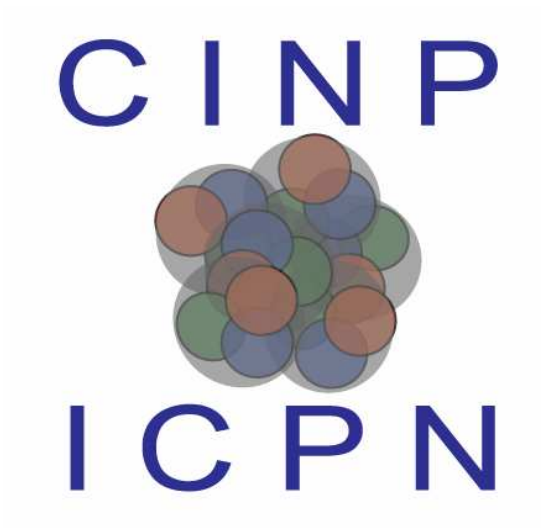


Canadian Institute of Nuclear Physics

Institut canadien de physique nucléaire

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

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 *President* 
Jean Barrette
Paul Garrett
Gerald Gwinner
Rituparna Kanungo
Jeff Martin

Executive Director
Garth Huber 

Scientific Working Groups

SWGs facilitate collaboration among researchers with common interests, and to enhance the profile of a specific research area within Canada.

- **hold topical workshops or other initiatives.**
- **Provide input to CINP external scientific briefs.**
- **encourage new collaborative efforts.**

- **Individual Members may belong to one or more SWGs.**
- **SWG leadership was renewed in 2014, in preparation for 2015 Long Range Planning efforts.**
  - **3 new Chairs and 2 Chairs renewed for second term.**

SWG	Chair	Institution
Nuclear Structure	Adam Garnsworthy	TRIUMF
Nuclear Astrophysics	Iris Dillmann	TRIUMF
Fundamental Symmetries	Gerald Gwinner	University of Manitoba
Hadron Structure/QCD	Charles Gale	McGill University
Nuclear Physics Education and Training	Juliette Mammei	University of Manitoba

CINP Individual Membership

CINP Membership March 1, 2015	
Total Membership	113
Faculty (Full) Members	68
Associate Members (Grad Students, PDFs, Professor Emeriti)	45
Experimentalists	83
Theorists	29

SWG Membership	
Nuclear Astrophysics	**39**
Nuclear Structure	**49**
Fundamental Symmetries	**43**
Hadrons/QCD	**35**
Nuclear Physics Education & Training	**38**

CINP 2014-15 Accomplishments

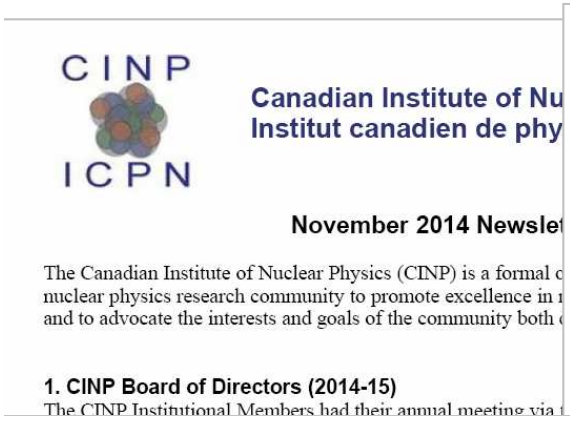
- **Nuclear Physics Representation.**
  - The CINP has been vital in giving the nuclear physics community a coherent and strong voice.
  - Joint CINP+IPP White Paper on High Performance Computing to Compute Canada in July, 2014.
  - “Context Document” for SAPES Fall Policy Meeting.
  - Observer at Fall 2014 NuPECC meeting in Edinburgh, UK.
  - NP Community Representative at Advisory Committee on TRIUMF (ACOT), spring and fall annually.

- **Preparations already underway for NSERC 2017-21 Subatomic Physics Long Range Plan.**
  - Elected/appointed new SWG Chairs, to lead consultations for CINP Brief to LRPC.
  - CINP Town Hall meeting tentatively planned for June 13-14, 2015 in Edmonton, AB, immediately preceding CAP Congress.

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.

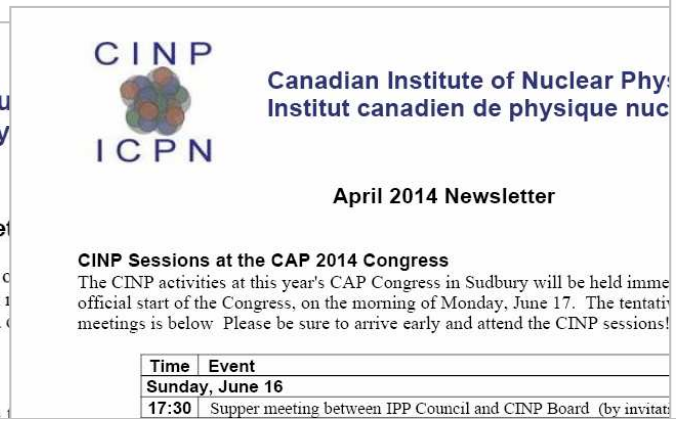

CINP ICPN

Canadian Institute of Nu
Institut canadien de phy

November 2014 Newslet

The Canadian Institute of Nuclear Physics (CINP) is a formal
nuclear physics research community to promote excellence in
and to advocate the interests and goals of the community both

1. CINP Board of Directors (2014-15)
The CINP Institutional Members had their annual meeting via

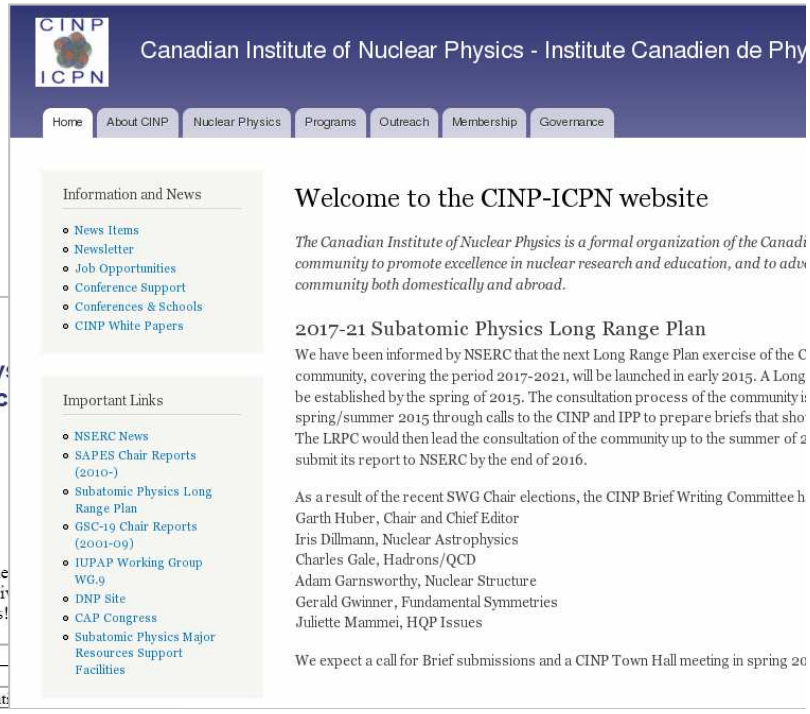

CINP ICPN

Canadian Institute of Nuclear Phys
Institut canadien de physique nuc

April 2014 Newsletter

CINP Sessions at the CAP 2014 Congress
The CINP activities at this year's CAP Congress in Sudbury will be held imme
official start of the Congress, on the morning of Monday, June 17. The tentati
meetings is below Please be sure to arrive early and attend the CINP sessions!

