



Canada's national laboratory
for particle and nuclear physics
and accelerator-based science

Physical Science Division TARA-November 2016

Jens Dilling
Associate Laboratory Director
Physical Sciences Division

November 17 2016

Nuclear physics department

Nuclear Physics - J. Dilling

Deputy - J. Behr

J. Behr

A. Kwiatkowski

M. Pearson

I. Dillmann

T. Brunner (McGill)

B. Davids

J. Dilling

M. Alcorta (P&S)

M. Good (tech)

C. Ruiz

A. Garnsworthy

S. Georges (tech)

G. Hackman

D. Muecher (Guelph)

ARIEL @PSD

Principle Scientist

A. Garnsworthy

MPS:

M. Alcorta (P&S)

D. Bishop (P&S)

L. Doria (P&S)

S. Yen

CANREB:

J. Dilling

L. Graham (PDF)

M. Pearson

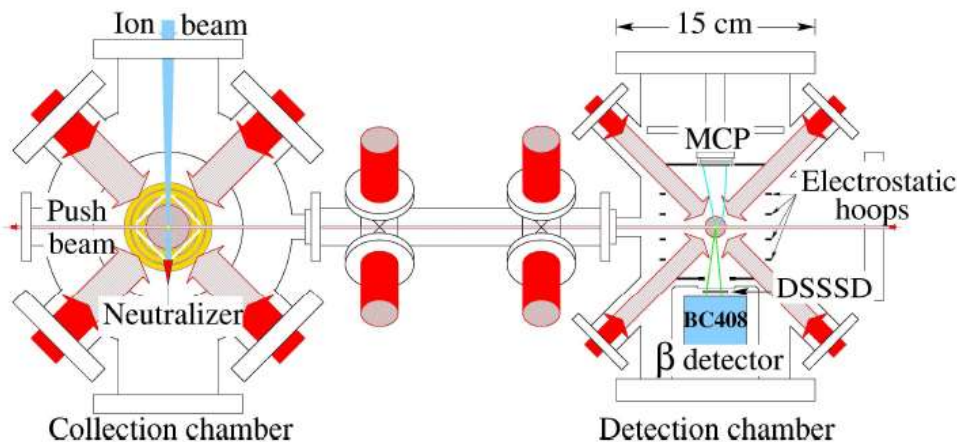
B. Barquest (PDF)

Execute and support nuclear physics experiments at ISAC (and ARIEL) or complementary studies at other RIB facilities

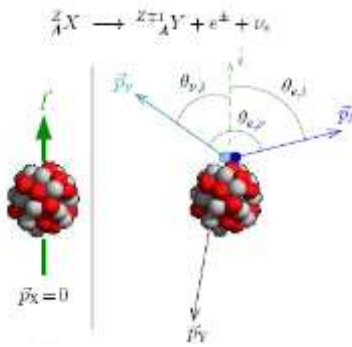
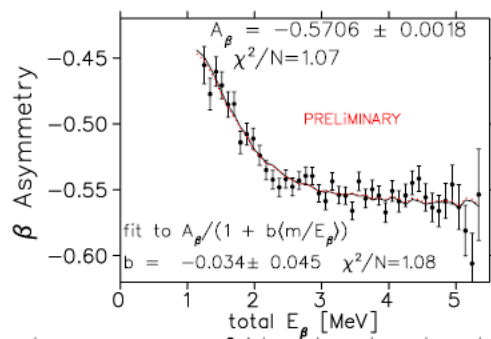
Nuclear Structure

Nuclear Astrophysics

Test of Fundamental Symmetries



Traps provide a backing-free, cold ($\lesssim 1$ mK), localized ($\lesssim 1$ mm³) source of short-lived radioactive atoms

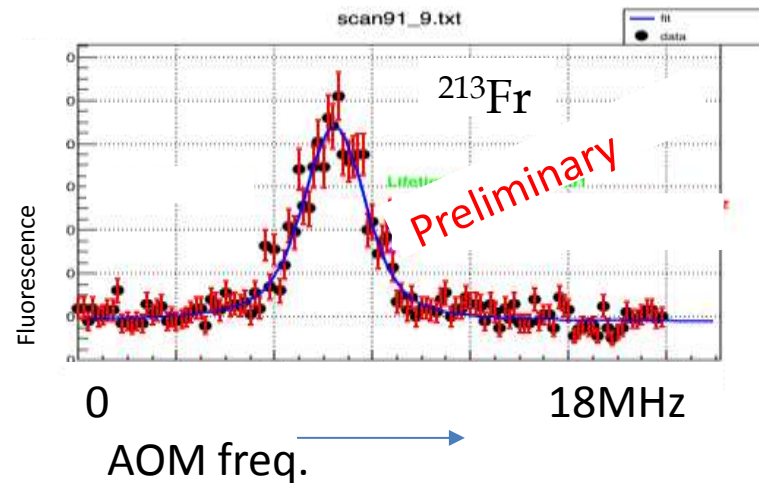
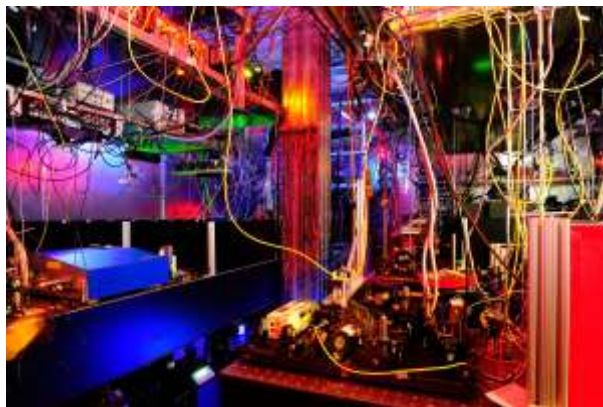
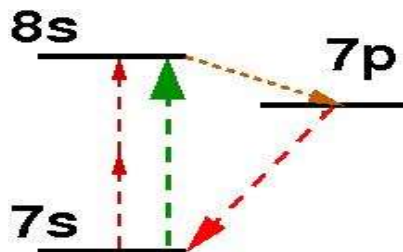


