Closeout Presentation

2020 Director's Review of MOLLER

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Executive Summary

The MOLLER experiment at JLab proposes to measure the weak mixing angle, $\sin^2 q_W$, to unprecedented precision at low energy, thus improving our understanding of the running of this fundamental constant and providing a sensitive probe of new physics. The purely leptonic scattering channel is complementary to current efforts and future proposals to measure A_{PV} from e-p scattering, and is particularly relevant in an era where a number of other anomalies have emerged in the lepton sector. The theoretical uncertainty on Q^e_W is currently at 1.4% with an expected reduction to <0.5% after the full 2-loop treatment is complete, which compares favorably to the expected experimental uncertainty of 2.4%. The MOLLER experiment represents a unique opportunity for JLab that leverages the large investment made in the 12 GeV upgrade. The experiment is a compelling opportunity for the US DOE Nuclear Physics program and represents a 5-fold improvement over the last measurement made in E158. Mission need was recognized in 2016 and the science motivation for MOLLER remains strong.

The MOLLER project team was formed in December 2018 after a two-year hiatus for the project due to budget pressure. The team was charged by JLab to begin the conceptual design of MOLLER and preparation for a CD-1 review. A director's review of the MOLLER project was held in April 2019 followed by a Cost and Schedule Review in November 2019 and a Design Review in December 2019. The Project Team is to be commended for the enormous progress that has been made over the last year. The team consists of a strong balance of individuals with prior management and technical experience. There is an active and close interaction between the Project and the Collaboration with many members serving dual roles in the two organizations.

While there is still work to be completed prior to a DOE-OPA CD-1 review, the Committee finds the maturity of the proposal to be appropriate for this stage of the project. The Project team has laid a good foundation based on best project management principles. We encourage the Project team to continue their good progress in preparation for a CD-1 review in 2020.

Answers to Charge Questions

1. Science Basis: Is the MOLLER conceptual design capable of achieving the scientific goals of the experiment? **Yes**

2. Conceptual Design: Is the MOLLER conceptual design sound, achievable and sufficiently defined to meet the scientific and technical requirements? **Yes**

3. KPP: Are the proposed Key Performance Parameters (KPP) appropriate for determination of successful project completion? **Yes** after responding to the comments and recommendations.

4. Cost and Schedule: Are the cost and schedule estimates credible and realistic for this stage of the project? Do they include adequate scope, cost and schedule contingency? **Yes** the cost and schedule estimates are realistic for this stage of the project, however see the comments in the report. **Yes** for cost contingency, but additional work is needed in defining the schedule and scope contingency.

5. Management: Is the Project being properly managed at this stage? Is there a capable team in place to produce a credible technical, cost and schedule baseline in the next phase? **Yes** but the transition in the Project Manager position presents a challenge in the short term.

6. ES&H: Is ES&H being properly addressed given the Project's current stage of development? **Yes**

7. Documentation: Does the documentation required by DOE satisfy order 413.3B, ready for approval of CD-1? **Mostly Yes**. Drafts exist for most DOE-required CD-1 documents however the Basis of Estimate documents need to be completed. Confirm with the Program Office whether an Acquisition Strategy document that includes an Analysis of Alternatives needs to be written. Any missing documents need to be written and draft documents turned into final documents prior to a CD-1 review.

8. Previous reviews: Has the project team responded appropriately to recommendations from prior Director's Reviews? **Mostly Yes** they have addressed most recommendations associated with pre-CD-1 activities from past reviews. They are actively working on new recommendations from reviews that have taken place within the past 3 months.

1.0 Project Management

Committee Members: Xiaofeng Guo, Ed O'Brien, Chris Polly

Findings

- The MOLLER Project received CD-0 in Dec 2016. After a two-year pause due to