



Conference collection

# Workshop to Explore Physics Opportunities with Intense, Polarized Electron Beams at 50–300 MeV

**Cambridge, Massachusetts, USA**

14–16 March 2013

## Editors

**Richard Milner**

Massachusetts Institute of Technology, Massachusetts, USA

**Roger Carlini**

Jefferson Lab, Virginia, USA

**Frank Maas**

Helmholtz-Institute Mainz, Mainz, Germany

All papers have been peer reviewed.

## Sponsoring Organizations

Massachusetts Institute of Technology

Johannes Gutenberg Universität

Jefferson Lab



Melville, New York, 2013  
AIP Proceedings

Volume 1563

To learn more about AIP Proceedings visit <http://proceedings.aip.org>

## Editors

### Richard Milner

Massachusetts Institute of Technology  
Laboratory for Nuclear Science  
26-505, MIT  
Cambridge, MA 02139  
USA  
E-mail: milner@MIT.EDU

### Roger Carlini

Jefferson Lab  
Department of Physics  
12000 Jefferson Avenue  
Suite 6, MS 12H4  
Newport News, VA 23606  
USA  
E-mail: carlini@jlab.org

### Frank Maas

Helmholtz-Institute Mainz  
Department of Physics  
J.J. Becherweg 45  
Mainz 55128  
Germany  
E-mail: maas@uni-mainz.de

Authorization to photocopy items for internal or personal use, beyond the free copying permitted under the 1978 U.S. Copyright Law (see statement below), is granted by the AIP Publishing LLC for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$30.00 per copy is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923, USA: <http://www.copyright.com>. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Services is: 978-0-7354-1191-3/13/\$30.00



© 2013 AIP Publishing LLC

No claim is made to original U.S. Government works.

Permission is granted to quote from the AIP Conference Proceedings with the customary acknowledgment of the source. Republication of an article or portions thereof (e.g., extensive excerpts, figures, tables, etc.) in original form or in translation, as well as other types of reuse (e.g., in course packs) require formal permission from AIP Publishing and may be subject to fees. As a courtesy, the author of the original proceedings article should be informed of any request for republication/reuse. Permission may be obtained online using RightsLink. Locate the article online at <http://proceedings.aip.org>, then simply click on the RightsLink icon/“Permissions/Reprints” link found in the article abstract. You may also address requests to: AIP Publishing Office of Rights and Permissions, Suite 1N01, 2 Huntington Quadrangle, Melville, NY 11747-4502, USA; Fax: 516-576-2450; Tel.: 516-576-2268; E-mail: [rights@aip.org](mailto:rights@aip.org).

ISBN 978-0-7354-1191-3 (Original Print)

ISSN 0094-243X

Printed in the United States of America

*AIP Conference Proceedings, Volume 1563*  
**Workshop to Explore Physics Opportunities with Intense, Polarized Electron Beams at  
50-300 MeV**

**Table of Contents**

**Preface: Workshop to Explore Physics Opportunities with Intense, Polarized Electron Beams at  
50-300 MeV**

Roger Carlini, Frank Maas, and Richard Milner	1
---	---

<b>PEB Workshop Committee</b>	2
-------------------------------	---

<b>PEB Workshop Sponsors</b>	3
------------------------------	---

<b>PEB Workshop Chairs and Co-Conveners</b>	4
---	---

**PLENARY TALKS**

<b>The MESA accelerator</b> Kurt Aulenbacher	5
---	---

<b>The 300 mA SRF ERL</b> Ilan Ben-Zvi	13
---	----

<b>Nucleon measurements at the precision frontier</b> Carl E. Carlson	20
--	----

<b>Precision electron polarimetry</b> E. Chudakov	29
--	----

<b>The Jefferson lab FEL driver ERLs</b> David R. Douglas and Christopher D. Tennant	37
---	----

<b>Polarized electron beams at milliampere average current</b> M. Poelker	45
--	----

