TRIUMF

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

Physical Science Division Report

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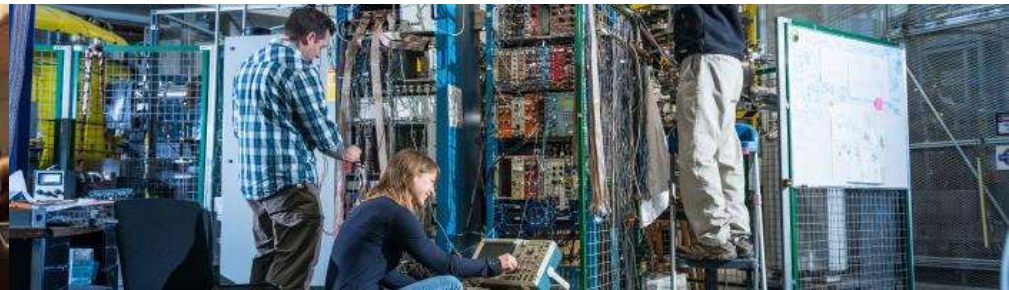
Associate Laboratory Director
Physical Sciences Division

July 24 2017

Outline

- A very good year for science so far:
  - Science highlights from the Division
  - New science capabilities ✓

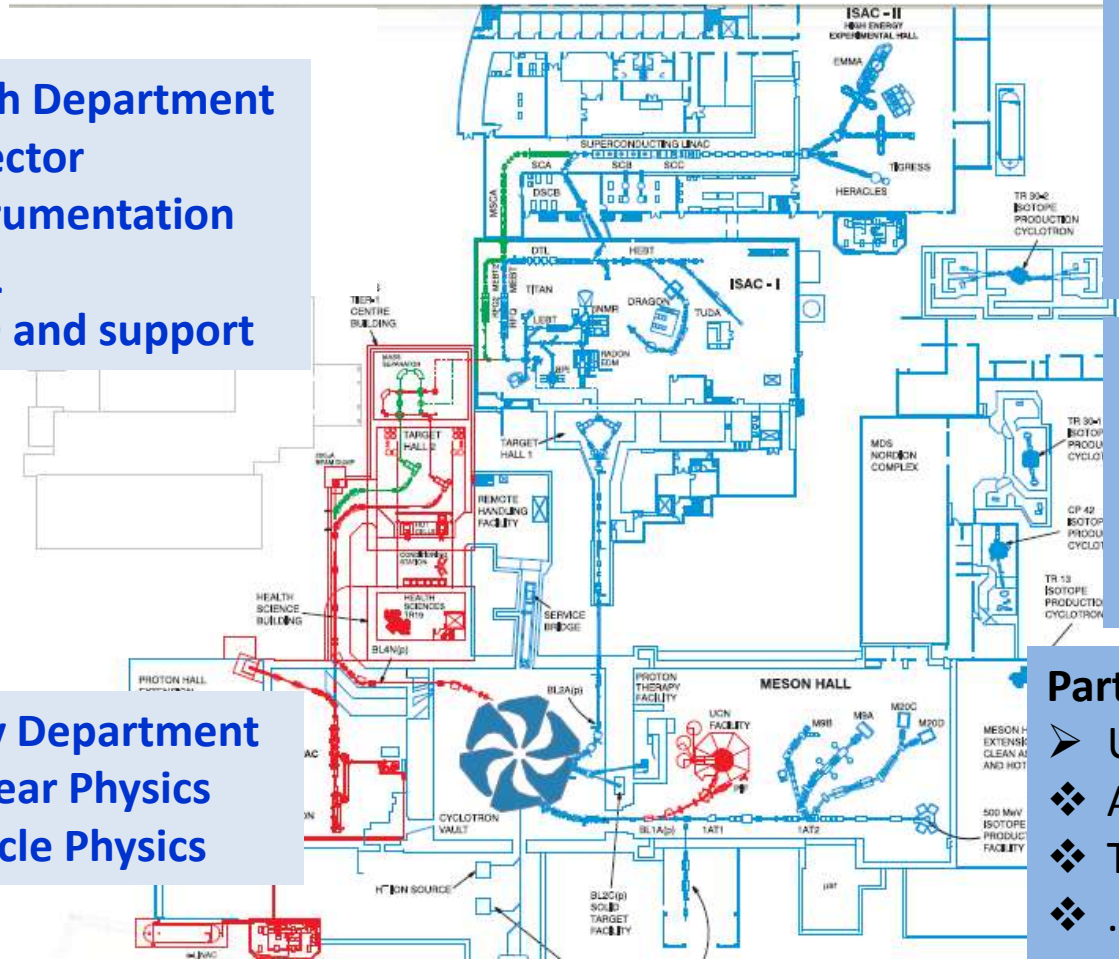
- PS Division news and updates
- Conclusion



