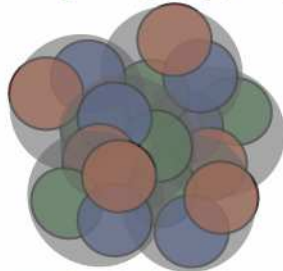


C I N P



I C P N

**Canadian Institute of
Nuclear Physics**

**Institut canadien de
physique nucléaire**

**2015 Individual Members AGM
June 15, 2015
Edmonton, AB**

Agenda

1. **Approval of Agenda**
2. **Executive Director's report**
3. **Financial Report – prepared by Paul Garrett**
4. **Discussion items:**
 - **Ideas for renewed MRS grant**
 - **Questions from SAPES re. CINP Joint Faculty Positions**
 - **Possible Registered Charity status under the Income Tax Act**
5. **Nuclear Science Week – Jason Donev**
6. **Updates from the Scientific Working Groups**
7. **Comments and Suggestions from the Membership**
8. **CINP Scientific Summary from Large Projects Day**
9. **Adjourn**

What is the CINP?

- The CINP is a formal organization of the Canadian nuclear physics research community to promote excellence in nuclear research and education, and to advocate the interests and goals of the community both domestically and abroad.
 - Federally incorporated under the Canada Not-for-profit Corporations Act.
- Represents researchers covering all aspects of experimental and theoretical nuclear physics. Co-ordinates planning on a national scale and exchanges information within and between the various sub-fields of nuclear physics.
- Leads initiatives to strengthen the level and quality of nuclear physics research in Canada, including fellowships, undergraduate research scholarships, student travel awards, and targeted conference support.

CINP Governance

Institutional Members
McGill University
Mount Allison University
Saint Mary's University
TRIUMF
University of Guelph
University of Manitoba
University of Regina
University of Winnipeg



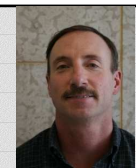
Pay Annual Dues and Elect Board

Board of Directors
Jens Dilling (TRIUMF) <i>President</i>
Jean Barrette (McGill)
Gerald Gwinner (Manitoba)
David Hornidge (Mt. Allison)
Rituparna Kanungo (St. Mary's)
Jeff Martin (Winnipeg)



Employs part-time Exec. Dir. to oversee daily affairs of CINP

Executive Director
Garth Huber (Regina)



Our thanks to:

- **A very special thank you to Paul Garrett (Guelph) who is stepping down from the CINP Board after many years of service.**
 - Treasurer and Board member since founding of CINP in 2007.
 - Assisted also with the initial incorporation and set-up of CINP in 2005-07.
- **Please welcome Sonia Bacca (TRIUMF) as the new CINP Treasurer (appointed by the Board).**
- **Thanks also to Zisis Papandreou (Regina) who has put in a lot of time and effort on the CINP web server.**

CINP Individual Membership

- Membership growth of past several years continued in 2014-15.
 - 12 new memberships, but 4 associate memberships not renewed
 - Net gain of +8.
- Many Associate Member applications are associated with Graduate Travel Support Programs.

New Faculty Members:

Jason Holt (TRIUMF)
Rachid Ouyed (Calgary)
Ruediger Picker (TRIUMF)
Michael Wieser (Calgary)

New Associate Members:

Tegan Beattie (Regina)
Ahmed Foda (Regina)
Jack Henderson (TRIUMF)
Noemi Ochoa (Regina)
Jaspreet Randhawa (St. Mary's)
Lori Rebenistsch (Winnipeg)
Jamie Stoker (Regina)
Mehrnoosh Tahani (Calgary)

	Now	1 Year Ago	Change
As of April 30, 2015			
Faculty Level	69	66	+3
Associate	46	41	+5
Experiment Major Interest	85	80	+6
Theory Major Interest	29	26	+3

Scientific Working Groups

Working Group	Members	Chair
Nuclear Astrophysics	40	Iris Dillmann (TRIUMF)
Nuclear Structure	51	Adam Garnsworthy (TRIUMF)
Fundamental Symmetries	43	Gerald Gwinner (Manitoba)
Hadrons/QCD	35	Charles Gale (McGill)
Nuclear Physics Education & Training	39	Juliette Mammei (Manitoba)

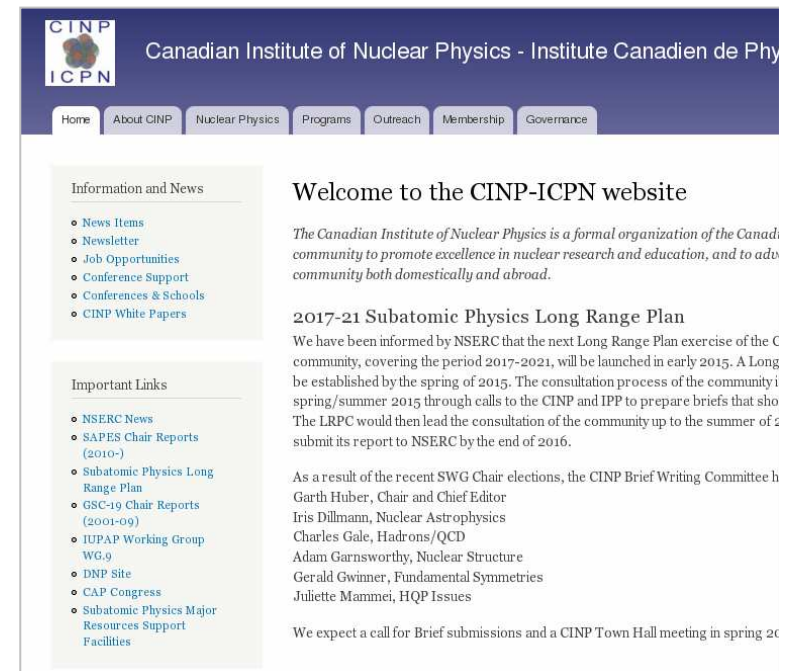
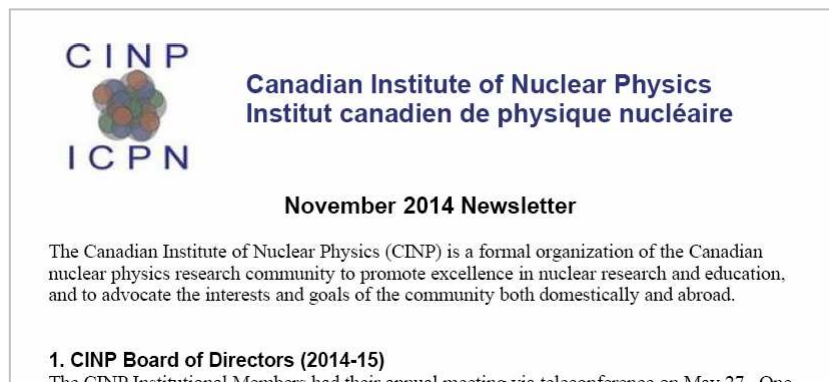
SWG Chair Duties:

- be the main point-of-contact for the SWG membership.
- help facilitate the CINP scientific program, e.g. contribute material to or suggest authors for the CINP website and newsletter, and help organize workshops.
- help write the CINP Brief for input to the NSERC Subatomic Physics Long Range Plan, and to provide input on other CINP activities, such as the annual presentation at NSERC Large Projects Day and the AGM.
- act as an advisor to the CINP Executive Director on related scientific issues.
- work together with the CINP Executive Director and other SWG Chairs on issues related to funding, long-range planning, and outreach.
- encourage people to join CINP, and to participate in the SWG.

CINP 2014-15 Accomplishments



- **Conference Support Program remains in high demand.**
 - Nuclear Structure 2014
 - r-Canada Workshop 2014
 - CUPC 2014 (Silver level sponsor)
 - International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions 2015
 - Symposium on Symmetries in Subatomic Physics 2015
- **Community Outreach.**
 - CINP facilitates new connections and allows the disparate Canadian nuclear physics community to develop a common identity.



CINP 2014-15 Accomplishments



- **Successful programs to assist students in presenting their Nuclear Physics research at domestic conferences.**
 - 4 undergraduates supported to Canadian Undergraduate Physics Conference (CUPC) at Kingston, ON in October, 2014.
 - 4 graduate students supported to Winter Nuclear and Particle Physics Conference (WNPPC) at Mt. Tremblant, QC in February, 2015.
- **The CINP Undergraduate Research Scholarship was awarded for a second time in 2015.**
 - \$3400 student stipend which must be matched by supervisor to at least \$7k.
 - For 2015, the average stipend is \$8530.
 - \$1300 travel supplement available if the supervisor intends to send the student to a laboratory or to work with a second collaborator for an extended period.
 - **Applications evaluated by committee:**
 - Jean Barrette (McGill), Board Member
 - Adam Garnsworthy (TRIUMF), Non-Board Member
 - Gerald Gwinner (Manitoba), Board Member
 - **13 applications were received, and the top 5 were awarded.**

CINP 2014-15 Accomplishments



- **Nuclear Physics Representation.**

- **The CINP has been vital in giving the nuclear physics community a coherent and strong voice.**
- Joint CINP+IPP White Paper on High Performance Computing to Compute Canada in July, 2014.
- “Context Document” for SAPES Fall Policy Meeting.
- Observer at Fall 2014 NuPECC meeting in Edinburgh, UK.
- NP Community Representative at Advisory Committee on TRIUMF (ACOT), spring and fall annually.
- Feedback to NSERC on LRPC membership and charge, SAPES conflict of interest guidelines, SAPES membership, and other matters.
- Coordinating NP input to NSERC Subatomic Physics Long Range Plan.
 - Thanks to everyone who attended this weekend’s Town Hall meeting.
 - Please submit your final written brief for consideration by June 26.
 - We will circulate a draft CINP Brief for community input once it is ready, probably late August.