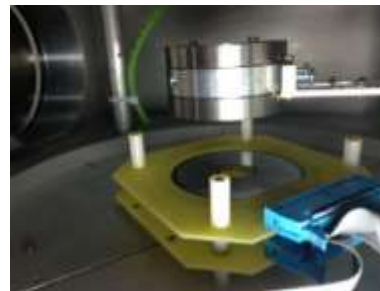
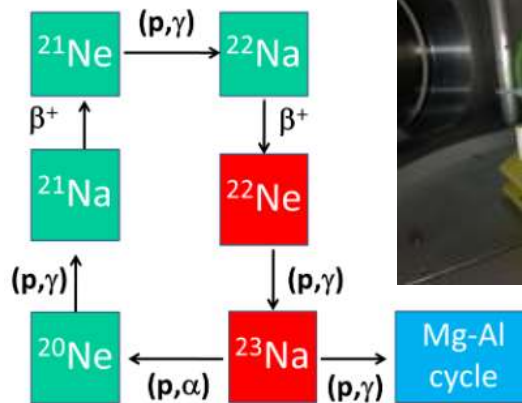
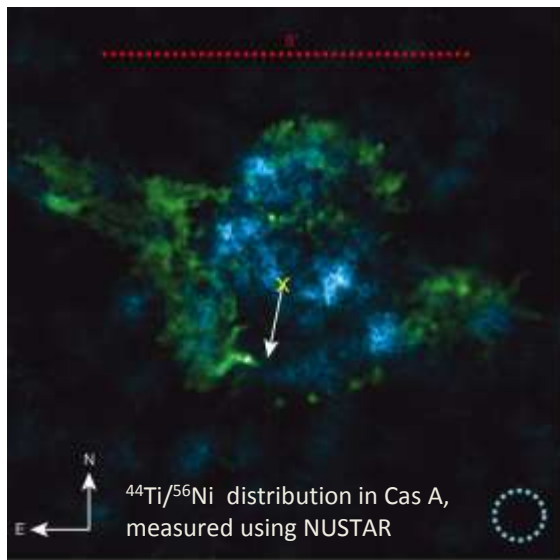
Atom trap: electro-weak study to probe S/V/T interactions using β - ν correlations.

- TAMU PhD 2016 B. Fenker
- best A_β accuracy measurement in a nucleus or neutron
- complementary sensitivity to LHC for 4-fermion contact interaction.
- publication in preparation

Atom trap experiment for tests of parity non-conservation and searches for an anapole moment in Fr isotopes.

- Observed for the first time the 7s-8s transition (the parity-violating transition) using two-photon spectroscopy
- Demonstrated DC Stark shift of the 7s-8s transition
- Major milestone!
- Neutralizer worked well
- Science trap operational

