

2025-26

Characterization Facilities at UBC

Survey and Data Analysis Report



THE UNIVERSITY OF BRITISH COLUMBIA

Characterization @ UBC
Research Excellence Cluster



Land Acknowledgment

We acknowledge that UBC Vancouver is situated on the traditional, ancestral and unceded territories of the x^wməθk^wəyəm (Musqueam) people.

We acknowledge, also, that UBC Okanagan is situated on the traditional, ancestral and unceded territories of the Syilx Okanagan Nation.

*Image credit:
Jamil Rhajiak,
UBC Brand &
Marketing*

Message from the cluster lead,

Dr Ben Britton



Welcome to the first report from the *Characterization@UBC* Research Cluster. We're excited to share a comprehensive overview of the state-of-the-art characterization capabilities that help make the University of British Columbia - across both our Vancouver and Okanagan campuses - a hub of innovation and discovery.

This report highlights the depth and breadth of facilities, infrastructure, and ongoing investments that support world-class research, education, and training within the UBC community and beyond. Our goal is to offer insights into the collaborative ecosystem that enables groundbreaking science and engineering - one that brings together researchers, students, and partners to explore, understand, and create the materials and technologies that shape our world.

As our cluster continues to grow, we hope this report serves not only as a snapshot of progress but also as an invitation to connect, collaborate, and contribute to a shared vision: developing the materials of tomorrow while advancing sustainability and practicality in the materials of today, for the benefit of people and the planet.

While the facilities featured here represent more than \$46 million in capital investment at UBC, this only begins to tell the story. Beyond the impressive equipment and infrastructure lies the true heart of *Characterization@UBC* - the talented researchers, technicians, and staff whose curiosity and expertise transform data into discovery. Together, we're pushing the boundaries of what can be seen, measured, and understood, driving research impact across disciplines and industries.

Dr T Ben Britton (he/him), CEng, CSci, FIMMM

Cluster lead, *Characterization@UBC*
Professor & Associate Head of Department (Graduates),
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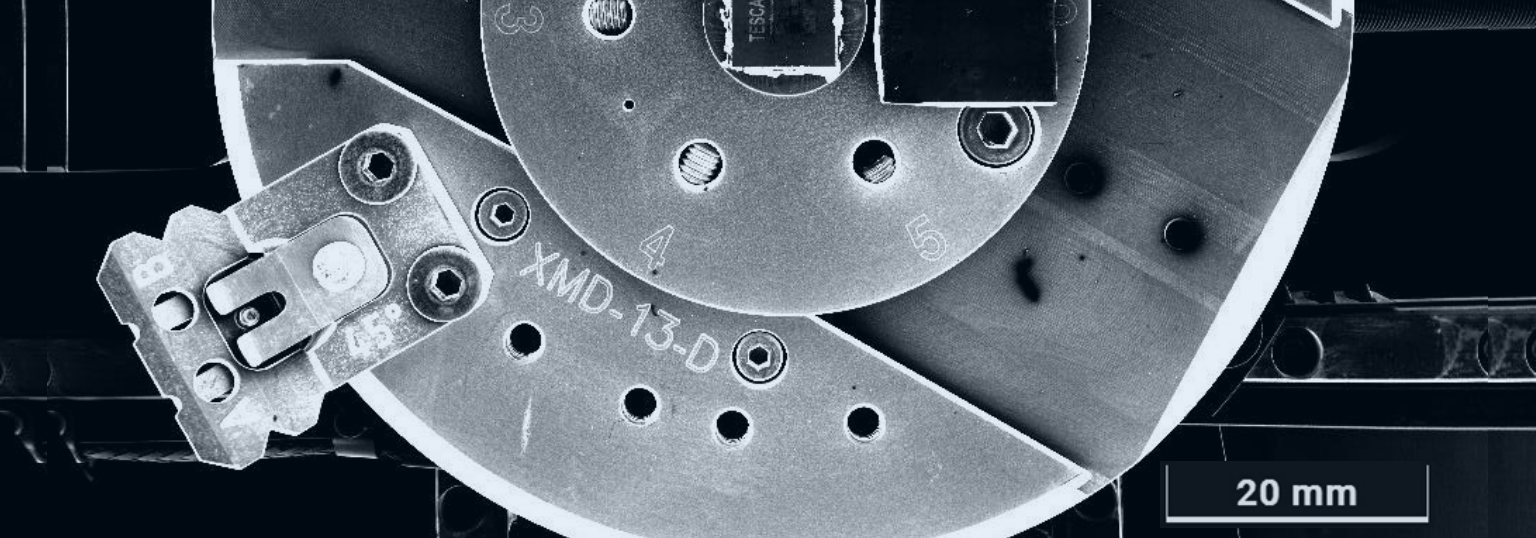