CINP 2014-15 Accomplishments

- **CINP (GH) and IPP Director (Mike Roney) met with officials in Ottawa several times:**
 - **June 13/14:** Met to discuss improved co-ordination between NSERC and CFI and funding for subatomic physics with:
 - Pierre Charest (NSERC)
 - Gilles Patry, President & CEO, CFI
 - Robert Dunlop, Assistant Deputy Minister for Science & Innovation, Industry Canada
 - **March 9/15:** Second set of meetings after Large Projects Day, with:
 - Elizabeth Boston and Sarah Overington (NSERC) re. the LRPC, and upcoming Discovery Grant reallocation exercise.
 - Pierre Charest (NSERC) re. increased funding for Discovery Grants, conflict of interest regulations for SAPES, etc.
 - Lawrence Hanson, incoming ADM for Science & Innovation, re. funding issues, coordination of granting agency decision making, TRIUMF CAPTURE.
 - Guy Levesque, CFI, re. SAP LRPC, future of MSI program, invitation to speak at CAP.

2014-15 Financial Report



The CINP has two sources of revenue:

1. NSERC MRS Grant.

- Prescribed use only.
- e.g. Conference support, Scholarships and NSERC-related travel (CINP input to LRPC, Large Projects Day, ACOT).
- Grant renewed for 5 years in 2015 competition:
→ \$42k (15), \$45k (16), \$45k (17), \$46k (18), \$48k (19)

2. General Operating Funds provided from Institutional Membership dues.

- Used for not-NSERC eligible expenses, such Board meeting teleconference fees.
- Major expense: Teaching relief coverage for Executive Director.
- Projected revenue for 2015: \$19,500.

Financial Statements

- Prepared by Paul Garrett



NSERC Account FY14 (actual)	
FY13 Carry forward	\$12,819
FY14 Installment	\$22,500
Undergrad Summer + T.S.	\$20,881
Travel	
ACOT (2 trips)	\$1892
SAP Large Projects Day	\$1295
NuPECC	\$1035
Other	\$1811
Student Conf Support	
CUPC 2014	\$2000
WNPPC 2015	\$2000
Conference Sponsorship	
r-Canada 2014	\$1000
CUPC 2014	\$1000
Symmetries 2015	\$4000
FY14 Expenses	\$36,914

NSERC Account FY15	
FY14 Carry forward	\$1,295
FY15 Installment	\$42,000
Undergrad Summer + T.S.	\$22,200
Travel	
ACOT (2 trips)	\$1900
SAP Large Projects Day	\$1300
Other	\$1000
Long Range Plan	
Town Hall meeting	\$650
Brief Cmte and ED travel	\$13500
Student Conf Support	
CUPC 2015	\$2000
WNPPC 2016	\$2000
Conference Sponsorship	
Hard Probes 2015	\$4000
DREB 2016	\$4000
Projected FY15 Expenses	\$52,550

Financial Statements

- Prepared by Paul Garrett



Private Account FY14 (actual)	
FY13 Carry forward	\$70,179
FY14 Dues assessed	\$19,500
Board Meeting Expenses	\$669
CAP Congress AGM	\$379
Executive Director	\$20,000
Finance Expenses	
Bank	\$69
Industry Canada	\$30
Total FY13 Expenses	\$21,147

Private Account FY15 (projected)	
FY14 Carry forward	\$68,512
FY15 Estimated dues	\$19,500
Board Meeting Expenses	\$700
CAP Congress AGM	\$250
Executive Director	\$20,000
Finance Expenses	
Bank	\$60
Industry Canada	\$30
Multi-year audit	\$10,000
Potential transfer to NSERC account due to LRP	\$10,000
Projected FY15 Expenses	\$41,040
Projected Year End Balance	\$46,972

Ideas for renewed MRS grant

- Due to likely significant deficit in FY15, we propose to trim some expenses (e.g. CUPC Grad Fair) and maintain other programs at current level.
- After FY15, we will see small increases in our grant:
 - \$42k (15), \$45k (16), \$45k (17), \$46k (18), \$48k (19)
 - **What are your ideas for how we should spend the grant in FY16-19?**

Question from SAPES at Large Projects Day



A great way for CINP to add value to the NSERC funding could be to negotiate bridging positions at some universities. Is such a program being considered?

Long discussion about this and other issues at CINP AGM last June.

- Bridge positions are indeed attractive.
- A major issue is that if NSERC funds are used to pay part of a faculty-member's salary, that person is not eligible to apply or co-apply for NSERC grants.
- The only way any CINP bridge faculty would be grant-eligible is if NSERC granted an exemption to this rule (such as IPP has obtained), but the answer to this question is a firm NO.
- **Without the ability to apply for NSERC funds and build up an independent research program, we do not believe such bridge positions would be able to attract very good applicants.**
- **Thus, we do not believe the use of NSERC funds to create bridge positions is a viable option for CINP at this time.**

Possible Registered Charity status under the Income Tax Act



- **We have received an inquiry from a CINP member who was interested in adding us as a beneficiary in their will for the purpose of endowing a scholarship.**
- **In the end, their lawyer suggested not to add us to their will as CINP is not presently a Registered Charity.**
 - The CINP applied for Registered Charity status upon incorporation in 2007, but this was denied by Revenue Canada.
 - Some changes to bylaws and other matters would need to be implemented to qualify.
- **Would other people be interested in this?**
- **Should we pursue the legal changes needed to qualify?**
- **If so, can anyone recommend a lawyer who might be willing to take this on for minimal cost?**



Nuclear Science Week

Dear CINP members,

The Canadian nuclear scientists are invited to participate in outreach events to celebrate Nuclear Science Week (NSW). The hope is that every nuclear science program across Canada will hold a public talk, to discuss "What's new and exciting in the world of nuclear science?" While this can take any form, we suggest inviting the public to come and hear why nuclear science research is critical.

The Nuclear Science Week is a broadly observed, week-long celebration to focus international interest on all aspects of nuclear science, will take place October 19-23, 2015. NSW will be recognized for the sixth year this October, providing a platform where educators, students and members of the community participate in an international recognition of how nuclear science plays a vital role in the lives of people around the world.

As an international event, NSW is celebrated in cities big and small. It is through the participation of corporations, universities, member organizations and individuals that NSW advances education, stimulates participation and generates communication that provides insight and visibility for the achievements of the nuclear sciences.

It is my sincere hope that you consider this wonderful opportunity to support this nuclear science initiative and international project. For more information, and to support Nuclear Science Week 2015, please contact me at jmdonev@ucalgary.ca.

Sincerely,

Jason Donev, P. Phys.
403-210-6343
jmdonev@ucalgary.ca
Department of Physics and Astronomy
University of Calgary

GET TO KNOW NUCLEAR

nuclearscienceweek.org

Agenda Items

- 6. Updates from the Scientific Working Groups**
- 7. Comments and Suggestions from the Membership**

