

*The Department of Energy has opted to utilize the following agreement for Designated Non-Proprietary User Facilities transactions. Because these transactions are widespread across Departmental facilities, uniformity in agreement terms is desirable. Except for the *** provisions, minor modifications to the terms of this agreement may be made by CONTRACTOR, but any changes to the *** provisions or substantive changes to the non *** provisions will require approval by the DOE Contracting Officer, WHICH WILL LIKELY DELAY YOUR ACCESS TO THE USER FACILITY. In instances where DOE Contracting Officer approval for substantive changes cannot be obtained, Strategic Partnership Program (SPPs) and Cooperative Research and Development Agreements (CRADAs) may be more appropriate due to the increased flexibility such agreements afford. Where this agreement is to be used as an umbrella agreement for multiple transactions it may be modified to reflect such usage.*

Non-Proprietary User Agreement

No. JSA-19-T001

Between

JEFFERSON SCIENCE ASSOCIATES, LLC

"CONTRACTOR"

Operator of Thomas Jefferson National Accelerator Facility (hereinafter "Jefferson Lab" or "Laboratory") under Prime Contract No. DE-AC05-06OR23177 with the United States Government (hereinafter "U.S. Government" or "Government"), as represented by the United States Department of Energy (hereinafter "DOE"),

AND

THE UNIVERSITY OF MANITOBA

"USER"

(Collectively, "the Parties")

The obligations of the above-identified DOE CONTRACTOR may be transferred to and shall apply to any successor in interest to said CONTRACTOR continuing the operation of the Laboratory.

ARTICLE I. FACILITIES AND SCOPE OF WORK

CONTRACTOR will make available to duly authorized employees, consultants and/or representatives of USER (hereinafter called "Participants") certain Laboratory Non-Proprietary User Facilities, which may include equipment, services, information and other material, with or without Laboratory scientist collaboration, for purposes as described in individual proposals approved by said User Facilities, as attached in Appendix A, and made a part of this Agreement.

In order for the USER to gain access to and/or use of the User Facilities, the research must first receive programmatic approval of the User Facility director and available scheduling therefor. It is understood and agreed that the approval determinations of the director of the Facility are final. To receive such approval, the USER is obligated to provide a proposal disclosing a functional non-proprietary description of the experimental work, since such information is essential to the CONTRACTOR to operate the Facility. The scope of work shall not be considered proprietary information and shall be publicly releasable.

ARTICLE II. TERM OF THE AGREEMENT

This Agreement shall be effective as of the date on which it is signed by the last of the Parties. This Agreement shall remain in effect for five years and will be automatically renewed in the absence of a prior written objection to such renewal by either Party.

ARTICLE III: COST

Each Party will bear its own costs and expenses associated with this Agreement. No money will be transferred to or from either Party as consideration, in whole or in part, for this Agreement, except for reimbursement for support services that are provided above and beyond those normally or routinely provided by the User Facility upon request by USER and at the discretion of CONTRACTOR. Support services above and beyond those normally or routinely provided by the Facility may include, for example, sample preparation and Facility operation outside of normal working hours, but shall not include conduct of research. Costs associated with said USER support shall be agreed upon in advance and set forth in an executable, project-specific appendix to this Agreement. CONTRACTOR will invoice USER for these costs, and USER shall pay each invoice according to the instructions therein.

ARTICLE IV: ADMISSION REQUIREMENTS

USER and Participants are subject to the administrative and technical supervision and control of CONTRACTOR and will comply with all applicable rules of CONTRACTOR and DOE with regard to admission (including remote access as well as physical access) to and use of the User Facility, including safety, operating and health-physics procedures, environment protection, access to information, hours of work, and conduct. As a condition of User Facility access, Participants shall execute any and all documents required by CONTRACTOR acknowledging and agreeing to comply with such applicable rules of CONTRACTOR.

ARTICLE V: PROPERTY AND MATERIALS***

Note: Provisions of this Article do not apply to Technical Data, which are addressed in Article IX.