TRIUMF and its users…in the Physical Sciences Division

Sci Tech Department
- Detector
- Instrumentation
- DAQ
- R&D and support

Theory Department
- Nuclear Physics
- Particle Physics

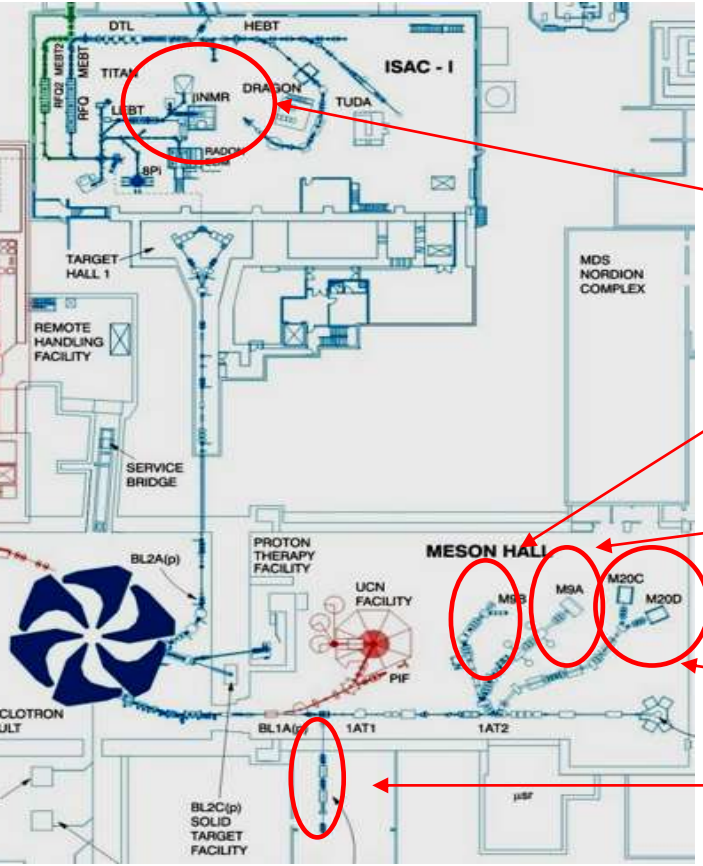


Nuclear Physics
ISOL RIB facility
- Nuclear Structure
- Nuclear Astrophysics
- Fund. Symmetries

CMMS
Centre for Molecular and Material Science
- (μSR)
- CMMS (βNMR)

Particle Physics
- Ultra Cold Neutrons
- ALPHA & ATLAS @ CERN
- T2K in Japan
- ….and more

CMMS, excellent user support



	Flux /s Lumin. /s-mm²
βNQR βNMR ^{8}Li, ^{9}Li, ^{11}Li,^{11}Be, ^{31}Mg	1.0e7 1.0e7 1.0e7 1.0e7
M9H* μ+, μ⁻ *(est)*	7.5e5,e4 5e3
M9A* μ+ *(est)*	7.5e5 1.0e4
M20 C&D μ+	5.5e5 7.1e3
M15 μ+	7.5e5 6.0e3

- High productivity
- Developing new capabilities
- Liquefier system commissioned
- Committed to M9 ✓

- More Automation

Partnership with the UBC SB-QMI: New TRIUMF position as part of CFREF initiative

- **ALPHA-2 highlights:**
  - Charge neutrality test to10^{-9}; e+ mass & charge (Nature 2016)
  - First laser spectroscopy, 10^{-10} level (Nature 2017)
  - 200-fold Improved microwave spectroscopy (Nature, in press)

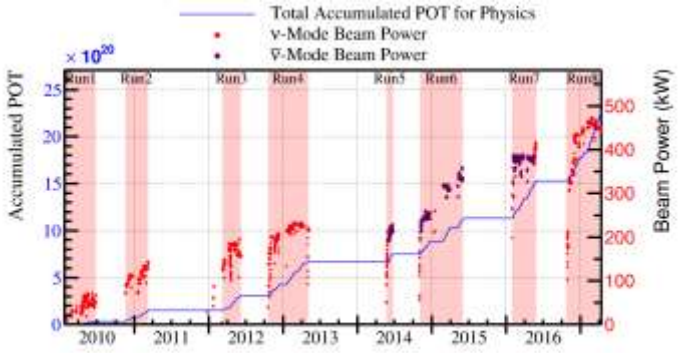
UCN Program:
1st neutrons November 2016 ✓

UCN source:
Source cryostat installed shutdown
Project Review June
UCN production August 2017!

