

CANADA FOUNDATION FOR INNOVATION

## MSIF Workshop Panel 3

**Keeping Canadian facilities at the global forefront as technology rapidly changes and new opportunities and challenges arise / Maintenir les installations de recherche canadiennes sur le devant de la scène mondiale, compte tenu de l'évolution rapide des technologies et donc de l'apparition de nouvelles opportunités mais aussi de nouveaux défis**

**Moderator: Mark Boland, Machine Director, CLS / CCRS**

**Naveed Aziz, CEO, CGEn**

**François Légaré, Scientific Head, ALLS/ LSF**

**Warren Wakarchuk, Scientific Director, GlycoNet Integrated Services / SIG**

November 2, 2023

**INNOVATION**

Canada Foundation  
for Innovation

Fondation canadienne  
pour l'innovation

# GlycoNet Integrated Services – Facility Update

**Mission:** *Enable the translation of glycomics research into real-world applications, commercialize technologies and create socioeconomic value.*



Presentation to CFI-MSI November 2, 2023

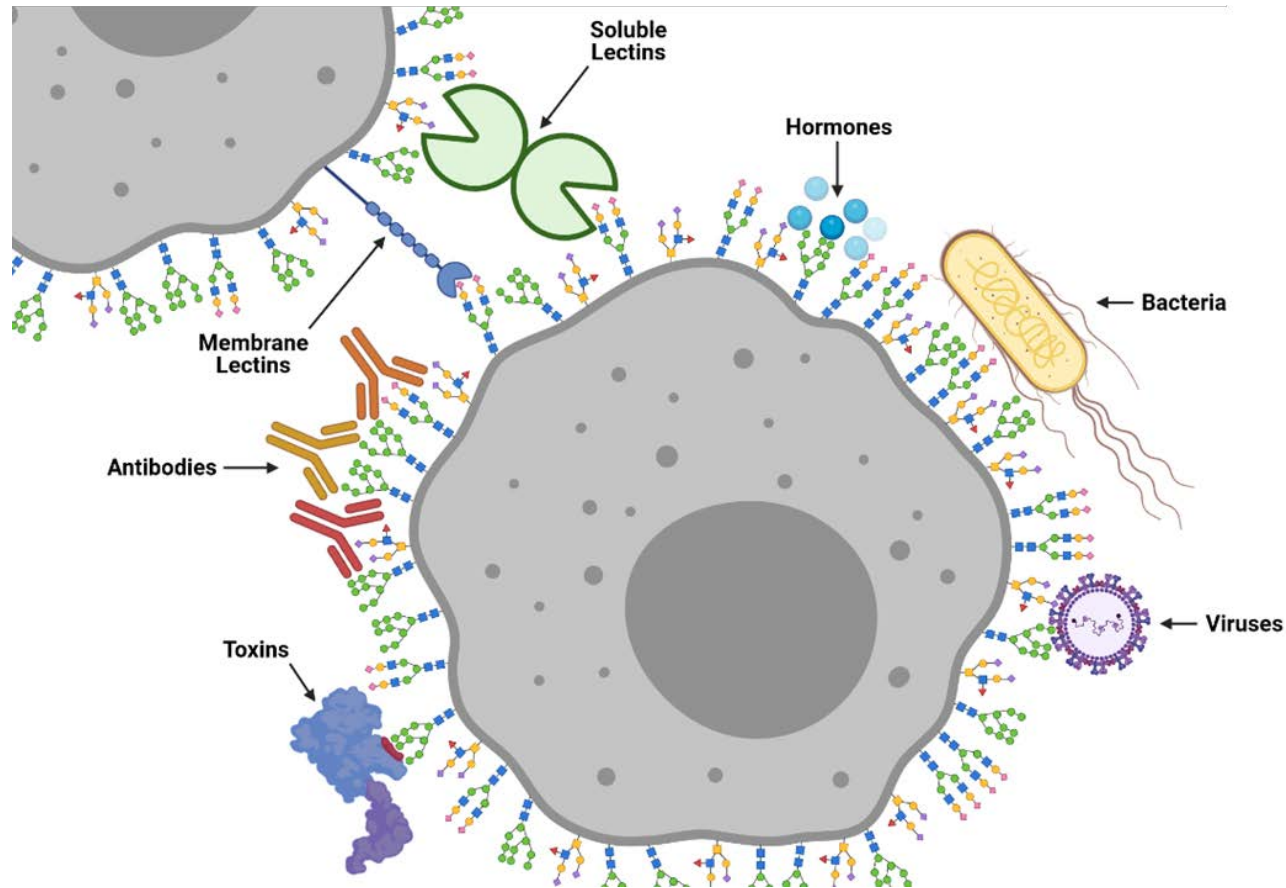
# Goals of the Panel Discussion

---

*This panel will discuss challenges and opportunities created by rapidly evolving analytical tools and instruments and how research facilities continue to enable state-of-the-art science. The panelists will discuss strategies to address obsolescence, retrain staff on new instrumentation and extend the useful life of infrastructure.*

# GlycoNet Integrated Services

## Why We Care about Glycomics



- Glycans coat all cells – and as such are responsible for molecular recognition in biology
- This means they are intimately involved in health and disease
- *This information is not encoded in our DNA*

# One of World's Most Comprehensive Suite of Glycomics Services Canada is a Global Leader in the Field of Glycomics!

Services Offered	GIS	US CCRC	US NCFG	San Diego	Adelaide	Griffiths access ?
Synthesis	●					
HTS Screening	●●●					✓
Glycan–Ligand Screening	●	✓				✓
Glycan Discovery	●	✓	✓			✓
Glycan Analysis	✓	✓		✓	✓	✓
Glycan Engineering	✓				✓	✓

*\*Unique technologies offered*

Glyconeer and  
expertise!