USER may be permitted by CONTRACTOR to furnish equipment, tooling, test apparatus, or materials necessary to assist in the performance of its experiment(s) at the User Facility. Such items shall remain the property of USER. Unless the Parties otherwise agree, all such property furnished by USER or equipment and test apparatus provided by USER will be removed by USER within sixty (60) days of completion, termination, or expiration of the work conducted under each approved proposal or will be disposed of as directed by USER at USER's expense. Any equipment that becomes integrated into the Facility shall be the property of the Government. USER acknowledges that any material supplied by USER may be damaged, consumed or lost. Unless otherwise agreed in writing, materials (including residues and/or other contaminated material) remaining after performance of the work or analysis will be removed in their then condition by USER or CONTRACTOR (at CONTRACTOR'S option) at USER's expense. USER will return facilities and equipment utilized in their original condition except for normal wear and tear.

CONTRACTOR shall have no responsibility for USER's property in CONTRACTOR's possession other than loss or damage caused by willful misconduct or gross negligence of CONTRACTOR or its employees.

Personal property produced or acquired during the course of this Agreement shall be disposed of as directed by the owner at the owner's expense.

ARTICLE VI: SCHEDULING***

USER understands that CONTRACTOR will have sole responsibility and discretion for allocating and scheduling usage of the User Facilities and equipment needed for or involved under this Agreement.

ARTICLE VII: INDEMNITY AND LIABILITY***

- A. **Personnel Relationships** - USER shall be responsible for the acts or omissions of Participants.
- B. **Product Liability** - To the extent permitted by US federal law and the law of the USER's country or US state, if USER utilizes the work derived from this Agreement in the making, using, or selling of a product, process or service, then USER hereby agrees to hold harmless and indemnify CONTRACTOR and the United States Government, their officers, agents and employees from any and

all liability, claims, damages, costs and expenses, including attorney fees, for injury to or death of persons, or damage to or destruction of property, as a result of or arising out of such utilization of the work by or on behalf of USER, its assignees or licensees.

- C. General Indemnity** - To the extent permitted by US federal law and the law of the USER's country or US state, USER hereby agrees to indemnify and hold harmless CONTRACTOR and the United States Government, their officers, agents and employees from any and all liability, claims, damages, costs and expenses, including attorney fees, for injury to or death of persons, or damage to or destruction of property, to the extent such liability, claims, or damages is caused by or contributed to by the negligence or intentional misconduct of USER or its Participants during the performance of the work under this Agreement.
- D. Patent and Copyright Indemnity—Limited** - To the extent permitted by US federal law and the law of the USER's country or US state, USER shall fully indemnify the Government and CONTRACTOR and their officers, agents, and employees for infringement of any United States patent or copyright arising out of any acts required or directed or performed by USER under this Agreement to the extent such acts are not normally performed at the User Facility.
- E.** The liability and indemnity provisions in paragraphs B, C and D above shall not apply unless USER shall have been informed as soon as practicable by CONTRACTOR or the Government of the suit or action alleging such infringement, and such indemnity shall not apply to a claimed infringement that is settled without the consent of USER unless required by a court of competent jurisdiction.

F. General Disclaimer -

THE GOVERNMENT AND CONTRACTOR MAKE NO EXPRESS OR IMPLIED WARRANTY AS TO THE CONDITIONS OF THE USER FACILITY FURNISHED HEREUNDER. IN ADDITION, THE GOVERNMENT, CONTRACTOR AND USER MAKE NO EXPRESS OR IMPLIED WARRANTY AS TO THE RESEARCH OR ANY INTELLECTUAL PROPERTY, GENERATED INFORMATION, OR PRODUCT MADE OR DEVELOPED UNDER THIS AGREEMENT, OR THE OWNERSHIP, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE OF THE RESEARCH OR RESULTING PRODUCT; THAT THE GOODS, SERVICES, MATERIALS, PRODUCTS, PROCESSES, INFORMATION, OR DATA TO BE FURNISHED HEREUNDER WILL ACCOMPLISH INTENDED RESULTS OR ARE SAFE FOR ANY PURPOSE INCLUDING THE INTENDED PURPOSE; OR THAT ANY OF THE ABOVE WILL NOT INTERFERE WITH PRIVATELY OWNED RIGHTS OF OTHERS. THE GOVERNMENT, CONTRACTOR AND/OR USER SHALL NOT BE LIABLE FOR SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES ATTRIBUTED TO USE OF SUCH FACILITIES, RESEARCH OR RESULTING PRODUCT, INTELLECTUAL PROPERTY, GENERATED INFORMATION, OR PRODUCT MADE OR DELIVERED UNDER THIS AGREEMENT.