Time	Event
Sunday, June 16	
17:30	Supper meeting between IPP Council and CINP Board (by invitat


CINP ICPN

Canadian Institute of Nuclear Physics - Institute Canadien de Phy

Home | About CINP | Nuclear Physics | Programs | Outreach | Membership | Governance

Information and News
- News Items
- Newsletter
- Job Opportunities
- Conference Support
- Conferences & Schools
- CINP White Papers

Important Links
- NSERC News
- SAPES Chair Reports (2010-)
- Subatomic Physics Long Range Plan
- GSC-19 Chair Reports (2001-09)
- IUPAP Working Group WG.9
- DNP Site
- CAP Congress
- Subatomic Physics Major Resources Support Facilities

Welcome to the CINP-ICPN website

The Canadian Institute of Nuclear Physics is a formal organization of the Canadi community to promote excellence in nuclear research and education, and to adv community both domestically and abroad.

2017-21 Subatomic Physics Long Range Plan

We have been informed by NSERC that the next Long Range Plan exercise of the C community, covering the period 2017-2021, will be launched in early 2015. A Long be established by the spring of 2015. The consultation process of the community i spring/summer 2015 through calls to the CINP and IPP to prepare briefs that sho The LRPC would then lead the consultation of the community up to the summer of 2 submit its report to NSERC by the end of 2016.

As a result of the recent SWG Chair elections, the CINP Brief Writing Committee h
Garth Huber, Chair and Chief Editor
Iris Dillmann, Nuclear Astrophysics
Charles Gale, Hadrons/QCD
Adam Garnsworthy, Nuclear Structure
Gerald Gwinner, Fundamental Symmetries
Juliette Mammei, HQP Issues

We expect a call for Brief submissions and a CINP Town Hall meeting in spring 20

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.
- **In Summer 2014, we started the CINP Undergraduate Research Scholarship.**
  - $3400 student stipend which must be matched by supervisor to a total between $7-10k.
  - $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:**
    - Peter Blunden (Manitoba), Chair & Board Member
    - Jean Barrette (McGill), Board Member
    - Chris Ruiz (TRIUMF), Non-Board Member
  - **11 applications were received, and the top 5 were awarded.**

CINP NSERC Expenditures

FY14 (projected)	
FY13 Carry forward	15,422
FY14 Installment	22,500
Undergrad Scholarships	20,882
Travel	
ACOT (2 trips)	1866
SAP Large Projects Day	1252
Grad Fairs (CUPC, AUPAC)	560
Other (Ottawa, NuPECC,web)	2608
Student Conf Support	
CUPC 2014	2000
WNPPC 2015	2000
Conference Sponsorship	
r-Canada 2014	1000
CUPC 2014	1000
Hard Probes 2015	4000
Symmetries 2015	4000
FY14 Expenses	41,168

MRS Grant Request	FY15	FY16	FY17
PDF Excellence Fellowship	46,667	93,333	93,333
Undergrad Scholarships	31,250	32,200	33,150
Long Range Plan	16,300	1850	0
Travel			
ACOT (2 trips)	2600	2700	2800
SAP Large Projects Day	1500	1550	1600
CUPC Grad Fair	1750	1750	1750
Other (Ottawa, NuPECC)	3800	3850	3900
Student Conf Support	5000	5500	6000
Conference Sponsorship	10,000	10,000	10,000
Grad & PDF Support	9000	9000	9000
Website & Postage	1000	1000	1000
NSERC Total	128,867	162,733	162,533

MRS Application - Question #1

1. 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.

PDF Excellence Fellowship

4. The CINP proposes to start a Postdoctoral fellow program. How will these fellowships differ from those offered through NSERC grants?

- Significantly different than NSERC PDF, some similarities to Banting Fellowship.
- Intended to attract or retain very gifted candidates to conduct nuclear physics research in Canada.
- Fellow can be within 5 years of award of Ph.D. degree.
- The Fellowship is a joint application between fellow supervisor in every respect, and we believe the direct commitment of the supervisor is very important to the success of the program.
- Our judgment criteria will be a bit different than SAPES in that we will be able to evaluate the excellence of both the fellow and the supervisor, so we expect CINP Fellowships to be distributed to researchers in both small and large groups, while small groups tend to have a more difficult time to hire PDFs from their NSERC grants.

PDF Excellence Fellowship - 2

4. How will they be advertised?

- Plan to advertise nationally (to the CINP membership and through the CAP) and internationally (through the mailing lists of various physics laboratories, etc.)

- **I understand that one fellowship will be offered each year. Is that enough to make a difference?**
  - We feel it is best to start the program with one fellowship per year initially.
  - If the program is successful, as we anticipate, we would consider expanding it in a future application.
- **One third of the fellowship amount will have to come from the supervisor. Could this not be a problem for small university groups?**
  - The cost of the fellow to the supervisor is not much different than a grad student, so we do not believe this is particularly onerous.
  - In fact, our program should help level the playing-field between individual researchers and larger groups.

PDF Excellence Fellowship - 3

2. The IPP PDF program has been discontinued. In what way is the CINP model going to be more successful?

- It is our understanding that the IPP program was not discontinued because it was unsuccessful, but because they do not have sufficient funds to support both their Research Scientists and the PDF program.
- In fact, we understand the 2013 review of the IPP PDF program considered it to be very successful.
- We believe the CINP PDF program will have a better impact per dollar and be more flexible than the former IPP program.
- It is intended to make Canada an attractive place for very gifted candidates to do nuclear physics research at.
- Cost is 2:1 shared with the supervisor, to ensure the commitment of the supervisor towards the success of the fellow's research, and to place the salary at a competitive level to attract the very top candidates.
- Unlike the former IPP program, the CINP program is open to both experimentalists and theorists.

MRS Application – Question #3

3. Why are CINP Undergraduate Research Scholarships (URS) needed in view of the existing Undergraduate Student Research Awards (USRA)?

CINP URS is complementary to USRA in several key respects:

1) Gifted international students studying in Canada are not eligible to apply for USRA.
2) An important element of the URS is the optional Travel Award, which allows the supervisor to send student to a lab or work with second collaborator for an extended period. This can have a significant impact on the quality of the research experience for some undergrads. The USRA has no such component.
3) There is a strict quota on USRA held at each university and demand significantly outstrips supply. CINP URS is reserved to nuclear physics and has a strong supervisor component.

Our experience from 2014 is that the program fills a real need beyond that available through the USRA program.