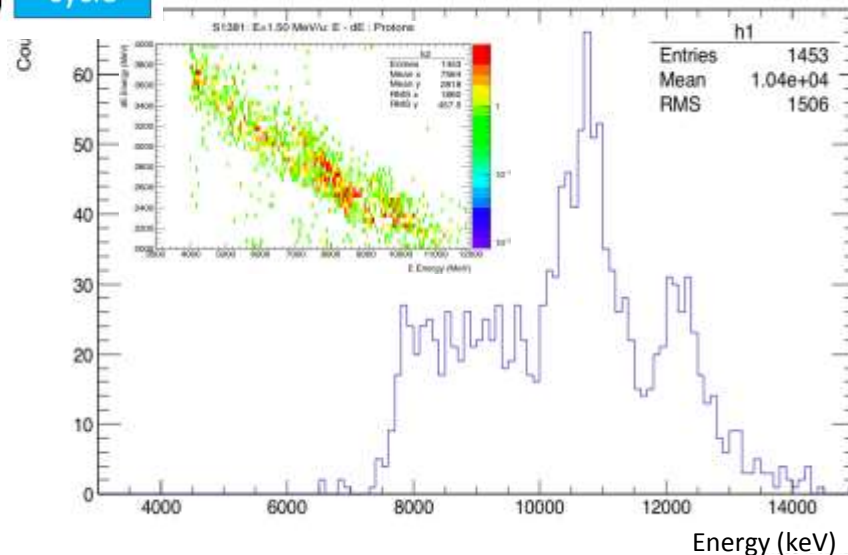




UNIVERSITY of York



S1381: E=1.50 MeV/u: Total Energy : Protons



- ^{44}Ti production in core-collapse SNe
- Affected by $^{21}\text{Na}(\alpha, p)^{24}\text{Mg}$ reaction in alpha-rich freeze-out
- Measure with TUDA facility and ^{21}Na beam
- Data taken July 2016 → under analysis

- Beam line to EMMA completed, tested
- EMMA electrostatic deflectors conditioned to potential difference of 200 kV with currents of 10-25 μ A
- 3 slit systems installed, 2 aligned
- Vacuum control system operational in 2 of 4 sections
- Position-sensitive focal plane detector vacuum box installed and aligned

International EMMA workshop Science Program July 2016



EMMA installation on track, ready for commissioning in 2016. First RIB experiments in 2017.



Milestone	Date
DAQ system complete	May 23 rd 
EMMA beam line installed	May 31 st 
Focal plane chambers ready to install	June 6 th 
Target chamber ready to install	June 20 th 
ED2 HV tests complete	July 21 st 
ED1 HV tests complete	September 15 th 
EMMA installed	September 15 th 
Alpha source commissioning complete	November 8 th 
Stable beam commissioning complete	December 22 nd

Center for molecular and material science

CMMS - S. Kreitzman

Deputy - G. Morris

[S. Kreitzman](#)

G. Morris (P&S)

R. Abasalti (tech)

D. Arseneau (P&S)

B. Hitti (P&S)

M. McLay (tech)

[I. McKenzie](#)

D. Vyas (tech)

[S. Percival \(SFU\)](#)

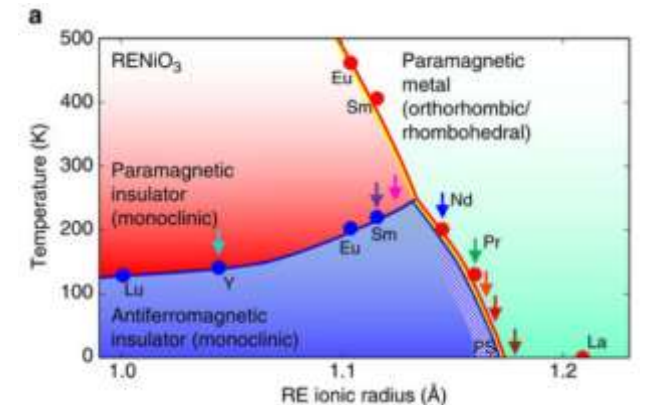
Support quantum material science experiments (molecular and material science) at μ SR and β NMR or β NQR facilities at TRIUMF.

Develop and operate customized and user-friendly spectrometers for the community.

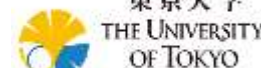
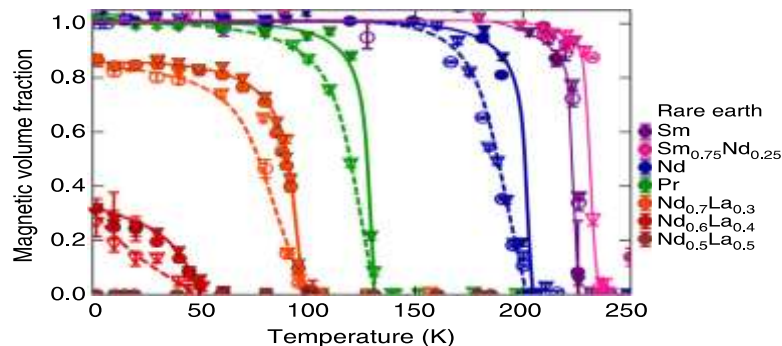
Volume-wise Destruction of the Antiferromagnetic Mott Insulating State Through Quantum Tuning

B. Frandsen et al.

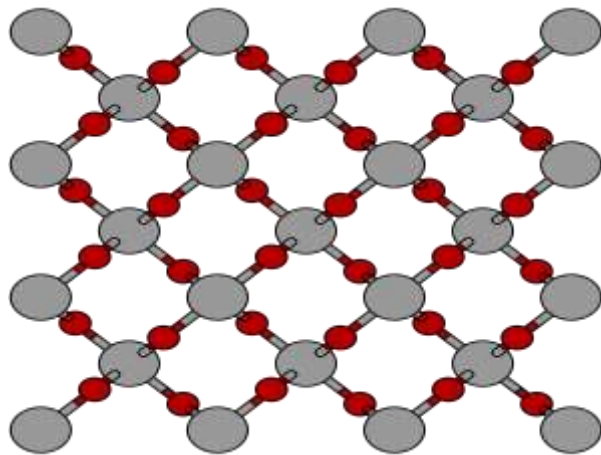
Nature Communications, **2016**, 7, 12519



RENiO₃ (RE = rare-earth element): Mott insulator systems that can be tuned by chemical substitution and exhibit a quantum phase transition (QPT) between an antiferromagnetic Mott insulating state and a paramagnetic metallic state. μ Sr measurements demonstrated the QPT is first order.