Image: Wide field scanning electron micrograph captured on Tescan Mira-4, EM Lab

Contents

Message from the cluster lead	3
Executive summary	5
About the Characterization@UBC cluster	6
Introduction to the survey	8
Innovation & impact	10
Background & survey methodology	11
Summary of findings:	12
1. Equipment types, costs and year of investment	12
2. Facility investment and funding sources	14
3. Sample preparation facilities	17
4. Types of users	18
5. Equipment maintenance	19
6. Capabilities of scanning electron microscopes in the cluster	20
7. Capabilities of X-ray diffraction instruments associated with the cluster	22
8. X-ray Tomography instruments	23
9. Access and costing	24
10. Other facilities & wider access	25
Glossary of acronyms	26
Acknowledgements	27
Finding out more	28

Executive summary

Image: Large area chemical quantification and analysis of mica © Britton

Characterization@UBC is a VPRI-supported research cluster that unites advanced characterization facilities across UBC's Vancouver and Okanagan campuses, anchored by more than 46 major instruments and over \$46 million in capital investment. The cluster brings together 15 principal investigators and 14 research staff spanning 9 departments, focussing **electron microscopy**, **X-ray diffraction and tomography**, and **advanced optical and analytical methods**.

This report presents findings from structured interviews and a comprehensive survey of nine major facilities across both UBC campuses, exploring current capabilities and recent investments in advanced research infrastructure. These insights are used to identify potential strategic priorities that can strengthen UBC's research impact and further enhance Canada's broader research and innovation capacity.

For industrial partners, the report highlights that Characterization@UBC offers a **world-class portfolio** of tools to solve complex materials and process challenges, from microstructure and defect analysis to non-destructive 3D imaging and trace-element mapping. Tiered academic/commercial pricing, technician-assisted services, and established booking and contracting pathways enable research partners and industry to access instruments such as high-end SEM/FIB systems, in situ X-ray tomography, and advanced XRD platforms. **Case studies** in nanocellulose composites, 3D pulp-fiber tomography, and lightweight alloys for electric vehicles demonstrate direct industrial relevance and impact. For more information, head to pages 19-22 to learn about our capabilities.

For UBC academics, the report serves as a strategic map of shared characterization assets, showing what instruments exist, where they are located, who manages them, and how they can be accessed by graduate students, postdoctoral researchers, PIs, and trained users from other groups. The data support planning around **sustainable maintenance and service contracts, equipment renewal, and future infrastructure + training-grant proposals** leveraging federal, provincial, UBC, and donor funding. Cluster activities - including seminars, micro-grants, a Fall School, and a centralized database - strengthen training, interdisciplinarity, and campus-wide collaboration, **reinforcing UBC's position as a leader** in materials and research.

15

Principal investigators

\$ 46.59 M

Total financial investments

46

Advanced characterization equipment

9

Facilities involved

14

Staff/managers, other than PIs

and more...

About the Characterization@UBC cluster

Characterization@UBC is a VPRI supported research cluster at UBC that unites experts across departments and faculties who lead state-of-the-art facilities in advanced characterization across both campuses - Vancouver and Okanagan. It involves 15 Principal Investigators from Applied Science (V), Applied Science (O), Science (V), Science (O), Dentistry (V) and it links nine high-end characterization facilities.