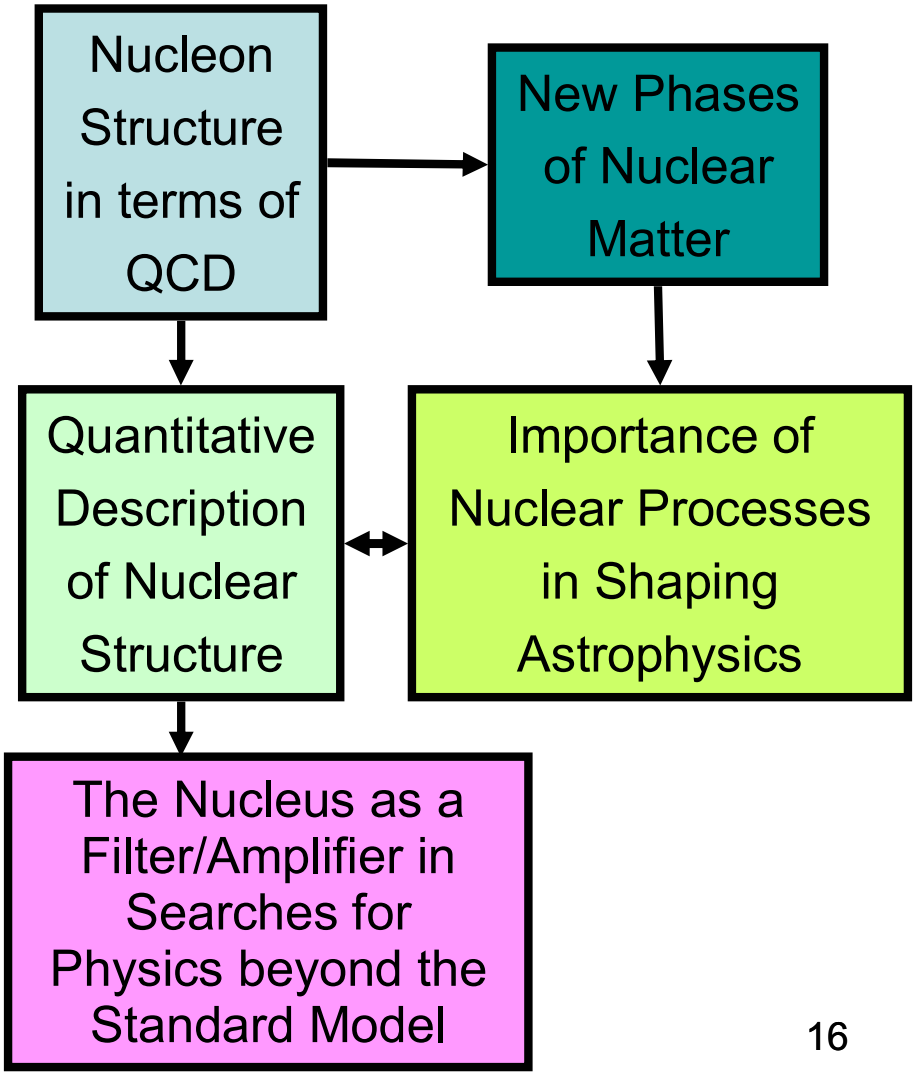
CINP Scientific Summary

A Few Slides on:

The Breadth of Canadian Nuclear Physics Research
and
Important Current and Future Priorities

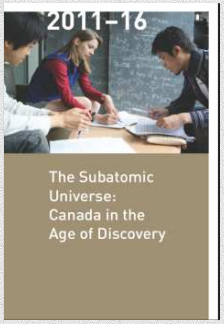
Nuclear Physics is driven by fundamental investigations on the origin, evolution and structure of strongly interacting matter.

- **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.**

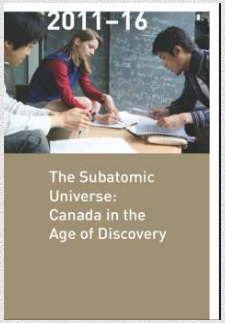


Examples of key Canadian initiatives from 2011-16 LRP:

- 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?**



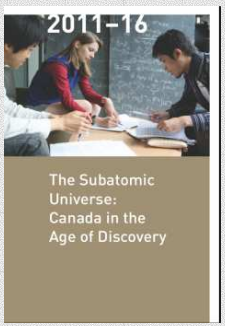
Examples of key Canadian initiatives from 2011-16 LRP:

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

Nuclear Astrophysics – Big Questions

CINP ICPN

- **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).

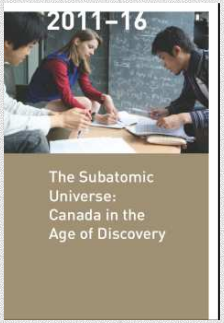
Fundamental Symmetries – Big Questions

CINP ICPN

- **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

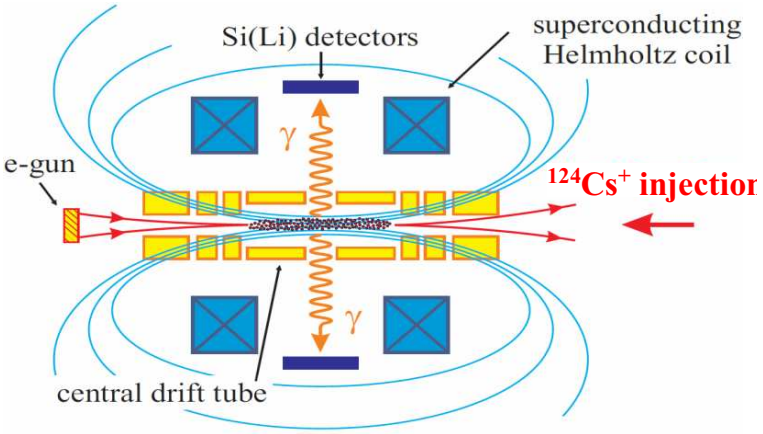
- Spectroscopy of highly charged ions (TITAN)