HTS x 3 unique  
expertises

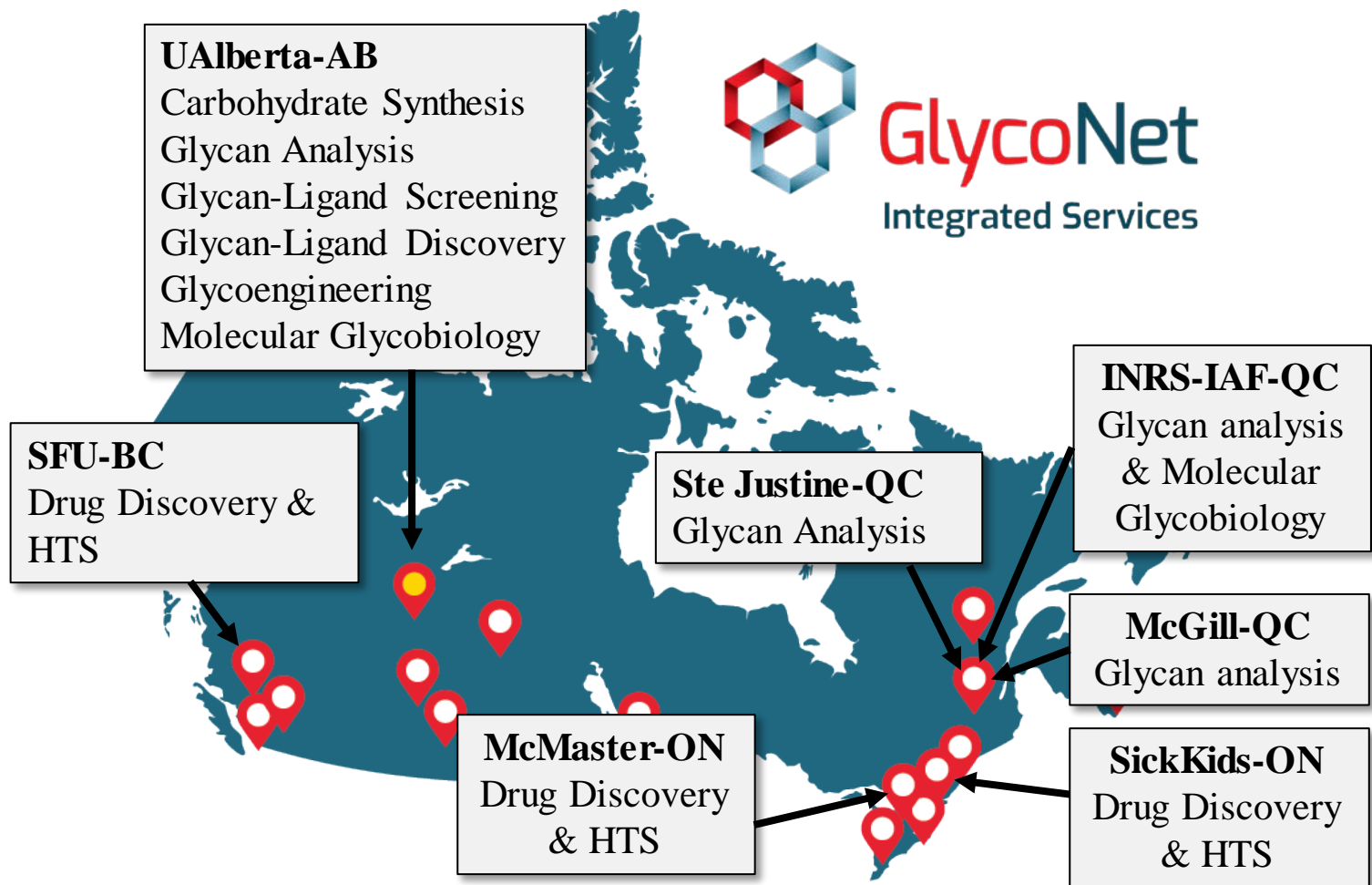
Unique MS  
15T-FT-ICR

LiGA – bar  
coded library



**GlycoNet**  
Integrated Services

# GlycoNet Integrated Services – the Current Nodes

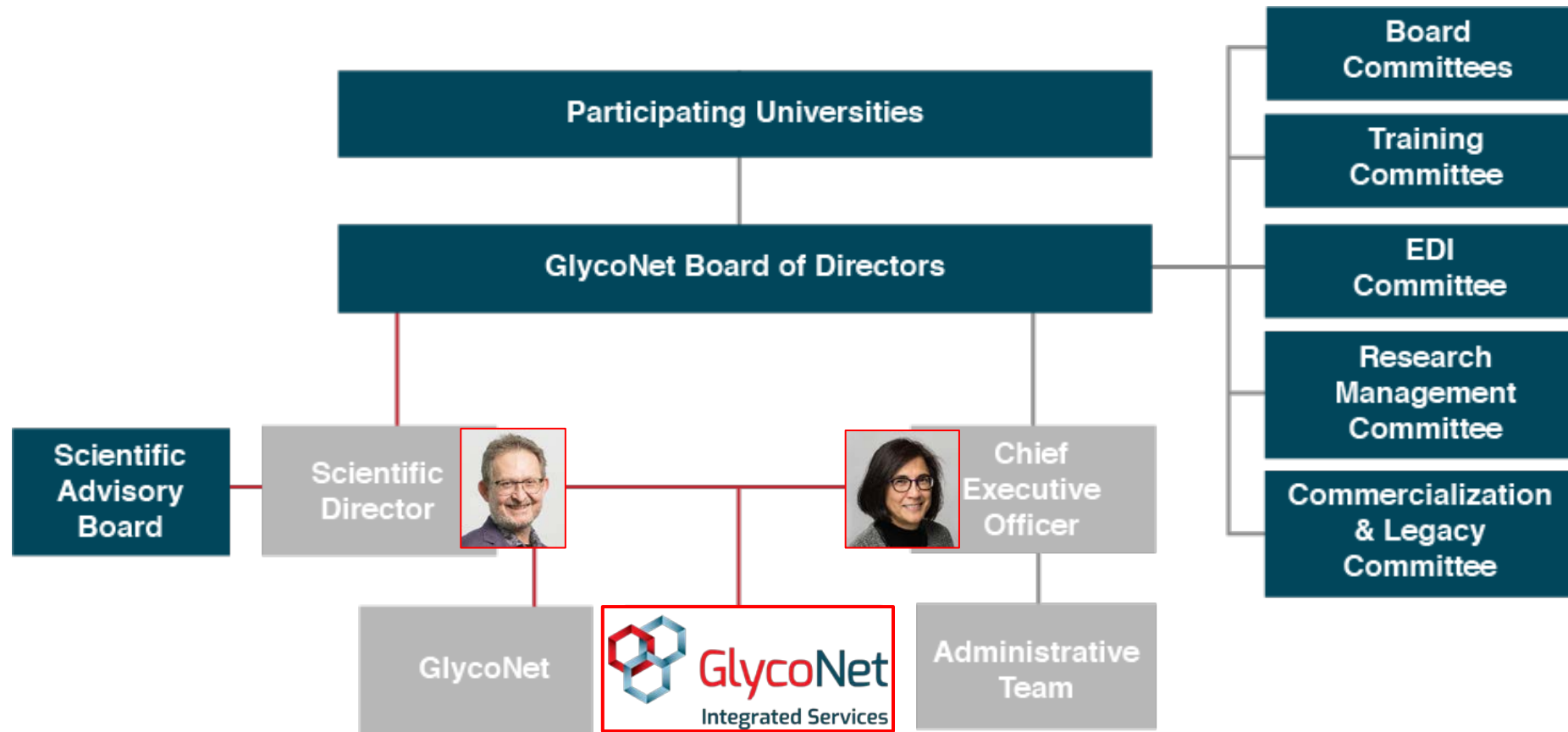


## GlycoNet's Current Network

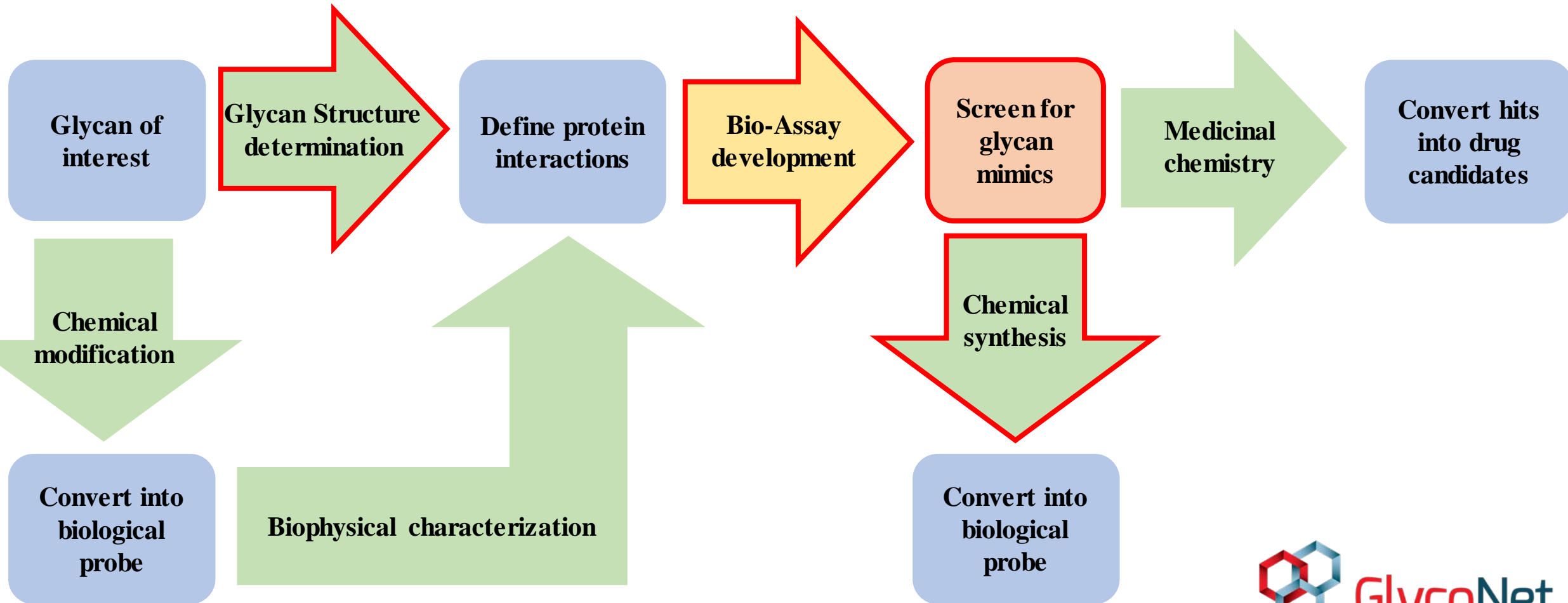
- 193 Laboratories
- 36 Academic Institutions
- 161 Partners
- 147 Projects
- 665 Trainees