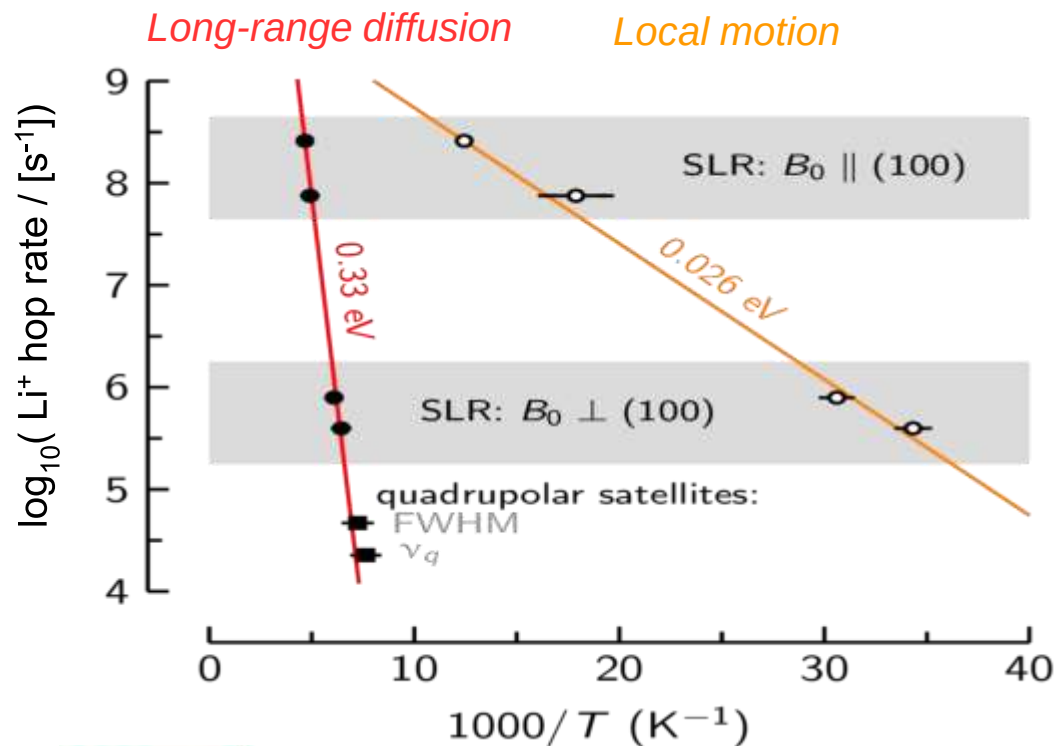


Li^+ dynamics in rutile TiO_2 :
solving a long-standing mystery



Rutile TiO_2 : a candidate electrode for solid-state lithium-ion batteries. Detailed studies on ionic motion and diffusion behavior.

Publication: R. McFadden (UBC chem) PRL in prep



Theoretical physics department

Theory - P. Navratil
Deputy NN

P. Navratil

S. Bacca

J. Ng

J. Holt

D. Morrissey

S. Stroberg (PDF)

M. Vorabbi (PDF)

A. Wijangco (PDF)

N. Nevo (PDF)

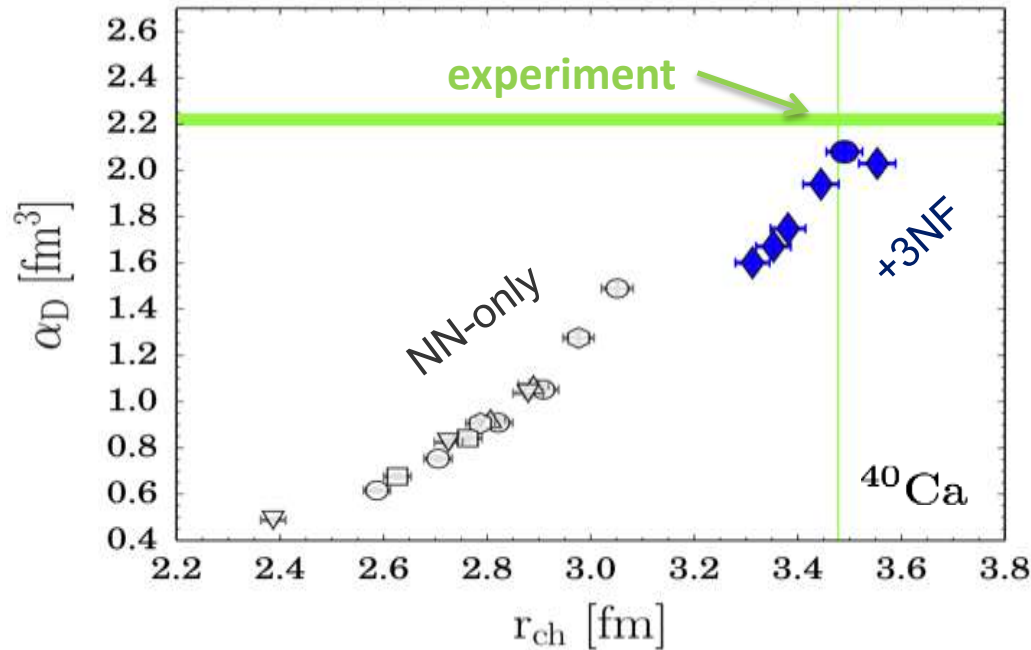
A. Calci (PDF)

