Cover Letter for KLF Proposal Submission to PAC46

This Proposal follows Proposal PR12-17-001, *Strange Hadron Spectroscopy with a Secondary K_L beam at GlueX* presented to PAC45 in 2017. The Issues and Recommendations included in the PAC45 Final Report document read as follow:

Issues: *Mounting this experiment will transform the existing Hall D beamline, so it represents an almost irreversible change in direction for the GlueX apparatus. As such, the physics driver must be compelling, and the PAC doesn't feel that a sufficiently convincing physics case has been made. A broad program is suggested, so the PAC would welcome a larger presentation format along the lines of a run group proposal.*

The CPS design is progressing but details on the KL target and shielding for the detector need to be fleshed out. The 64 ns beam structure will also require study to ensure that other halls are not adversely affected.

The beam time request is dominated by the hyperon polarimetry measurements. A simulated example of a PWA, and how it would feed into the proposed spectroscopy measurements, will be needed in a future proposal.

The LOI included doubly strange baryons but this topic was not much expanded upon in the proposal. This topic remains of considerable interest.

Summary: *This experiment would introduce a new and interesting area of physics at JLAB. The PAC recommends that the collaboration work with the lattice and theoretical nuclear physics community to sharpen the physics case. In addition, more details on the KL production target and shielding will be needed before we can fully assess the feasibility of the experiment. Despite the progress made in delineating the expanded physics possibilities, the very substantial beam time request would be better motivated if more details could be provided on its impact on the proposed spectroscopic measurements.*

The KLF Collaboration for the GlueX Collaboration believes that the current proposal addresses all the concerns expressed in the recommendations by the PAC45:

Q1: *Mounting this experiment will transform the existing Hall D beamline, so it represents an almost irreversible change in direction for the GlueX apparatus*.
A1: Changeover from the photon to KL beamline and from the KL beamline to photon is expected to take less than 6 months (after the radiological cooldown). This break matches the CEBAF Accelerator schedule well and the beam collimator cave has enough space for the Be-target assembly to be stored next to the beamline.

Q2: *As such, the physics driver must be compelling, and the PAC doesn't feel that a sufficiently convincing physics case has been made. A broad program is suggested, so the PAC would welcome a larger presentation format along the lines of a run group proposal.*
A2: With the current proposal, we aim to show the broad range of outstanding problems related to strange hadron spectroscopy, which can be solved by improving the existing database by orders of magnitude. We believe, the run group proposals will naturally occur when the proposed facility is approved. In particular, we are focusing on studies of doubly strange cascade baryons and the kappa-meson. Following Bob McKeown's suggestion, we plan to have three presentations at the PAC46 meeting:

(i) KL Beam Facility at GlueX
(ii) Hyperon Spectroscopy with a KL Beam
(iii) Strange Mesons with a KL Beam.
(iv) Interest of the RHIC/LHC Community in Excited Hyperon Measurements **??**

Q3: *The CPS design is progressing but details on the KL target and shielding for the detector need to be fleshed out.*

A3: Following to that, we improve the conceptual design for both the CPS and the Be- target (KL production target):

(i) The JLab CPS Working Group has considered the CPS case for Halls C/A in detail. The recent HIPS2017 Workshop (February 2017) aimed at producing an optimized photon source concept with potential increase of scientific output at Jefferson Lab, and at refining the science for hadron physics experiments that will benefit from a high-intensity photon source. The high intensity photon beam will be produced by a CPS, very similar to the one designed by the JLab CPS group for Halls A/C. A rough cost estimate is about **$1.5–2M** per CPS. Upon accomplishment of a conceptual design, more detailed figures may come in August 2018. In case of the approval at the upcoming PAC meeting, CUA-GW-ODU will apply for the NSF MRI grant or make supplement for available DOE grants.

The CPS will be located downstream of the tagger magnet. The tagger alcove has more space than that available in Halls A/C, so positioning and shielding placement are simplified.

a) The beam current can reach 60 kW (less than 5 μA at 12 GeV). The ceiling shielding of the Tagger hall above the CPS position is the same as it is above the existing 60 kW dump. No radiation increase at the site boundary is expected with respect to 60 kW operations using the existing dump.
b) The floor in the area can hold a 100t CPS.
c) A 30 kW CPS has been designed by a CPS working group for Halls C/A. The group intends to provide the design for a 60 kW device for Hall D. The latter device has to be somewhat larger, but the Tagger hall provides more available space than the Hall C location.
d) Different length/field magnet. Shielding may differ.
e) If one uses a 2nd raster system for Hall D to compensate for the initial 1mm rater, this can be an equivalent essential design.

ii) The Be-target assembly will be located downstream at the beginning of the collimator cave. Our MC studies show that the Be-target assembly conceptual design satisfies the RadCon requirement establishing the radiation dose rate limit in the experimental hall. The full engineering design is pending the proposal approval.