CINP Scientific Summary

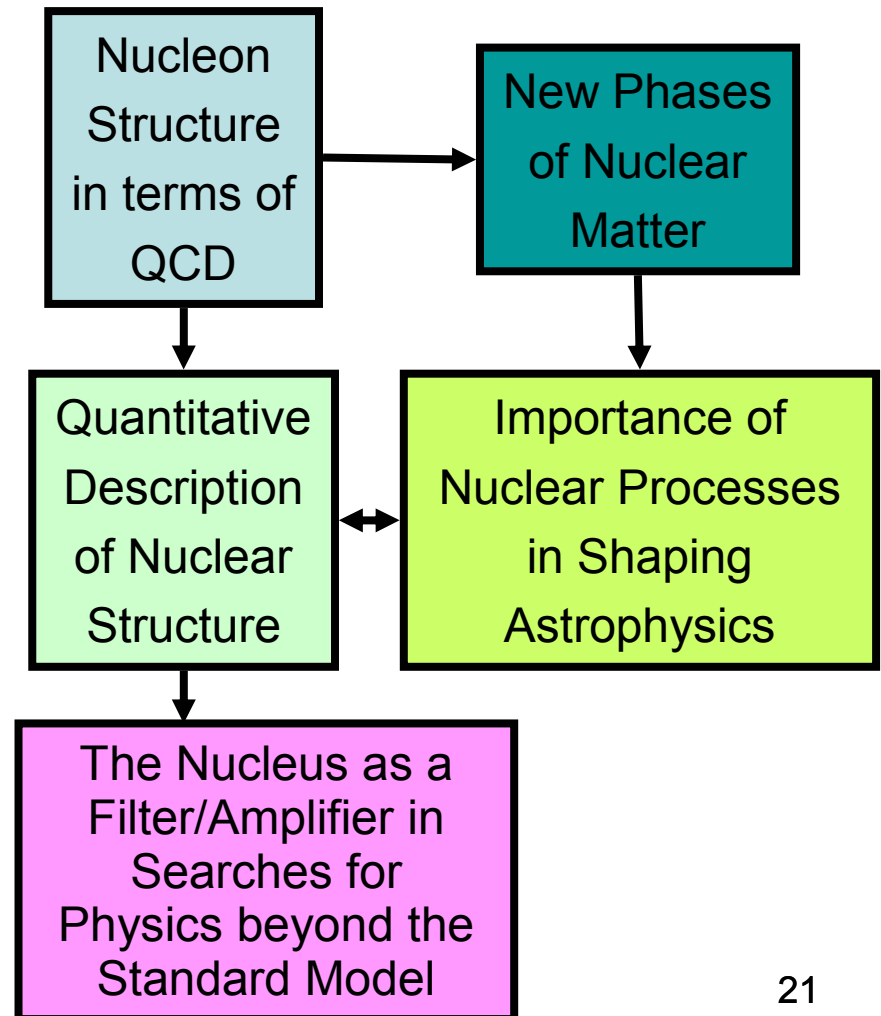


A Few Slides on:
**The Breadth of Canadian Nuclear
Physics Research
and
Important Current and Future
Priorities**

NSERC Subatomic Physics Large Project Day
Ottawa, March 8, 2015

Nuclear Physics is driven by fundamental investigations on the origin, evolution and structure of strongly interacting matter.

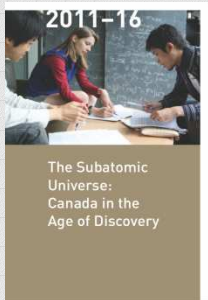
- **A far reaching mission that requires a *balanced program* of experimental and theoretical effort.**
- **Broad international consensus on the key questions of significance to the broader community.**



Hadrons/QCD

– Big Questions

- **How do the nucleon's properties (mass, spin, charge radius, etc.) arise from its quark and gluon constituents?**
 - **Transition from pQCD to Strong QCD needs data with high precision for a quantitative understanding of confinement.**
- **What is the phase diagram of QCD?**
 - **Nuclear collisions are the only way to probe QCD at high temperature/density in the laboratory.**

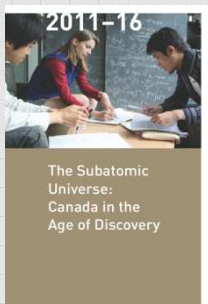


Examples of key Canadian initiatives from 2011-16 LRP:

- Search for exotic hybrid mesons (qqg states) with unique quantum numbers (JLab - Hall D/GlueX).
- Determine the structure of the pion at small distance scales to better understand the transition of QCD from short- to long-distance scales (JLab – Hall C/Pion Form Factor Expt).

Nuclear Structure - Big Questions

- **Where are the limits of nuclear existence and can these limits be understood and/or predicted from first principles?**
- **How do the properties of nuclei evolve as a function of the neutron-proton asymmetry and also as a function of proton and neutron number?**
- **What are the mechanisms responsible for the organization of individual nucleons into the collective motions that are observed?**



Examples of key Canadian initiatives from 2011-16 LRP:

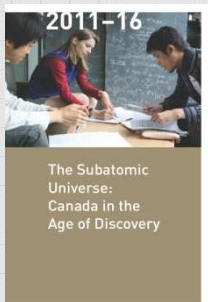
- Precision nuclear mass measurements (ISAC - TITAN).
- Studies of nuclear spectroscopy (ISAC - TIGRESS, GRIFFIN, EMMA spectrometers + auxiliary devices).
- Laser spectroscopy studies.

Nuclear Astrophysics

– Big Questions



- How, when, and where were the chemical elements produced?
- **What role do nuclei play in the liberation of energy in stars and stellar explosions?**
- How are nuclear properties related to astronomical observables such as solar neutrino flux, rays emitted by astrophysical sources, light emitted by novae and X-ray bursts, etc.?



Examples of key Canadian initiatives from 2011-16 LRP:

- Measurements of key nuclear reaction rates and to understand the nature of relevant nuclear resonances (ISAC - DRAGON, TUDA, TACTIC).
- Study origin of heavy elements via spontaneous fission of ^{252}Cf (Argonne - CARIBU facility).

Fundamental Symmetries

– Big Questions



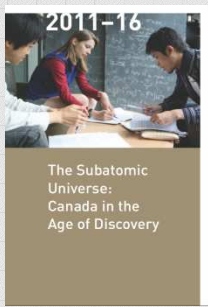
- **Studies of fundamental symmetries via very precise low and intermediate-energy experiments have been part of nuclear physics since its inception.**
- **Complementary to direct probes by high energy physics since precision lower-energy experiments indirectly probe mass scales and parameter spaces not otherwise accessible.**
- **Is there additional CP & T violation beyond that identified in Kaons and B-mesons?**
- **What is the structure of the Weak Interaction?**
- **Can we find violation of CPT and Lorentz invariance?**

Fundamental Symmetries

- Answering the Big Questions

Examples of key Canadian initiatives from 2011-16 LRP:

- Probe electroweak coupling and its dependence on distance scale in ISAC - Francium Parity Non-Conservation experiment.
- Probe CP/T-violation in ISAC - Radon Electric Dipole Moment experiment (new GRIFFIN γ array is commissioned).
- CKM unitarity tests in nuclear β -decay (ISAC - TITAN, GRIFFIN).
- Constrain weak scalar interactions via β - ν correlations from spin-polarized trapped atoms (ISAC - TRINAT).
- Measure the electron weak charge and the running of $\sin^2\theta_w$ at intermediate energy in the MOLLER Experiment (JLab - Hall A).
- Search for CPT Violation in trapped Antihydrogen (CERN - ALPHA).



2014 Research Highlights

- Honours Received by CINP Members



NSERC John C. Polanyi Award for a recent outstanding Canadian advance in Natural Sciences or Engineering **ALPHA-Canada Team**

“played key roles in demonstrating that it was possible to capture antimatter atoms in a magnetic bottle, and developed methods that led to the first measurement of the properties of atomic antimatter”

- **Charles Gale** (McGill) received the prestigious Humboldt Research Award from the Humboldt Foundation.
- **Sangyong Jeon** (McGill) received the Overseas Scientist of the Year Award from the Korean Federation of Science and Technology.
- **Iris Dillmann** (TRIUMF) awarded an NSERC Discovery Accelerator Supplement (DAS).

2014 Research Highlights

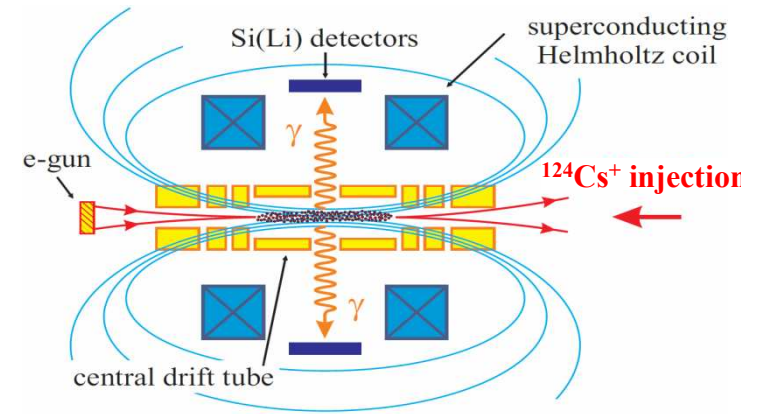
- Spectroscopy of highly charged ions (TITAN)

First ever demonstration of in-trap decay spectroscopy with highly-charged radioactive ions.