# Governance: GIS is Part of GlycoNet



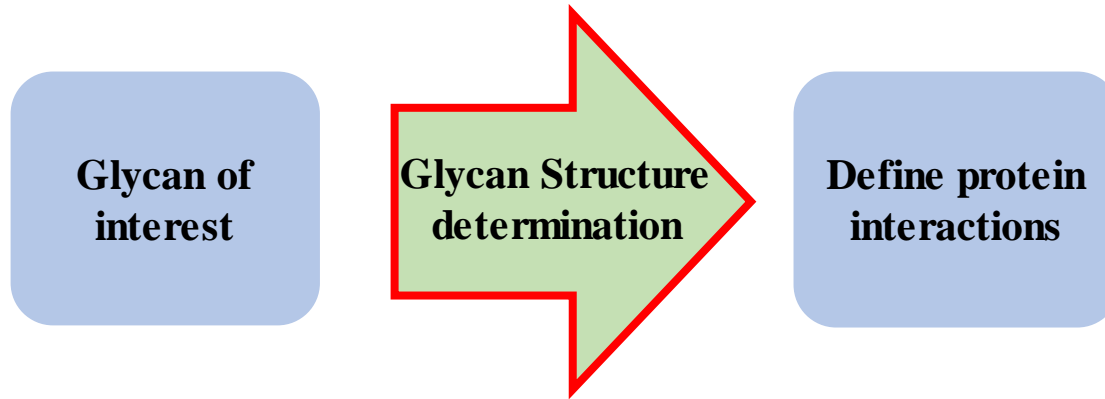
# An Integrated Pipeline of GIS Services from Glycan to Pre-Clinical Drug Candidate





# Where are the challenges and opportunities?

## Glycomics Analysis – the Physical and Bio-Informatics

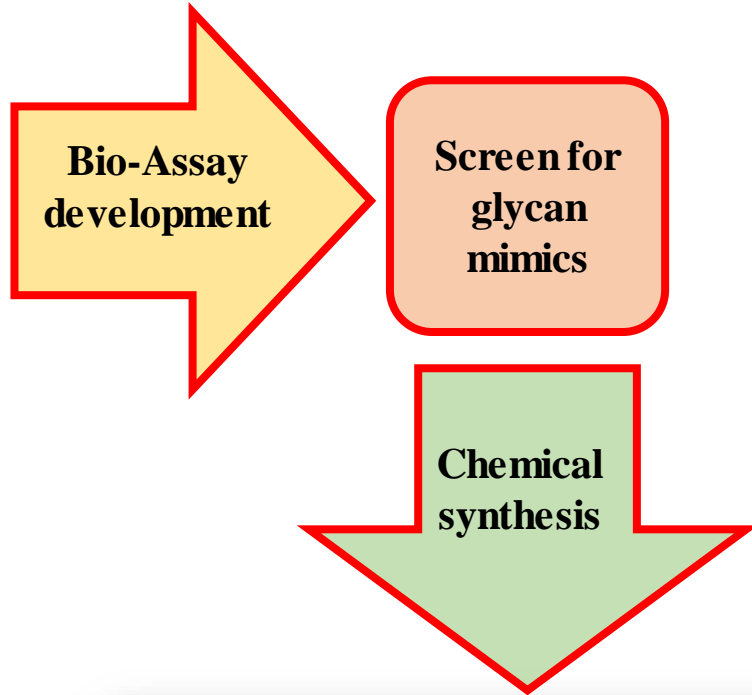


Challenges	Opportunity
- Integration of omics databases – data formats are not compatible – large amounts of data need to be incorporated	- <b>AI and ML</b> can be applied to link databases – international cooperation is growing, GIS has started on this process
- Trained personnel are hard to find	- Providing training through GIS to <b>keep the expertise in Canada</b>

60% matching required!

# Where are the Challenges and Opportunities?

## High Throughput Screening for New Therapeutics



Challenges	Opportunity
- Patient cell-based assays are needed for efficient screening, as standard cell lines are not representative.	- GIS has many patient cell-based screening protocols, and has been at the <b><i>forefront of developing molecules for cell-based assays in Glycomics</i></b>
- Specialized chemical probes and substrates are required for screening in cells	- <b><i>GIS has world leading expertise in chemical biology for glycan applications!</i></b>



# GIS Going Forward

---

- Heavy reporting requirements – *collection of data from 7 different nodes*
  - *We have developed an internal LIMS which collects data to help with the reporting – still in development but is needed for complex data collection!*
- Attraction and Retention of HQP – where does the salary come from?
  - *Technology development is strong and can support some of this.*
- *Services for academic labs can be expensive*, it is not always possible to offset that with company services.



# Canada Foundation for Innovation MSIF Workshop

November 2, 2023



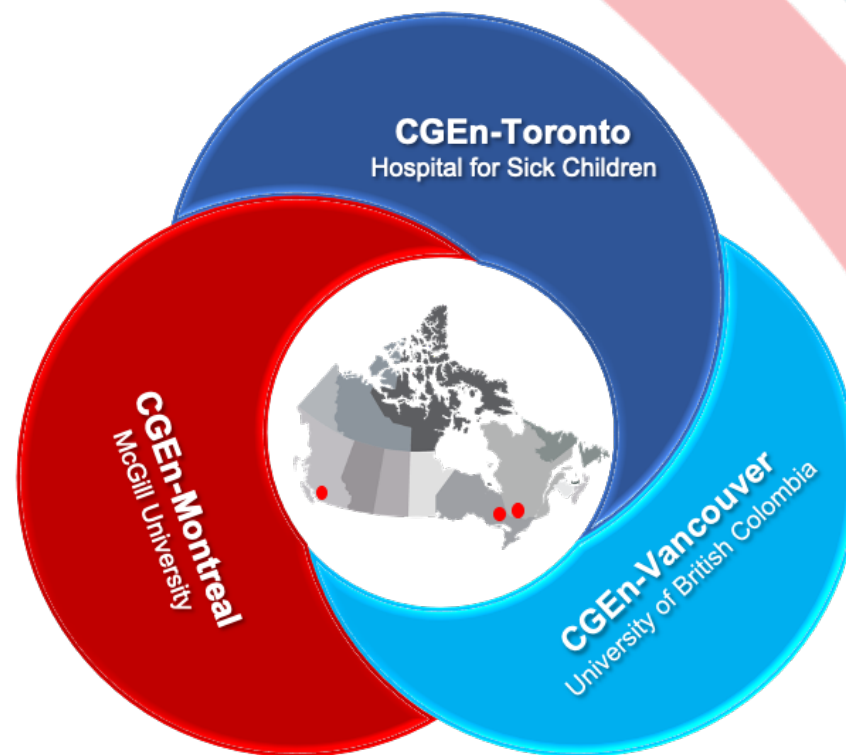
**Dr. Naveed Aziz**  
Chief Executive Officer, CGEn



## Canada's national platform for genome sequencing and analysis

CGEn provides complete high-throughput, low-cost, and high-quality sequence generation and analysis services to decode whole genomes from humans and other species.

Primarily as a Major Science Initiative (MSI) of the Canada Foundation for Innovation (CFI) from 2017-2023 & 2023-2029, CGEn is supported by a number of partners including host institutions, provincial funders and Genome Canada.



# Canada's National Platform for Genome Sequencing & Analysis

## STRATEGIC PRIORITIES:

ENHANCE | ACCELERATE | SUPPORT

### Vision

To serve as Canada's engine for genomics-enabled research and discovery, supporting a healthier and more sustainable future for all Canadians.

### Mission

1. Enhance Canada's national capacity for genome sequencing and informatics analysis.
2. Accelerate next-generation scientific solutions underpinned by large-scale data generation.
3. Support Canadian national and international projects in sequencing, databasing and open science collaborations.

