Response on the critical comments of the TAC Report addressed to
the KLF proposal C12-19-001 for PAC48

Noticed typos in the 2020 proposal: **Table 4**: K°/K°-bar ratio is expected to be 2:1 at the Be target, rather than at the cryogenic target. At the cryogenic target it is expected to be close to 1:1. **Fig.22 caption, and page 32**: Radiator thickness: instead of 0.005% should be 0.05%.

Thanks to the reviewers for their careful reading.

The appropriate line of Table 4 on pg. 28 has reading as ``*K°/K°-bar ratio at Be-target is 2:1.*", where on Be-target reads as just before the tungsten plug. On a cryogenic target we have pure K_L beam, hence "expected $K^0/\overline{K^0}$ ratio expected to be close to 1:1."

The appropriate line in Fig. 22 caption on pg. 31 has reading as ``*Left: Nominal Hall D configuration with an amorphous radiator of 0.05% R.L.*"

Then 2nd paragraph on pg. 32 has reading ``*Additionally, we show in Fig. 22 a comparison of radiation dose rates in the Tagger Hall at 5 μA beam current between a radiator of 0.05% R.L. in the standard GlueX beamline configuration and an early configuration of the CPS. Similar levels are seen for both configurations, showing more evidence that the CPS will deliver a level of radiation not higher than what could potentially be seen in standard GlueX configuration operating at the maximum beam current of 5 μA."*

Major modifications:
1. Accelerator: The bunch spacing of 64 ns (16 MHz repetition rate) will require new injector equipment, estimated at about $130k, as well as an R&D and installation labor performed by the injector group… This may cause interference with the beams for other halls and needs an R&D effort.

According to the assessment of the accelerator experts (in particular, Todd Satogata), the required accelerator modifications are unlikely to cause a problem, however we agree that for full confidence additional R&D may be required. More details about electron beam delivery are outlined in Sec. 5.1 of the proposal.

2. **Compact Photon Source** (CPS) **(**updated since 2019 due to the completion of the Hall A/C design)

There is no final design of the CPS for Halls A/C yet, as it is the conceptual design of CPS which was published as a NIM paper. More details are in the Sec. 5.3 of the proposal.

Regarding the beam spot requirements, unfortunately there was an error in the calculation of the electron beam spot size which lead to an overestimation of the expected beam size. A rough estimate suggests that a Gaussian beam with RMS radius 1.25 mm (corresponding to a beam spot of 5 mm, compared to the 15 mm spot mentioned in the proposal) would be adequate, assuming a

CPS roughly twice longer than the design for the CPS for Halls A/C (totaling approximately 2 m). This beam size is not expected to run into any aperture constraints that would require the replacement of any beamline magnets. As the TAC report mentions, these calculations need to be verified using simulations, which are currently being performed and on track to allow us to finalize the conceptual design for the KLF CPS by early next year, as given in the timeline shown in Fig. 32 of our proposal.

Electron beamline: *(new development in 2020) CPS* operations may require a 15mm beam spot on the radiator (see the previous item in the list). … According to Jay Benesch the cost of such a scenario may be about $1.5M.

Unfortunately, the TAC report didn't elaborate on details of such an estimation. While the final design of the CPS is still being optimized by the CPS Collaboration, as discussed above a smaller electron beam size than quoted above is sufficient and there is no expected need to replace the existing quadrupole magnets.

6. **Kaon Flux Monitor:** will be a new device consisting of a superconducting solenoid and a detector system, all installed on the platform downstream of the Pair Spectrometer (PS) magnet. The plan is to keep the PS magnet off in order to extend the effective decay volume. A conceptual design has been presented. Achieving a few percent precision appears challenging. The detector should be able to separate well the 3 decays modes. The spectrum of the detected kaons will be different from the spectrum of the kaons reaching the target. On the technical side, the installation and operation of another superconducting magnet will require considerable efforts.

There are two statements from the reviewer regarding Flux monitor which are not fully correct and require clarification: *"The detector should be able to separate well the 3 decays modes." and "The spectrum of the detected kaons will be different from the spectrum of the kaons reaching the target".* The flux monitor does not (!) need to separate various decay modes to reconstruct the flux. The branching ratios between major decay channels are known extremely well, so as their decay kinematics, hence the shape of $K_L \rightarrow 2\text{charged} + X$ decays, can be reproduced by MC; its scaling would give the flux. Particle identification and decay separation within the FM is designed to ensure the absence of any sizable unexpected background in the K_L flux determination.

Regarding spectrum of kaons: Kaons are decaying in flight, so kaon flux in any point of space, even within the target, is different. In this situation the task of the Flux monitor is to measure larger Kaon beam phase space (both in coordinate and momentum space) than seen by the target. Current design of the Flux Monitor at its proposed location fulfills this criteria within the large margins.

Summary:

Feasibility: The project appears to be technically feasible…. The beamline modifications described by T. Satogata may add $1.5M.

Thanks to our reviewers, we are glad to hear that the TAC report concluded that the project is technically feasible. We agree that additional studies will be needed to make a realistic cost estimate of the proposed facility, and expect that they will continue to proceed along the timeline presented in our proposal.