Charge breeding lengthens storage times without ions losses:

- longer observation times
- large sample: up to $1 \cdot 10^8$ ions

Moderate charge states do not affect lifetimes or EC branching ratios towards $2\nu 2\beta$ NME tests



PRL 113, 082502 (2014)

PHYSICAL REVIEW LETTERS

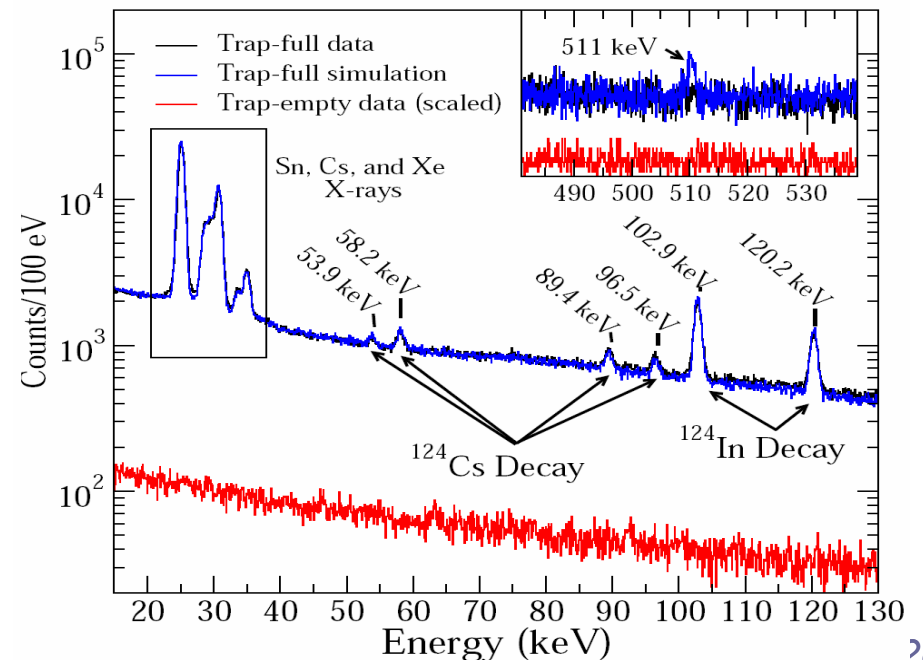
week ending
22 AUGUST 2014

In-Trap Spectroscopy of Charge-Bred Radioactive Ions

A. Lennarz,^{1,2} A. Grossheim,^{2,3} K. G. Leach,^{2,3} M. Alansari,¹ T. Brunner,^{2,†} A. Chaudhuri,² U. Chowdhury,^{2,4}
J. R. Crespo López-Urrutia,⁵ A. T. Gallant,^{2,6} M. Holl,¹ A. A. Kwiatkowski,² J. Lassen,² T. D. Macdonald,^{2,6}
B. E. Schultz,² S. Seeraji,³ M. C. Simon,² C. Andreoiu,³ J. Dilling,^{2,6} and D. Frekers^{1,*}



K.G. Leach, A. Grossheim, A. Lennarz,
T. Brunner et al.,
Nuclear Inst. and Methods in Physics
Research, A 780 (2015), 91-99



2014 Research Highlights

- Isospin-symmetry breaking in $A = 20,21$ multiplets



High-precision Penning trap (TITAN) mass spectrometry of very neutron deficient nuclides

- Breakdown of the isobaric multiplet mass equation for the $A = 20$ and 21 multiplets.
- This was the first "physics measurement" made with TRIUMF-ISAC's new Ion-Guide Laser Ion Source (IG-LIS)

PRL 113, 082501 (2014)

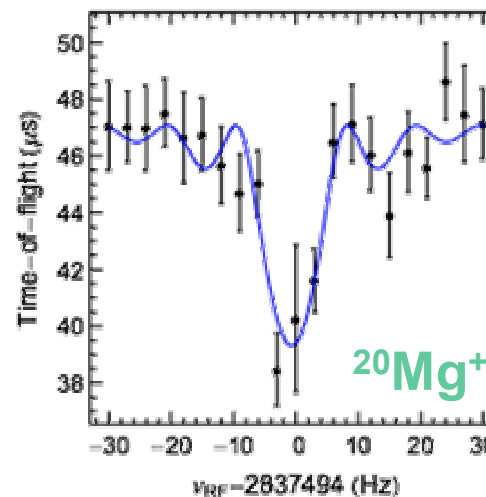
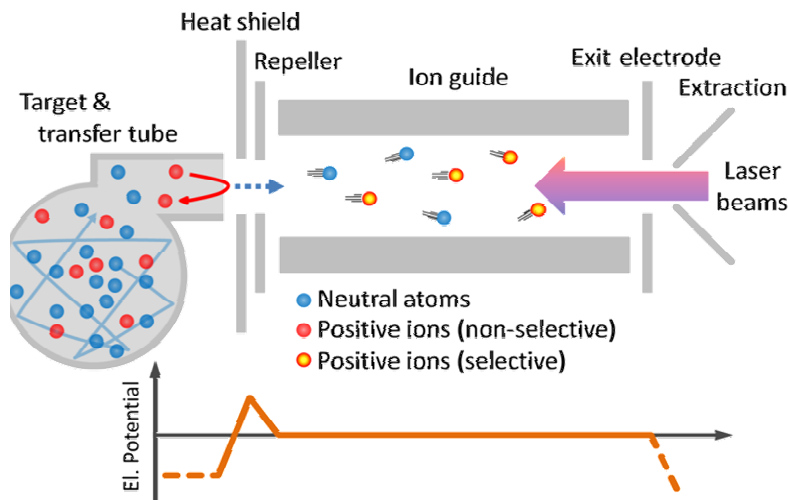
PHYSICAL REVIEW LETTERS

week ending
22 AUGUST 2014

Breakdown of the Isobaric Multiplet Mass Equation for the $A = 20$ and 21 Multiplets

A. T. Gallant,^{1,2,*} M. Brodeur,³ C. Andreoiu,⁴ A. Bader,^{1,5} A. Chaudhuri,^{1,†} U. Chowdhury,^{1,6} A. Grossheim,¹
R. Klawitter,^{1,7} A. A. Kwiatkowski,¹ K. G. Leach,^{1,4} A. Lennarz,^{1,8} T. D. Macdonald,^{1,2} B. E. Schultz,¹
J. Lassen,^{1,6} H. Heggen,¹ S. Raeder,¹ A. Teigelhöfer,^{1,6} B. A. Brown,⁹ A. Magilligan,¹⁰ J. D. Holt,^{11,12,9,†}
J. Menéndez,^{11,12} J. Simonis,^{11,12} A. Schwenk,^{12,11} and J. Dilling^{1,2}

¹TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, V6T 2A3 Canada



^{20}Mg : 45σ deviation from AME12 & 15x improved precision

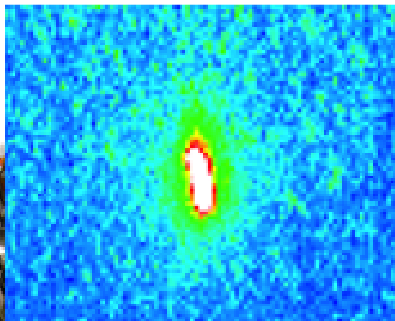
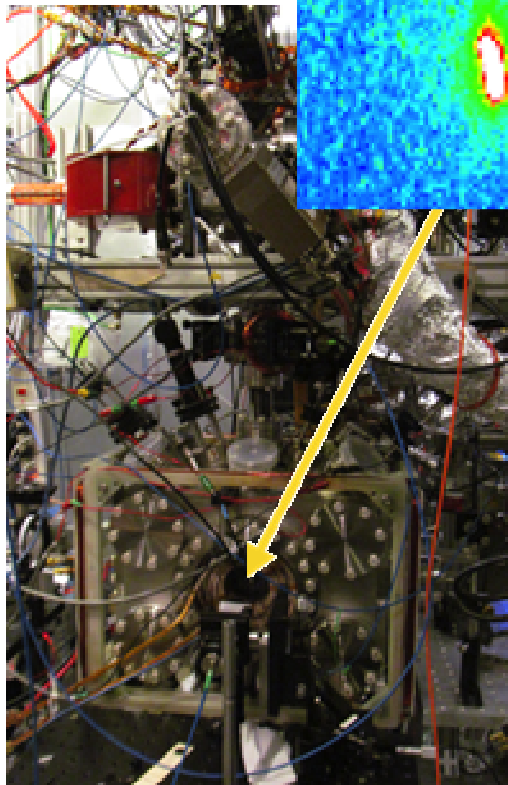
^{21}Mg : 14σ deviation & 22x improved precision