### Core Competencies

- |  |  |
|--|--|
|  DATA GENERATION  |  TOOLS DEVELOPMENT  |
|  DATA STEWARDSHIP |  TALENT DEVELOPMENT |

## STRATEGIC VISION

2025



1 Enable Large-scale Human Genome Sequencing Data Generation



2 Standardize, Assemble & Leverage Disease Specific Clinical Data



3 Support Sequencing of Species Critical to Canadian Biodiversity



4 Develop Powerful & Efficient Data Storage & Sharing Solutions

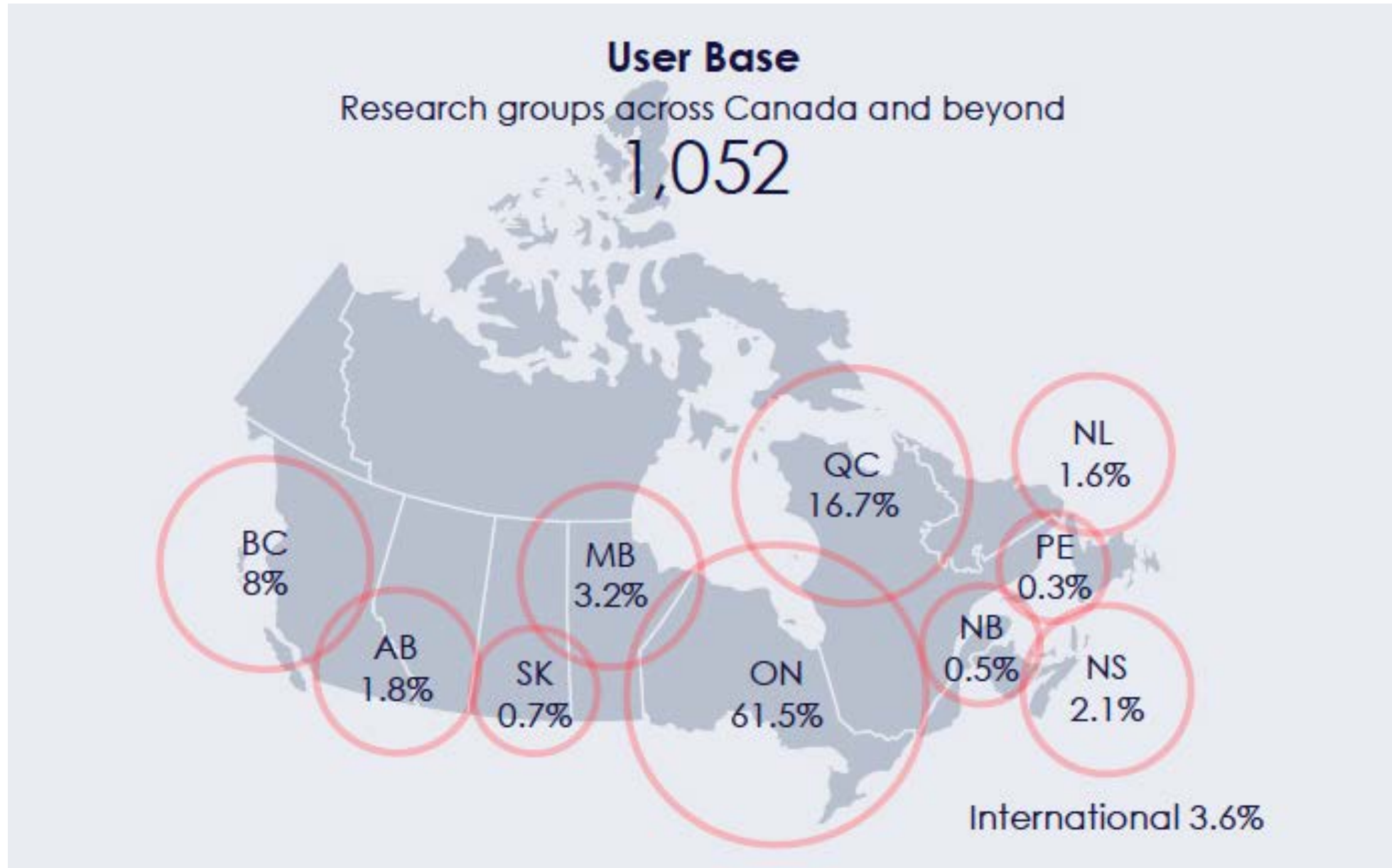


5 Lead Technology Development Through Innovation & Integration



6 Educate, Diversify & Enrich Canadian Talent Pool

# Geographic Distribution of CGEn Users 2022-23



# Keeping Canadian facilities at the global forefront as technology rapidly changes and new opportunities and challenges arise

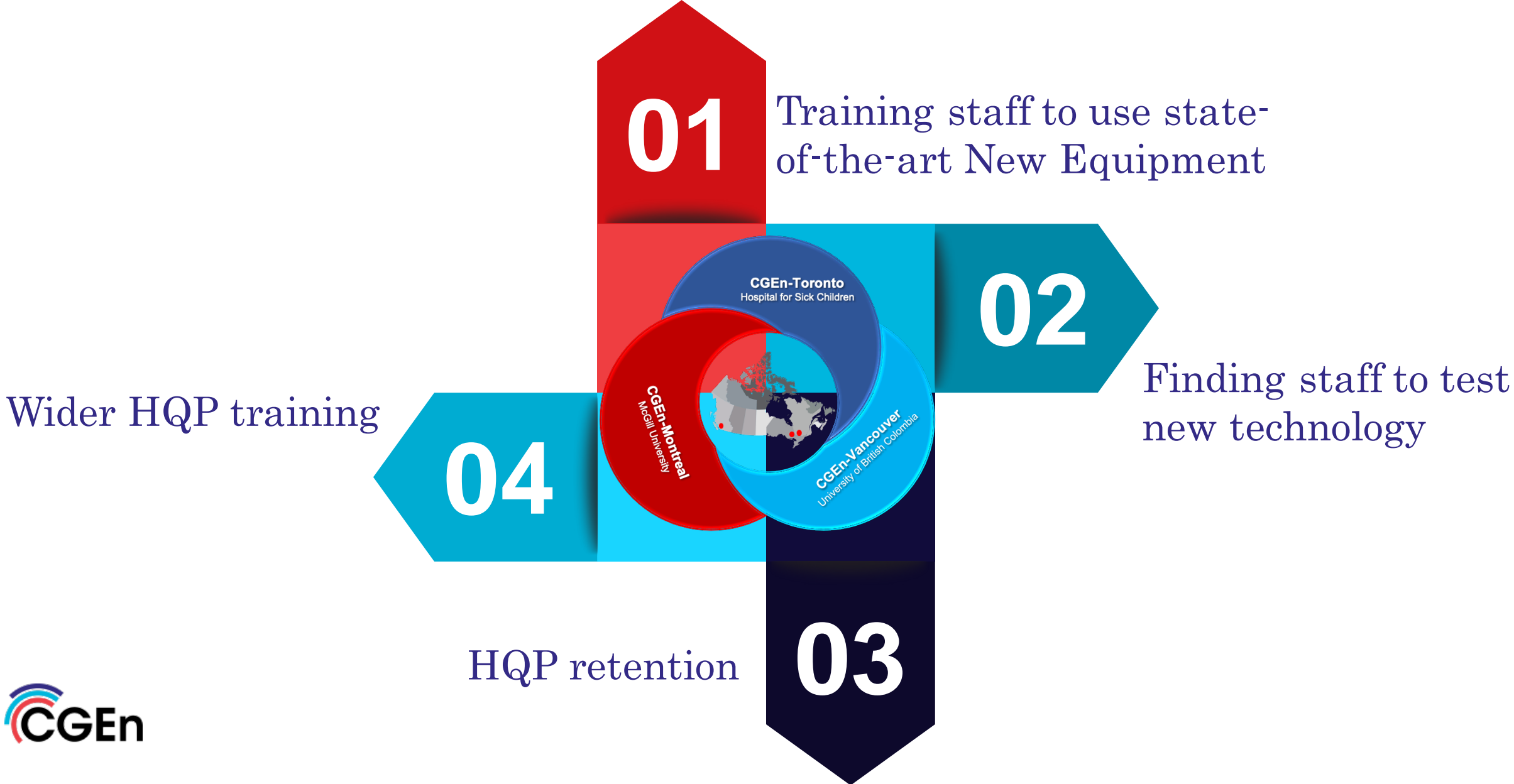
1. Managing Rapid Change in Technology
2. Training & Retention of HQP
3. Constant Pressure of Match'ed Funding