Carry out theoretical research in nuclear and particle physics, to guide and support experiments, or to do exploratory studies.

New hire in Particle Theory:

- Search underway, over 100 applications recieved

Coupled-cluster theory computations



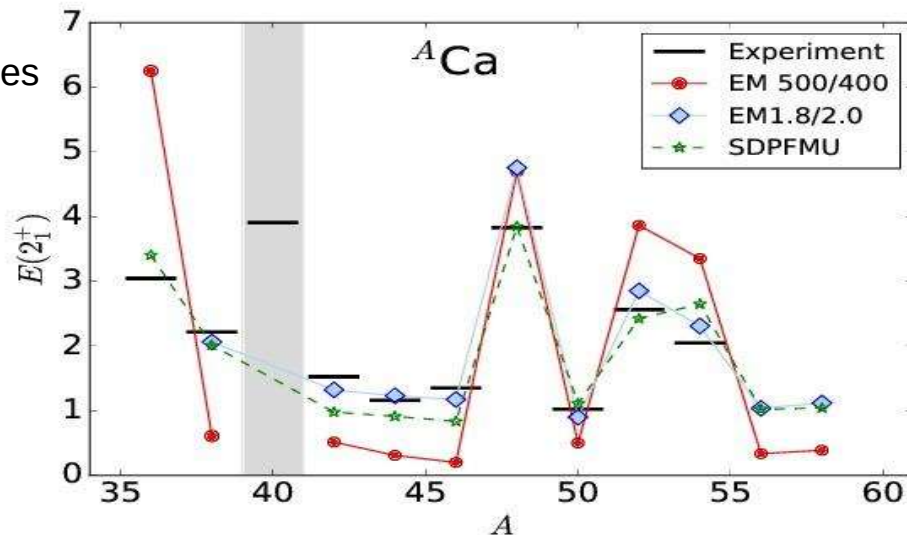
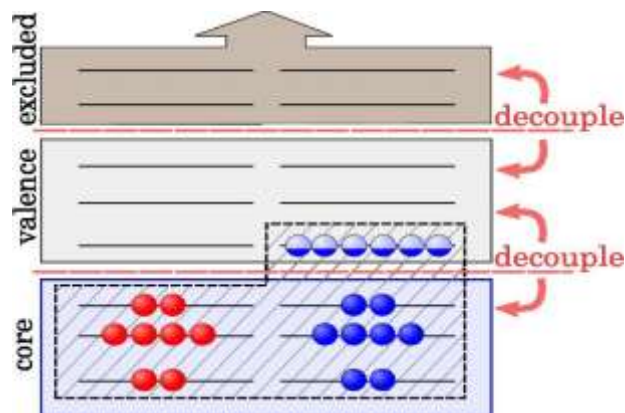
M. Miorrelli et al., PRC 94, 034317 (2016)



- Follow-up study of recent Nature Physics
- Strong correlation between electric dipole polarizability and charge radius
- Two-body forces substantially underestimate both quantities
- We explore different three nucleon forces
- Three nucleon forces play a crucial role and are needed to improve agreement with experiment

Valence-space In-Medium SRG

- Follow-up study of recent Nature Physics
- Same cost as coupled-cluster (CCSD)
- Access to all nuclei up to $A \sim 100$
- Access to absolute energies and excited states
- Consistent treatment of moments and transitions