FURTHERMORE, NEITHER THE GOVERNMENT, DOE, THE CONTRACTOR, NOR PERSONS ACTING ON THEIR BEHALF WILL BE RESPONSIBLE, IRRESPECTIVE OF CAUSE, FOR FAILURE TO FURNISH THE FACILITIES, EQUIPMENT, MATERIAL, INFORMATION OR PERSONNEL UNDER THIS AGREEMENT AT ANY PARTICULAR TIME OR IN ANY PARTICULAR MANNER.

If research subject to this Agreement is performed by the USER under a U.S. federal agency grant, cooperative agreement, or contract, then, to the extent that the Intellectual Property Provisions in the USER's grant, cooperative agreement, or contract with a U.S. federal agency are inconsistent with the terms and conditions contained in Articles VIII (Patent Rights) and IX (Rights in Technical Data) below, the terms and conditions of the U.S. federal grant, cooperative agreement, or contract shall apply to the work performed by the USER under this Agreement.

A. Definitions

1. "Subject Invention" means any invention or discovery conceived or first actually reduced to practice in the course of or under this Agreement.
2. "USER Invention" means any Subject Invention of USER.
3. "CONTRACTOR Invention" means any Subject Invention of CONTRACTOR.
4. "Patent Counsel" means the DOE Counsel for Intellectual Property assisting the DOE contracting activity.

B. Subject Inventions

CONTRACTOR and USER agree to disclose their Subject Inventions, which include any inventions of their Participants, to each other, concurrent with reporting such Subject Inventions to DOE. The Parties agree that they will protect Subject Inventions from public disclosure for a reasonable period of time so that patent applications can be filed. CONTRACTOR employees are bound by the confidentiality requirements of their employer and the CONTRACTOR's Prime Contract with DOE with respect to intellectual property disclosures.

C. CONTRACTOR's Rights

Except as provided below in the case of joint inventions, CONTRACTOR Inventions will be governed by the provisions of CONTRACTOR'S Prime Contract for operation of the Laboratory.

D. USER's Rights

Subject to the provisions herein, USER may elect title to any USER Invention and in any resulting patent secured by USER within one year of reporting the Subject Invention to DOE. The USER shall file a US patent application within a reasonable period of time. Where appropriate, the filing of patent applications by USER is subject to DOE security regulations and requirements.

E. Joint Inventions

For Subject Inventions conceived or first actually reduced to practice under this Agreement that are joint Subject Inventions made by CONTRACTOR and USER, each Party shall have the option to elect and retain title to its undivided rights in such joint Subject Inventions.

F. Rights of Government

1. USER agrees to timely assign to the Government, if requested, the entire right, title, and interest in any country to each USER Invention where USER:
 - a. Does not elect to retain such rights; or
 - b. Fails to timely have a patent application filed in that country on the USER Invention or decides not to continue prosecution or not to pay the maintenance fees covering the Invention; or
 - c. At any time, no longer desires to retain title.
2. USER shall provide the Government a copy of any application filed by USER promptly after such application is filed, including its serial number and filing date.
3. USER hereby grants to the Government a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States the USER Invention made under said project throughout the world.

