Status of Canadian contribution to HiLumi (and outlook to accelerator R&D)

Bob Laxdal

TRIUMF

2018-10-15


TRIUMF is Canada’s
particle accelerator centre


TRIUMF

TRIUMF

50 anniversary
anniversaire

www.triumf50.com


TRIUMF

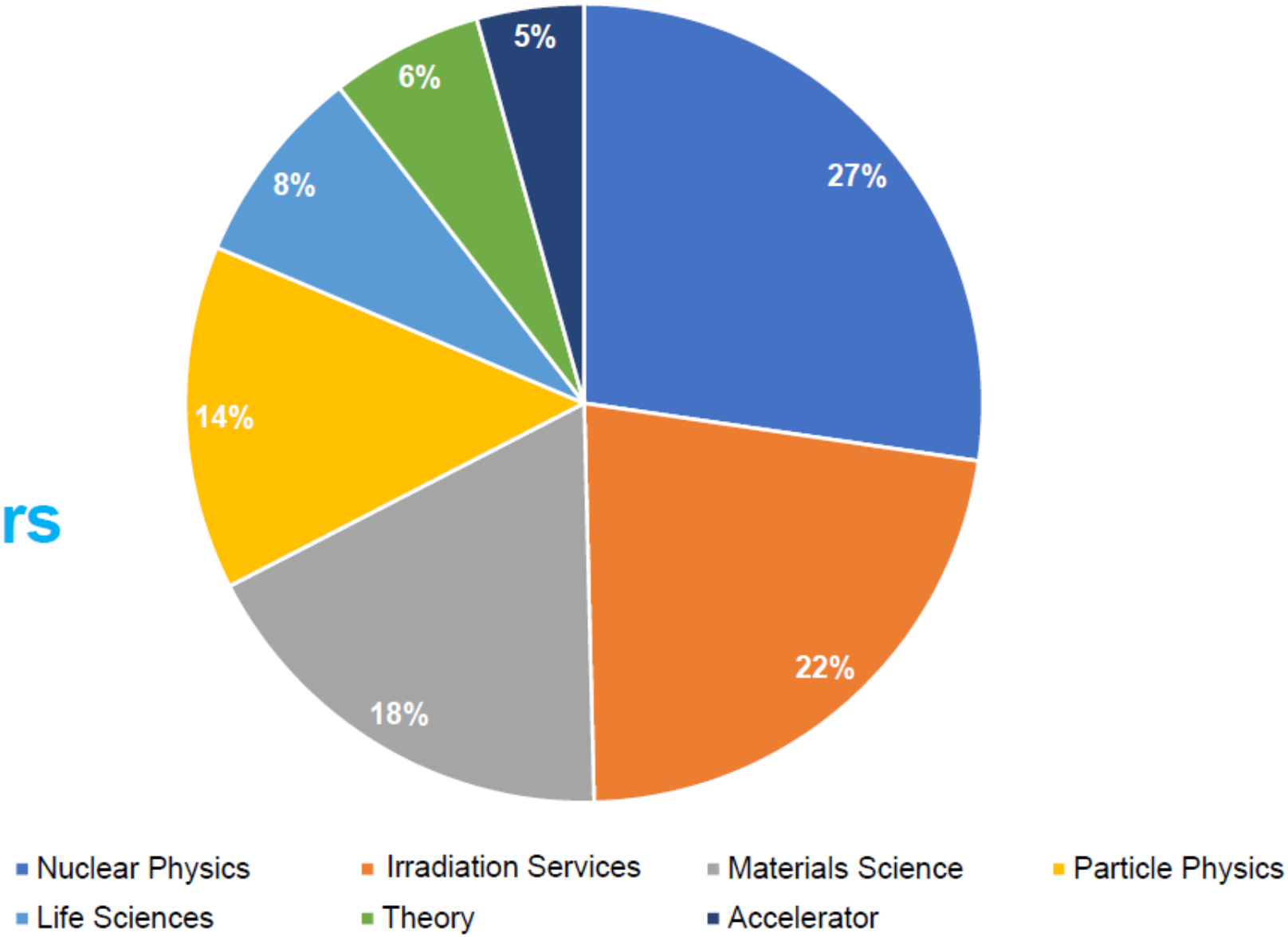
20 Member Universities

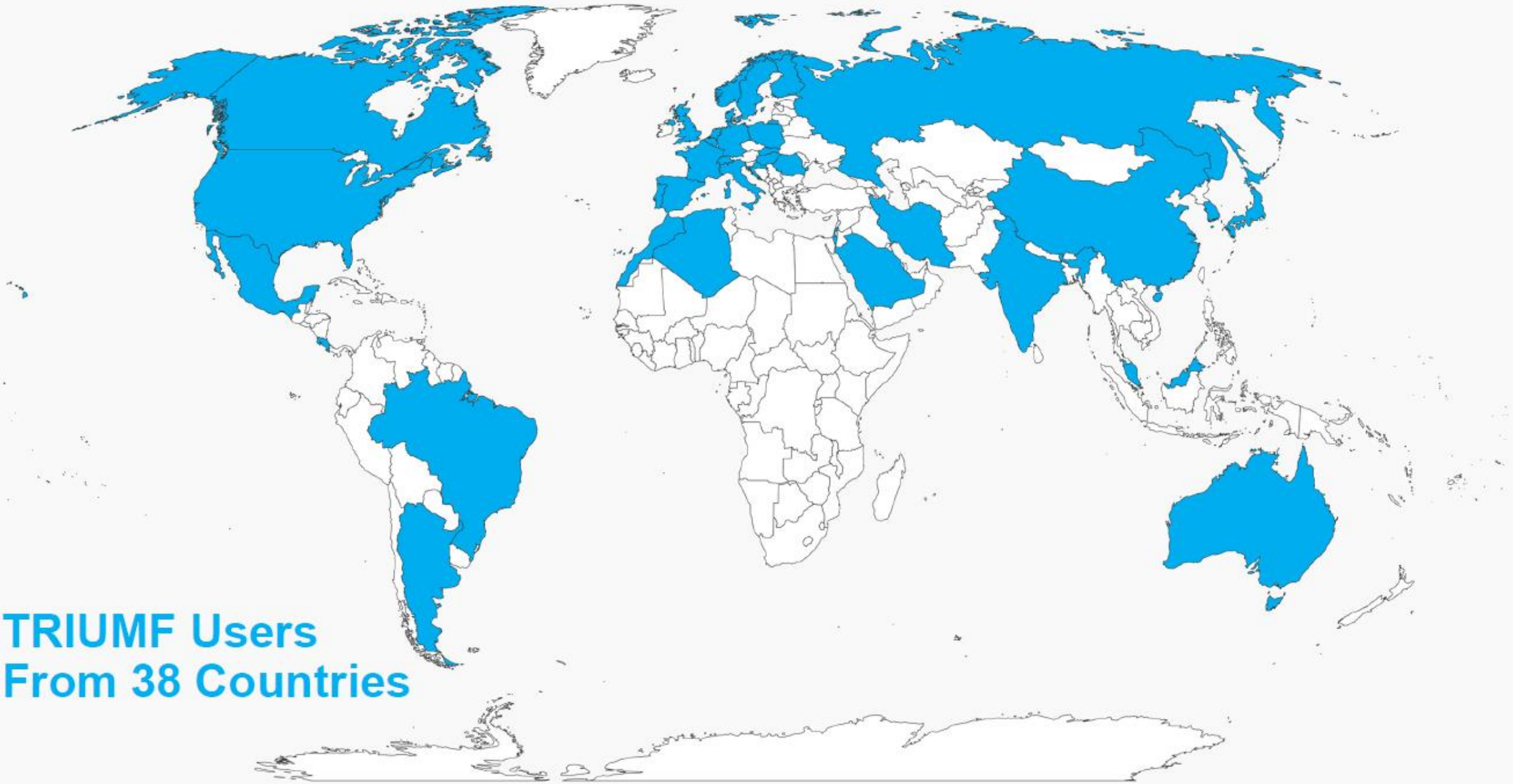
University of Alberta
University of British Columbia
University of Calgary
Carleton University
University of Guelph
University of Manitoba
McGill University
McMaster University
Université de Montréal
University of Northern
British Columbia
Queen's University
University of Regina
Saint Mary's University
Université de Sherbrooke
Simon Fraser University
University of Toronto
University of Victoria
Western University
University of Winnipeg
York University