Particle Physics: ATLAS / T2K

- **ATLAS Run 2 is well underway**
  - Higgs boson characterization
- **Tier-1 performing well**
  - Smooth 24x7 operations
- **Phase 1 Installation 2019-20**
  - New Small Wheel
  - LAr electronics
- **Phase 2 Installation 2024-26**
  - New Inner Tracker (ITK) (clean room) ✓

- **T2K/HyperK status**
  - Successful data taking till April
    - Doubled the statistics of the neutrino mode
    - Result and press release soon
  - NuPRISM and T2K-II receive Stage-1 by PAC
  - Rapid progress in HyperK
    - Dec. Funding approval if successful



Theory highlights

- Research on:
  - exotic Higgs decays at the LHC and future colliders
  - new theories and tests of dark matter
  - searches for new gauge bosons in precision experiments and cosmology
  - particle physics explanations for the ^{8}Be anomaly

PHYSICAL REVIEW D **95,** 115024 (2017)

Light axial vector bosons, nuclear transitions, and the ^{8}Be anomaly

Jonathan Kozaczuk,[1,2,*] David E. Morrissey,[2,†] and S. R. Stroberg[2,3,‡]

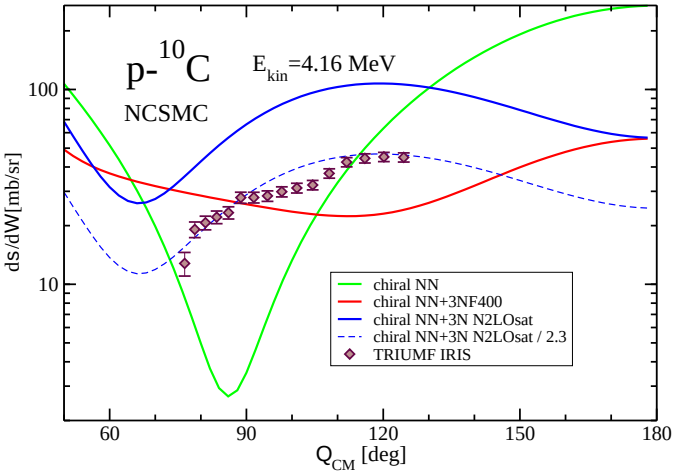
- New theory cluster consisting of 10 nodes with 32 cores/node and 256 GB memory/node ✓

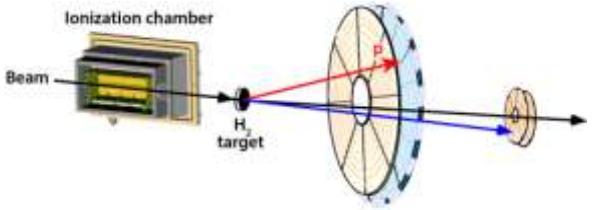
Nuclear Physics: highlights ISAC exp. with theory

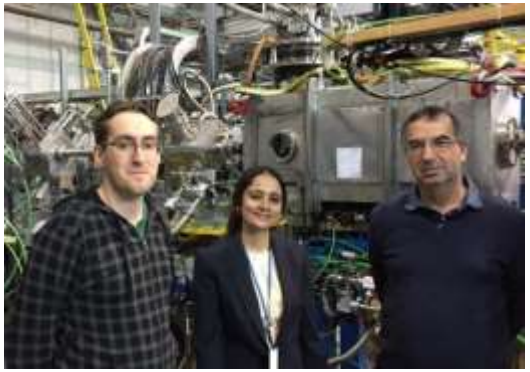
PRL 118, 262502 (2017) | Selected for a Viewpoint in *Physics* | PHYSICAL REVIEW LETTERS | week ending 30 JUNE 2017