Compared to USDA/B & χ EFT $NN+3N$ predictions

2014 Research Highlights

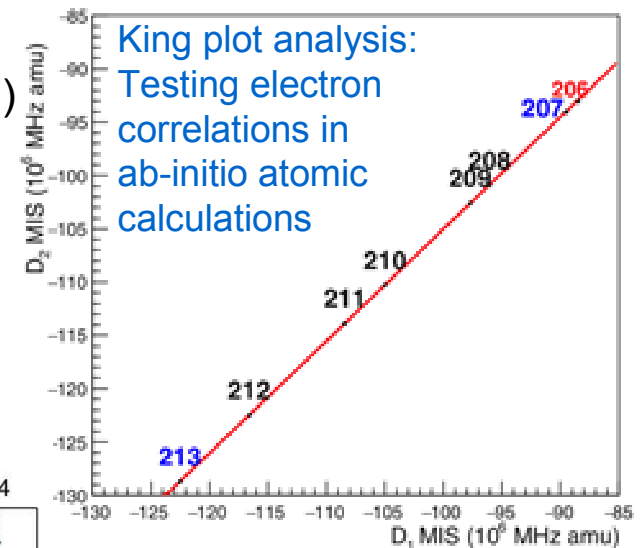
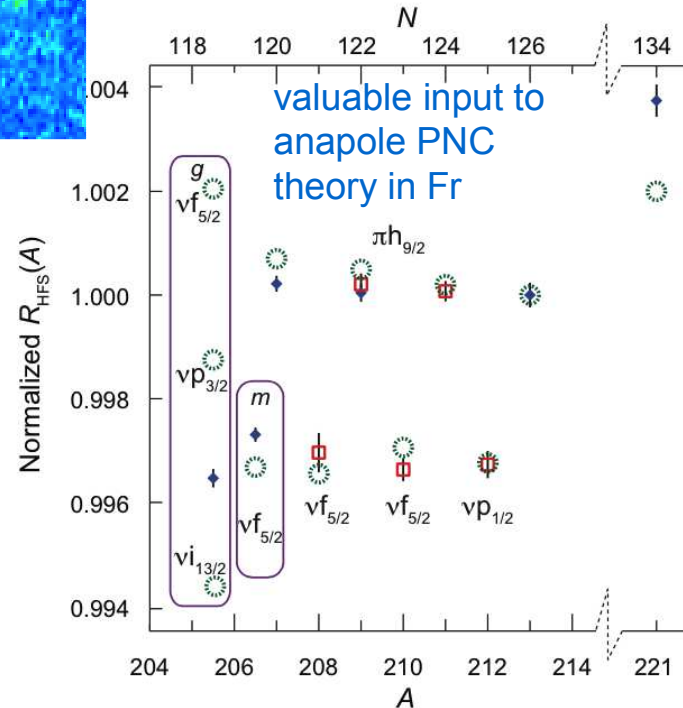
- Francium Trapping Facility @ ISAC

Dec. 2014: First transfer of ultra-cold francium atoms from the capture trap to the science chamber trap.



Collister et al.
PRA 90, 052502 (2014)

Isotope shifts in $^{206-213}\text{Fr}$ and ^{221}Fr



Zhang et al.
submitted to PRL

Hyperfine anomalies in Fr: boundaries of the spherical single particle model

2014 Research Highlights

- Proton Radii of Light Neutron-rich Nuclei



New approach of Rp from **charge changing cross section** measurements @ FRS, GSI

First determination of Rp for borromean halo nuclei ^{17}B and ^{14}Be : Halo correlation

PRL 113, 132501 (2014)

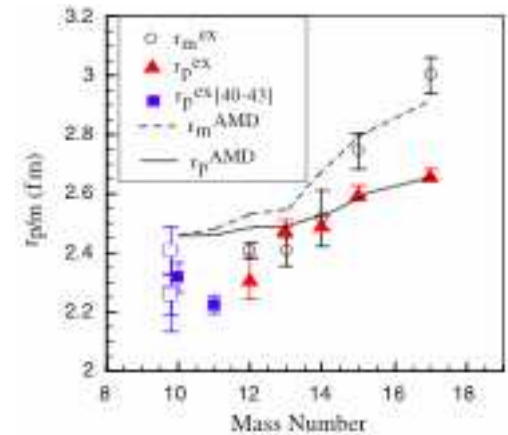
PHYSICAL REVIEW LETTERS

week ending
26 SEPTEMBER 2014

Boron isotopes

Proton Radii of $^{12-17}\text{B}$ Define a Thick Neutron Surface in ^{17}B

A. Estradé,^{1,2,*} R. Kanungo,^{1,†} W. Horiuchi,³ F. Ameil,² J. Atkinson,¹ Y. Ayyad,^{4,‡} D. Cortina-Gil,⁴ I. Dillmann,^{2,§} A. Evdokimov,² F. Farinon,² H. Geissel,^{2,5} G. Guastalla,² R. Janik,⁶ M. Kimura,³ R. Knöbel,² J. Kurcewicz,² Yu. A. Litvinov,² M. Marta,² M. Mostazo,⁴ I. Mukha,² C. Nociforo,² H. J. Ong,⁷ S. Pietri,² A. Prochazka,² C. Scheidenberger,^{2,5} B. Sitar,⁶ P. Strmen,⁶ Y. Suzuki,^{8,9} M. Takechi,² J. Tanaka,⁷ I. Tanihata,^{7,10} S. Terashima,¹⁰ J. Vargas,⁴ H. Weick,² and J. S. Winfield²



PTEP

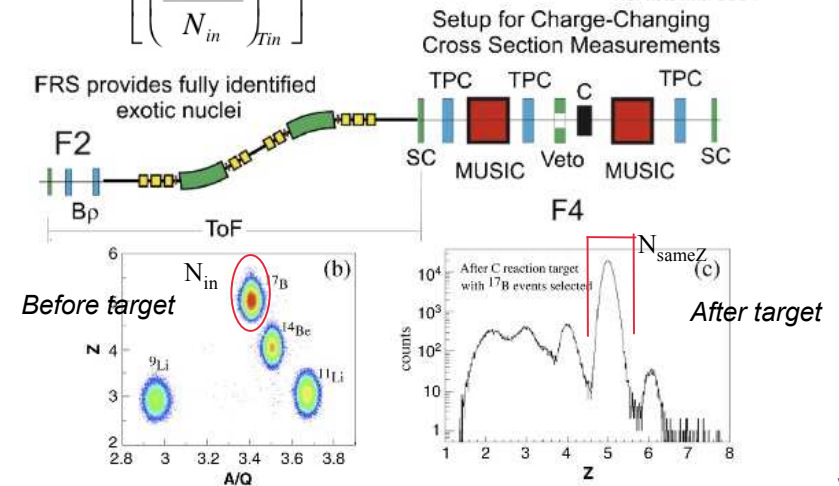
Prog. Theor. Exp. Phys. 2014, 101D02 (7 pages)
DOI: 10.1093/ptep/ptu134

$$\sigma_{cc} = \frac{1}{t} \ln \left[\frac{\left(\frac{N_{sameZ}}{N_{in}} \right)_{T_{out}}}{\left(\frac{N_{sameZ}}{N_{in}} \right)_{T_{in}}} \right]$$

Letter

Proton radius of ^{14}Be from measurement of charge-changing cross sections

S. Terashima^{1,*}, I. Tanihata^{1,2,*}, R. Kanungo³, A. Estradé^{3,4}, W. Horiuchi⁵, F. Ameil⁴, J. Atkinson², Y. Ayyad⁶, D. Cortina-Gil⁶, I. Dillmann⁴, A. Evdokimov⁴, F. Farinon⁴, H. Geissel⁴, G. Guastalla⁴, R. Janik⁷, M. Kimura⁵, R. Knoebel⁴, J. Kurcewicz⁴, Yu. A. Litvinov⁴, M. Marta⁴, M. Mostazo⁶, I. Mukha⁴, T. Neff⁴, C. Nociforo⁴, H. J. Ong², S. Pietri⁴, A. Prochazka⁴, C. Scheidenberger⁴, B. Sitar⁷, Y. Suzuki^{8,9}, M. Takechi⁴, J. Tanaka², J. Vargas⁶, J. S. Winfield⁴, and H. Weick⁴



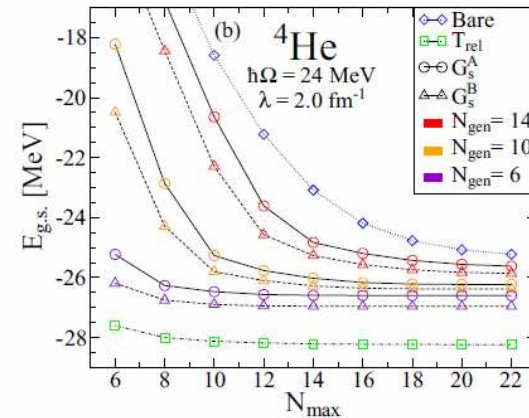
2014 Research Highlights

- Nuclear Structure Theory

N. Dicaire, C. Omand, P.Navratil

Softening of realistic nucleon-nucleon interactions by similarity renormalization group transformations to improve convergence of *ab initio* calculations. New generators proposed (G_s^A , G_s^B) and tested. These generators induce weaker three- and four-body forces compared to the standard (T_{rel}) generator. Three-term co-op student project.

PRC 90, 034302 (2014)



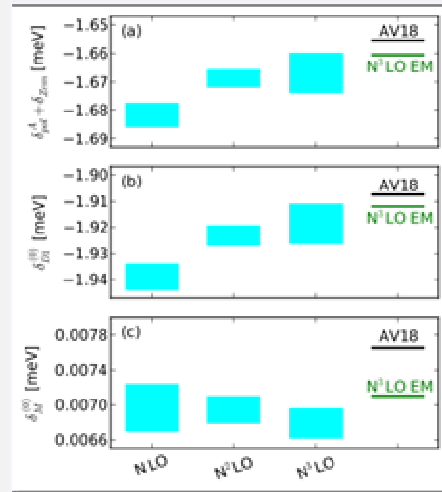
O. J. Hernandez, Chen Ji, S. Bacca et al.