Since 1968, TRIUMF has delivered 50 years of science and innovation for Canada

FY17/18:

875 Scientific Users and Visitors By Field

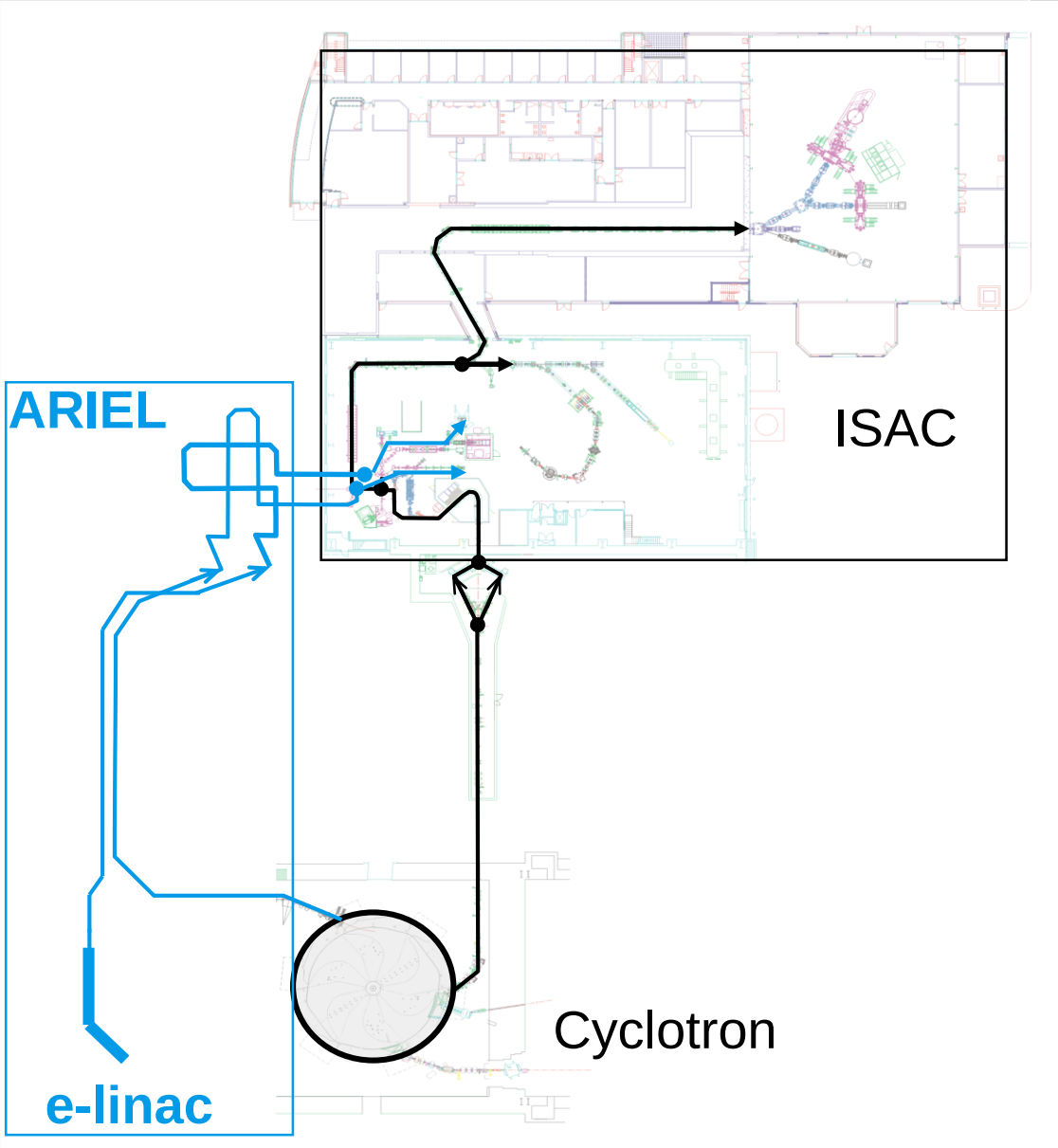




TRIUMF Users
From 38 Countries

ARIEL:
Advanced Rare Isotope Laboratory

Advanced Rare IsotopE Laboratory (2010-2023)