4. USER acknowledges that the DOE has certain March-in Rights to any USER Inventions elected by the USER in accordance with 48 C.F.R. 27.304-1(g) and that the USER is subject to the requirements with respect to preference for U.S. industry pursuant to 35 U.S.C. § 204 to any USER Inventions elected by the USER.
5. The USER agrees to include, within the specification of any U.S. patent applications and any patent issuing thereon covering a USER Invention, the following statement:

"The Government has rights in this invention pursuant to User Agreement (specify number) between (USER name) and Jefferson Science Associates, LLC, which manages and operates Thomas Jefferson National Accelerator Facility for the US Department of Energy."
6. USER agrees to submit on request periodic reports to DOE no more frequently than annually on the utilization of USER Inventions or on efforts to obtain such utilization that are being made by USER or its licensees or assignees.
7. Facilities License: USER agrees to and does hereby grant to the Government a nonexclusive, nontransferable, irrevocable, paid-up license in and to any inventions or discoveries, regardless of when conceived or actually reduced to practice or acquired by USER, which are incorporated in the User Facility as a result of this Agreement to such an extent that the Facility is not restored to the condition existing prior to the Agreement (1) to practice or to have practiced by or for the Government at the Facility, and (2) to transfer such licenses with the transfer of that Facility. The acceptance or exercise by the Government of the aforesaid rights and license shall not prevent the Government at any time from contesting the enforceability, validity or scope of, or title to, any rights or patents herein licensed.

G. Invention Report and Election

USER shall furnish the Patent Counsel a written report concerning each USER Invention within six months after conception or first actual reduction to practice, whichever occurs first. If USER wishes to elect title to the Invention, a notice of election should be submitted with the report or within one year of such date of reporting.

ARTICLE IX: RIGHTS IN TECHNICAL DATA***

A. Definitions:

1. "Technical Data" means recorded information regardless of form or characteristic, of a scientific or technical nature. Technical Data as used herein does not include financial reports, costs analyses, and other information incidental to Agreement administration.
2. "USER Proprietary Directory" is a directory within a computer system that has been identified by the CONTRACTOR as being for the storage of files of USER containing Proprietary Data. Any and all Technical Data in subdirectories of any USER Proprietary Directory shall also be considered to be Proprietary Data.
3. "Proprietary Data" means Technical Data which embody trade secrets developed at private expense, outside of this Agreement, such as software, design procedures or techniques, chemical composition of materials, or manufacturing methods, processes, or treatments, including minor modifications thereof, provided that such data:
 - a. are not generally known or available from other sources without obligation concerning their confidentiality;
 - b. have not been made available by the owner to others without obligation concerning their confidentiality;
 - c. are not already available to the CONTRACTOR or the Government without obligation concerning their confidentiality; and

d. are either marked as "Proprietary Data" or stored in any USER Proprietary Directory.

4. "Unlimited Rights" means right to use, duplicate, or disclose Technical Data, in whole or in part, in any manner and for any purpose whatsoever, and to permit others to do so.

B. Allocation of Rights

1. The Government shall have Unlimited Rights in Technical Data first produced or specifically used in the performance of this Agreement except as otherwise provided in this Agreement. CONTRACTOR agrees that to the extent it receives or is given access to Proprietary Data or other technical, business or financial data in the form of recorded information from USER, CONTRACTOR shall treat such data in accordance with any restrictive legend contained thereon. DOE and the CONTRACTOR reserve the right to challenge the proprietary nature of any markings.
2. USER shall have the right to use, subject to patent, security or other provisions of this Agreement, Technical Data first produced in the performance of this Agreement provided the data delivery requirements of this Agreement have been met as of the date of the use of such data. USER agrees that to the extent it receives or is given access to Proprietary Data or other technical, business or financial data in the form of recorded information from DOE or a DOE contractor or subcontractor, USER shall treat such data in accordance with any restrictive legend contained thereon, unless use is specifically authorized by prior written approval of the DOE Contracting Officer for the CONTRACTOR's Prime Contract.