# 1. Managing Rapid Change in Technology

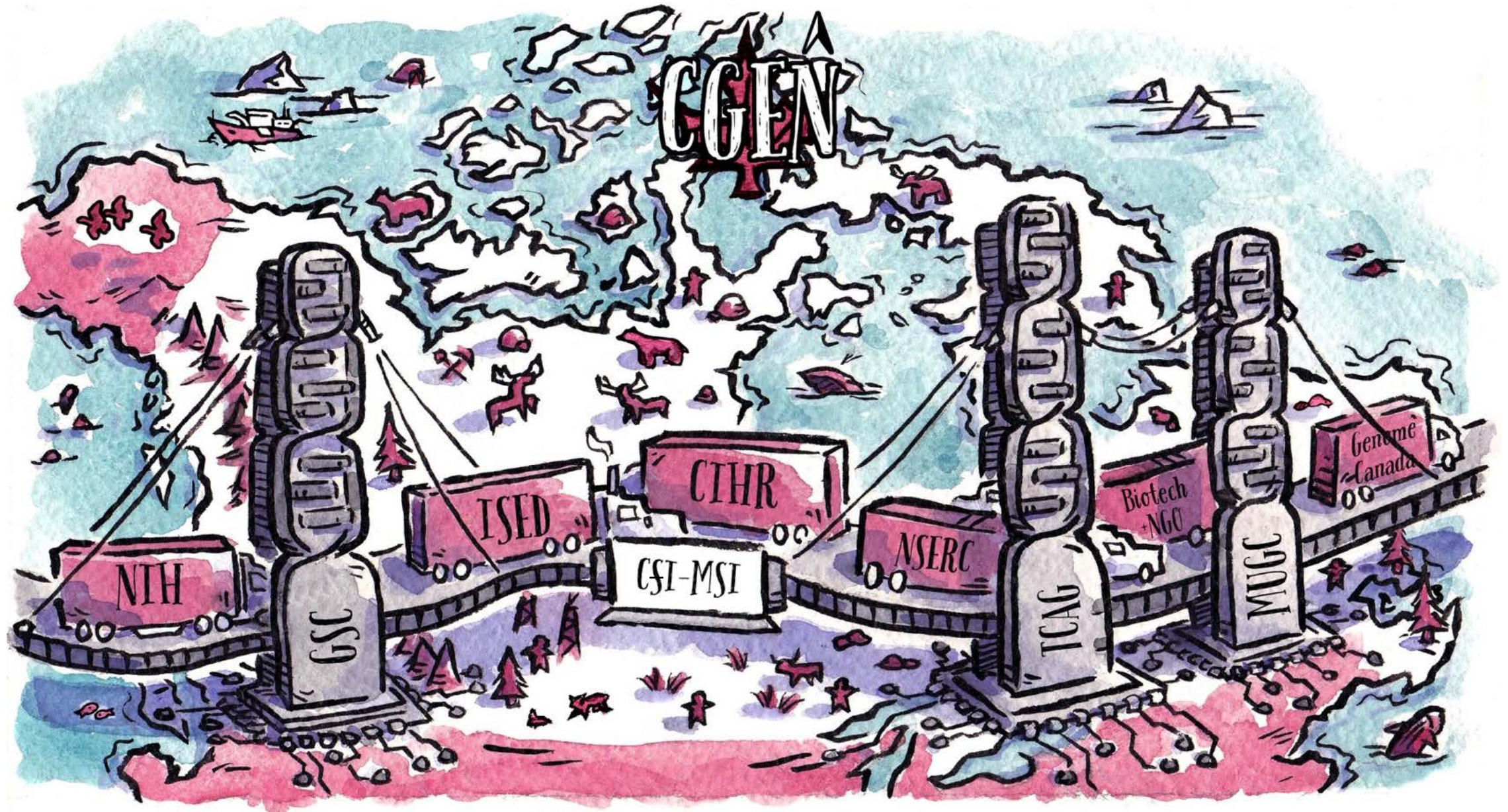


# 2. Training & Retention of HQP



# 3. Constant Pressure of Match'ed Funding





**INRS**

Institut national  
de la recherche  
scientifique

# Advanced Laser Light Source

## François Légaré, CEO

francois.legare@inrs.ca



Steve MacLean  
Co-chair of ALLS'  
Strategic Planning  
Committee (SPC)  
Infinite Potential  
Laboratories



Heide Ibrahim  
ALLS director,  
INRS-ÉMT



Fabio Boschini  
Professor,  
INRS-ÉMT



Sophie Lun  
CFI liaison,  
Research services, INRS



# How to remain internationally competitive, cutting-edge infrastructure?

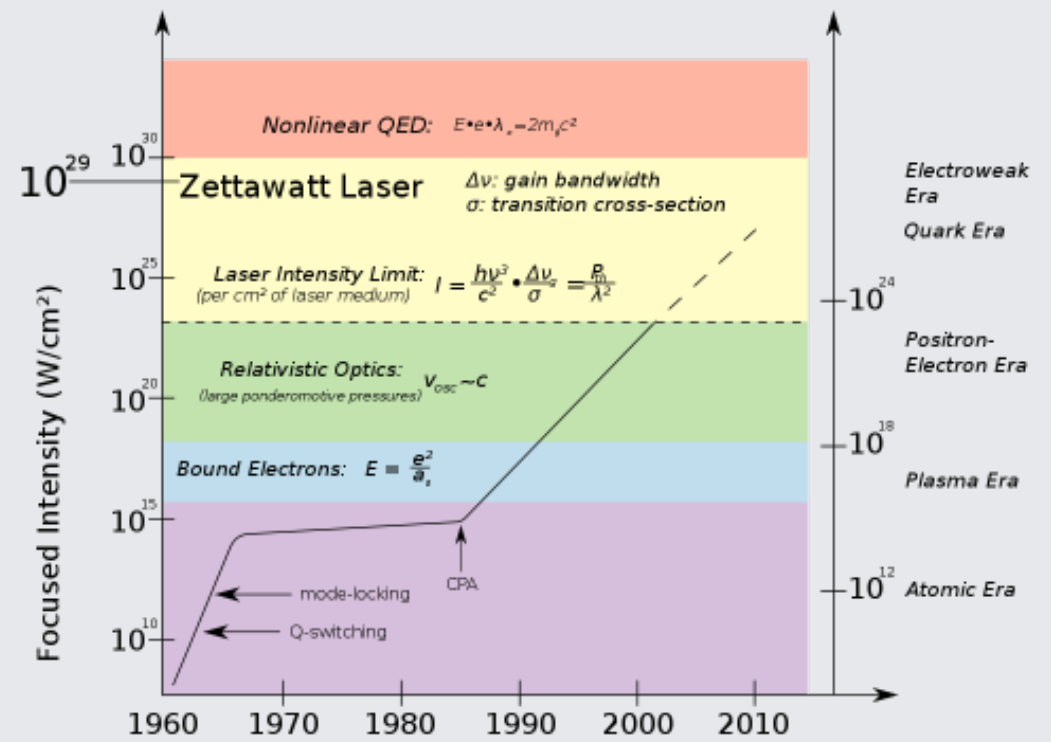
1. Drive a thriving research field
2. Help foster all 5 key innovation sectors of Canada
3. Build an excellent team to lead internationally
4. Focus on niches





Donna Strickland  
User of ALLS  
Co-chair of ALLS'  
Strategic Planning  
Committee (SPC)  
 University of Waterloo

Gérard Mourou  
User of ALLS  
 Adjunct professor at  
 INRS  
 École Polytechnique, Fr