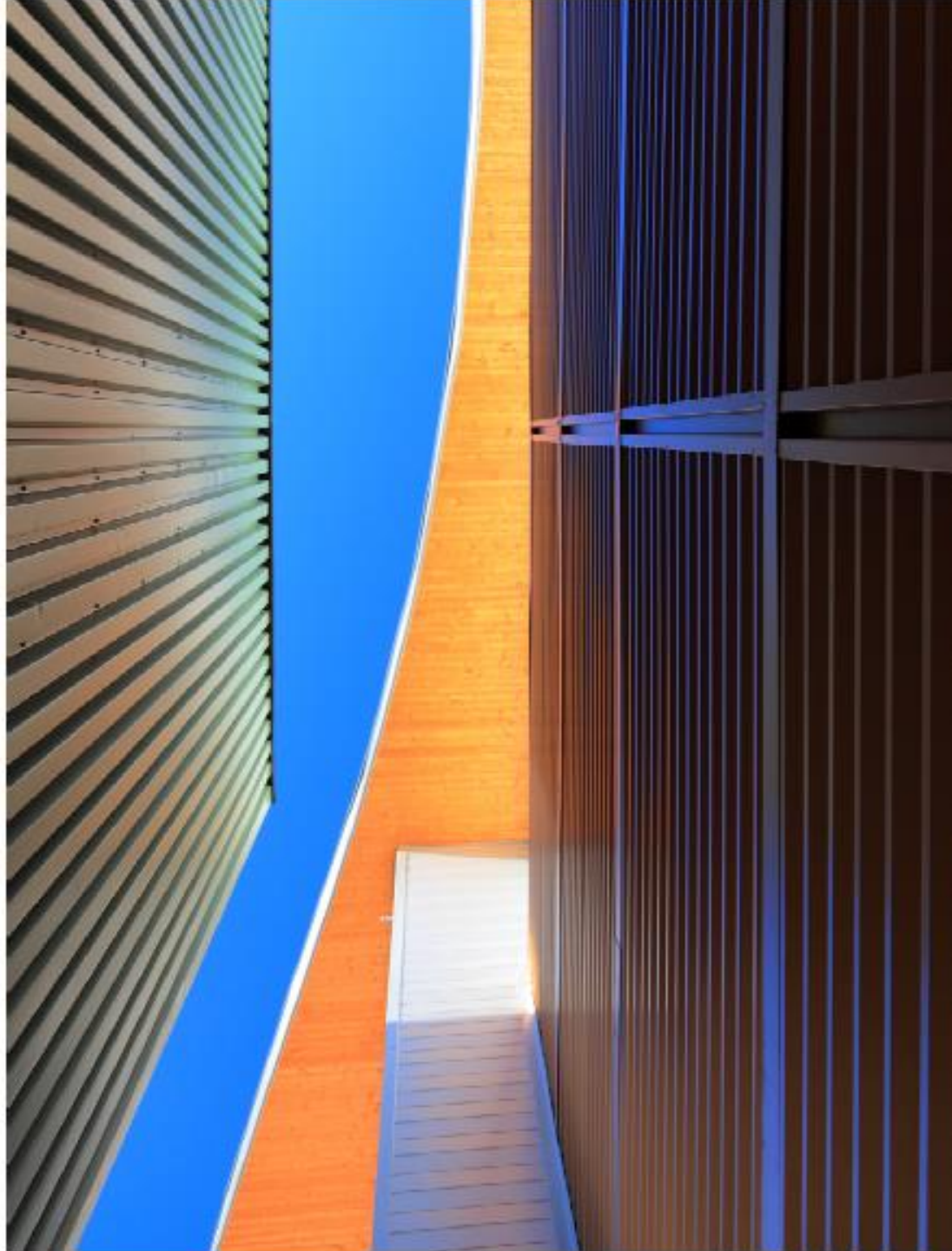


- ISAC: World class ISOL facility for the production and acceleration of rare isotope beams (RIB)
- ARIEL will allow up to three simultaneous RIB beams for ISAC
- Add e-Linac (30MeV 10mA cw - 1.3GHz SC linac) and target area to create RIBs via photo-fission
- Add a second cyclotron driver beam and target station

Status:

- 30 MeV e-linac installed and being commissioned
- New RIB transport and EBIS charge breeding system installed for commissioning in early 2019
- New electron and proton target ion source systems being designed and prototyped

First operations in 2019



50+

international agreements

CERN
Europe

KEK / J-PARC
Japan

VECC
India

Helmholtz Association
Centres
Germany

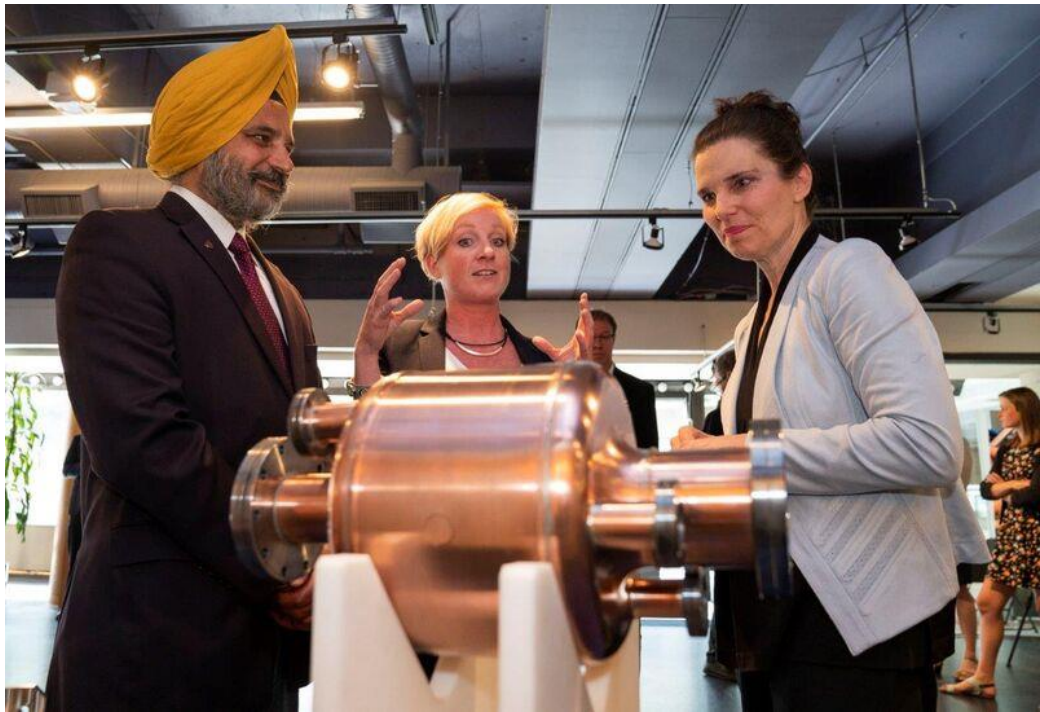
Department of Energy
Laboratories
USA

TRIUMF and Hi-Lumi RFD Cryomodules

June 25, 2018
“Great science knows no borders.” Minister Kirsty Duncan

Canadian Minister of Science and Sport Kirsty Duncan announces 10M$ support for TRIUMF to build 5 Hi Lumi LHC RFD Crab Cavity Cryomodules

Working with the Canadian research community and industry, TRIUMF will lead the production of the cryomodules with a $2 million in-kind contribution for a total project value of $12 million.