Ab initio calculation of nuclear polarization corrections to the μ D Lamb shift, most accurate evaluation so far:

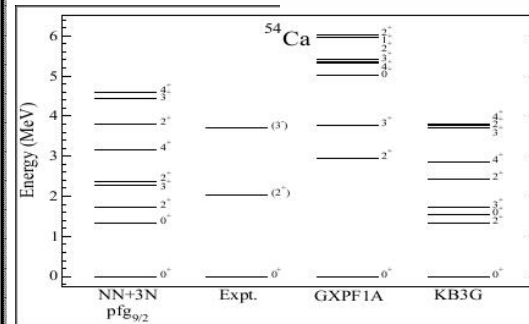
$$\delta_{nucl} = -1.24 \pm 1\% \text{ meV}$$



error obtained by averaging on several potential and studying several orders in chiral EFT



PLB 736, 334 (2014)



J. Holt et al., PRC 90, 024312 (2014)

Prediction of N=34 magic number from MBPT valence-space Hamiltonians

Phenomenology: inconsistent predictions
NN+3N: reproduces signature of new N=34 magic number

Agreement with new measurements from RIKEN



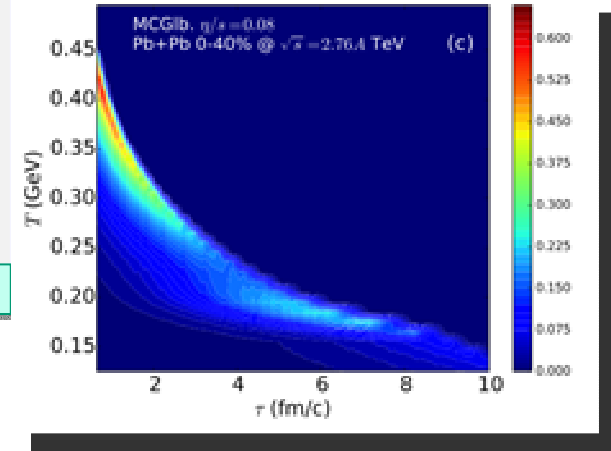
2014 Research Highlights

- Hadronic Physics/QCD Theory

Chun Shen, Ulrich W Heinz, Jean-François Paquet, Charles Gale

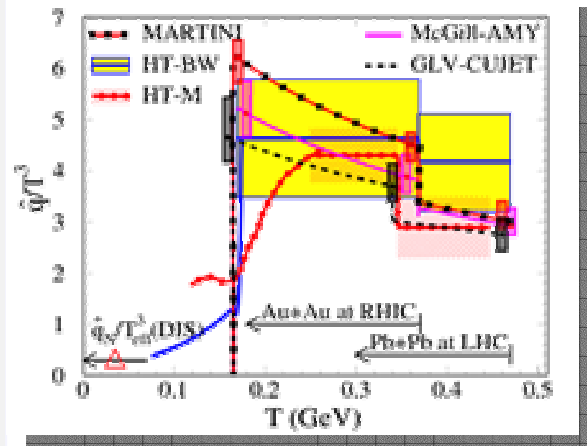
Using photons as penetrating probes to measure the temperature of the quark-gluon plasma at RHIC and at the LHC. The realistic expansion dynamics provided by relativistic hydrodynamics is important to get the true temperature of the expanding medium.

PRC 89, 044910 (2014)



K. M. Burke, A. Buzzatti, Ningbo Chang et al. [JET Collaboration]

Extracting the QCD jet transport coefficient \hat{q} from the analysis of relativistic nuclear collisions. Recent advances in theory are reflected in the convergence of results from five different approaches to jet energy loss.

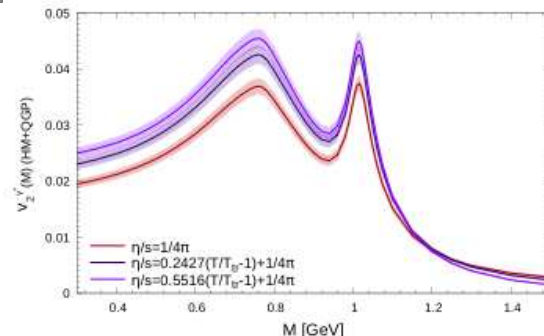


PRC 90, 014901 (2014)

G. Vujanovic et al., Nucl. Phys. A931, 701 (2014)

G. Vujanovic, J.-F. François Paquet, G. S. Denicol et al.

Using the thermal dilepton elliptic flow spectrum to extract the temperature-dependence of the specific shear viscosity of the quark-gluon plasma, and making predictions for RHIC.



2014 Research Highlights

- Deep Exclusive π^\pm Production from ^2H (JLab)



Last π data from JLab Pion Form Factor Experiments.

- Rosenbluth separations allow π^+/π^- ratios to be determined for longitudinal and transversely polarized virtual photons.
- R_L sensitive to non-pole backgrounds in F_π extraction.
- R_T results possibly indicate early transition to quark-degrees of freedom as $-t$ increased.

PRL 112, 182501 (2014)

PHYSICAL REVIEW LETTERS

week ending
9 MAY 2014

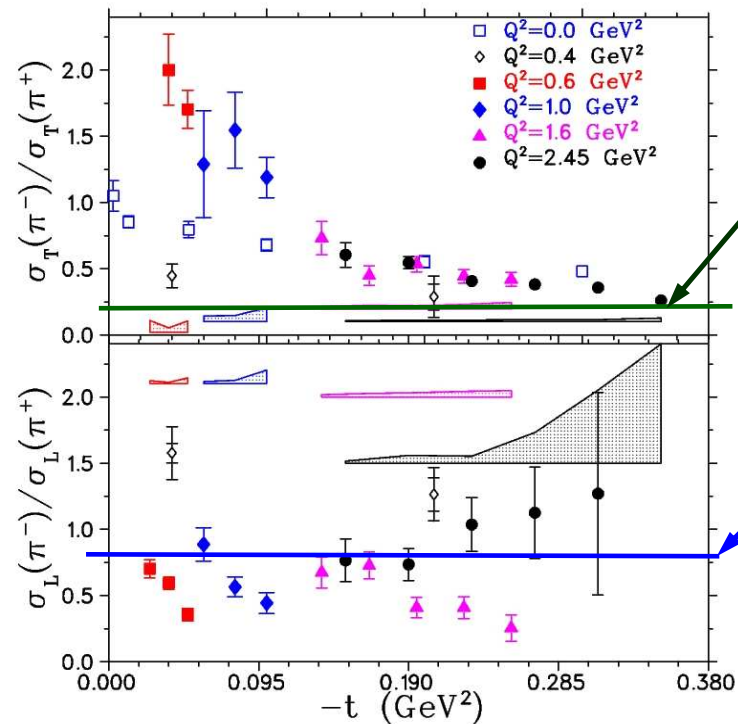
Separated Response Function Ratios in Exclusive, Forward π^\pm Electroproduction

G. M. Huber,¹ H. P. Blok,^{2,3} C. Butuceanu,¹ D. Gaskell,⁴ T. Horn,⁵ D. J. Mack,⁴ D. Abbott,⁴ K. Aniol,⁶ H. Anklin,^{7,4} C. Armstrong,⁸ J. Arrington,⁹ K. Assamagan,¹⁰ S. Avery,¹⁰ O. K. Baker,^{10,4} B. Barrett,¹¹ E. J. Beise,¹² C. Bochna,¹³ W. Boeglin,⁷ E. J. Brash,¹ H. Breuer,¹² C. C. Chang,¹² N. Chant,¹² M. E. Christy,¹⁰ J. Dunne,⁴ T. Eden,^{4,14} R. Ent,⁴ H. Fenker,⁴ E. F. Gibson,¹⁵ R. Gilman,^{16,4} K. Gustafsson,¹² W. Hinton,¹⁰ R. J. Holt,⁹ H. Jackson,⁹ S. Jin,¹⁷ M. K. Jones,⁸ C. E. Keppel,^{10,4} P. H. Kim,¹⁷ W. Kim,¹⁷ P. M. King,¹² A. Klein,¹⁸ D. Koltenuk,¹⁹ V. Kovaltchouk,¹ M. Liang,⁴ J. Liu,¹²

PHYSICAL REVIEW C 91, 015202 (2015)

Separated response functions in exclusive, forward π^\pm electroproduction on deuterium

G. M. Huber,^{1,*} H. P. Blok,^{2,3} C. Butuceanu,¹ D. Gaskell,⁴ T. Horn,⁵ D. J. Mack,⁴ D. Abbott,⁴ K. Aniol,⁶ H. Ankl C. Armstrong,⁸ J. Arrington,⁹ K. Assamagan,¹⁰ S. Avery,¹⁰ O. K. Baker,^{4,10} B. Barrett,¹¹ E. J. Beise,¹² C. Bochna,¹³ W. Boeglin,⁷ E. J. Brash,¹ H. Breuer,¹² C. C. Chang,¹² N. Chant,¹² M. E. Christy,¹⁰ J. Dunne,⁴ T. Eden,^{4,14} R. Ent,⁴ H. E. F. Gibson,¹⁵ R. Gilman,^{4,16} K. Gustafsson,¹² W. Hinton,¹⁰ R. J. Holt,⁹ H. Jackson,⁹ S. Jin,¹⁷ M. K. Jones,⁸ C. E. Ke P. H. Kim,¹⁷ W. Kim,¹⁷ P. M. King,¹² A. Klein,¹⁸ D. Koltenuk,¹⁹ V. Kovaltchouk,¹ M. Liang,⁴ J. Liu,¹² G. J. Lolos,^{1,4}



R_T tends to $(e_d/e_u)^2=1/4$ at higher $-t$.