**2018 Nobel Prize in Physics for Chirped Pulse Amplification.**



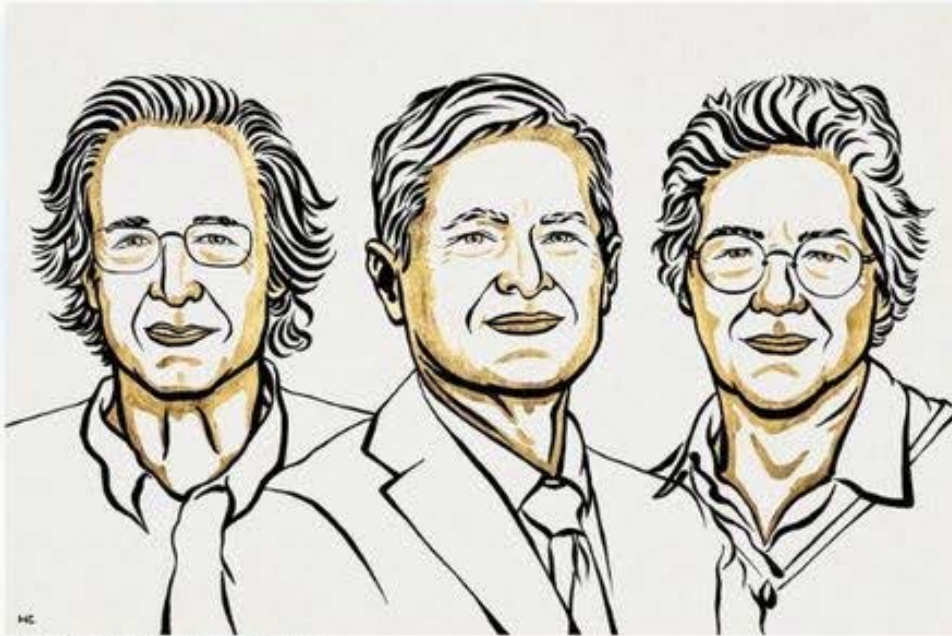


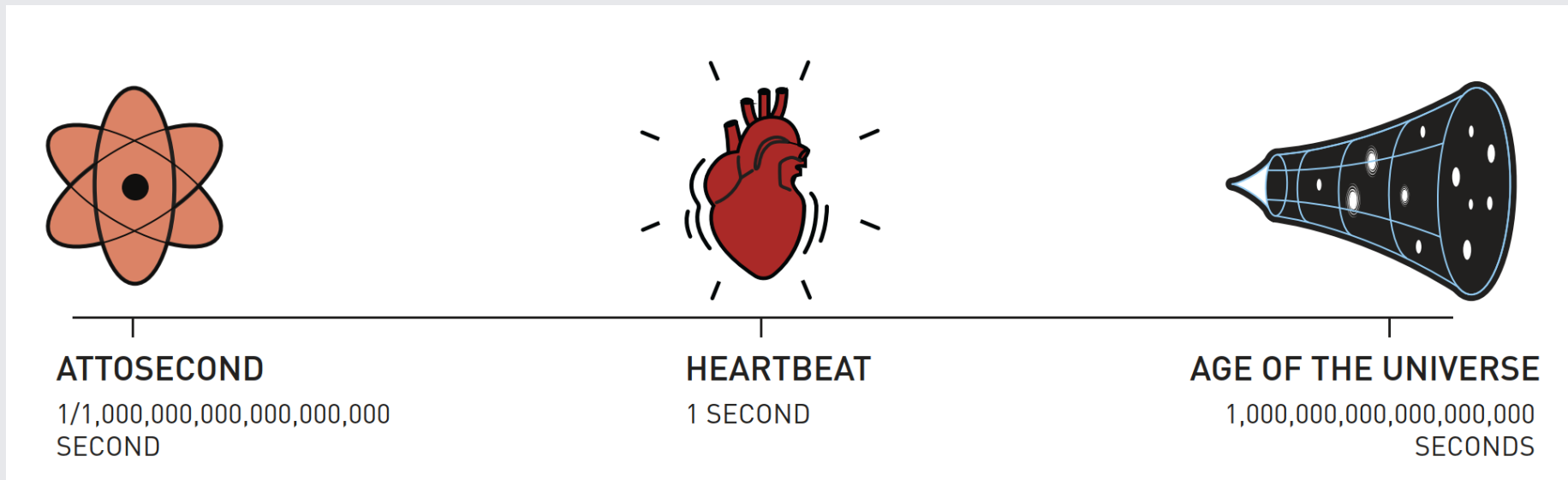
Photo credit: nobelprize.org

## The Nobel Prize in Physics 2023

**Pierre Agostini, Ferenc Krausz** and **Anne L'Huillier** was awarded the **Nobel Prize** for "experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter."



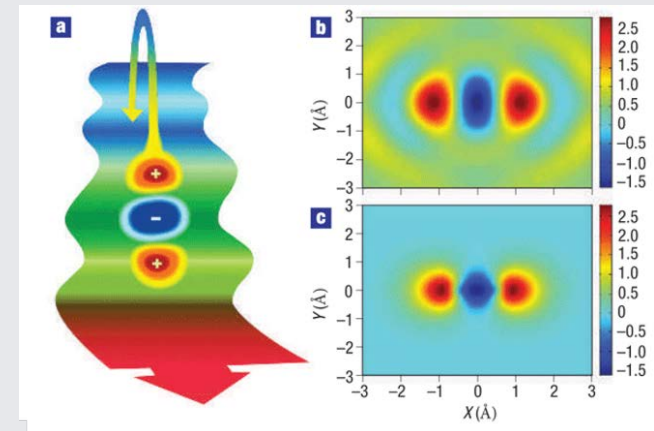




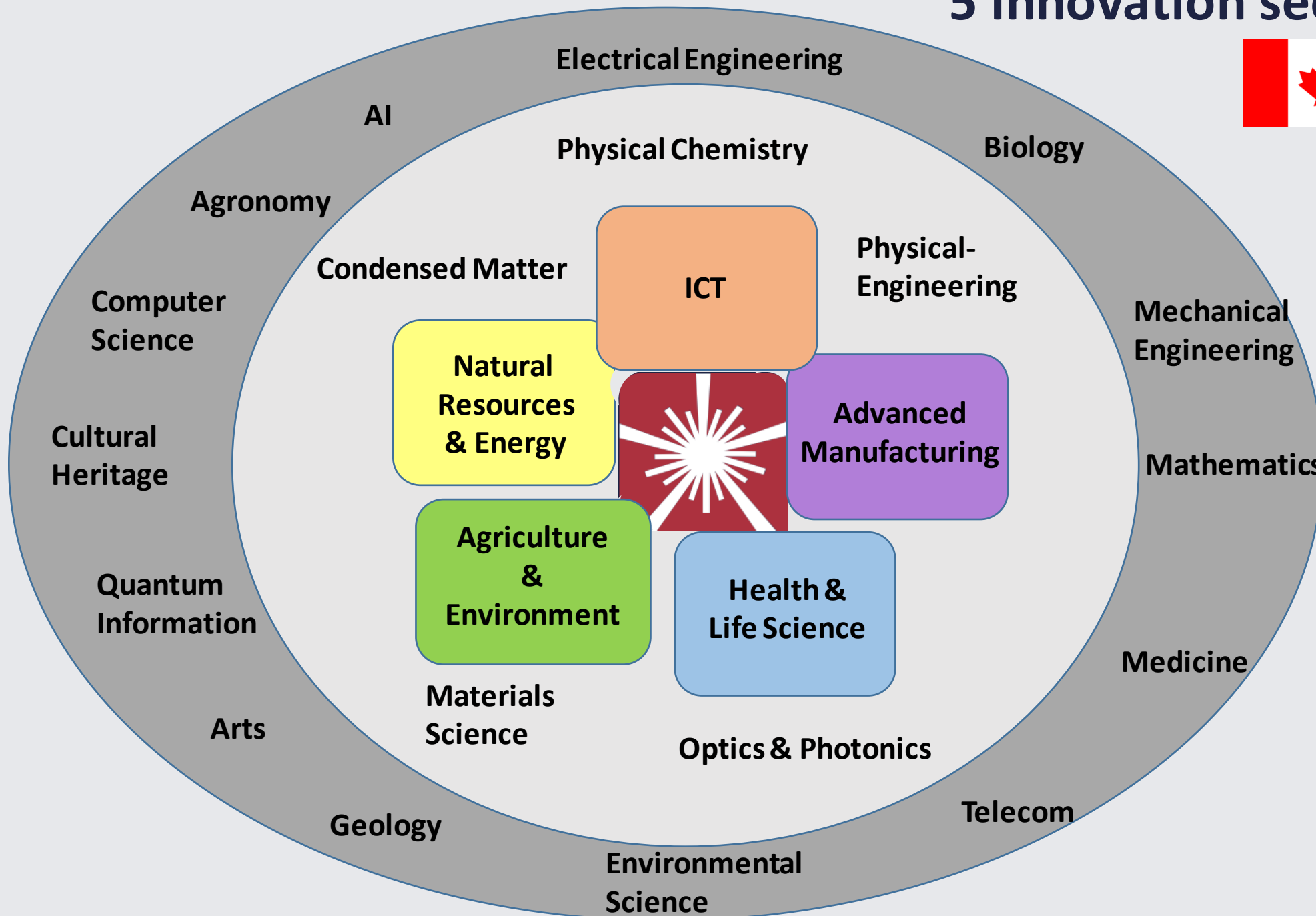
Age of universe = 436,117,076,600,000,000 seconds

1 femtosecond =  $1 \times 10^{-15}$  second

1 attosecond =  $1 \times 10^{-18}$  second



# 5 Innovation sectors



 Science & Technology

 Training & Inspiration

 Innovation & Economic Impact



# International Leadership

## 1. Team



## Major capital investment over the last two decades

- 2002: CFI – International Joint Ventures Fund program (PI: Jean-Claude Kieffer, total of 20.95M\$)
- 2014: Private donation for a total investment of 8M\$ (from 200 TW to 750 TW)
- 2017: CFI – Innovation fund (PI: François Légaré, total of 13.9M\$)

1 TW =  $1 \times 10^{12}$  Joules/second



World production – 10 TW

***ALLS 750 TW → 13 Joules in 17 femtoseconds***

Power = Energy / time = 13 J / 0.000,000,000,000,017 second = 750 TW



# International Leadership

## 3. Training and serving users

222 users in 2022-2023



# National training network and joining international efforts

## CREATE – TRUST (2023-2029)

NSERC  
CRSNG

DALHOUSIE  
UNIVERSITY

INRS  
Institut national de la recherche scientifique

McGill  
UNIVERSITY

uOttawa

UNIVERSITY OF  
WATERLOO

UNIVERSITY OF  
SASKATCHEWAN

UNIVERSITY OF  
ALBERTA

UNBC  
UNIVERSITY OF  
NORTHERN BRITISH COLUMBIA

## ALLS workshop 09/2023

Canada Foundation for Innovation / Fondation canadienne pour l'innovation

Québec / Ministère de l'Économie, de l'Innovation et de l'Énergie

## Memorandum of understanding with Extreme Light Infrastructure (2023)



Joining LaserNetUS (2019)

