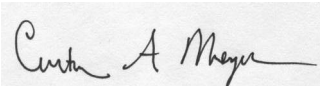




Jefferson Science Associates, LLC

Thomas Jefferson National Accelerator Facility

JSA Initiatives Fund Proposal Summary Sheet

Proposal title: <u>The 2nd Workshop on Photon-Hadron Physics in Hall D at Jefferson Lab</u>	
<input type="checkbox"/> New proposal	<input checked="" type="checkbox"/> Renewal
Total funds requested <u>\$4000.00</u>	Leveraged support / Matching resources <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
If your proposal includes leveraged support or anticipates matching resources, identify source, amount, and secure the signature of an authorized representative of the source.	
Source/Amt: JLab \$2500.00	Authorized Signature: _____
Source/Amt: CMU \$1500.00	Authorized Signature: 
Source/Amt	Authorized Signature: _____

Principal Investigator (PI) <u>Curtis Meyer</u>	
<input type="checkbox"/> JLab employee	Associate Director signature _____
<input checked="" type="checkbox"/> JLab user	Name of university <u>Carnegie Mellon University</u>
<input type="checkbox"/> Other	Name of institution _____
PI's Mailing Address	<u>Dept of Physics 5000 Forbes Avenue, Pittsburgh, PA 15213</u>
PI's Telephone / E-Mail	<u>412-268-2745 / cmeyer@cmu.edu</u>
Co-PI's (with affiliation)	_____

Executive summary including the projected begin/end dates.
 2 days in late February or early March 2010. The Glue X experiment at Jefferson Lab is a driving motivation for the CEBAF 12GeV Upgrade. GlueX addresses the fundamental question of confinement in QCD and had defined the choice of energy of the upgrade. The nature of this physics also demands hermetic detector with good resolution. The GlueX Collaboration has known for some time that there would be an extremely rich physics program possible with this detector and the high-rate polarized photon beam, extending far beyond the driving goal of the search for QCD exotics. In March 2008, we hosted the first JSA-supported meeting with the purpose of making researchers aware of the rich physics possibilities in Hall D; it met with considerable interest and attracted ~60 participants from across the nuclear physics community. It ultimately led to several new groups joining GlueX to work on new physics topics as well as a proposal submitted to the 2009 12 GeV PAC. In order to continue both the physics program and the GlueX collaboration, we are planning a 2nd 2-day workshop "Photon-Hadron Physics" in late February or early March 2010. We are requesting financial support from JSA to help facilitate this meeting.

Synopsis of scientific, educational, technical, and/or business merits, and alignment with and significance to Lab's current programs.
 The GlueX experiment is a critical part of the CEBAF 12 GeV Upgrade. Because of the drawn-out nature of DOE funding and the fact that the experiment requires a new hall and has no running physics program at JLab, the GlueX collaboration has recognized the need to take active steps to attract new collaborators and increase its manpower. Such outreach is important both for realizing the objectives of the core exotic meson spectroscopy program, and for expanding and broadening the physics agenda of the collaboration. The workshop aims to provide an environment where new people are made aware of the broad range of physics topics that can be addresses with the GlueX detector and the Hall D photon beam. This will strengthen the GlueX collaboration as well as the Jefferson Lab user community as a whole.

Proposed evaluation plan to measure success. If this is a request for renewal of funds, assessment of prior year performance.
 Measurable outcome will be: (a) New researchers with interest in photon-hadron physics joining the GlueX Collaboration; (b) Letters of Intent and possibly proposals submitted to future JLab 12 GeV Program Advisory Committees.

Authorized signature for proposal from:	
JLab employee	Lab Director signature _____
JLab user	JLab Users Group Board Chair _____
Other	Institutional authorization _____



Jefferson Science Associates, LLC
Thomas Jefferson National Accelerator Facility

Proposal received:	Submitted for review:	Disposition:
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Attachment A Technical Proposal – no more than 5 pages please. Up to 5 additional pages of letters of support, or other supporting materials may accompany proposal.
Attachment B Budget Proposal