CERN-TRIUMF MOU – Addendum No. 3

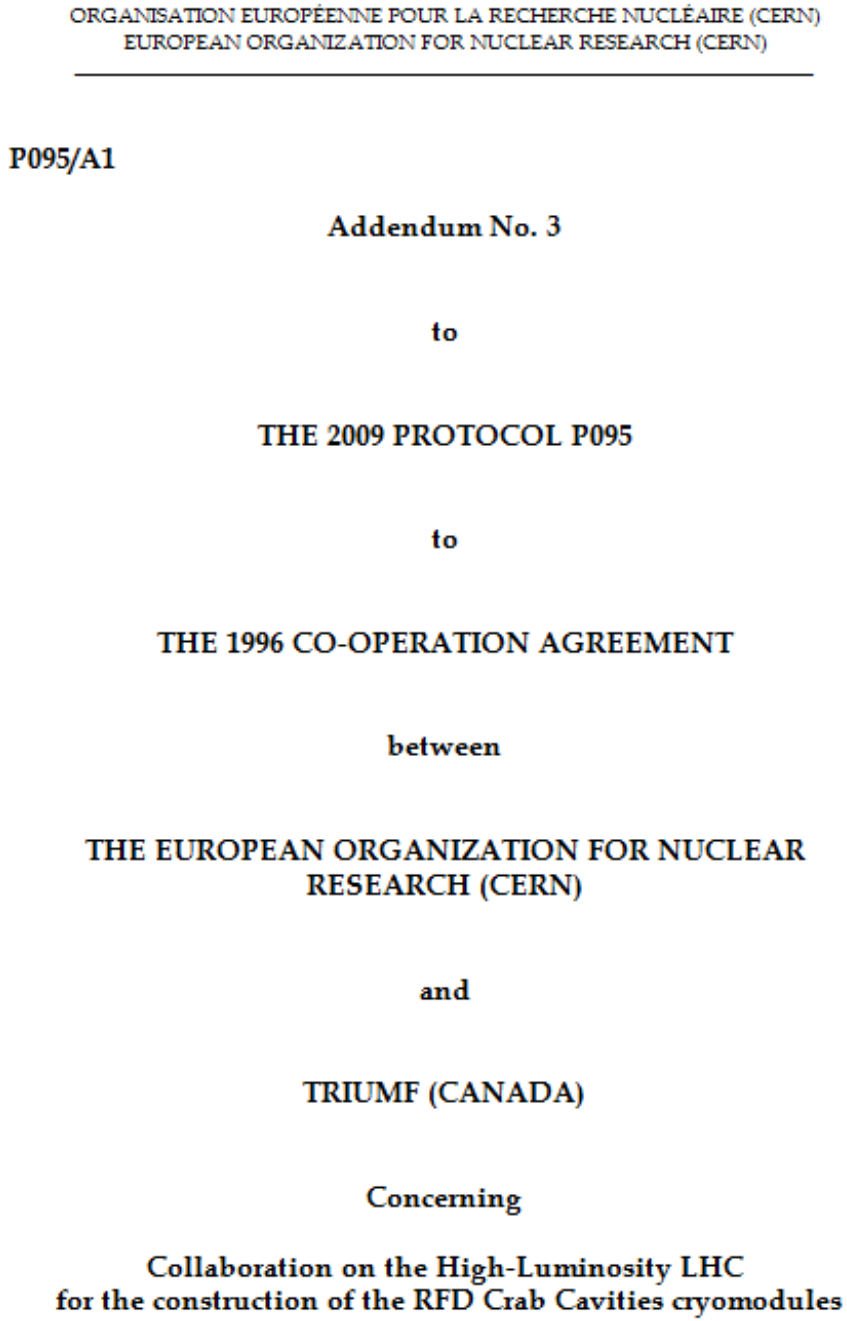
An agreement has been drafted – soon to be signed.

TRIUMF representatives on the Steering Committee
Jon Bagger – Director
Oliver Kester – Project Leader

TRIUMF's Technical Coordinator
Robert Laxdal – SRF Department Head

CERN representatives on the Steering Committee
Frédérick Bordry – Director for Accelerators and Technology
Lucio Rossi – HL-LHC Project Leader

CERN's Technical Coordinators and Safety Correspondents
Rama Calaga – HL-LHC Work Package 4 Leader
Ofelia Capatina – HL-LHC Work Package 4 Deputy Leader



ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE (CERN)
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

P095/A1

Addendum No. 3

to

THE 2009 PROTOCOL P095

to

THE 1996 CO-OPERATION AGREEMENT

between

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

and

TRIUMF (CANADA)