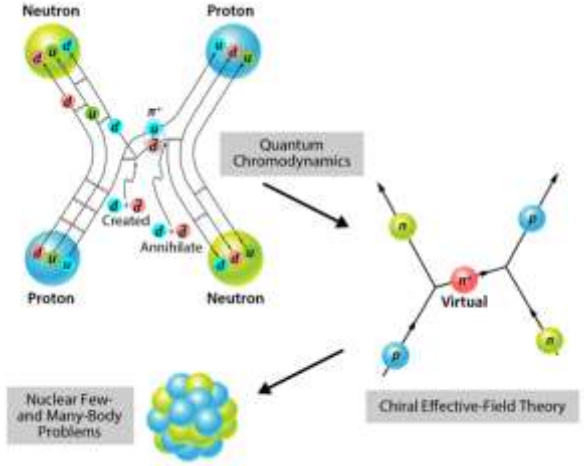
Nuclear Force Imprints Revealed on the Elastic Scattering of Protons with ^{10}C

A. Kumar,[1] R. Kanungo,[1*] A. Calci,[2] P. Navrátil,[2†] A. Sanetullaev,[1,2] M. Alcorta,[2] V. Bildstein,[3] G. Christian,[2] B. Davids,[2] J. Dohet-Eraly,[2,4] J. Fallis,[2] A. T. Gallant,[2] G. Hackman,[2] B. Hadinia,[3] G. Hupin,[5,6] S. Ishimoto,[7] R. Krücken,[2,8] A. T. Laffoley,[3] J. Lighthall,[2] D. Miller,[2] S. Quaglioni,[9] J. S. Randhawa,[1] E. T. Rand,[3] A. Rojas,[2] R. Roth,[10] A. Shotter,[11] J. Tanaka,[12] I. Tanihata,[12,13] and C. Unsworth[2]