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 2ν2β NME tests

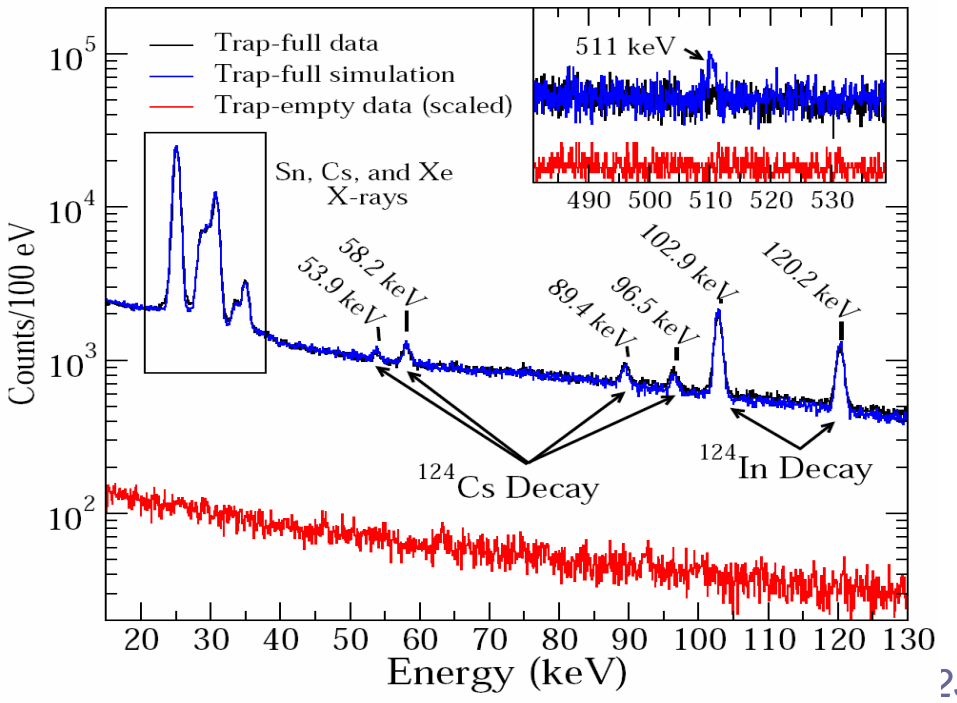


PRL 113, 082502 (2014) PHYSICAL REVIEW LETTERS week ending 22 AUGUST 2014

In-Trap Spectroscopy of Charge-Bred Radioactive Ions

A. Lennarz,[1,2] A. Grossheim,[2,3] K. G. Leach,[2,3] M. Alanssari,[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

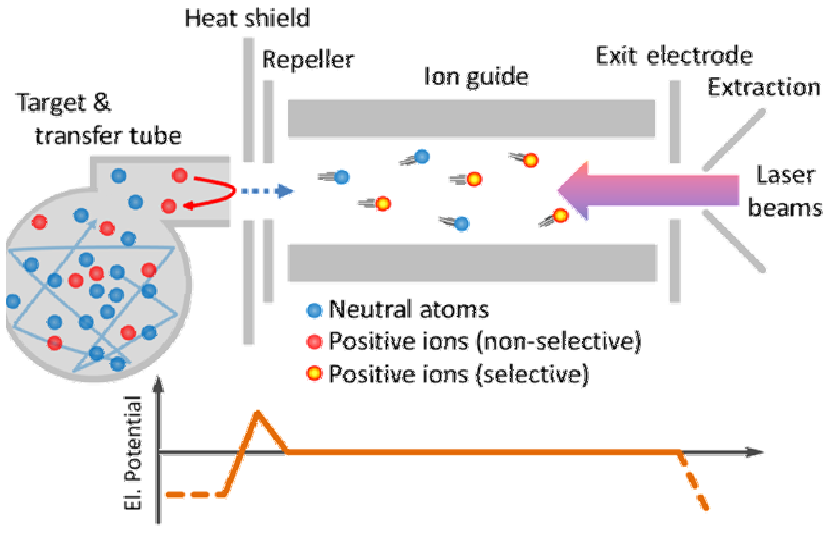
- Breakdown of the isobaric multiplet mass equation for the A = 20 and 21 multiplets.
- This was the first "physics measurement" made with TRIUMF-ISAC's new Ion-Guide Laser Ion Source (IG-LIS)

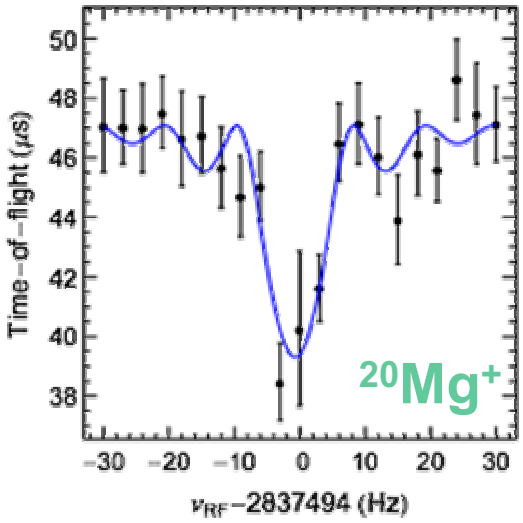
PRL 113, 082501 (2014) PHYSICAL REVIEW LETTERS week ending 22 AUGUST 2014

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]

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





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

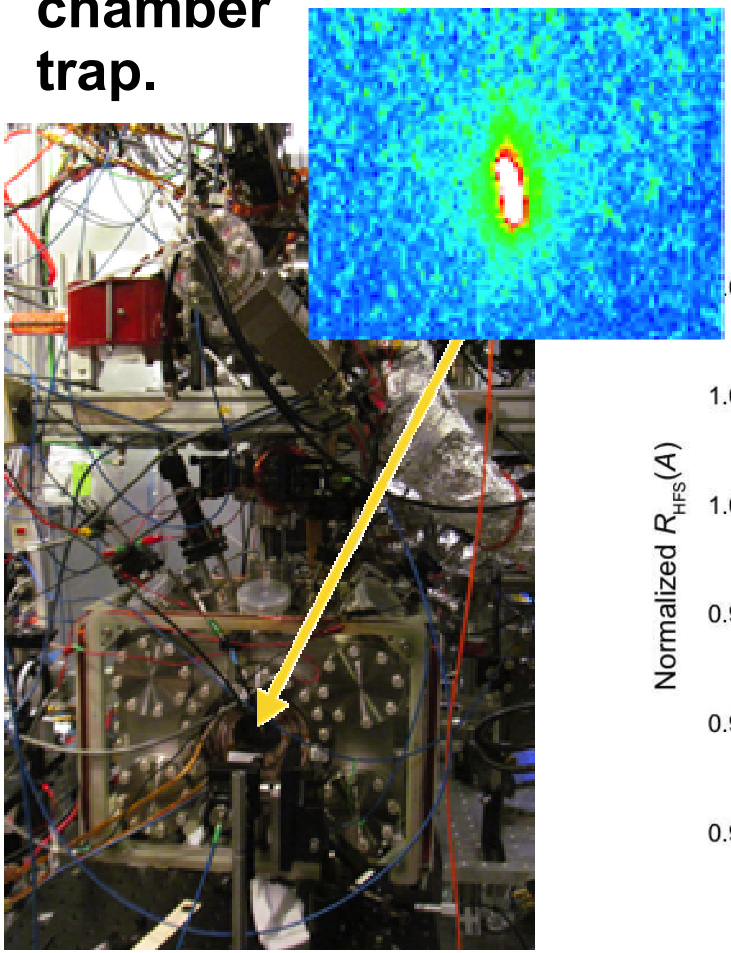
^{21}Mg: 14σ deviation & 22x improved precision