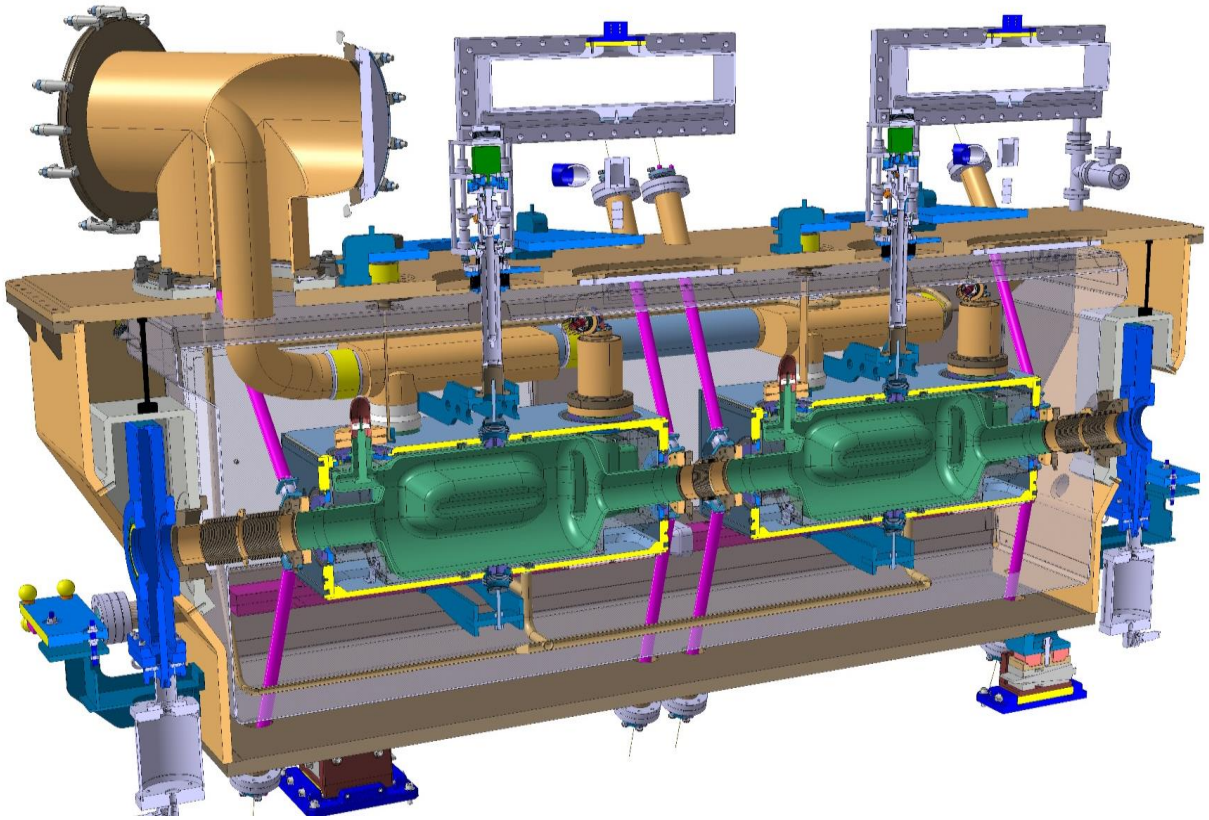
Concerning

Collaboration on the High-Luminosity LHC
for the construction of the RFD Crab Cavities cryomodules

HiLumi RFD Cryomodules

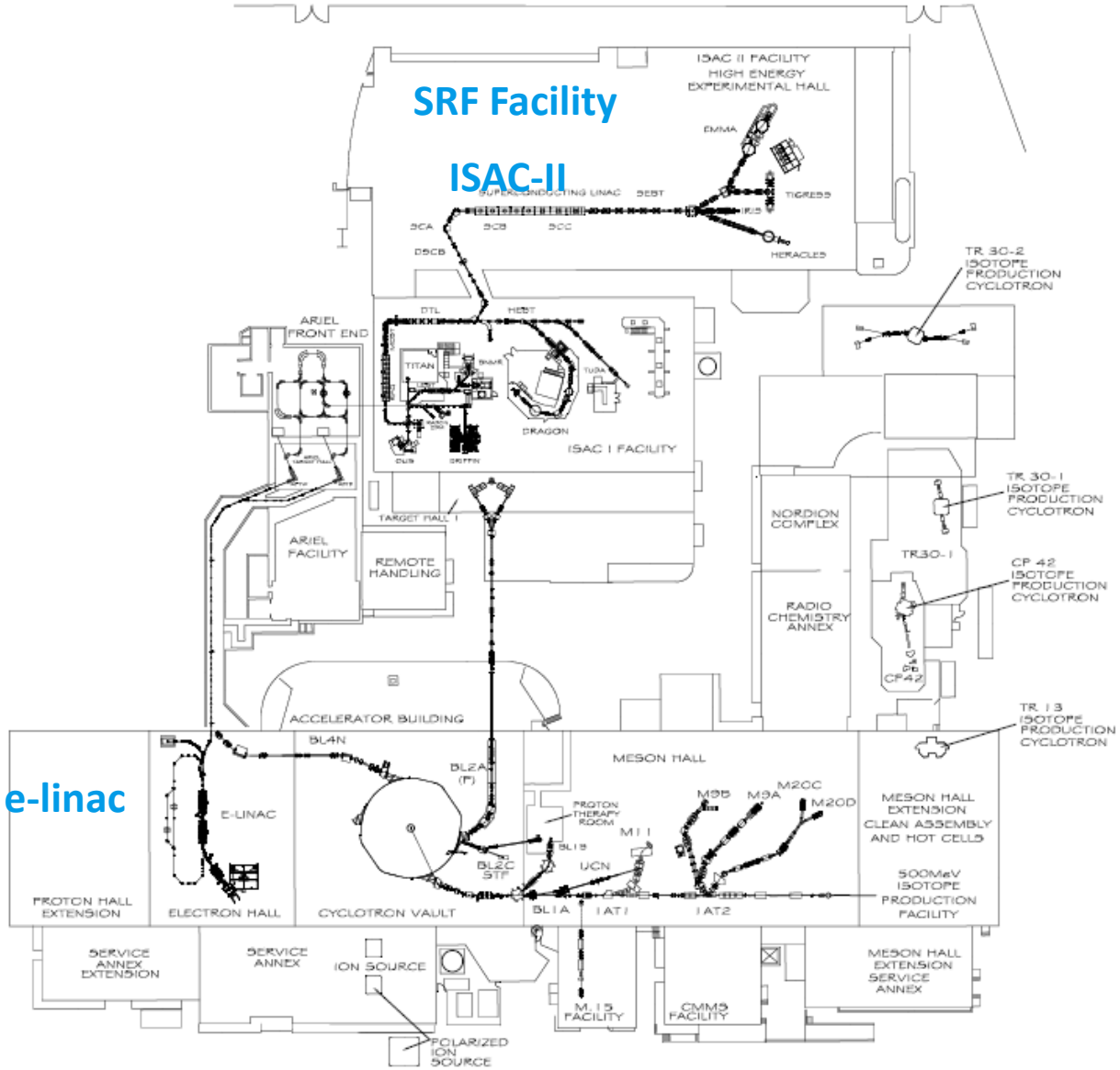
TRIUMF shall contribute to the construction of five (5) RFD Crab Cavity cryomodules

- Qualified RFD crab cavities will be delivered to TRIUMF
- TRIUMF will assemble the cavities into cryomodules and qualify the CMs
- Deliverables:
  - Documentation of fabrication and performance tests
  - The shipment of the five Cryomodules to CERN, according to the packaging and transport specifications
  - All tooling necessary for the maintenance and repair at CERN