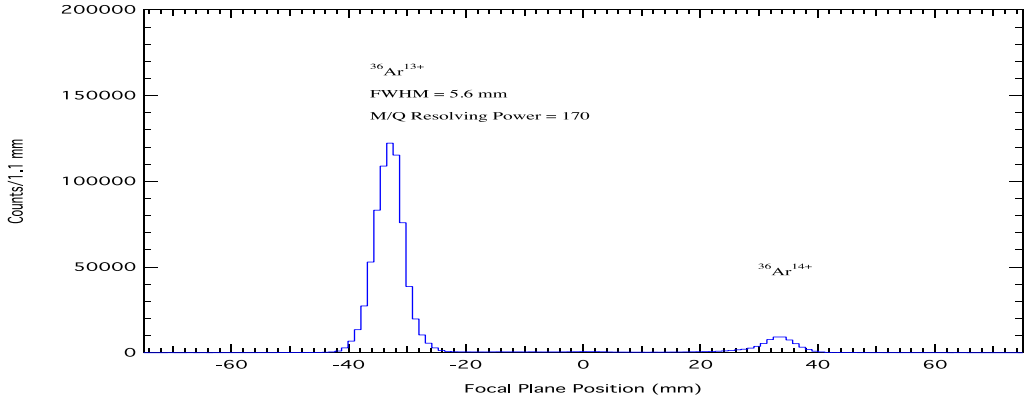




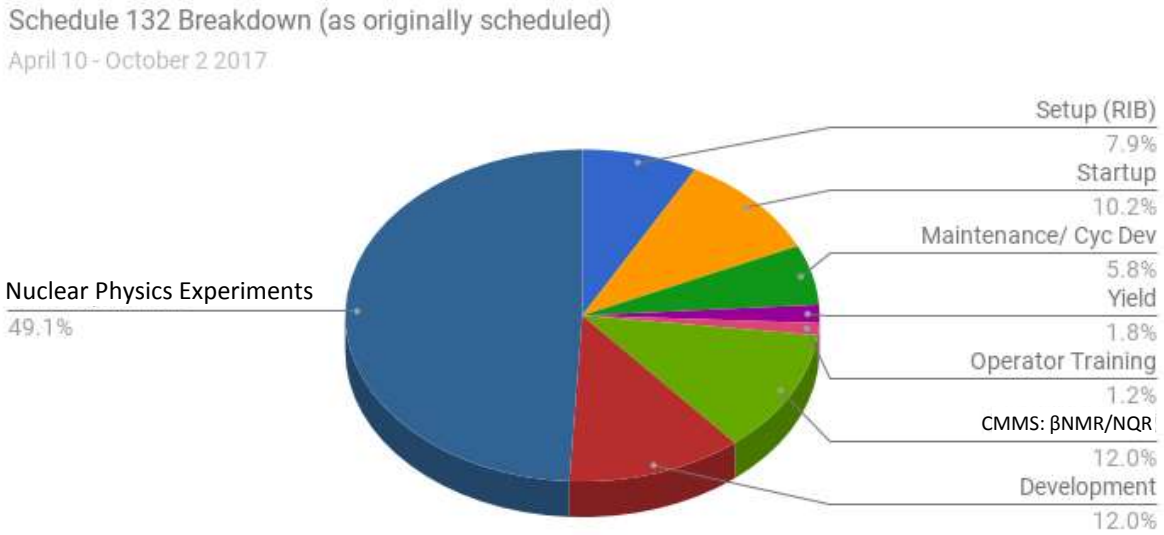


EMMA: installation completed

- Installation of the Electromagnetic Mass Analyzer EMMA completed in TRIUMF's ISAC-II experimental hall!
- Commissioning experiment with beam Dec. 2016
- Ready for on-line experiment in 2017 ✓



ISAC experiments



Nuclear Physics:

- 5.6 12h-shifts per experiment
- 15 RIB + 4 OLIS experiments
- ~ 1.1 NP publication per experiments (last 5 years)
- Lots of developments for new capabilities or new beams

- Development coordinated with the Beam Strategy Development Group
  - Joint Group between Accelerator Division and Physical Sciences Division plus User Representative (Iris Dillmann)
  - Ch. Ruiz contact for questions

User needs: beam development

Dates	Target	Ion Source	Module/Station	Priority	Beam	What	Exp	Facility	Area	Summary
April 14 - May 4 3 weeks	UCx	TRILIS	TM4 E	H	94Sr	CSB Stability	All (partc. GRSI)	YIELD	ALL	Charge state booster stability
May 5 - Jun 1 4 weeks	LPTa	TRILIS	TM2 W	H H	Sb,Gd,Tb? 52-56Ti, 51-55Sc	RILIS Devel. ield	 S1484	YIELD TITAN	 STRUCTURE	General TRILIS schemes. Extend S1484 to even further n-rich Ti & Sc.
June 2 - June 19 2.4 weeks	UCx	IG-LIS	TM4 E	H H H ~~H~~ ~~H~~ ~~H~~ ~~H~~ ~~H~~ ~~H~~ ~~H~~ M ~~M~~ M	128-130Ag 211-213Fr 85,86Ga ~~[illegible]~~ ~~221,223At~~ ~~221-224At~~ ~~130-135In~~ ~~130-135In~~ ~~130-135In~~ ~~208Hg~~ ~~71-80Cu~~ ~~221-224At~~ 160-164Eu	GRIFFIN Yield GRIFFIN Yield ~~GRIFFIN Yield~~ ~~Yield~~ ~~Yield~~ ~~GRIFFIN Yield~~ ~~Yield~~ 164Eu yield	S1542 S1549 S1728 ~~S921~~ ~~S929~~ ~~S1397~~ ~~S1415~~ ~~S1519~~ ~~S1547~~ ~~S1549~~ ~~S1630~~ ~~S1241~~ S1625	GRIFFIN GRIFFIN TITAN ~~GRIFFIN~~ ~~GRIFFIN~~ ~~TRILIS~~ ~~GRIFFIN~~ ~~GRIFFIN~~ ~~TITAN~~ GRIFFIN	STRUCTURE STRUCTURE STRUCTURE ~~STRUCTURE~~ ~~FUND-SYMM~~ ~~STRUCTURE~~ ~~STRUCTURE~~ ~~STRUCTURE~~ ~~STRUCTURE~~ ~~STRUCTURE~~ ~~STRUCTURE~~ ~~STRUCTURE~~ STRUCTURE	IG-LIS yields for beams where heavy surface-ionized contamination is expected - mainly GRSI experiments, but also TITAN/TRILIS.
June 20 - July 17 4 weeks	HPSiC	FEBIAD-CTL	TM2 W	H H H M M	18Ne 14O 14O 18Ne 18Ne	FEBIAD Optimizati FEBIAD Optimizati FEBIAD Optimizati FEBIAD Optimizati FEBIAD Optimizati	S870 S1140 S924 S1110 S874	TUDA GRIFFIN TUDA TUDA TIGRESS	ASTRO STRUCTURE ASTRO ASTRO STRUCTURE	Neon yields for high priority astro experiment, where contamination is also a concern. Also, molecular CO yields to see if suppressed relative to non-CTL FEBIAD.
July 18 - Aug 14 4 weeks	LPTa	TRILIS	TM4 E	H	Short-lived Be,Li	Yield	S841	ALL	ALL	Rotating beam, loosley packed Ta target. Can be operated at high T, [illegible]ns expected
Aug 15 - Sep 11 4 weeks	HPTa	TRILIS								
Sep 12 - Oct 2 3 weeks	UCx	TRILIS								[illegible]experiments, [illegible]be used to [illegible]extrapolation to likely graphite target yield for intense 7Be beams (last step?)