Compared to USDA/B & χEFT *NN+3N* predictions

2014 Research Highlights

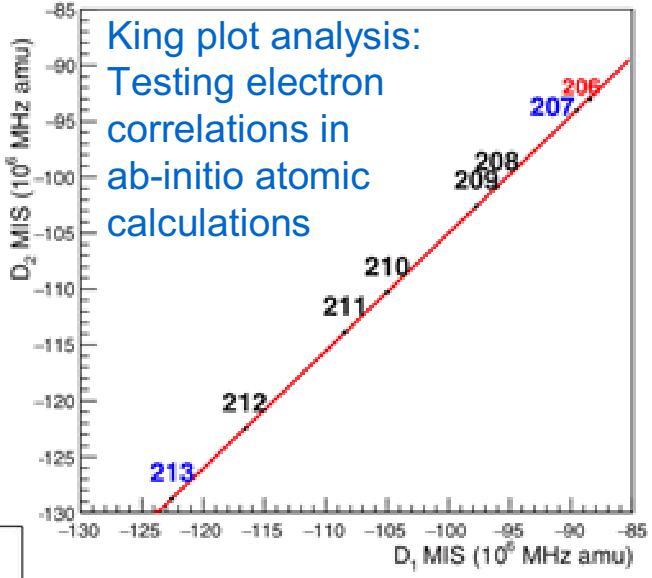
- Francium Trapping Facility @ ISAC

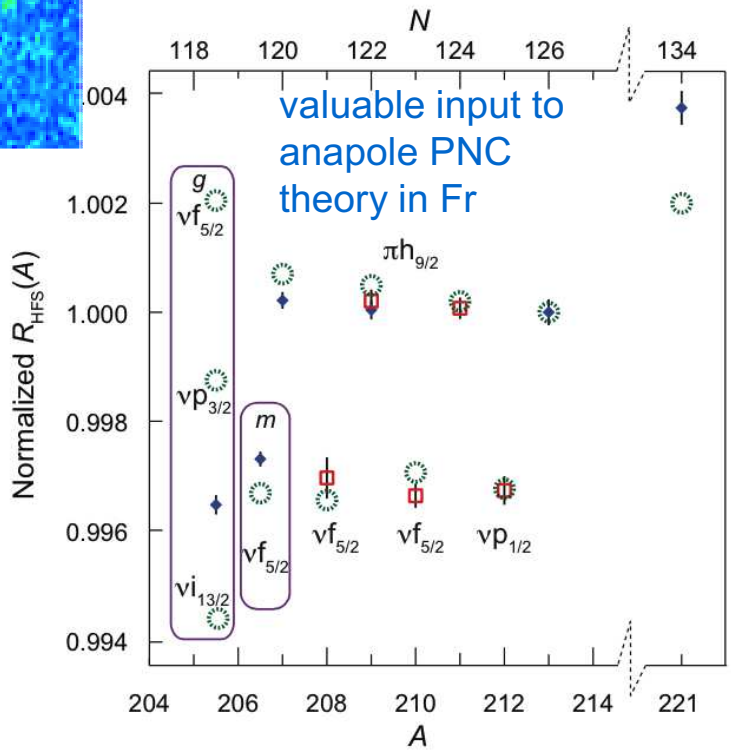
Dec. 2014: First transfer of ultra-cold francium atoms from the capture trap to the science chamber trap.



Collister et al.
PRA 90, 052502 (2014)

Isotope shifts in $^{206-213}$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

CINP ICPN

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

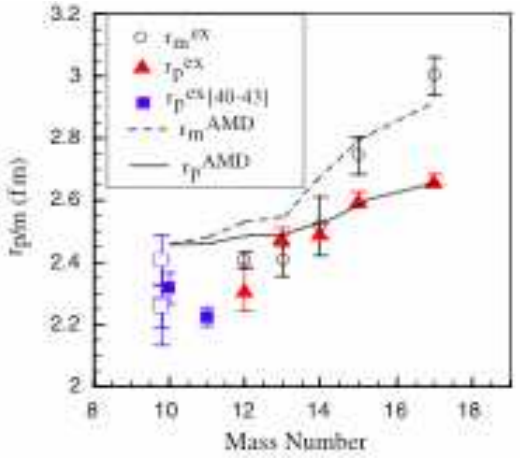
Proton Radii of $^{12-17}$B Define a Thick Neutron Surface in ^{17}B

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. Winfield[2]

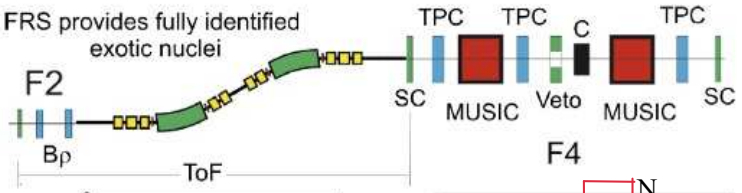
PTEP Prog. Theor. Exp. Phys. **2014**, 101D02 (7 pages)
DOI: 10.1093/ptep/ptu134

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

Boron isotopes



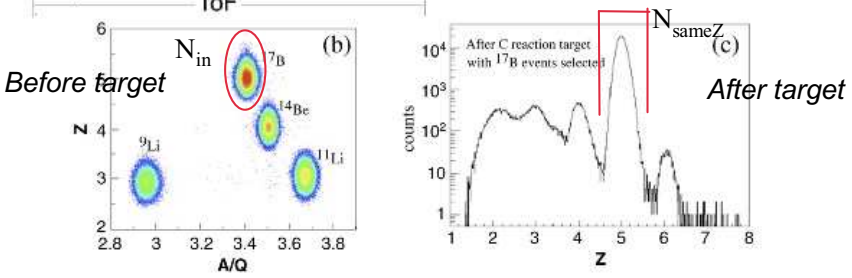
Setup for Charge-Changing Cross Section Measurements



Letter

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

S. Terashima[1,*], I. Tanihata[1,2,*], R. Kanungo[3], A. Estradé[3,4], W. Horiuchi[5], F. Ameil[4], J. Atkinson[2], Y. Ayyad[6], D. Cortina-Gil[6], I. Dillmann[4], A. Evdokimov[4], F. Farinon[4], H. Geissel[4], G. Guastalla[4], R. Janik[7], M. Kimura[5], R. Knoebel[4], J. Kurcewicz[4], Yu. A. Litvinov[4], M. Marta[4], M. Mostazo[6], I. Mukha[4], T. Neff[4], C. Nociforo[4], H. J. Ong[2], S. Pietri[4], A. Prochazka[4], C. Scheidenberger[4], B. Sitar[7], Y. Suzuki[8,9], M. Takechi[4], J. Tanaka[2], J. Vargas[6], J. S. Winfield[4], and H. Weick[4]

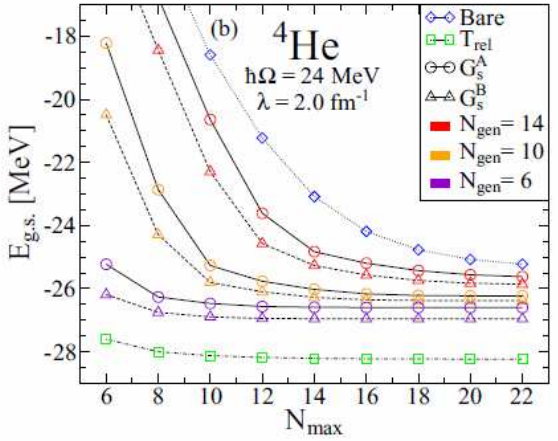


2014 Research Highlights
- Nuclear Structure Theory

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)