LaserNetUS

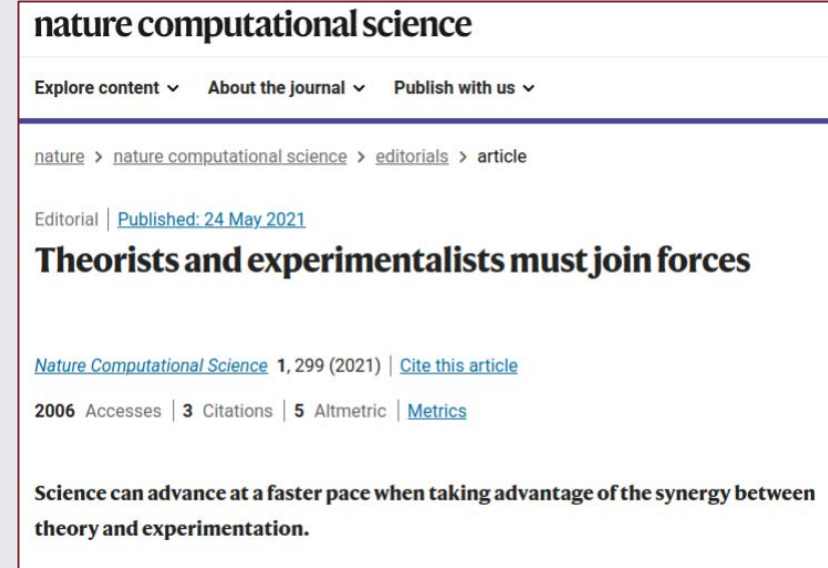
U.S. DEPARTMENT OF ENERGY



François Fillion-  
Gourdeau  
**Infinite Potential  
Labs and INRS-ÉMT**



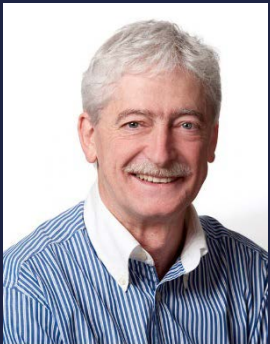
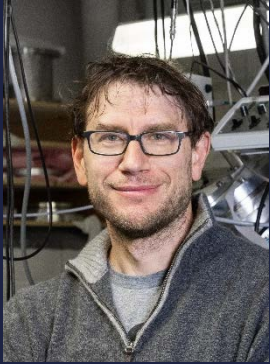
Lora Ramunno  
**uOttawa**



- **Communication is key** – to facilitate communication between theorists and experimentalists.
- **Strong network** – to foster new collaborations.
- **Toolbox** – to help experimentalists to find theoreticians with required expertise.
- **Change point of view** – to provide a platform for theory to drive experiments at ALLS.
- **Expected outcomes** – higher impact science, accelerate pace of scientific discoveries.

**Joining the unite expertise of theory and experiment to lead internationally**



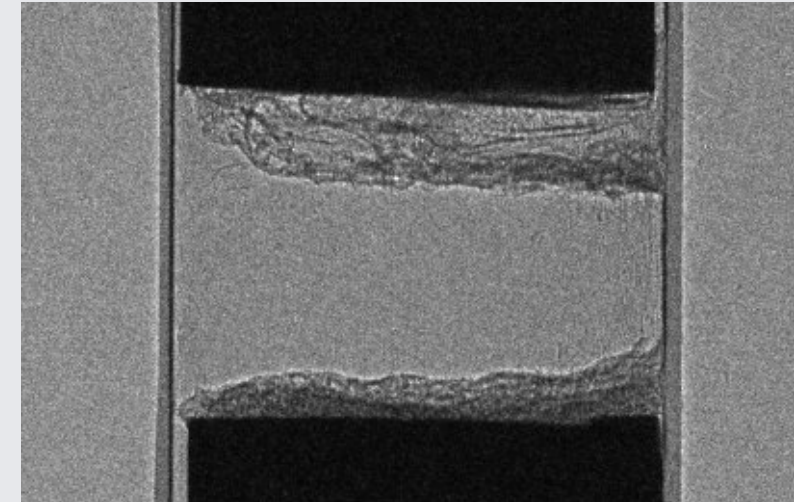


# The unique ALLS Laser Wakefield Hard X-ray Beamline

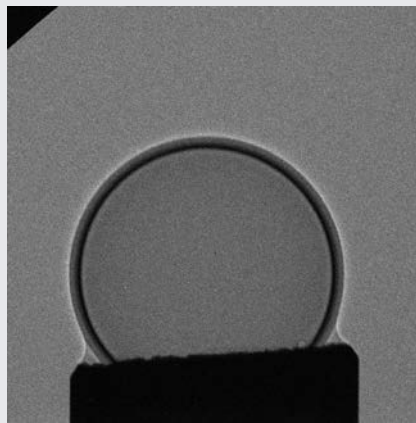
- **Unique X-ray source: high phase contrast / time-resolved**
- **Ready to serve users from all 5 innovation sectors**



Wheat seeds (E. Halin,  
Global institute for food  
security - Saskatoon)

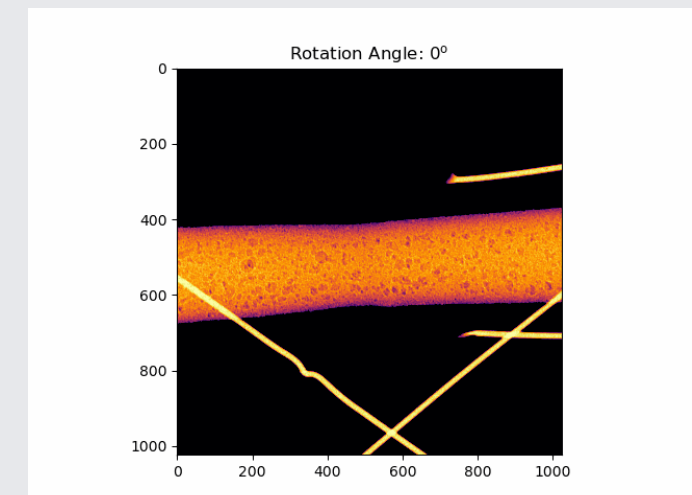


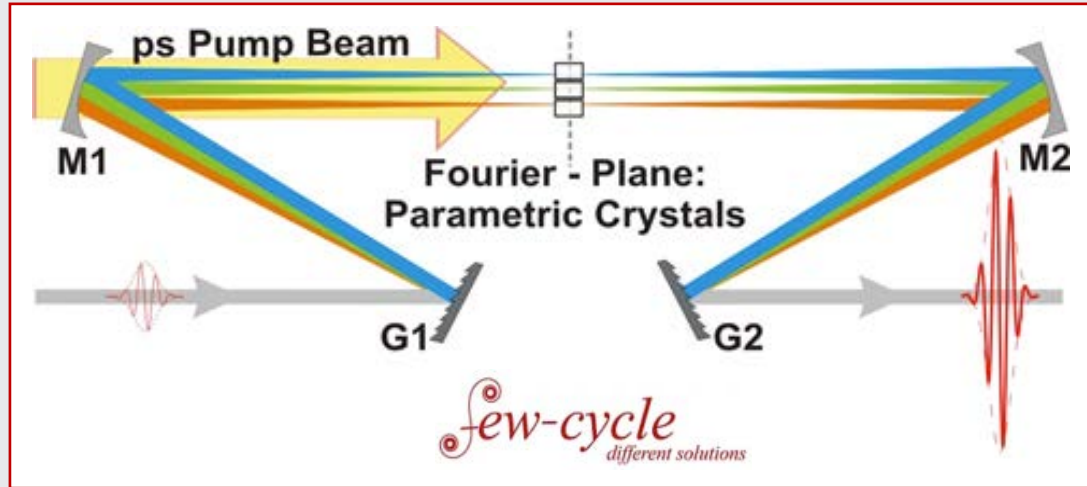
Lithium batteries (S. Cipiccia,  
University College London)



Capsule for laser fusion (F.  
Albert, Lawrence Livermore  
National Laboratory)

Additive materials (A. Hussein,  
University of Alberta)





## World leading hollow-core fibre systems

- 1.7M CAD of sales per year
- 150k CAD of investment in industry-driven projects in 2022
- Commercialization of FOPA technology
- Team of 10  
(9 employees + 1 industrial PDF )
- Access to ALLS critical to develop new technologies