<b>Light and dark: A survey of new physics ideas in the 1-100 MeV window</b> Maxim Pospelov	51
--	----

<b>Nuclear astrophysics and electron beams</b> A. Schwenk	57
--	----

<b>High-power beam transmission test</b> C. Tschalär	65
---	----

## PARALLEL SESSION 1

### **Measurement of the axial and the strangeness magnetic form factor of the proton with a P2 backward angle setup**

S. Baunack, D. Becker, K. Gerz, K. Kumar, and F. E. Maas

73

### **P2 - The weak charge of the proton**

D. Becker, K. Gerz, S. Baunack, K. S. Kumar, and F. E. Maas

78

### **Nuclear physics aspects involved in studies of low-Q parity-violating electron scattering from nuclei**

T. W. Donnelly and O. Moreno

82

### **Measurement of the weak charge of the carbon-12 nucleus within the P2 experiment in Mainz**

K. Gerz, D. Becker, S. Baunack, K. S. Kumar, and F. E. Maas

86

### **Polarized electron scattering, new physics and dark parity violation**

William J. Marciano

90

### **Constrained $\gamma Z$ correction to parity-violating electron scattering**

N. L. Hall, P. G. Blunden, W. Melnitchouk, A. W. Thomas, and R. D. Young

94

### **Precision electroweak studies using parity violation in electron scattering**

K. D. Paschke

98

### **Charge symmetry breaking and parity violating electron scattering**

Gerald A. Miller

102

### **$Q_{\text{weak}}$ experiment update and applications/opportunities at lower energies**

Mark L. Pitt and Qweak Collaboration

106

### **Comparison of $\gamma Z$ -structure function models**

Benjamin C. Rislow

110

## PARALLEL SESSION 2

### **Hidden photons in connection to dark matter**

Sarah Andreas, Mark D. Goodsell, and Andreas Ringwald

114

### **A framework to analyze searches for gauge bosons of the hidden light sector in electron scattering fixed target experiments**

T. Beranek

118

### **Searches for dark photons at $e^+ e^-$ colliders**

Fabio Bossi

122

<b>Experimental concept and design of DarkLight, a search for a heavy photon</b> Ray F. Cowan and DarkLight Collaboration	126
<b>Searching for an invisible dark photon with DarkLight</b> Yonatan Kahn	131
<b>DarkLight radiation backgrounds</b> N. Kalantarians and DarkLight Collaboration	135
<b>Detectors for dark photon search with MESA</b> Matthias Molitor	140
<b>Searches for dark photons at the Mainz Microtron</b> H. Merkel, P. Achenbach, C. Ayerbe Gayoso, T. Beranek, J. C. Bernauer, R. Böhm, L. Correa, A. Denig, M. O. Distler, A. Esser, M. Gómez, S. Kegel, Y. Kohl, M. Mihovilović, D. G. Middleton, U. Müller, L. Nungesser, J. Pochodzalla, M. Rohrbeck, S. Sánchez Majos, B. S. Schlimme, M. Schoth, F. Schulz, C. Sfienti, M. Thiel, A. Weber, M. Weinriefer, D. Bosnar, I. Friščić, H. Fonvieille, L. Debenjak, and S. Širca	143
<b>The TREK/E36 experiment at J-PARC</b> M. Kohl and TREK Collaboration	147
<b>APEX: An electron fixed-target experiment to search for a new vector boson <math>A'</math> Decaying to <math>e^+e^-</math></b> Philip Schuster and APEX Collaboration	151
<b>Heavy photon search experiment at JLAB</b> S. Stepanyan and HPS Collaboration	155
<b>PARALLEL SESSION 3</b>	
<b>Symmetry tests in photo-pion production</b> A. M. Bernstein	159
<b>Lattice QCD for nuclear physics</b> William Detmold	163
<b>Studying the proton "radius" puzzle with <math>\mu p</math> elastic scattering</b> R. Gilman	167
<b>Lamb shift in muonic deuterium</b> Mikhail Gorchein, Carl E. Carlson, and Marc Vanderhaeghen	171
<b>High-accuracy analysis of Compton scattering in chiral effective field theory: Status and future</b> Harald W. Grießhammer, Daniel R. Phillips, and Judith A. McGovern	175
<b>Low energy probes of chiral symmetry</b> Barry R. Holstein	179