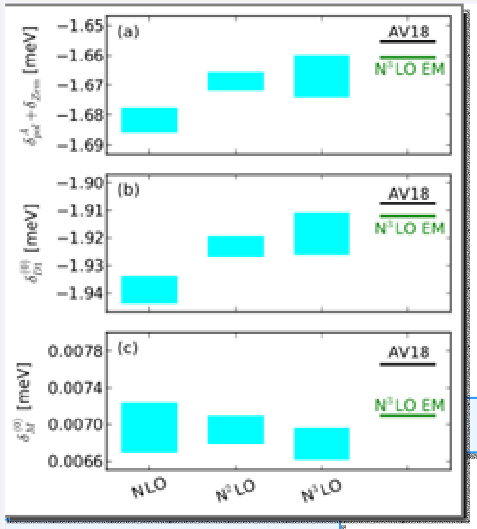


O. J. Hernandez, Chen Ji, S. Bacca et al.

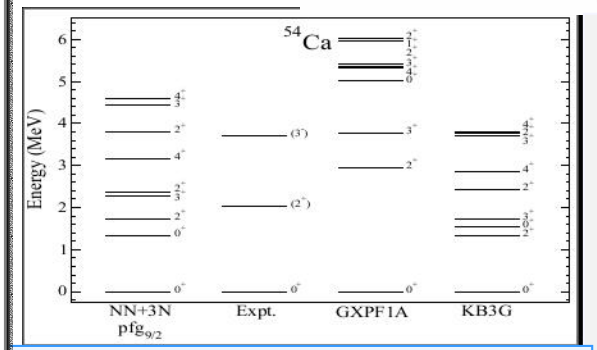
Ab initio calculation of nuclear polarization corrections to the μD Lamb shift , most accurate evaluation so far:

δ_{nucl}=-1.24± 1% 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

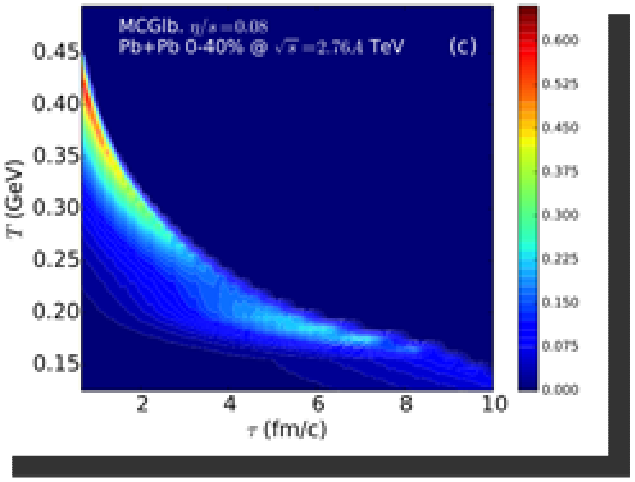
Agreement with new measurements from RIKEN

2014 Research Highlights
- Hadronic Physics/QCD Theory

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

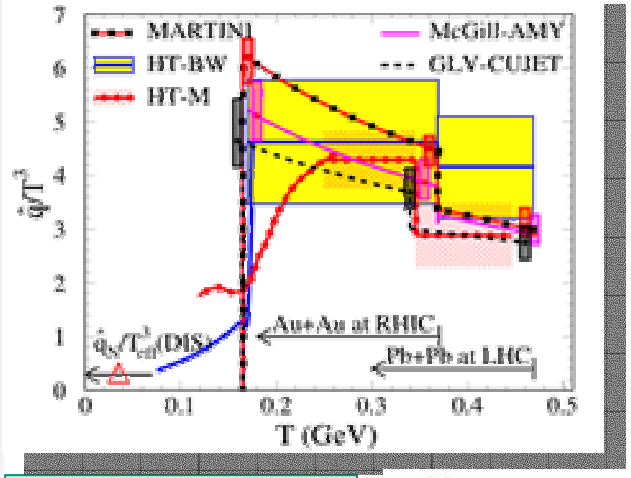
Using photons as penetrating probes to measure the temperature of the quark-gluon plasma at RHIC and at the LHC. The realistic expansion dynamics provided by relativistic hydrodynamics is important to get the true temperature of the expanding medium.

PRC **89**, 044910 (2014)



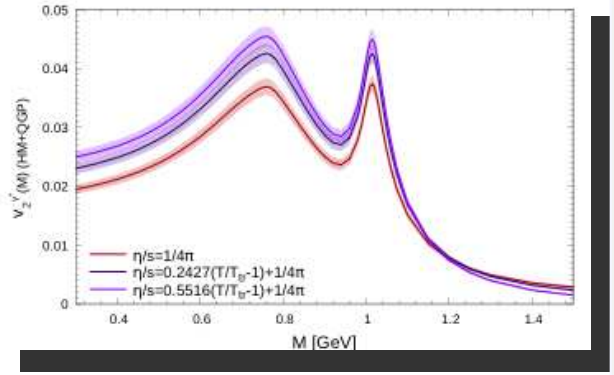
K. M. Burke, A. Buzzatti, Ningbo Chang et al. [JET Collaboration]

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 $\pi^{\pm}$ 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

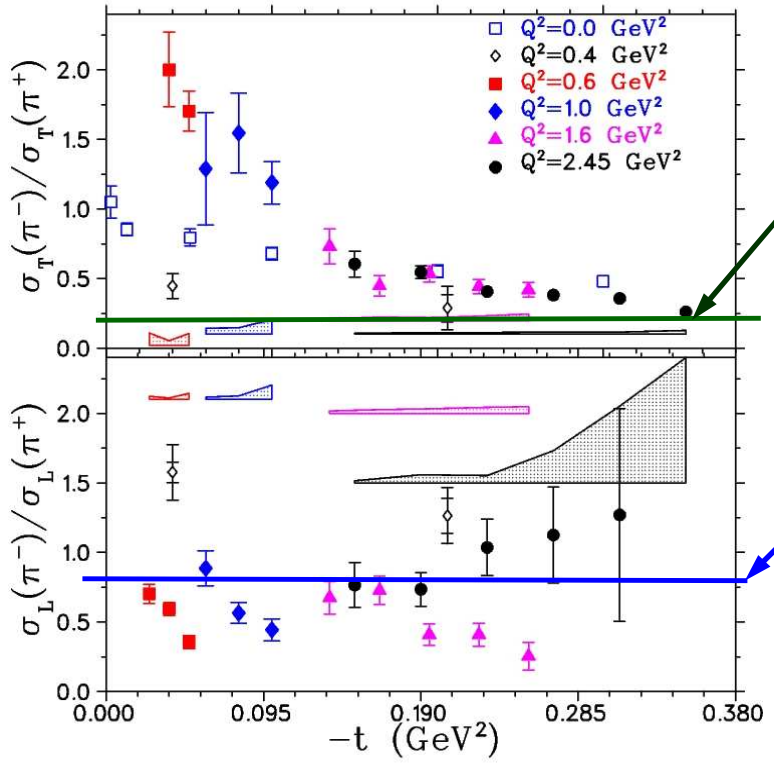
Separated Response Function Ratios in Exclusive, Forward $\pi^{\pm}$ Electroproduction

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 $\pi^{\pm}$ 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. Bochn 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] A



R_T tends to $(e_d/e_u)^2=¼$ at higher -t.