C. Deliverables

1. USER agrees to furnish to DOE or CONTRACTOR those data, if any, which are (a) specified to be delivered in Appendices and/or approved proposals, (b) essential to the performance of work by CONTRACTOR personnel or (c) necessary for the health and safety of such personnel in the performance of the work. Any data furnished to DOE or CONTRACTOR shall be deemed to have been delivered with Unlimited Rights unless marked as "Proprietary Data" of USER. DOE and the CONTRACTOR reserve the right to challenge the proprietary nature of any markings.
2. USER shall deliver to CONTRACTOR for each project a publicly releasable, initial abstract or description of the work to be performed.
3. Upon completion or termination of each project, USER agrees to deliver to DOE's Office of Science and Technology Information and CONTRACTOR a publicly releasable report describing the work performed.

D. Legal Notice

The following legal notice shall be affixed to each report or publication resulting from this Agreement which may be distributed by USER:

DISCLAIMER NOTICE

This document was prepared by Jessie Tenbusch as a result of the use of facilities of the U.S. Department of Energy (DOE), which are managed by Jefferson Science Associates, LLC., acting under Contract No. DE-AC05-06OR23177. Neither Jefferson Science Associates, DOE, the U.S. Government, nor any person acting on their behalf: (a) make any warranty or representation, express or implied, with respect to the information contained in this document; or (b) assume any liabilities with respect to the use of, or damages resulting from the use of any information contained in the document.

E. Copyrighted Material

1. USER agrees to, and does hereby grant to the Government, and to its officers, agents, servants and employees acting within the scope of their duties:
 - a. A royalty-free, nonexclusive, irrevocable license to reproduce, translate, publish, use, and dispose of and to authorize others so to do, all copyrightable material first produced or composed in

the performance of this Agreement by USER, its employees or any individual or concern specifically employed or assigned to originate and prepare such material; and

b. A license as aforesaid under any and all copyrighted or copyrightable works not first produced or composed by USER in the performance of this Agreement but which are incorporated in the material furnished or delivered under this Agreement (excluding any software temporarily uploaded or stored on User Facility resources to which CONTRACTOR does not need access for performance of work by CONTRACTOR personnel), provided that such license shall be only to the extent USER now has, or prior to completion or final settlement of this Agreement may acquire, the right to grant such license without becoming liable to pay compensation to others solely because of such grant.

2. USER agrees that it will not knowingly include any copyrightable material furnished or delivered under this Agreement without a license as provided for in subparagraph 1(b) hereof, or without the consent of the copyright owner, unless it obtains specific written approval of the Contracting Officer for the inclusion of such copyrighted materials.

F. Proprietary Data

1. USER agrees that it shall have the sole responsibility for storing all proprietary electronic files (such as data, documentation, source code, object code, executable code, and libraries) within USER Proprietary Directories. The Government and CONTRACTOR shall not disclose the contents - or any portion thereof - of these USER Proprietary Directories outside the Government and CONTRACTOR and CONTRACTOR's representatives. The Government and CONTRACTOR reserve the right to challenge the proprietary nature of any file in a USER Proprietary Directory.
2. USER is solely responsible for the removal of all of its Proprietary Data, in accordance with storage policies, if any, of the particular User Facility. In the absence of such policies, the USER must remove its related Technical Data (including Proprietary Data) from all areas to which it has access within thirty (30) days after completion or termination of projects authorized under this Agreement. The Government and CONTRACTOR will treat any remaining appropriately identified Proprietary Data, including Proprietary code, as Restricted Computer Software and/or Limited Rights Data, as appropriate. The Government shall have Unlimited Rights in any Technical Data (including Proprietary Data) which are incorporated into the User Facility under this Agreement to such extent that the User Facility or equipment is not restored to the condition existing prior to such incorporation.
3. All Proprietary Data shall be protected from disclosure for a period of three years from the date of disclosure to CONTRACTOR. CONTRACTOR may provide employees of DOE access to proprietary data. DOE employees are required by 18 USC 1905 to protect proprietary data.