JSA Initiatives Fund Request—Cover Page

Title	The 2nd Workshop on Photon-Hadron Physics in Hall D at Jefferson Lab
Requesters	Curtis A. Meyer (P.I.), Eugene Chudakov and Christian Weiss
Position	Curtis Meyer is Spokesperson of the GlueX Collaboration and a Professor of Physics at CMU. Eugene Chudakov is the head of the Hall-D group at JLab. Christian Weiss is a member of the JLab Theory Center.
Status	This is a New request.
Executive Summary	The GlueX experiment at Jefferson lab is a driving motivation for the CEBAF 12 GeV Upgrade. GlueX addresses the fundamental question of confinement in QCD and has defined the choice of energy of the upgrade. The nature of this physics also demands a hermetic detector with good resolution. The GlueX collaboration has known for some time that there would be an extremely rich physics program possible with this detector and the high-rate polarized photon beam, extending far beyond the driving goal of the search for QCD exotics. In March 2008, we hosted a first JSA-supported meeting with the purpose of making researchers aware of the rich physics possibilities in Hall D; it met with considerable interest and attracted ~ 60 participants from across the nuclear physics community (http://conferences.jlab.org/php2008/). It ultimately led to several new groups joining GlueX to work on new physics topics as well as a proposal submitted to the 2009 12 GeV PAC. In order to continue to expand both the physics program and the GlueX collaboration, we are planning a 2nd 2-day workshop “Photon-Hadron Physics” in late February or early March 2010. We are requesting financial support from JSA to help facilitate this meeting.
Synopsis	The GlueX experiment is a critical part of the CEBAF 12 GeV Upgrade. Because of the drawn-out nature of DOE funding and the fact that the experiment requires a new hall and has no running physics program at JLab, the GlueX collaboration has recognized the need to take active steps to attract new collaborators and increase its manpower. Such outreach is important both for realizing the objectives of the core exotic meson spectroscopy program, and for expanding and broadening the physics agenda of the collaboration. The workshop aims to provide an environment where new people are made aware of the broad range of physics topics that can be addressed with the GlueX detector and the Hall D photon beam. This will strengthen the GlueX Collaboration as well as the Jefferson Lab user community as a whole.
Funds	Requested \$ 4,000
Funds	Leveraged at least \$4,000
Dates	2 days in late February or early March 2010.
Evaluation Plan	Measurable outcomes will be: (a) New researchers with interest in photon-hadron physics joining the GlueX Collaboration; (b) Letters of Intent and possibly proposals submitted to future JLab 12 GeV Program Advisory Committees.

Photon-Hadron Physics in Hall D at Jefferson Lab

C. A. Meyer (Carnegie Mellon U., P.I.), E. Chudakov (JLab) and C. Weiss (JLab)

04 August 2009

Executive Summary

The GlueX experiment at Jefferson lab is a driving motivation for the CEBAF 12 GeV Upgrade. GlueX addresses the fundamental question of confinement in QCD and has defined the choice of energy of the upgrade. The nature of this physics also demands a hermetic detector with good resolution. The GlueX collaboration has known for some time that there would be an extremely rich physics program possible with this detector and the high-rate polarized photon beam, extending far beyond the driving goal of the search for QCD exotics. In March 2008, we hosted a first JSA-supported meeting with the purpose of making researchers aware of the rich physics possibilities in Hall D; it met with considerable interest and attracted ~ 60 participants from across the nuclear physics community (<http://conferences.jlab.org/php2008/>). It ultimately led to several new groups joining GlueX to work on new physics topics as well as a proposal submitted to the 2009 12 GeV PAC. In order to continue to expand both the physics program and the GlueX collaboration, we are planning a 2nd 2-day workshop “Photon-Hadron Physics” in late February or early March 2010. We are requesting financial support from JSA to help facilitate this meeting.

Introduction

The GlueX experiment, housed in a new photon-only hall (Hall D) at Jefferson Lab, is a crucial piece of the CEBAF 12-GeV upgrade. The main physics goals driving GlueX is the search for exotic and hybrid gluonic excitations in the meson spectrum, a problem whose significance has been widely recognized by the scientific community (a brief summary of the GlueX physics motivation is given in the following section). In addition to this well-known goal, there is a broad range of issues in hadronic physics which could be addressed using the Hall D photon beam and the GlueX detector, such as *e.g.* electromagnetic processes in meson production (Primakoff effect), charm production near threshold, high- t exclusive reactions, and nuclear effects. These topics have matured over the last couple of years and are now ripe for serious consideration by the scientific community.