$R_L \approx 0.8$ near $-t_{min}$ at each Q^2 . Predicted in large N_c limit calculation

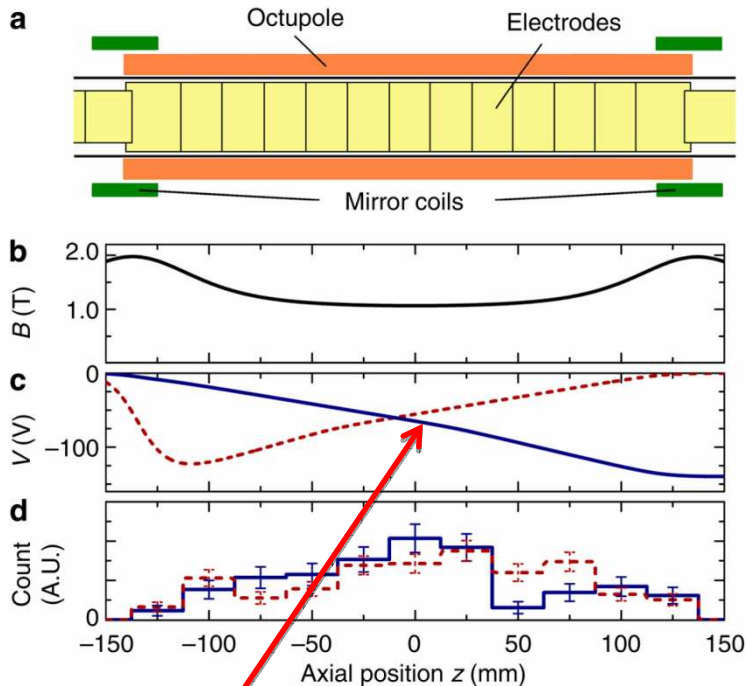
2014 Research Highlights

- ALPHA@CERN Anti-Hydrogen Trap

Is Anti-Hydrogen neutral? (Canadian Proposal) Nature Comm. 5, 3955 (2014)



Result (Ph.D. theses: Berkeley, York):
 $Q = (-1.3 \pm 1.1 \pm 0.4) \times 10^{-8}$
New limit on e^+ charge
ALPHA's first precision result!



Biassing E field

Key: position sensitive detection

2014-15 Progress:

- ALPHA-2 commissioning with antiproton beam (after ~2yr shutdown)
- Excellent performance
 - Trapping rate >x2 larger! (without optimization)
 - Expanded Si detector/DAQ commissioned
- Towards First Laser Spectroscopy & Cooling
 - Canadian Lyman-alpha laser installed at CERN
 - Power improved to >10 nJ x 10Hz; sufficient for first measurements

2014 Research Milestones

- Cold Neutron Physics @ SNS



NPDGamma : $\vec{n} + p \rightarrow D + \gamma$

HPV test of χ PT based Low E QCD models

- Running completed May 2014
- Measured PV asymmetry precision: 13 ppb (first HPV exp. to reach this)
- Final touches on analysis to be completed by May (PRL ready to go)

$n^3\text{He}$: $\vec{n} + {}^3\text{He} \rightarrow T + p + 764 \text{ keV}$

HPV test of χ PT with different iso-spin comb. compared to NPDGamma

- Target/main detector Canadian effort
- Production running started (continues through 2015)
- Cold neutron Hadronic PV program completed after this
- Together with NPDGamma and p-p scattering constraints neutral current HPV couplings using only simple, few body measurements.

Next Steps in 2015:

- Complete $n^3\text{He}$ and therefore the HPV program
- Prepare and install the Nab high precision β -decay experiment at the SNS

New measurement of the scattering cross section of slow neutrons on liquid parahydrogen from neutron transmission

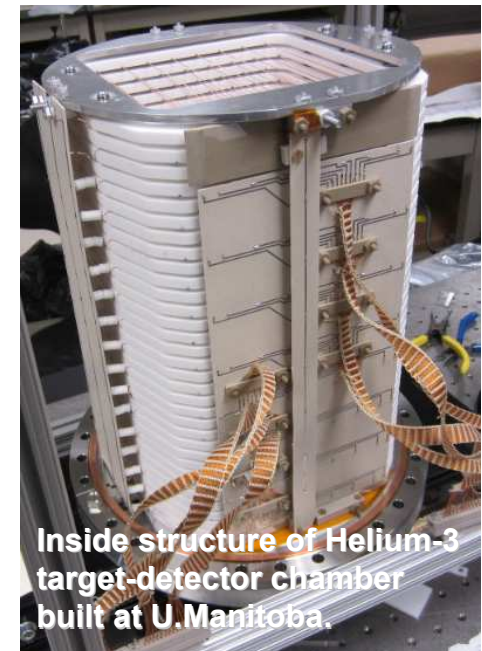
K. B. Grammer,^{1,*} R. Alarcon,² L. Barrón-Palos,³ D. Blyth,² J. D. Bowman,⁴ J. Calarco,⁵ C. Crawford,⁶ K. Craycraft,^{1,6} D. Evans,⁷ N. Fomin,¹ J. Fry,⁸ M. Gericke,⁹ R. C. Gillis,⁸ G. L. Greene,^{1,4} J. Hamblen,¹⁰ C. Hayes,¹ S. Kucuker,¹ R. Mahurin,^{11,9} M. Maldonado-Velázquez,³ E. Martin,⁶ M. McCrea,⁹ P. E. Mueller,⁴ M. Musgrave,¹ H. Nann,⁸ S. I. Penttilä,⁴ W. M. Snow,⁸ Z. Tang,^{12,8} and W. S. Wilburn¹²

¹University of Tennessee, Knoxville, TN, USA

²Arizona State University, Tempe, AZ, USA

³Universidad Nacional Autónoma de México, México, DF, México

⁴Oak Ridge National Lab, Oak Ridge, TN, USA



Inside structure of Helium-3 target-detector chamber built at U. Manitoba.

2014 Research Milestones

- Commissioning of GlueX underway @ JLab

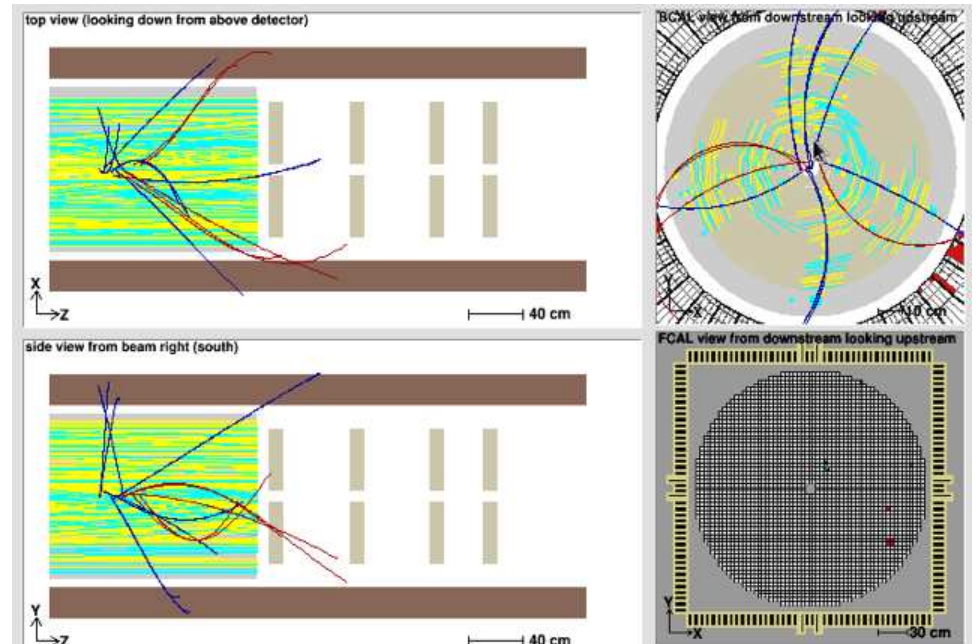
Search for hybrid mesons with exotic J^{PC} via 9 GeV linearly polarized photon beam.