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

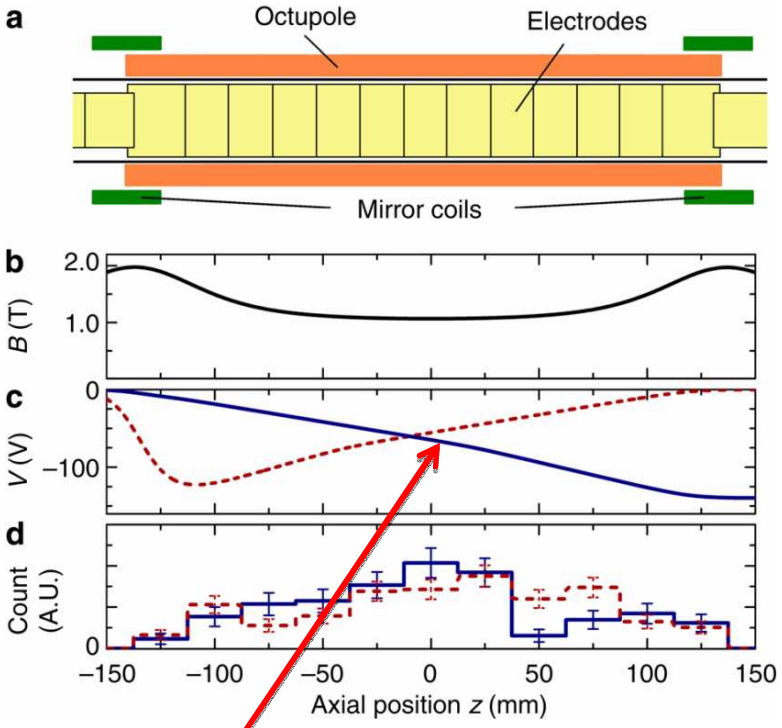
2014 Research Highlights
- ALPHA@CERN Anti-Hydrogen Trap

CINP ICPN

Is Anti-Hydrogen neutral?
(Canadian Proposal)

Nature Comm. 5, 3955 (2014)

Result **(Ph.D. theses: Berkeley, York)**:
$Q=(-1.3\pm1.1\pm0.4)\times10^{-8}$
New limit on e^+ charge
ALPHA's first precision result!



Biasing 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

CINP ICPN

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. Wilburn[12]

[1] *University of Tennessee, Knoxville, TN, USA*
[2] *Arizona State University, Tempe, AZ, USA*
[3] *Universidad Nacional Autónoma de México, Mexico, DF, Mexico*
[4] *Oak Ridge National Lab. Oak Ridge. TN. USA*

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

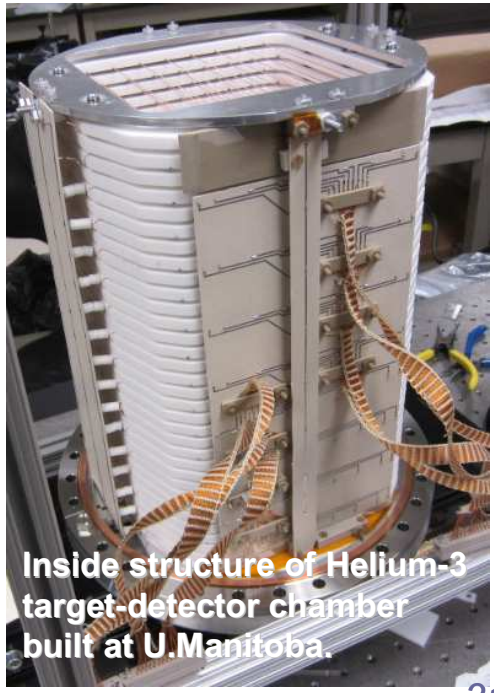
HPV test of χPT based Low E QCD models

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

HPV test of χPT 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.



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

Next Steps in 2015:

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

2014 Research Milestones

- Commissioning of GlueX underway @ JLab

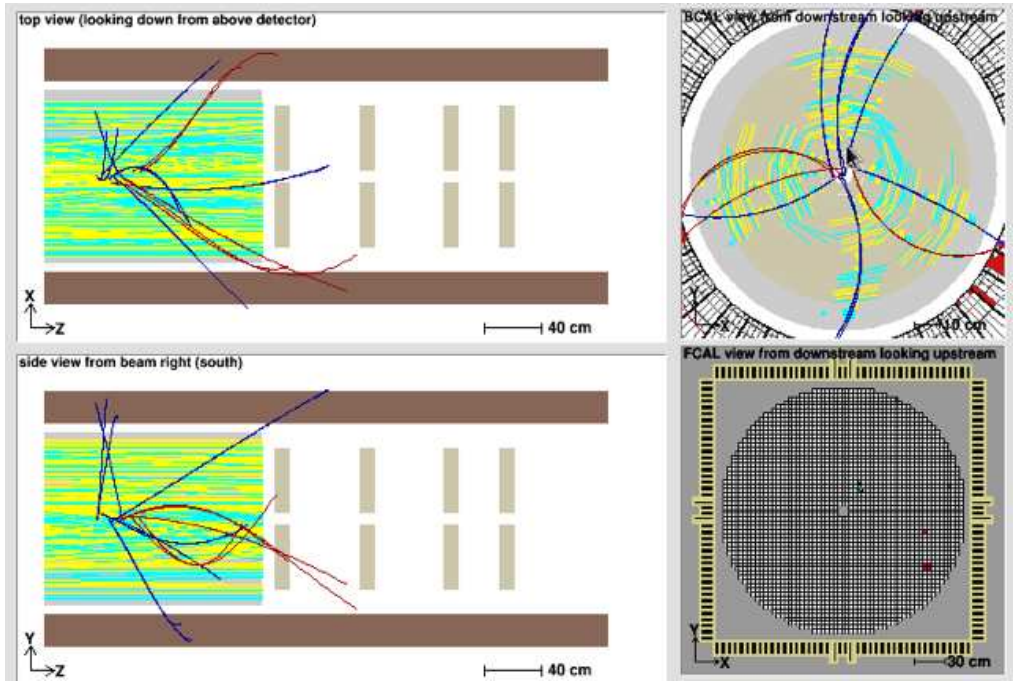
Search for hybrid mesons with exotic J^{PC} via 9 GeV linearly polarized photon beam.