Beam Development very successful so far:
TIS & Beam Delivery Groups worked very hard! Thank you!
Much learned & gained. New elements. New isotopes. ✓

Beam Development Strategy

- Moving Forward:
  - Consultation with Users through Facility or Experiment Collaborations to be sent out this month
  - Prioritize LOIs / Experiments that require beam development
  - “Top Five” List
  - This will help focus development, allow user feedback and be current

User Support Updates

- We have a new user support system:
  - User liaison coordinator: M. Pavan
  - User liaison scientists
    - SAP RIB: M. Alcorta
    - CMMS Rib and muSR: I. KcKenzie
    - Pion, muon, electron, and proton test beam: S. Yan
    - Science technology services: T. Lindner

  - Will help with on-boarding, EEC-proposals, beam requests, setting-up of experiment, etc
  - User survey after experiment or service completion

User Support Updates

User Liaison Scientists

The Liaison Scientists assist visitors with their technical needs, including:

- proposal writing and submission
- beam time requests
- project initiation
- equipment transport to TRIUMF
- access to local infrastructure
- safety orientations and report preparations

The Liaison Scientists are available if there are any questions or concerns about an experiment.

CMMS
Dr. Iain McKenzie is the Liaison for the Centre for Material and Molecular Science. He is responsible for all material and molecular science experiments performed on the muons channels and the nanoLIME facility.

Iain can be reached at:

- iain.mckenzie [at] triumf [dot] ca
- 1-604-222-7355 (direct)

Nuclear Physics with Isotope Beams
Dr. Martin Alcorta is the Liaison for nuclear physics experiments involving isotope beams at ISAC and ARIEL.

Martin can be reached at:

- malcorta [at] triumf [dot] ca
- 1-604-222-7419 (direct)

Science Technology Services
Dr. Thomas Lindner is the Liaison for users requiring help from the Science Technology Detachment e.g. detectors and instrumentation.

Thomas can be reached at:

- lindner [at] triumf [dot] ca
- 1-604-222-1047 ext 6151

Non-muon Experiments and Testing in Meson Hall
Dr. Stanley Yen is the Liaison for experiments and testing utilizing the M11 beam channel in the Meson Hall.

Stan can be reached at:

- stan [at] triumf [dot] ca
- 1-604-222-7414 (direct)

Note: the M11 channel is not yet in operation (as of July 2017)

user support system:

ordinator: M. Pavan

entists

corta

l muSR: I. KcKenzie

ectron, and proton test beam: S. Yan

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n-boarding, EEC-proposals, beam
g-up of experiment, etc

er experiment or service completion

User (& Scientific Visitor) Liaison Coordinator

Dr. Marcello Pavan, can assist with general questions from experimenters:

- visit protocols
- safety training requirements
- travel and accomodation at TRIUMF
- information about Vancouver area
- all questions regarding the visitor experience at TRIUMF

and can point visitors to the appropriate Facility Liaison Scientist (see below) for more technical needs.

Marcello can be reached at:

- marcello [at] triumf [dot] ca
- 1-604-222-7525 (direct)

Conferences, workshops, summer schools; connect to users

- Theory Workshop in 2017

  "Progress in *Ab-Initio* Techniques in Nuclear Physics," Feb.28- Mar.03

- Winter Nuclear and Particle Physics Conference, Banff
  - Canadian conference to bring students and post-docs together:
  - Organized together with SNOlab and universities

- ARIS conference
  - Jointly organized by TRIUMF and FRIB/MSU
  - Flagship conference for RIB sciences
- APS DNP in Vancouver

- NuInt 2017
  - Neutrino Interaction conference
  - TRIUMF co-organizer
    with Toronto and York

TRIUMF

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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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