TRIUMF SRF Program

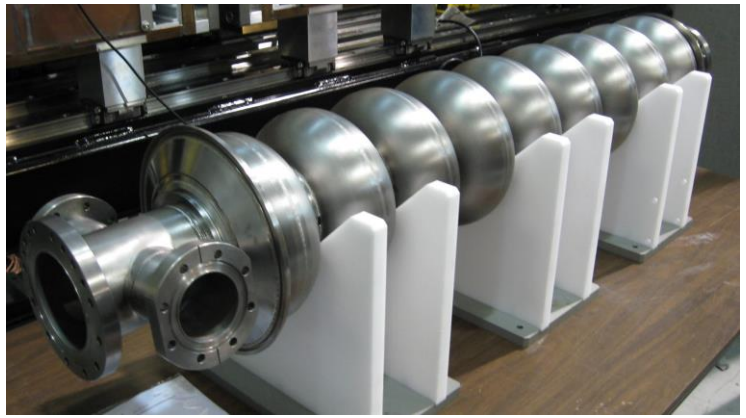
- Program initiated in 2000 to support the development of the ISAC-II heavy ion linac
- TRIUMF now has two SC linacs installed – the 40MV ISAC-II heavy ion linac and the 30MeV ARIEL 1.3GHz electron linac
- We have an active program in student based SRF research and Work for Others to augment our operational capabilities

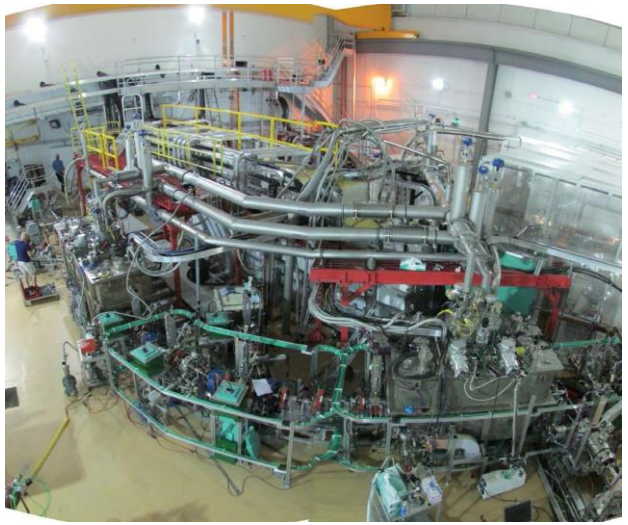


TRIUMF SRF Accelerators

40MV ISAC-II SRF heavy ion linac @ 106MHz - operational since 2006

30MV ARIEL SRF 10mA electron linac @ 1.3GHz – first beam 2014





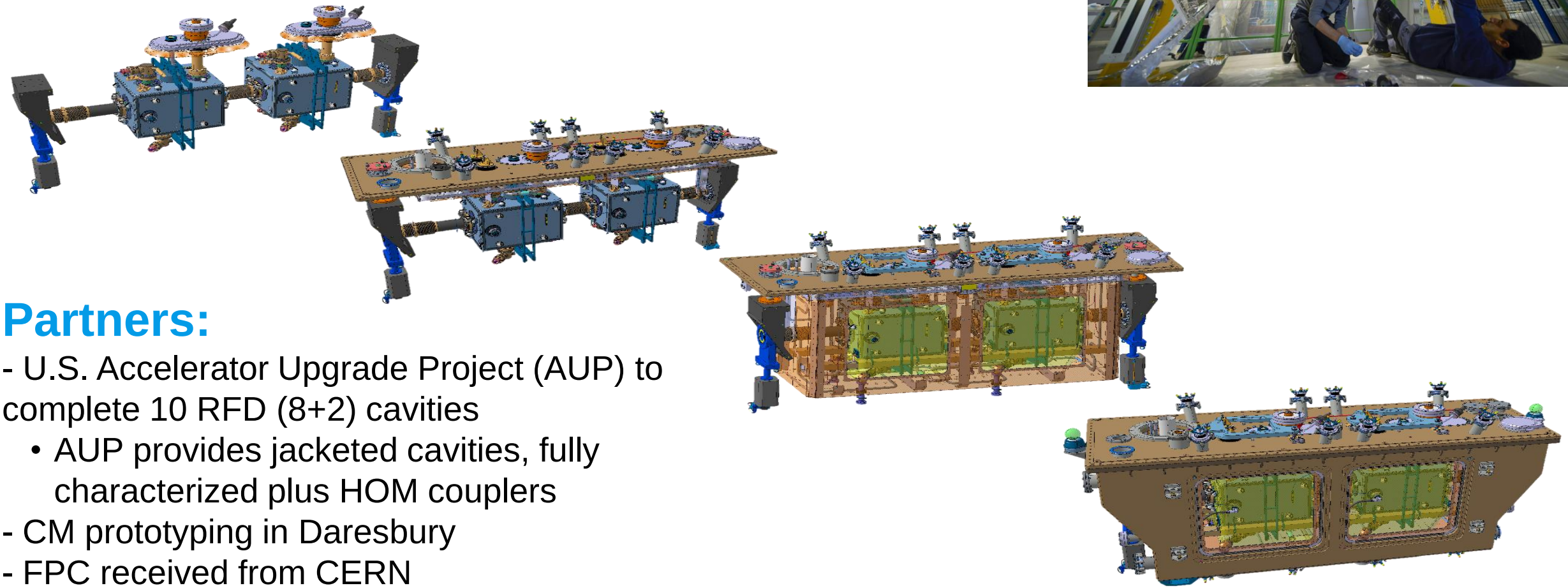
TRIUMF and SRF Cryomodules

TRIUMF has designed 5 CM variants and fabricated and tested 11 CMs in the last 14 years

The ARIEL ACM cryomodule (below) is similar in size and complexity to the Hi-Lumi RFD cryomodule

Rough assembly sequence – similar to ARIEL e-Linac

Assembly infrastructure exists from e-Linac assembly



Partners:

- U.S. Accelerator Upgrade Project (AUP) to complete 10 RFD (8+2) cavities
  - AUP provides jacketed cavities, fully characterized plus HOM couplers
- CM prototyping in Daresbury
- FPC received from CERN