With this proposal, we are requesting support for a 2-day workshop “Photon-hadron physics in Hall D at Jefferson Lab,” to be held at Jefferson Lab in late February or early March 2010. It will provide a forum in which the physics motivation and the experimental requirements for the study of such photon-induced reactions can be discussed, particularly with the view of measuring them using the GlueX detector. In addition to assessing the potential of the new physics ideas, we anticipate that the workshop will attract new collaborators to GlueX and ultimately broaden the entire physics program of the 12 GeV Upgrade.

The Science Motivation of GlueX

An article in an August 2000 issue of the New York Times listed understanding confinement of quarks inside of protons and neutrons as one of the ten fundamental questions in physics to ponder for the 'next millennium or two'. Nearly all of the visible matter in the universe is forever trapped inside the nuclear cores of the atoms that we observe. While scientists believe that the theory of Quantum Chromodynamics, (QCD), can explain confinement, an exact understanding of how QCD works has been extremely elusive. We know that QCD works under the extreme conditions found in high energy particle collisions, but our knowledge of what it is doing under normal conditions found in the every day world is quite limited. Using advances in high speed computing and experimental facilities that could soon be available at laboratories in the United States, scientists hope to go a long way in answering this question within the next decade.

QCD is a theory that describes how quarks and gluons interact with each other. It was originally formulated based on experiments in the 60's and 70's, leading to many Nobel Prizes for experimentalists and theorists alike. QCD describes quarks as carrying three types of charge called color charge: red, green and blue. These names have nothing to do with the colors we are familiar with; it is only a naming scheme. However, like the colors we are familiar with, equal combinations of each color yields a white or color-neutral object. Each of these color charges can be positive or negative (quark or anti-quark). QCD requires that the combinations of quarks that can exist in nature are colorless. The simplest combinations satisfying this are called baryons (three quarks each of different color) and mesons (quark and anti-quark, color and anti-color).

In addition to the quarks and anti quarks, QCD has force-carrying particles called gluons which are exchanged between quarks and antiquarks to produce the force that holds matter together. What is unique about QCD is that the gluons also carry color; they are not white or neutral objects. It is exactly these colored gluons that allow for the complex nature of QCD, but have also made a complete understanding extremely elusive. We can solve for what quarks are doing when they are very close together, but when we try to look at something the size of a proton, all of our tools fail. Because gluons are not neutral, it should be possible for gluons to interact with each other to form matter containing only gluons with no quarks. All that is required is that the combinations are colorless. Combinations of two or three gluons will do the trick and such states are called glueballs. Other new mesons should also be possible and these would involve combinations of quarks and gluons called hybrid mesons. There are specific combinations that lead to hybrid mesons with quantum numbers that are not allowed for simple quark-anti-quark combinations, called exotic hybrid mesons. The beauty of these exotic hybrids arises from the fact that they cannot become mixed up with other mesons. Recent experimental results have hinted at the existence of a single such state, but the rich spectrum that would directly yield information on the confining force has so far been elusive. Taken as group, glueballs and hybrid mesons are known as gluonic matter or gluonic excitations. The GlueX experiment as part of the 12-GeV upgrade will carry out the measurements to identify these new states

The GlueX collaboration was formed in 1999 to tackle the confinement problem by designing a world-class experiment that would utilize high-energy linearly polarized photons to

create and observe these gluonic excitations. The detector required to carry out this program needs to have very high acceptance and high-rate capabilities to collect enough quality data to significantly change the experimental situation. This experiment is now the high-profile new detector being built as part of the CEBAF 12 GeV upgrade which reached the Department of Energy CD-3 milestone in 2008. The upgrade and the GlueX experiment is now under construction and new collaborators would be very welcome to join the GlueX effort.

Results of the Previous Meeting

In March 2008 we hosted a first JSA-supported meeting “Photon-hadron physics with the GlueX detector at Jefferson Lab” at JLab. More than 60 people from across the nuclear physics community attended; the proceedings are posted online at <http://conferences.jlab.org/php2008/>. This workshop made researchers aware of the potential of the GlueX Detector for studies of meson properties via the Primakoff effect, and resulted in the submission of a PAC34 proposal for a Primakoff measurement of the eta radiative decay width in Hall D (PR12-09-015). The PAC clearly recognized the scientific merits of this proposal and encouraged that it be coordinated with the program of the GlueX Collaboration. Further discussion of the physics of Primakoff production and its incorporation into the GlueX program will be one of the objectives of the proposed second meeting. The first meeting also led to several new groups deciding to join GlueX, adding significantly to the strength of the collaboration.