ARTICLE X. LABORATORY SITE ACCESS, SAFETY AND HEALTH***

As a precondition to accessing User Facilities, Participants must complete all CONTRACTOR Site Access documents and requirements. USER and Participant shall take all reasonable precautions in activities carried out under this Agreement to protect the safety and health of others and to protect the environment. Participants must comply with all applicable safety, health, access to information, security and environmental regulations and the requirements of the Department and CONTRACTOR, including the specific requirements of the User Facilities covered by this Agreement. In the event that USER or Participant fails to comply with said regulations and requirements, CONTRACTOR may, without prejudice to any other legal or contractual rights, issue an order stopping all or any part of USER's activities at the User Facility.

ARTICLE XI. PERSONNEL RELATIONSHIPS***

Participants will remain employees or representatives of the USER at all times during their participation in the work under this Agreement, and shall not be considered employees of CONTRACTOR or DOE for any purpose. Consistent with Article IV, Participants shall be subject to the administrative and technical supervision and control of CONTRACTOR during and in connection with the Participant's activities under this Agreement.

ARTICLE XII: EXPORT CONTROLS***

The Parties acknowledge that the export of goods or Technical Data may require some form of export control license from the U.S. Government and that failure to obtain such export control license may result in criminal liability under the laws of the United States.

ARTICLE XIII: PUBLICATIONS***

- A. For collaborative work between the Parties, USER and CONTRACTOR will provide each other copies of proposed written and oral publications of information generated pursuant to this Agreement for review and comment 30 days prior to submission for publication. Proposed oral publications shall be submitted to the recipient Party in the form of a written presentation synopsis or abstract.
- B. USER will not use the name of CONTRACTOR or the United States Government or their employees in any promotional activity, such as advertisements, with reference to any product or service resulting from this Agreement, without prior written approval of the Government and CONTRACTOR.

ARTICLE XIV: DISPUTES***

The Parties will attempt to jointly resolve all disputes arising under this agreement. If the Parties are unable to jointly resolve a dispute within a reasonable period of time, either Party may contact CONTRACTOR's Technology Transfer Ombudsman (TTO) to provide assistance. The TTO may work directly to resolve the dispute or, upon mutual agreement of the Parties, contact a third-party neutral mediator to assist the Parties in coming to a resolution. The costs of the mediator's services will be shared equally by the Parties. In the event that an agreement is not reached with the aid of the ombudsman or mediator, the Parties may agree to have the dispute addressed by neutral evaluation. The decision rendered by the neutral evaluator shall be nonbinding on the Parties, and any costs incurred there from shall be divided equally between the Parties. Upon mutual agreement, the Parties may request a final decision by the DOE Contracting Officer. Absent resolution, either Party may seek relief in a court of competent jurisdiction.

ARTICLE XV. CONFLICT OF TERMS***

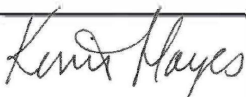

This Agreement constitutes the primary document which governs the work conducted under approved proposals at Jefferson Lab's User Facilities. In the event of any conflict between the terms of this Agreement and any other document issued by either Party, the terms of this Agreement shall prevail.

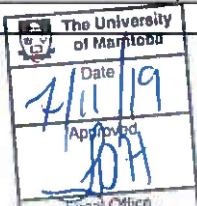
ARTICLE XVI: TERMINATION***

Either Party may terminate this Agreement for any reason at any time by giving not less than thirty (30) days prior written notice to the other Party. Notice will be deemed made as of the day of receipt. The obligations of any clause of this Agreement, which by their nature extend beyond its termination, shall remain in full force and effect until fulfilled.

AUTHORIZED SIGNATURES:

By signing this Agreement, the signatories attest that they are legally authorized to commit their respective Parties to this Agreement.

Proposed on behalf of USER		Accepted on behalf of CONTRACTOR	
Signature:		Signature:	
Name (print):	The University of Manitoba Kerrie Hayes	Name:	Rolf Ent



Jefferson Science Associates, LLC Non-Proprietary User Agreement

Title (print): Director, Research Contracts	Title: Associate Director for Physics
Date: May 25, 2020	Date: 6/16/20

To be completed by USER:

Organizational Classification (select one)

- U.S. Small For-Profit Business (per SBA definition)
- Other U.S. For-Profit Business
- U.S. Non-profit Organization
- U.S. University or Educational Institution
- U.S. Contractor-Operated National Laboratory
- U.S. Federal Agency
- Non-U.S. For-Profit Business
- Non-U.S. Non-Profit Organization
- Non-U.S. University or Educational Institution
- Non-U.S. Government Agency or Entity
- Other (Please specify): _____

Appendix A
Approved Proposals

This agreement will also apply to persons affiliated with the “User”, using JLab facilities for any research or educational activity approved by the institution that is not included below. These individuals have the intent to be physically present at the JLab Facility.