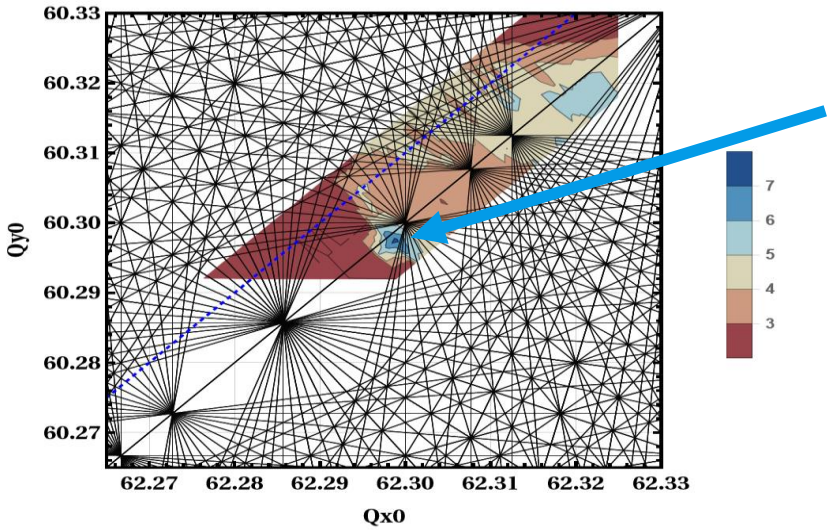
Technical details in discussion

TRIUMF and Hi-Lumi Beam Physics

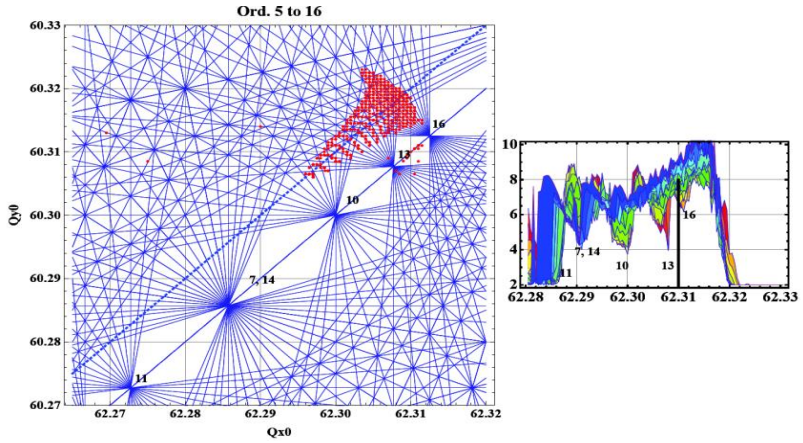
Collaboration on Beam Dynamics of High-Luminosity LHC (Extended Domain Tune Scans - D. Kaltchev, et al, IPAC18)

Tune-scans: looking for dependencies of the dynamic aperture (DA) of HL-LHC on the tune working point

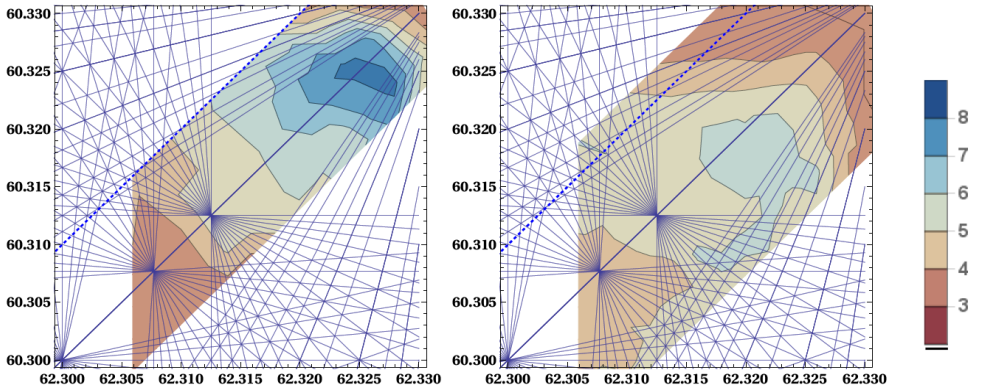
- cover 1-D (linear) and 2-D tune domains considering beam-beam and field errors
- part of a detailed tracking campaign aimed at luminosity optimization and identification of operational scenarios for the HL-LHC.



Alternative working point was found with good DA ~7 sigma. A candidate for future studies.



1D tune-scan: footprint and resonances (left) and Min DA (right)



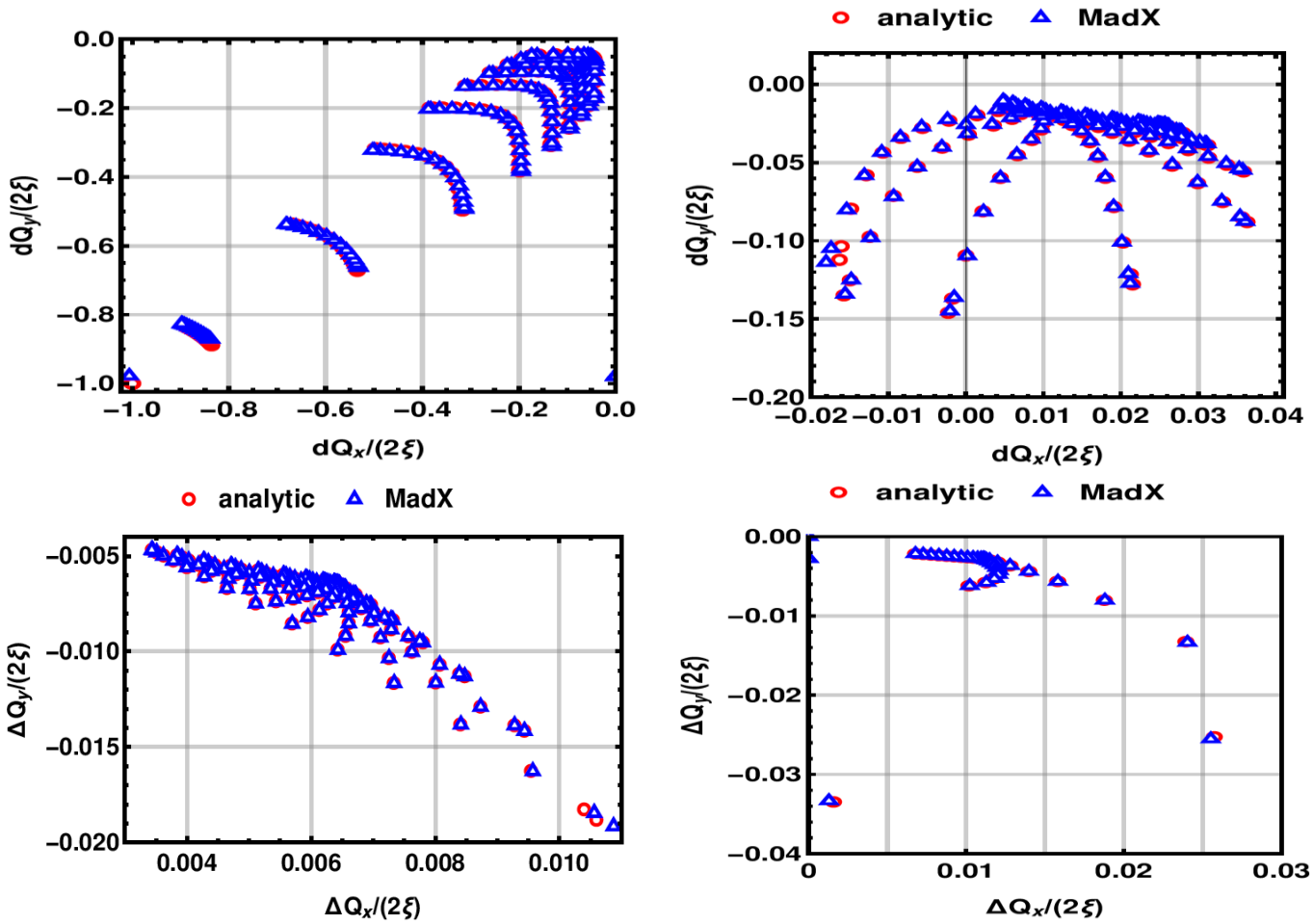
2D tune-scan under leveling scenario: Min DA > 6 sigma