Expanding the Physics of GlueX

The GlueX collaboration has known for some time that there would be an extremely rich physics program possible with the GlueX detector and the Hall D linearly polarized photon beam, extending far beyond the driving goal of the search for QCD exotics. In order to facilitate this expansion, the collaboration is organizing a workshop to be held in late February or early March of 2010, with the purpose of reviewing and discussing specific topics in photon-hadron physics which could be addressed by future measurements with the GlueX detector in Hall D; to assess their merits and feasibility, and to organize them into a coherent program. The aim is both to significantly expand the physics program within the GlueX collaboration, and to encourage new groups to join as collaborators. The workshop will make researchers aware of the physics possibilities that GlueX will provide and identify ways in which new collaborators could make important contributions to the experiment.

The GlueX collaboration has established an organizing committee to take the first steps in convening this meeting. In order to make sure that this occurs in a timely fashion, the initial organization is being carried by members of the GlueX collaboration and JLab staff: Eugene Chudakov (Jefferson Lab, Hall D Group Leader), Curtis Meyer (Carnegie Mellon U., Spokesperson of GlueX), Christian Weiss (Jefferson Lab Theory Center). Experts from the wider nuclear physics community will be involved and consulted in the next stage of the organization.

The workshop will cover a broad range of physics topics in photon-induced hadronic and nuclear reactions, addressing both their general physical interest, the status of their theoretical understanding, and their experimental requirements. The preliminary agenda includes:

I Introduction: The GlueX Detector

This session will present an overview of the initial capabilities of the GlueX detector and then discuss possible major upgrades. The nominal upgrades include better particle identification such as a Cerenkov Detector in the forward direction.

II Exclusive Reactions at High Momentum Transfer

The nominal data collected during the running of GlueX will be rich in data on reactions that could help explore the GPDs in a way that is highly complementary to what is planned with CLAS-12. Such reactions include *Real Compton scattering at high t* (WACS), *Exclusive Meson production at high t* and *Inverted deeply-virtual Compton scattering* (DVCS).

III Nuclear Effects in Photoproduction

There is also a program of experiments using nuclear targets in place of the normal hydrogen target in GlueX. Photo-nuclear reactions could allow one to study *Color Transparency* in high- t reactions. In addition, Hadron attenuation in the nuclear medium could be studied as well as effects on the properties of hadrons when they are embedded in the nuclear medium.

IV Charm Production Near Threshold

The 12 GeV beams available open the possibility to study charm quark production near threshold. Both open charm in the form of $D\Lambda_c$ production and J/Ψ production are energetically possible using nominal GlueX photon beams. Such reactions may be able to study gluon Generalized Parton Distributions (GPDs) and effects associated with coherent multi-gluon reactions. On nuclear targets, one could look for bound states and potentially study color Van-der-Waals forces.

V Chiral Anomaly and Primakoff Effect

A natural area of interest with the GlueX detector would be to continue the program of PrimeX which ran in Hall B. This is to use the so-called Primakoff effect to study the two-photon couplings of mesons. One could also address issues of the Chiral Anomaly. Such a program would probably require upgrades to the forward calorimeter in GlueX.

VI Baryon Spectroscopy

This session will present an overview of current status of baryon spectroscopy. It will then present the planned baryon spectroscopy program of GlueX as well extensions to this.

VII Other Ideas

This workshop will also include a section of contributed *ideas* for physics that could be carried out. It is very important that this be left open to new and exciting ideas that the organizing committee failed to recognize.

Some of the possible applications described here were already discussed during the early stages of GlueX but got somewhat sidelined during the intervening years, because of the exigencies of moving GlueX and the 12 GeV Upgrade forward, and because of the lack of clear proponents within the collaboration. With the planned workshop, the collaboration is looking forward to resume discussion of these ideas, which could add significantly to the overall physics reach of GlueX.

Most of the larger physics topics discussed for GlueX can and will be addressed also by measurements in the other experimental halls at JLab, either through photoproduction as in GlueX, or through closely related electroproduction processes. One objective of the proposed workshop is to explore possible synergies between measurements with GlueX and experiments in other halls at JLab, continuing discussions which arose during our 2008 meeting. This includes the questions:

- Can meson and dilepton photoproduction with GlueX complement GPD studies in electroproduction with CLAS12 and Hall A?
- Which aspects of J/ψ production could be studied with which detector, and what do we learn from them?
- How will the photoproduction programs at JLab complement each other?

