efficiency and/or the radiative corrections with a Q^2-dependent factor. The Review Committee agrees with the plan, and recommends that both aspects of the analysis be independently blinded.

The PRad-II collaboration detailed their plans to improve radiative correction uncertainties by about a factor of 20. The improvement arises both from technical improvements in the experiment compared to PRad and from improved theoretical calculations. The Review Committee finds the plan plausible. There is some concern on the part of the Committee over how well the uncertainty of the two-photon-exchange correction is known, given the poor constraints from data in the PRad-II kinematic range and the limited number of calculations compared. Given the unprecedented precision planned for PRad-II, the Review Committee recommends that the collaboration continue, as the field develops, to explore the variation in these corrections predicted from additional calculations and/or fits.

The committee considers that the PRad-II collaboration has adequately responded to the issues identified by the PAC, and recommends converting the conditional approval to full approval.