Fourier Coefficients of Long-Range Beam-Beam Hamiltonian via Two-Dimensional Bessel functions (D. Kaltchev, IPAC18)

Objective: Advance the theory of motion in the presence of multiple long-range beam-beam interactions

Most promising are analytical calculations of the combined action of all long-range collisions (as an effective Hamiltonian).

There is good agreement between the analytical model and Mad-X tracking.



Agreement between model and Mad-X tracking for different collision points in HL-LHC: Head-On, Long-range, round or flat- beam collision

Summary

TRIUMF has secured funding to construct and deliver five RFD Crab Cavity cryomodules to the HiLumi LHC Project in Collaboration with CERN and Hi-Lumi partners.

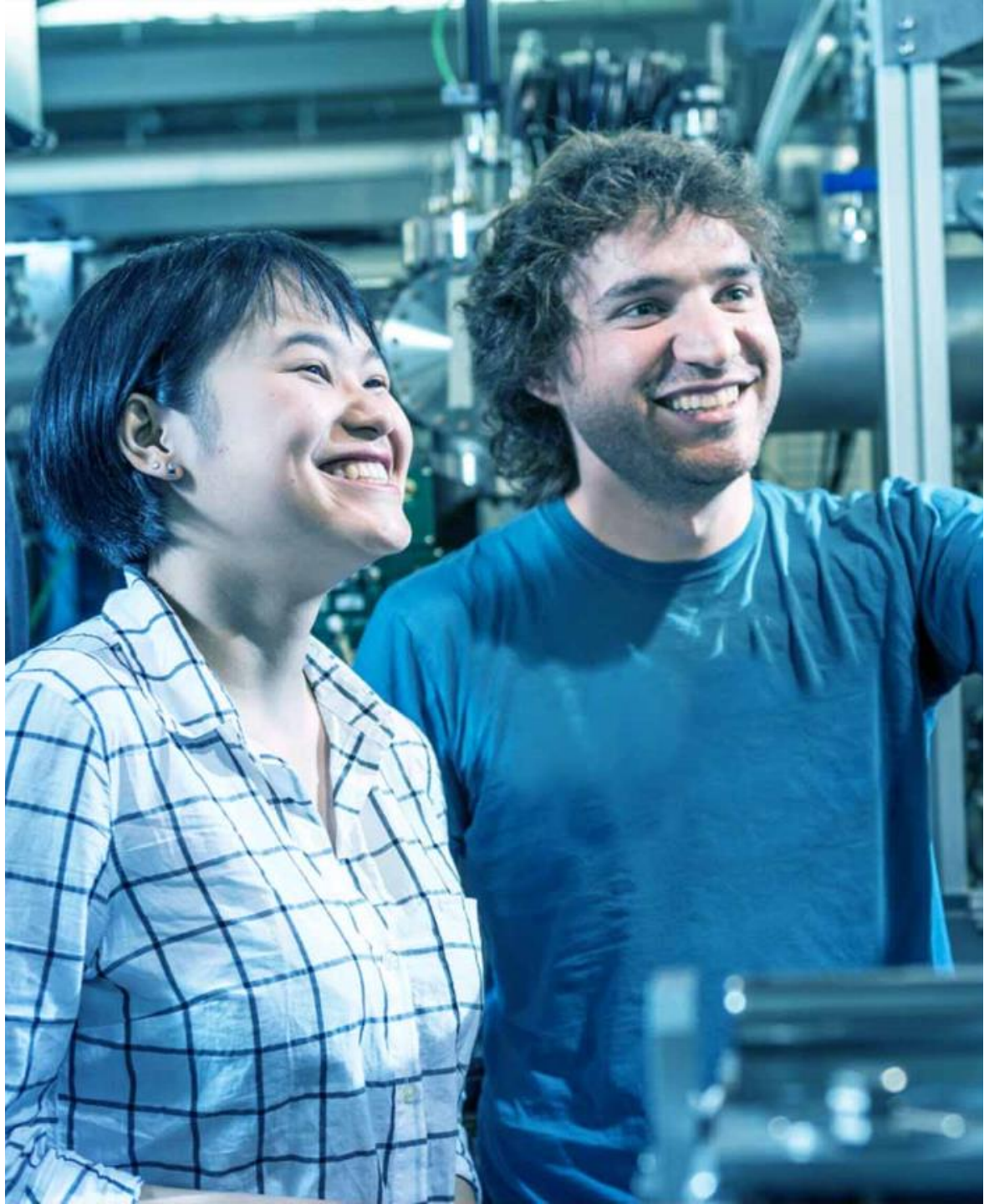
Status: Addendum 3 to CERN-TRIUMF MOU is in preparation. Technical meetings are being held this week.

In addition TRIUMF is contributing 1FTE (D. Kaltchev) and one student to on-going HiLumi Beam Dynamics Investigations.

Thank you
Merci

www.triumf.ca

Follow us **@TRIUMFLab**



Discovery, accelerated