R. Stroberg, J. Holt et al., arXiv: 1607.03229

Particle physics department

Particle Physics - M. Fujiwara

Deputy - O. Stelzer- Chilton

G. Azuelos (UofM)

M. Vetterli (SFU)

D. Gingrich (UofA)

P. Savard (UofT)

I. Trigger

O. Stelzer-Chilton

G. Oakham (Carleton)

M. Fujiwara

A. Carpa (PDF)

S. Yen

R. Tacik (UofR)

M. Hartz (KAVLI-IPMU) D. Karlen (Uvic)

R. Gornea (Carleton) A. Konaka

T. Numao

G. Marshall

R. Picker

R. Mammei A (UofW)

ATLAS Tier 1 - R. Tafirout

R. Tafirout

A. De Silva (P&S)

D. Deatrich (P&S)

A. Wong (P&S)

R. Devbhandri (tech)

V. Kondratenko (P&S)

D. Qing (P&S)

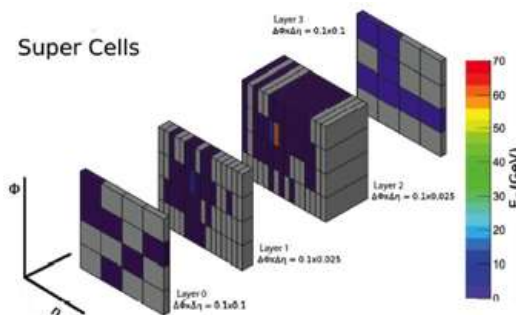
S. Liu (P&S)

Y. Shin (P&S)

Carry out and support particle physics experiments with the TRIUMF community.

- ATLAS
- ALPHA
- Neutrino-program (T2K, EXO, HALO)
- PINU
- g-2
- UCN

- LHC & ATLAS Run 2 at 13 TeV well underway
- Local Analysis Effort
 - Searches for Beyond the Standard Model
 - Higgs Boson Characterization
- ATLAS Upgrades
- Phase 1 2019-2020
 - NSW, LAr Electronics
- Phase 2 2024-2026
 - ITK, LAr Electronics



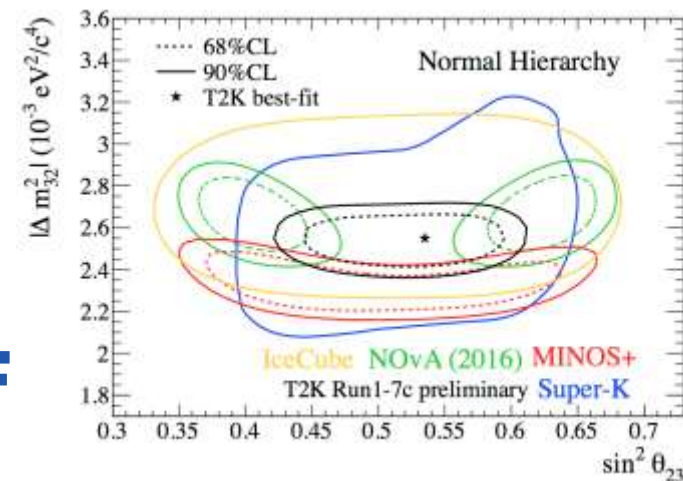
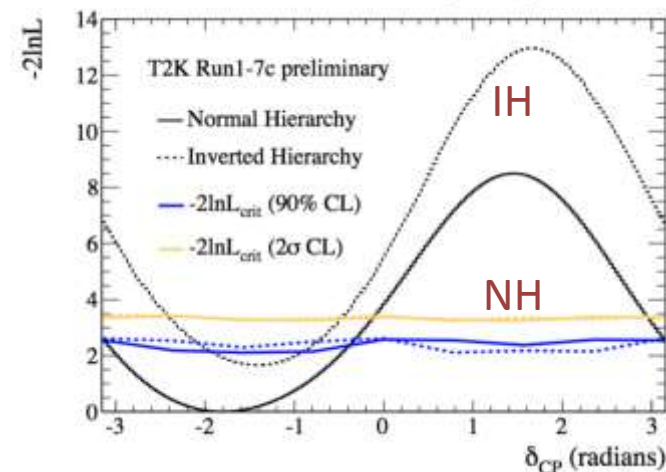
New Small Wheel
~10 m