Expected results

- Assessment of broad range of new physics topics which can be addressed using the GlueX detector in conjunction with the Hall-D photon beam at Jefferson Lab.
- Development of new 12 GeV PAC Letters of Intent and proposals.
- New collaborators for GlueX, in particular researchers interested in exploring new physics opportunities.
- Identification of synergies in the experimental program in GlueX/HallD and the other halls at Jefferson Lab.
- Increased awareness of physics opportunities with JLab 12 GeV.

For measuring the success of this workshop, several simple metrics that can be applied: (a) attendance of the workshop itself; (b) addition of new researchers and groups to the GlueX collaboration; (c) Letters of Intent and proposals to future Jefferson 12 GeV PACs.

Budget Needs for a Successful Workshop

In order to make this workshop successful, it is clear that financial support will be needed. The most expensive component of such an endeavor is the travel expenses that would need to be covered for key speakers. Finally, there is support for local amenities such as coffee

breaks and a reception. Because of the desire to have as large a participation as possible, it is felt that the workshop should avoid a registration fee if at all possible.

Based on experience with other workshops, it is felt that approximately \$8,000 will be needed to make the workshop successful. The organizing committee expects contributions from Jefferson lab and Carnegie Mellon at the level of \$4,000. We are also looking for additional support from other universities. With this proposal, we are requesting support from SURA for this workshop at the level of \$4,000.

JSA Initiatives Fund Request—Budget Page

Salary		
	Subtotal Salary	\$ 0.00
Fringe		\$ 0.00
Equipment		\$ 0.00
	Subtotal Equipment	\$ 0.00
Travel	Travel Support for key workshop participants	\$ 3,800.00
Supplies	Workshop supplies such printed material, name tags, note pads	\$ 200.00
Consultants		\$ 0.00

Budget Total **\$ 4,000.00**

Budget Justification

We anticipate a total budget of about \$ 8,000, of which we expect to secure \$4,000 from Jefferson Lab and Carnegie Mellon University. The workshop will be held at Jefferson Lab, so we have little or no cost for the local conference support. If we have to, we will charge a nominal workshop fee, However at this point in time, we would like to avoid doing that.

The *travel* amount, supplemented by money from the non-JSA money will be used to support key people to attend the conference. A number of the world experts are retired and would require full support to be able to attend. In addition, it is likely that we will need to provide some level of support to bring in international participants. We anticipate some of our other funds supplementing the \$3,800 in this request. Our anticipated numbers are not to different from other 50 to 60 person conferences that we have organized.

The *supplies* number will go to support the actual running of the conference. This number will likely be supplemented from other sources.

Other expenses not mentioned here will include coffee and tea for breaks and an opening reception. There will also be expenses associated with producing and mailing out advertisement for the workshop.



Jefferson Science Associates, LLC

Thomas Jefferson National Accelerator Facility

JSA Initiatives Fund Proposal
Attachment B - Budget Proposal

	Item Description		Amount
* Salary	_____	_____	
	_____	_____	
	_____	_____	
* Fringe Benefits		_____	
		Subtotal Salary & Fringes	_____
Equipment	_____	_____	
	_____	_____	
	_____	_____	
		Subtotal Equipment	_____
Travel	Participant support	3800	
	_____	_____	
	_____	_____	
		Subtotal Travel	\$3,800.00
Supplies	Conference Supplies	200	
	_____	_____	
	_____	_____	
		Subtotal Supplies	\$200.00
Consultants/Subcontracts	_____	_____	
	_____	_____	
	_____	_____	
		Subtotal Consultants/Subcontracts	_____
Other Expenses (including * Indirect Costs)	_____	_____	
	_____	_____	
	_____	_____	
		Subtotal Other Expenses	_____
Total Budget Proposal			4000

* Note: The Initiatives Fund is not intended for salary support or for the payment of indirect costs, and the inclusion of these costs in a proposal will be a factor in the evaluation for award.

Budget Justification
As with the last workshop, it is necessary to be able to provide some level of travel support, particularly for European participants in the conference. The 3800 will be supplemented by the funds from other sources to allow us
The \$200 for supplies will provide for name tags, some pads, and some support for posters.

; to provide such support to several people.