Modifications of the beamline from the beginning of the collimator cave to the cryogenic target, which includes the Be-target assembly, the shielding, etc. (see **A1**) The Scenario is to use smaller pieces of shielding and keeping (but moving) the current sweep magnet and not removing Pair Spec magnet. All else is removed from the collimator enclosure and the upstream platform. Materials and Equipment: **$1.2M**.

Q4: *The 64 ns beam structure will also require study to ensure that other halls are not adversely affected.*

A4: According to our discussions with accelerator experts (Geoff Krafft, Matt Poelker, Todd Satogata, and Jay Benisch) following the iTAC Report for PAC45 it has been explicitly stated that no problems are expected for a 64 ns beam structure from the beam delivery point of view. Geoff and Todd are members

of our team and we do have a Section addressing this task. Let us add what Matt Poelker's (polarized electron source expert at CEBAF) already noted in our response to the TAC Physics *Report ...it is rather challenging to generate a 15.6 MHz repetition rate beam for the required 64 ns bunch spacing. Specifically, our fiber laser amplifiers that produce the light delivered to the photocathode become damaged at this low repetition rate. We learned this through painful experience, damaging equipment that cost about $50k to replace. On the bright side, fiber amplifiers can be purchased that are designed to operate at low repetition rate (i.e., higher peak power), but he just wanted to tell us that we don't presently have them. We would need to purchase some optical equipment to generate your requested bunch repetition rate. I don't know the exact cost but probably less than $100k. So just a speed bump, not a show-stopper.*

Q5: *A simulated example of a partial wave analysis, and how it would feed into the proposed spectroscopy measurements, will be needed in a future proposal.*
A5: We generated quasi-data for the toy PWA model for spectroscopy of hyperons to demonstrate impact of the proposed experiment on the world knowledge. The result will be presented during PAC46.

Q6: *The LOI included doubly strange baryons but this topic was not much expanded upon in the proposal. This topic remains of considerable interest.*
A6: We made the cases for doubly strange baryons and the pion-kaon interactions more compelling.

Q7: *The PAC recommends that the collaboration work with the lattice and theoretical nuclear physics community to sharpen the physics case.*
A7: We are collaborating closely with the lattice and theory community. In addition, we had the forth Workshop PKI2018 (February 2018) hosted at JLab recently and dedicated to the physics of strange mesons produced by the neutral kaon beam. Meanwhile, many lattice and theory researchers are co-authors of our proposal and our proposal has a significant contribution from them.

Q8: *In addition, more details on the KL production target and shielding will be needed before we can fully assess the feasibility of the experiment.*
A8: All is done (see **A3**).

Q9: *Despite the progress made in delineating the expanded physics possibilities, the very substantial beam time request would be better motivated if more details could be provided on its impact on the proposed spectroscopic measurements.*
A9: We believe that the current proposal addresses all the concerns following the recommendations expressed by the PAC45. The new data will significantly constrain PWAs and reduce model-dependent uncertainties in the extraction of the properties and pole positions of the strange hyperon resonances, and establish the orbitally excited multiplets in the spectra of the \Xi and \Omega hyperons. The experiment will settle the still open issue of the existence or non-existence of the low lying strange scalar meson \kappa(800). All details will be presented during PAC46.

Statistics

Proposal is signed by **198** researchers from **61** institutions representing **20** countries around the world.

The physics scope for the KL Facility has been explored in four international workshops:

KL2016 [**60** people from **10** countries, **30** talks] https://www.jlab.org/conferences/kl2016/
OC: M. Amaryan, E. Chudakov, C. Meyer, M. Pennington, J. Ritman, & I. Strakovsky

YSTAR2016 [**71** people from **11** countries, **27** talks] https://www.jlab.org/conferences/YSTAR2016/
OC: M. Amaryan, E. Chudakov, K. Rajagopal, C. Ratti, J. Ritman, & I. Strakovsky

HIPS2017 [**43** people from **4** countries, **19** talks] https://www.jlab.org/conferences/HIPS2017/
OC: T. Horn, C. Keppel, C. Munoz-Camacho, & I. Strakovsky

PKI2018 [**48** people from **9** countries, **27** talks] http://www.jlab.org/conferences/pki2018/
OC: M. Amaryan, U.-G. Meissner, C. Meyer, J. Ritman, & I. Strakovsky