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

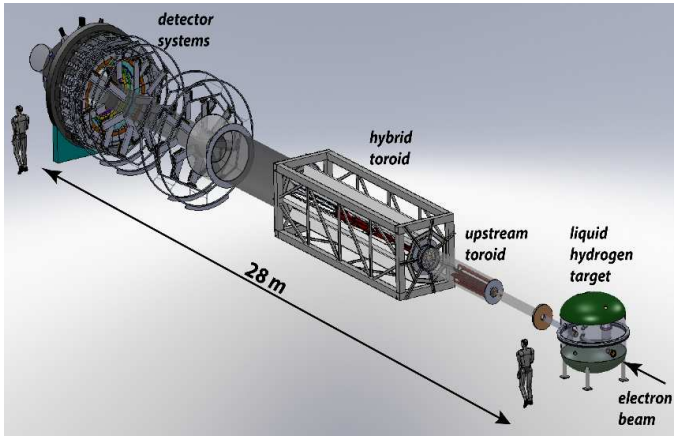
GlueX commissioning with photon beam at 10.5 GeV took place in fall.

- 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:

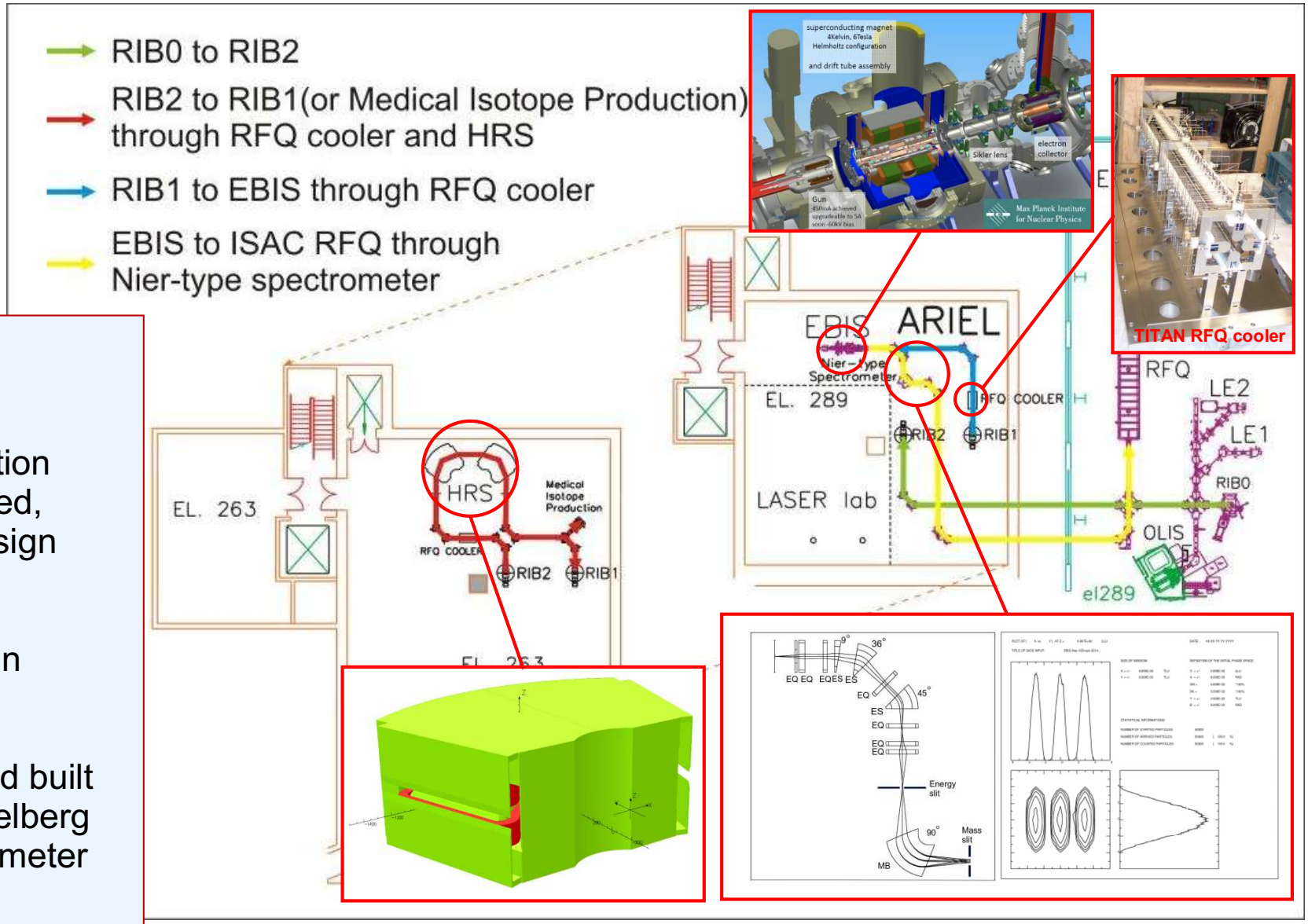
- September 2014 – DOE review science case – STRONG endorsement
  - Science of MOLLER was uniformly considered "MUST DO"
  - MOLLER could have best pure lepton discovery reach until new lepton collider $\Lambda^{ee}_{RR-LL} \cong 38\,\mathrm{TeV}$ $\Lambda^{ee}_{LL} \cong 27\,\mathrm{TeV}$
- Science 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)

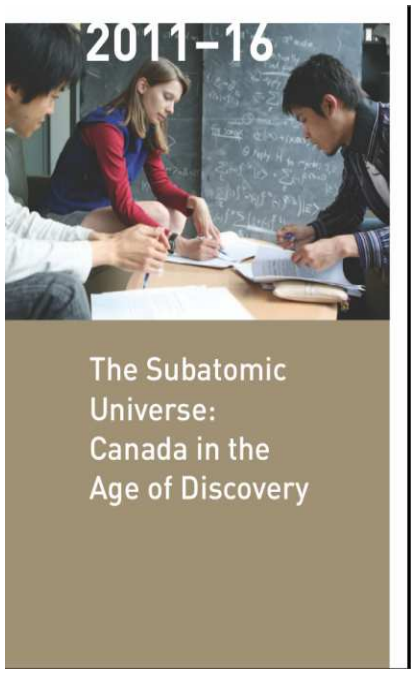
Full MIE proposal can be accessed at http://arxiv.org/abs/1411.4088

New Research Capabilities
- CANREB@ISAC funded by CFI-NIF



- 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

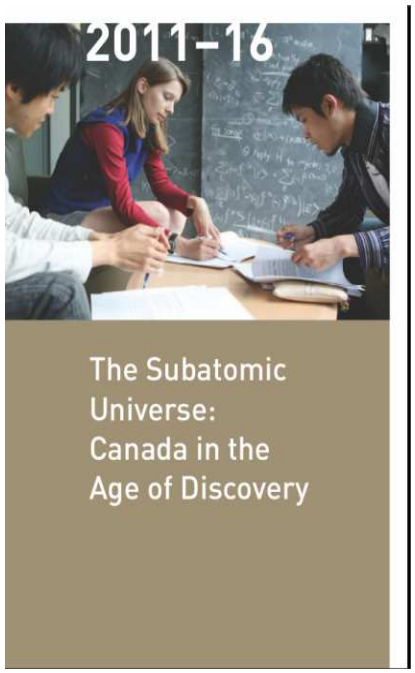
Canadian Subatomic Physics LRP
2011-16: Priorities in Nuclear Physics



- 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



- 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.