- GlueX Barrel Calorimeter designed and constructed at U.Regina.

GlueX commissioning with photon beam at 10.5 GeV took place in fall.

- Main detector subsystems (two calorimeters and tracking detectors) worked well together and in (remarkably) 3-4 days were able to reconstruct multi-track (up to 10) events.
- Soon thereafter, the calorimeters reconstructed π^0 's and achieved first pass energy calibration.

Commissioning to continue in 2015.



New Research Capabilities

- Canadian role in MOLLER @ JLab

2014 Canadian R&D:

- Detector development (Canada/USA)
(new prototypes, beam tests)
- Spectrometer development (Canada/USA)
(electron optics, systematics, engineering)

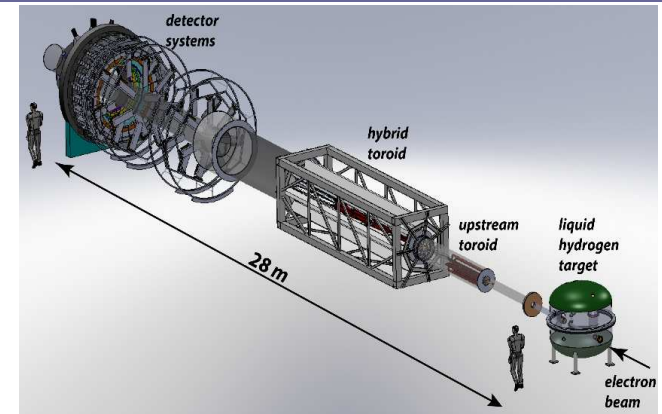
2014 Progress on the DOE side:

- September 2014 – DOE review science case – STRONG endorsement
 - Science of MOLLER was uniformly considered “MUST DO”
 - MOLLER could have best pure lepton discovery reach until new lepton collider
- $$\Lambda_{RR-LL}^{ee} \cong 38 \text{ TeV} \quad \Lambda_{LL}^{ee} \cong 27 \text{ TeV}$$
- Science review outcome establishes “mission need” – required for CD0

Next Steps in 2015:

- Cost and schedule review at CD1 level before September 2015
- J. Mammei and M. Gericke - DOE level 2 managers (Spectr. & Detector)
- Continue Detector Development (more beam tests)
- Continue Spectrometer Studies (tracking/sensitivities)

Full MIE proposal can be accessed at <http://arxiv.org/abs/1411.4088>

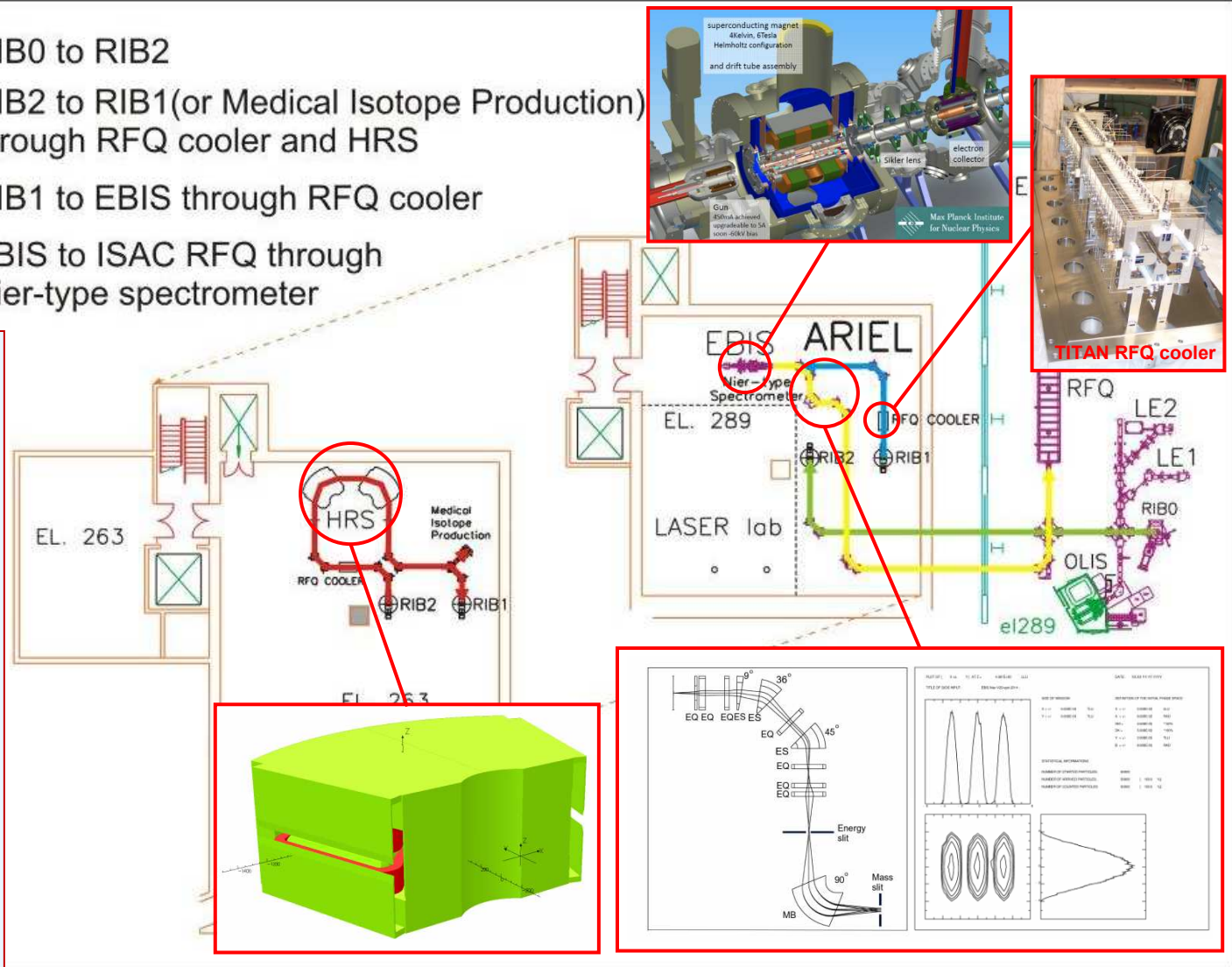


New Research Capabilities

- CANREB@ISAC funded by CFI-NIF

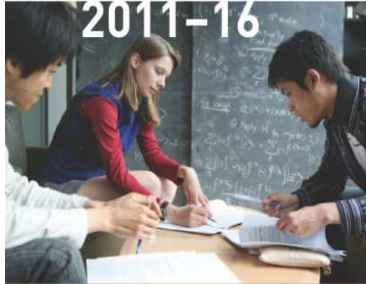
- ➔ RIB0 to RIB2
- ➔ RIB2 to RIB1(or Medical Isotope Production) through RFQ cooler and HRS
- ➔ RIB1 to EBIS through RFQ cooler
- ➔ EBIS to ISAC RFQ through Nier-type spectrometer

- Layout fixed
- Reqs specs released
- HRS simulation being finalized, magnets design started
- RFQ cooler simulations in progress
- EBIS being designed and built at MPI Heidelberg
- Nier spectrometer simulations completed



Canadian Subatomic Physics LRP

2011-16: Priorities in Nuclear Physics

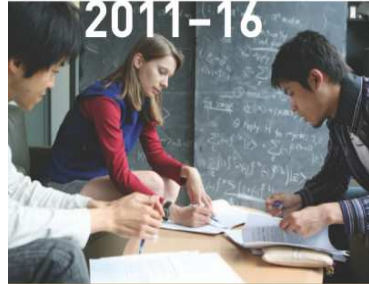


The Subatomic
Universe:
Canada in the
Age of Discovery

- Continue and expand full exploitation of TRIUMF's ISAC-I and ISAC-II facilities, with unique suite of measurement tools, including new spectrometers and devices.
- Support key experimental initiatives offshore where Canadians lead. Examples:
 - Jefferson Lab Halls D,C,A following 12 GeV Upgrade.
 - Canadian Penning Trap at Argonne.
 - ALPHA at CERN.
- Maintain a vibrant and diverse theoretical community pursuing the most actively pursued questions in nuclear physics.

Canadian Subatomic Physics LRP

2017-21: Upcoming Nuclear Physics Projects



The Subatomic
Universe:
Canada in the
Age of Discovery

- Implementation of ARIEL project at TRIUMF, including second ISAC proton beam line and new actinide target stations, has tremendous potential for scientific discovery and advancement of the field.
- Movement of the Ultra-Cold Neutron (UCN) source from RCNP to TRIUMF would make it the world's most intense source of cold neutrons and allow the current limit on the neutron EDM to be improved by a factor of ~ 3 .