The MOLLER Experiment
Measurement Of Lepton Lepton Elastic Reactions

An Ultra-precise Measurement of the
Weak Mixing Angle using
Møller Scattering

E12-09-005

Update submitted to PAC 37

December 2, 2010

Abstract

The upgraded 11 GeV CEBAF polarized electron beam presents a compelling opportunity to measure a weak neutral current amplitude to unprecedented precision at $Q^2 \ll M_Z^2$. The result would yield a precise measurement of the weak mixing angle $\sin^2 \theta_W$, a fundamental parameter of the electroweak theory. The experimental goal of $\delta(\sin^2 \theta_W) \sim 0.1\%$, matching the accuracy of the two single best measurements by e^+e^- colliders at the Z resonance, would be accomplished by a precise measurement of the parity-violating asymmetry in fixed-target Møller scattering. The quantitative goals, the measurement strategy, and the major parameters of the experimental design in the original proposal remain unchanged, and we will refer to it frequently in this document. The original proposal document can be found at

http://hallaweb.jlab.org/12GeV/Moller/moller_final.pdf.

After presenting a brief overview of the experiment, we address a few aspects of the experimental design that have seen progress in recent months, both due to dedicated studies as well as due to technical accomplishments in other related projects. We conclude with a projection of the required beam time to achieve the proposed accuracy for the measurement.

Proposal to Jefferson Lab PAC 38

E12-11-101

PREX-II: PRECISION PARITY-VIOLATING
MEASUREMENT OF THE NEUTRON SKIN OF LEAD

Spokespersons: K. Paschke, K. Kumar, R. Michaels, P.A.Souder, G.M. Urciuoli

P.A. Souder, R. Holmes, Chun-Min Jen, L. Zana, Z. Ahmed, A. Rakhman
Syracuse University

E. Cisbani, S. Frullani, F. Garibaldi, F. Meddi, G.M. Urciuoli, M. Capogni
INFN / Rome

K. Allada, A. Camsonne, A. Deur, J.P. Chen, O. Hansen, D. Higinbotham,
J. Gomez, J. LeRose, R. Michaels, S. Nanda, B. Sawatzky, B. Wojtsekhowski, J. Zhang
Thomas Jefferson National Accelerator Facility

K. Kumar, S. Riordan, L. Mercado, J. Wexler, S. Johnston, J. Mammei
University of Massachusetts

A. D'Angelo, C. Schaerf, I. Zonta
INFN / Rome Tor Vergata

R. De Leo, L. Lagamba
INFN/Bari

E. Bellini, A. Giusa, F. Mammoliti, G. Russo, L. Sperduto, C. Sutura
INFN/Catania

M. Aghasyan, E. De Sanctis, D. Hasch, V. Lucherini, M. Mirazita, S. A. Pereira, P. Rossi
INFN/Frascati

ABSTRACT

This is a follow-up measurement to PREX-I which ran in 2010 and demonstrated successful control of systematic errors and overcame many technical challenges, but which ran into difficulties with radiation and the vacuum system that reduced the running efficiency. PREX measures the parity-violating electroweak asymmetry in the elastic scattering of polarized electrons from ^{208}Pb at an energy of 1.0 GeV and a scattering angle of 5° . Since the Z^0 boson couples mainly to neutrons, this asymmetry provides a clean measurement of R_N , the RMS radius of neutrons in a heavy nucleus. PREX-I was statistics limited, yet already established the existence of the neutron skin at the 95% confidence level. PREX-II is designed to achieve the originally proposed experimental precision in R_N of $\pm 1\%$. In addition to being a fundamental test of nuclear theory, a precise measurement of R_N pins down the density dependence of the symmetry energy of neutron rich nuclear matter which has impacts on neutron star structure, heavy ion collisions, and atomic parity violation experiments. We are requesting 35 days of polarized beam running in Hall A at 925 to 1000 MeV using the 5° degree septum magnets. This includes 5 days of commissioning and 5 days of overhead for Møller Polarimetry and auxiliary measurements.