<b>High precision measurement of the proton charge radius: The PRad experiment</b> Mehdi Meziane and PRad Collaboration	183
<b>Initial state radiation experiment at MAMI</b> M. Mihovilović, H. Merkel, and A1-Collaboration	187
<b>Measuring the scalar and vector polarizabilities of the nucleon using polarized photons and electrons</b> R. Miskimen	191
<b>Proton polarizabilities: Status, relevance, prospects</b> Vladimir Pascalutsa	195
<b>PARALLEL SESSION 4</b>	
<b>Single-spin asymmetries in elastic electron-hadron scattering</b> Andrei Afanasev	199
<b>Measurement of the isovector axial form factor at <math>Q^2 = 0.23 \text{ (GeV/c)}^2</math></b> D. Balaguer Ríos, S. Baunack, B. Glaser, F. Maas, and Y. Imai	204
<b>Study of quantum spin correlations of relativistic electron pairs - Testing nonlocality of relativistic quantum mechanics</b> K. Bodek, P. Caban, J. Ciborowski, J. Enders, A. Köhler, A. Kozela, J. Rembieliński, D. Rozpedzik, M. Włodarczyk, and J. Zejma	208
<b>The neutron skin in neutron-rich nuclei at Jefferson Lab</b> Mark M. Dalton	212
<b>Clean measurements of the nucleon axial-vector and free-neutron magnetic form factors</b> A. Deur	215
<b>Measuring the axial form factor of <math>{}^3\text{He}</math> using weak capture of polarized electrons</b> D. Dutta	219
<b>Ideas for fundamental electron scattering at the S-DALINAC</b> J. Enders	223
<b>Neutron skins and neutron stars</b> J. Piekarewicz	227
<b>Status and prospects of <math>R_n</math> measurements at Mainz</b> C. Sfienti, D. Becker, M. I. Ferretti Bondy, M. Thiel, and K. Kumar	231
<b>Measurements of the astrophysical S factor of <math>{}^{12}\text{C}(\alpha, \gamma){}^{16}\text{O}</math> reaction</b> E. Tsentalovich	235

<b>Determination of astrophysical thermonuclear rates with a bubble chamber: The <math>^{12}\text{C}(\alpha\gamma)^{16}\text{O}</math> reaction case</b>	
B. DiGiovine, J. Grames, D. Henderson, R. J. Holt, D. Meekins, M. Poelker, K. E. Rehm, A. Robinson, A. Sonnenschein, R. Suleiman, and C. Ugalde	239
<b>Möller polarimetry with polarized atomic hydrogen at MESA</b>	
P. Aguar Bartolomé, K. Aulenbacher, and V. Tyukin	243
<b>The MESA polarimetry chain and the status of its double scattering polarimeter</b>	
K. Aulenbacher, P. Aguar Bartolomé, M. Molitor, and V. Tioukine	247
<b>An electron beam polarimeter based on scattering from a windowless, polarized hydrogen gas target</b>	
Jan Bernauer and Richard Milner	251
<b>Report from the workshop on TPCs at high-rate experiments</b>	
Ross Corliss	256
<b>Designing high power targets with computational fluid dynamics (CFD)</b>	
S. D. Covrig	260
<b>Large dynamic range diagnostics for high current electron LINACs</b>	
P. Evtushenko	264
<b>Electron polarimetry at low energies in Hall C at JLab</b>	
D. Gaskell	268
<b>Injector linac for the MESA facility</b>	
R. Heine	272
<b>Polarimetry at MAMI</b>	
V. Tioukine and K. Aulenbacher	276
<b>PEB Workshop Attendees</b>	
	281
<b>Author Index</b>	
	285