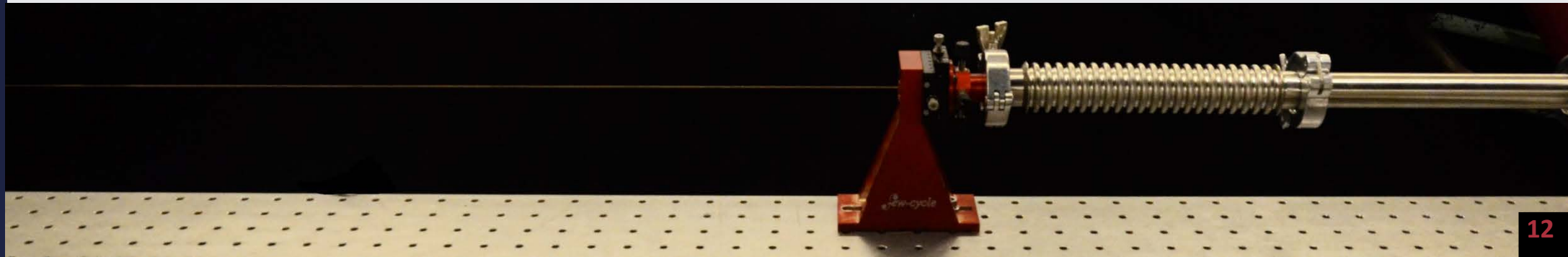
### Ti-Sa based system:

30 mJ, 12 fs (2 cycles), 1.8 micron @10Hz [1]

### Yb based system – 2x450mJ @100 Hz:

100 mJ, sub-30 fs (< 3 cycles), 3.2  $\mu\text{m}$

CA2,845,245, EP 2 745 170, US 9,203,208; [1] V. Gruson et al. Opt. Express **25**, 27706 (2017).

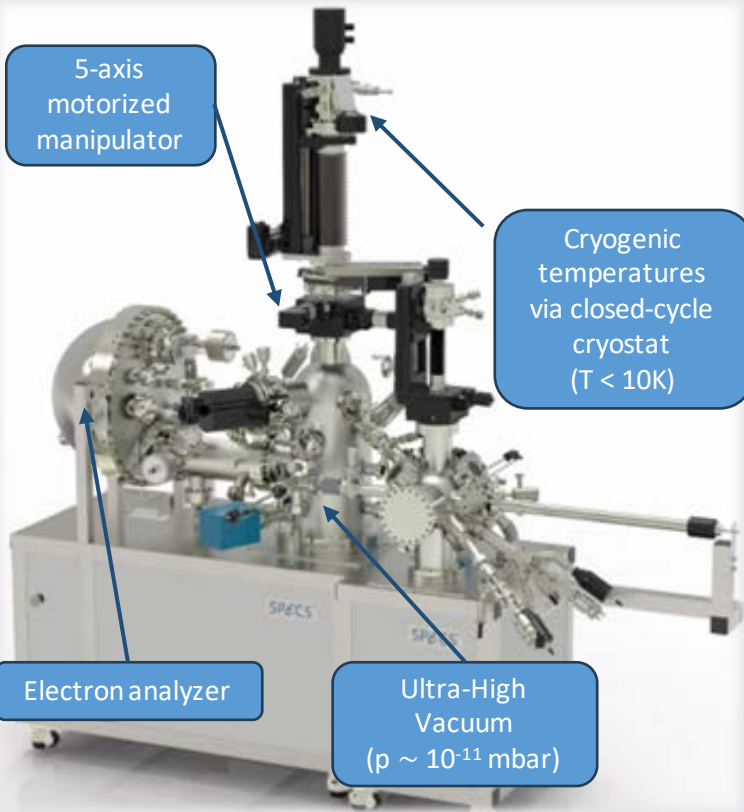
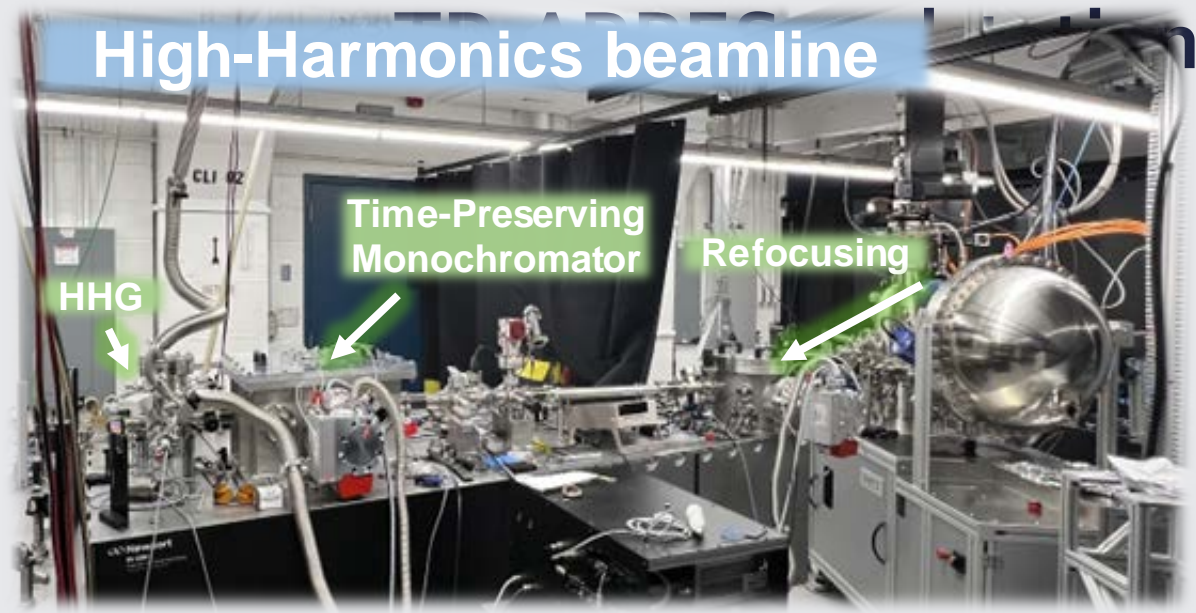




# Time- and Angle-Resolved Photoemission (TR-ARPES)

**Goal:** Use of intense long-wavelength optical excitation to investigate, and ultimately control, the electronic properties of Quantum Materials

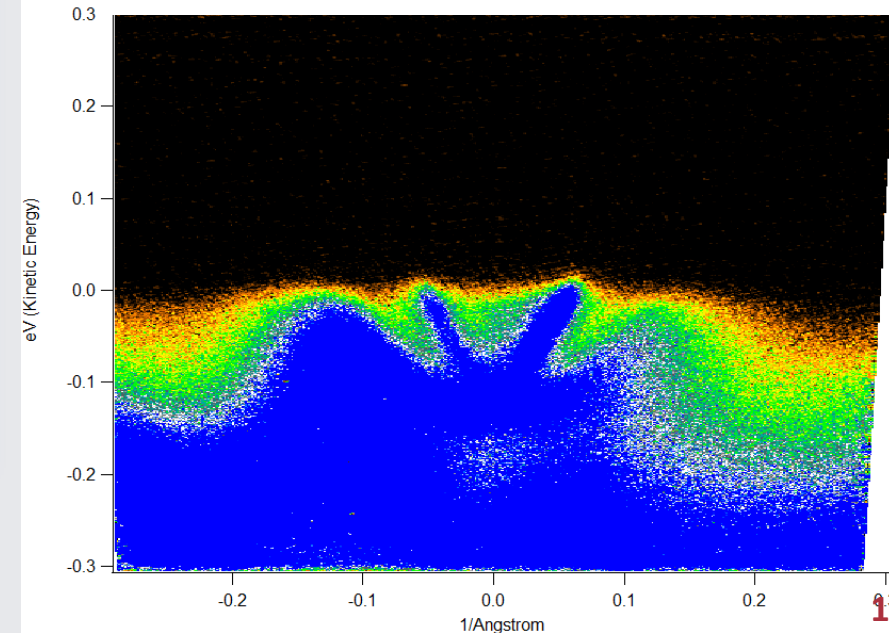
## High-Harmonics beamline



**Tech info:** ARPES requires extreme conditions

- Ultra-High Vacuum (14 order of magnitudes < atm pressure)
- Cryogenic Temperature (close to absolute zero)
- $\mu$ -metal chambers to screen magnetic fields

### Pump-induced electron dynamics in a topological insulators



# 22 Canadian companies using ALLS since 2015

Innovation &  
Economic Impact