Proposal to Jefferson Lab PAC 40

E12-12-004

**CREX: PARITY-VIOLATING MEASUREMENT of the
WEAK CHARGE DISTRIBUTION of ^{48}Ca to 0.02 fm ACCURACY**

Spokespersons: J. Mammei, D. McNulty, R. Michaels, K. Paschke, S. Riordan*, P.A. Souder

J. Mammei, J. Birchall, M. Gericke, R. Mahurin, W.T.H. van Oers, S. Page
University of Manitoba

S. Riordan, P. Decowski, K. Kumar, T. Kutz, J. Wexler
University of Massachusetts, Amherst

K. Paschke, G.D. Cates, M. Dalton, D. Keller, X. Zheng
University of Virginia

P.A. Souder, R. Beminiwattha, R. Holmes
Syracuse University

**R. Michaels, K. Allada, J. Benesch, A. Camsonne, J.P. Chen, D. Gaskell,
J. Gomez, O. Hansen, D.W. Higinbotham, C.E. Keppel, J. LeRose, B. Moffit
S. Nanda, P. Solvignon-Sliifer, B. Wojtsekhowski, J. Zhang**
Thomas Jefferson National Accelerator Facility

Konrad Aniol
California State University, Los Angeles

G.B. Franklin, B. Quinn
Carnegie Mellon University

D. Watts, L. Zana
The University of Edinburgh

P. Markowitz
Florida International University

*contact spokesperson, riordan@jlab.org

ABSTRACT

The ^{48}Ca Radius EXperiment (CREX) was conditionally approved at the C2 level by PAC39, which recommended that a stronger case be made demonstrating “how the ^{48}Ca result will test microscopic models.” In order to evaluate the case, a workshop was held at Jefferson Lab in March 2013 [1] with leading theorists from several fields that have an interest in our proposal. The status of these microscopic calculations was presented and the results of these calculations are expected to be available by the time the experiment will run. The conclusion of the workshop was that a measurement of the neutron skin of ^{48}Ca with a precision of 0.02 fm will be an essential benchmark in the field.

We propose to measure the parity-violating asymmetry for elastic scattering from ^{48}Ca at $E = 2.2$ GeV and $\theta = 4^\circ$. This will provide a measurement of the weak charge distribution and hence the neutron density at one value of $Q^2 = 0.022$ (GeV/c) 2 . It will provide an accuracy in the ^{48}Ca neutron radius R_n^{48} equivalent to ± 0.02 fm ($\sim 0.6\%$). A measurement this precise will have a significant impact on nuclear theory, providing unique experimental input to help bridge ab-initio theoretical approaches (based on nucleon-nucleon and three-nucleon forces) and the nuclear density functional theory (based on energy density functionals). Together with the planned ^{208}Pb neutron radius measurement (R_n^{208}), R_n^{48} will provide unique input in such diverse areas such as neutron star structure, heavy ion collisions, and atomic parity violation. A precise measurement on a small nucleus is favorable because it can be measured at high momentum transfer where the asymmetry is larger (for the proposed kinematics, about 2 ppm). Also, since ^{48}Ca is neutron-rich it has a larger weak charge and greater sensitivity to R_n . We are requesting 45 days of polarized beam running in Hall A at a 1-pass energy of 2.2 GeV using a septum magnet to reach a 4° scattering angle. The experimental setup is similar to PREX. This beam time request includes 35 days of production data-taking and 5 days of commissioning and 5 days of overhead for Møller polarimetry and other auxiliary measurements.