- Tier-1 performing well

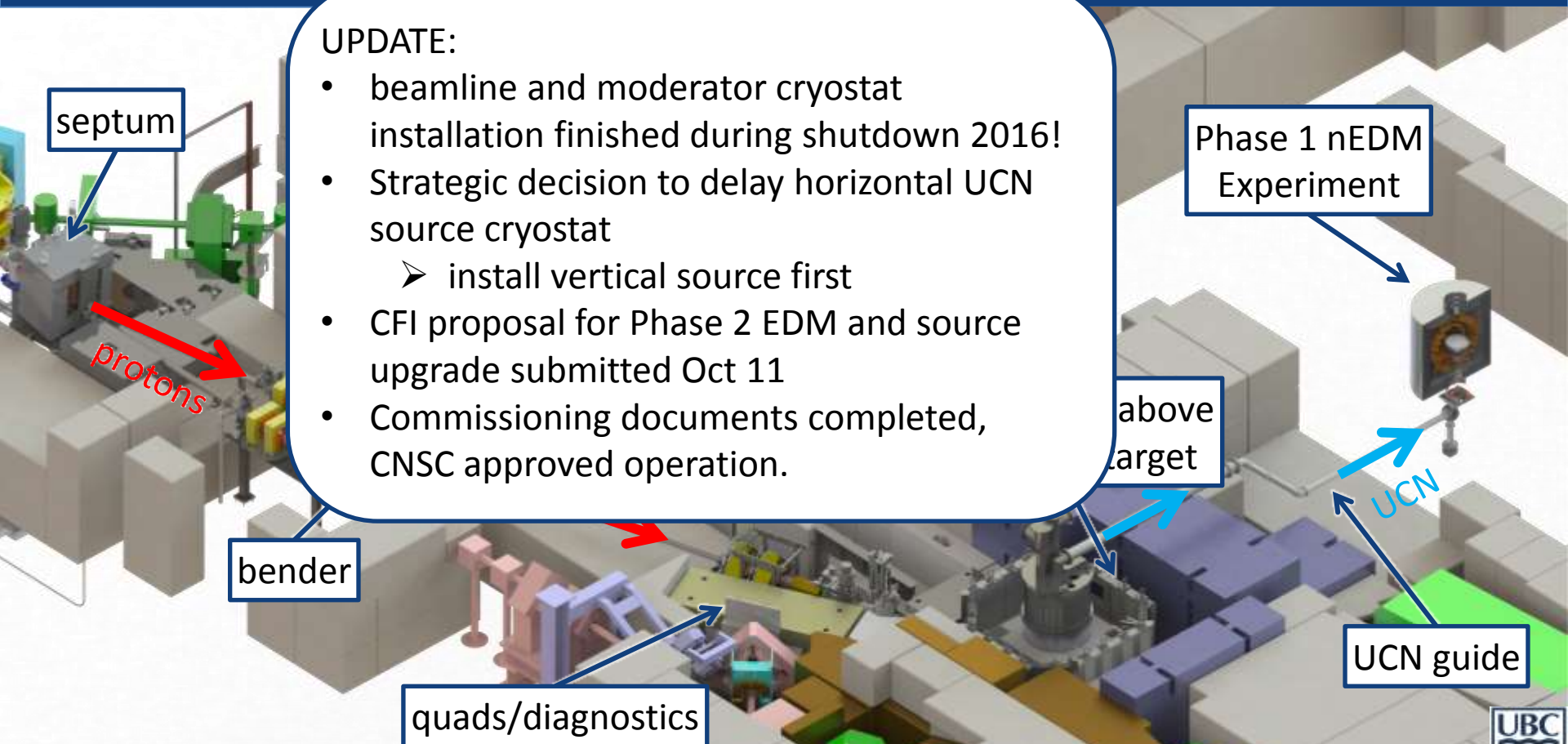


- T2K result @Neutrino2016
 - CP conserving δ_{cp} dis-favored @ 90%CL
 - $\delta_{cp} \sim -\pi/2$ and normal hierarchy (NH) favored
 - T2K favours maximal θ_{23} (atmospheric) mixing
 - Tension with the latest NOvA result (2.5σ)
- Data taking resumed in October 2016
 - Doubling the neutrino mode statistics by the next spring
- Progress on the future of T2K
 - T2K-II received Stage-1 @ J-PARC PAC
 - 3σ CP violation sensitivity at $\delta_{cp} \sim -\pi/2$ by 2025
 - NuPRISM received Stage-1 @ J-PARC PAC
 - Intermediate water Cherenkov for T2K-II and HyperK
 - CFI grant request for photo-sensor construction



UPDATE:

- beamline and moderator cryostat installation finished during shutdown 2016!
- Strategic decision to delay horizontal UCN source cryostat
 - install vertical source first
- CFI proposal for Phase 2 EDM and source upgrade submitted Oct 11
- Commissioning documents completed, CNSC approved operation.



Science technology department

Science Technology - F. Retiere

Deputy - R. Henderson

Engineering/Construction

R. Henderson (P&S)

W. Faszer (P&S)

C. Lim (P&S)

S. Chan (tech)

J. Zielinski (tech)

P. Lu (P&S)

R. Maharaj (tech)

I Nikinov (P&S)

P. Vincent (tech)

Instrumentation Physics

N. Hessey

B. Franke

L. Doria (P&S)

P. Gumplinger (P&S)

Detector Electronics

L. Kurchaninov (P&S)

M. Constable (P&S)

DAQ

P. Amaudruz (P&S)

S. Daviel (tech)

T. Lindner (tech)

D. Vavilov (tech)

L. Martin (PDF)

K. Olchanski (tech)

C. Pearson (P&S)

Electronics Development

D. Bishop (P&S)

Y. Linn (P&S)

B. Shaw (P&S)

Support detector and experiment development and fabrication for the TRIUMF community in Canada.

- Canadian Survey of Users at CAP Congress



- Presentations at CINP and IPP town-hall meetings
- New group: instrumentation physics
- Supported 5 CFI grant applications
 - Service: simulations and engineering
 - UCN EDM experiment
 - Mechanical design and electronics for future Water Cerenkov experiment
 - Electronics for MØLLER
 - Electronics for ATLAS LAr calorimeter
 - Photo-detector development for future Liquid Xenon and Argon experiments

- Setting up infrastructure for ATLAS-ITk (new hire N. Hessey)
 - New clean room in MHESA 1st floor
 - Coordinate Measuring Machine (CMM)
 - Silicon strip module assembly

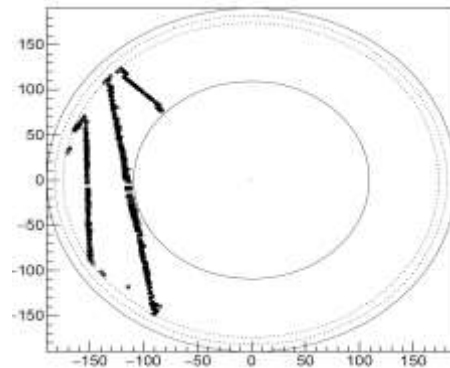
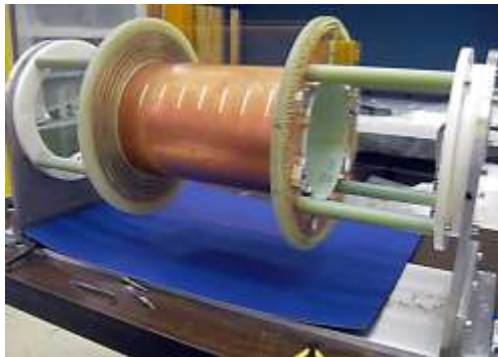


ALPHA-g prototype operational
project plan: on track

prototype TPC constructed
– 1/7th of the full system



- mechanical design
- fabrication
- gas system
- analog electronics
- digital electronics
- data acquisition



ALPHA α



- APS DNP (Division of Nuclear Physics) Fall Meeting held in Vancouver

- TRIUMF host of the 2016 DNP Fall Meeting
- first meeting in Canada since 1997

- excellent participation: 668 registered
- and 168 undergrad students (record)

- TRIUMF organized:

- 3 mini workshops:

- *Recent Atomic Physics for Nuclear Physics and Vice Versa*
- *New Frontiers in Low-Energy Nuclear Theory*
- *New Science Opportunities at RIB Facilities*

- 4 (7) mini-symposia

- *Opportunities in Underground Nuclear Physics (I and II)*
- *Physics of Ultra-Cold Neutron Sources (I and II)*
- *Instrumentation for Physics Beyond the SM*
- *Application of Nuclear Physics (I and II)*

- Invited session:

- *Rare Isotopes in Pure and Applied Nuclear Physics*

- Public Talk: V. Smil (Innovation and Moore's Law):

- 20 science ambassadors selected from undergrad poster session



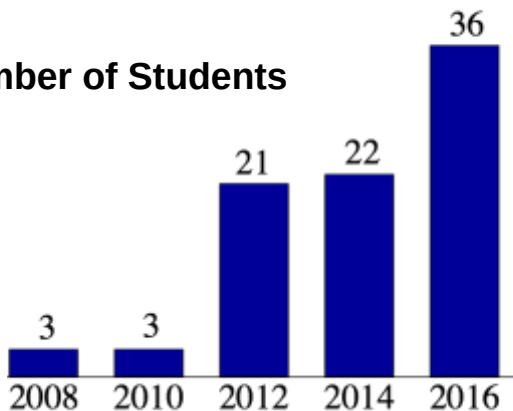
Nuclear Physics Course
currently offered through UBC, PHYS 505

(S. Yen & S. Bacca)

on-line tools allow to teach across the country:



Number of Students



TRIUMF is involved in many academic programs:

- teaching uni. undergrad and grad classes
- undergraduate program at TRIUMF
- training of post docs
- Summer schools
- Accelerator program

TRAC: TRIUMF's Academic Committee:

Chair: S. Bacca

Mandate:

- coordinate and advocate academic activities, liaison with universities
- all TRIUMF divisions involved

- Science Week at TRIUMF (July 18-23 2016)
 - TRIUMF User Group AGM
 - [Presentation of re-launched Beam Strategy Development Committee \(next slide\)](#)
 - International ARIEL Science Workshop – Instrumentation for ARIEL
 - [Start of ARIEL user consultation process, in particular for Science Phases \(next slide\)](#)
- Division All-Hands meeting
 - Division BAE Strategy Workshop (Dec 20/21)
 - Division Retreat Feb 2017
 - [Hiring plan, succession plan, upcoming TRIUMF 5YP](#)
 - [Division structures](#)
 - Health and Wellness Committee introduced
 - Rolled out Divisional and Departmental Safety Officers



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Thank you! Merci!

TRIUMF: Alberta | British Columbia | Calgary | Carleton | Guelph |
Manitoba | McGill | McMaster | Montréal | Northern British Columbia |
Queen's | Regina | Saint Mary's | Simon Fraser | Toronto | Victoria |
Western | Winnipeg | York

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