Ben Britton
Materials Engineering



Ismail El Baggari
Physics and Astronomy



Anette von der Handt
Earth, Ocean and
Atmospheric Sciences



Mark Martinez
Chemical and
Biological Engineering



Renelle Dubosq
Earth and
Environmental Sciences



Nancy Ford
Oral Biological and
Medical Sciences



Warren Poole
Materials Engineering



Alannah Hallas
Physics and Astronomy



Kiana Amini
Materials Engineering



Lacey Samuel
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Alireza Nojeh
Electrical and
Computer Engineering



Jian Liu
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Engineering



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Chemistry



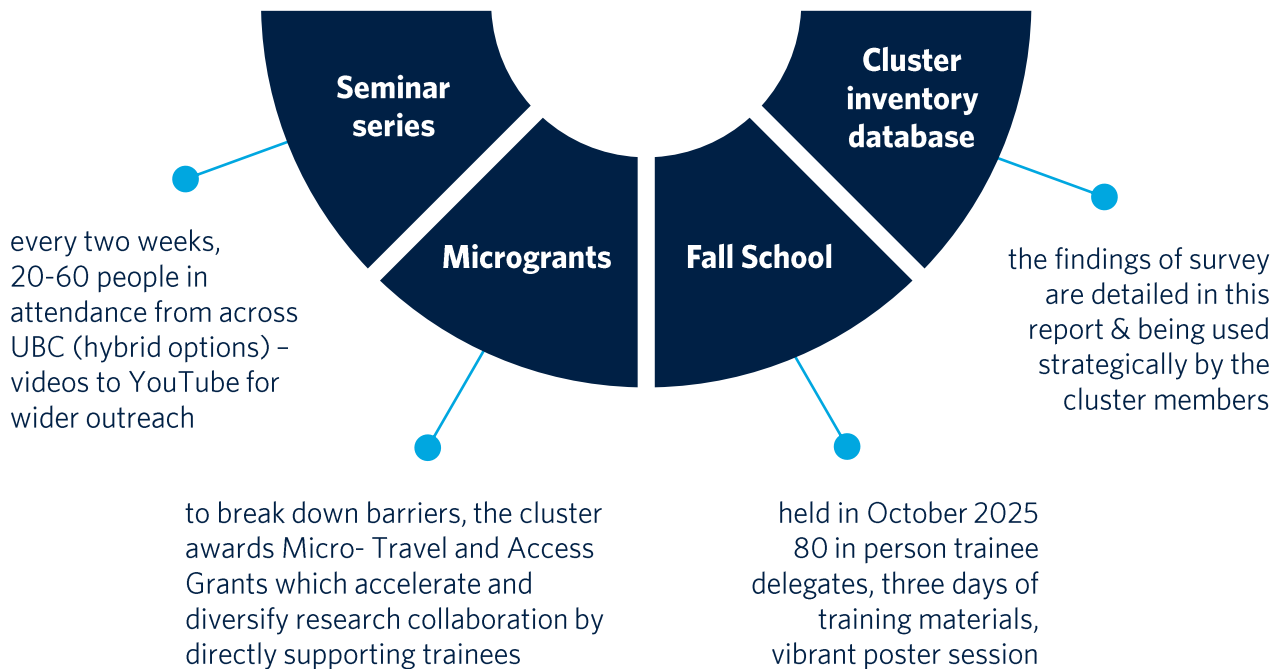
Matt Tarling
Earth, Ocean and
Atmospheric Sciences

The cluster is supported by a Project Manager, Joey Yeap, and in 2025-2026 we have two work learn co-funded students, Haroon Qaiser and Maria Fernanda Antunes de Souza Freitas.



Image: Glimpse from a thematic seminar at the Characterization@UBC Fall School, October 2025

Breaking barriers and widening access to characterization community, cementing of expertise and innovation at UBC





A world-class portfolio of characterization instrumentation

Image: pFIB-SEM Tescan AMBER-X, EM Lab

Introduction to the survey

This report provides a comprehensive overview of the specialized characterization infrastructure within the University of British Columbia's Characterization@UBC research cluster. It draws upon structured interviews and a systematic survey of the cluster's facilities, with a particular focus on electron microscopy, microanalysis, and X-ray diffraction/tomography. Additional details on related advanced techniques are also included.

The resulting database encompasses data captured from **9 facilities** housing **46 major** pieces of advanced characterization equipment. These facilities are overseen by a network of **15 Principal Investigators (PIs)** and **14 dedicated research staff**, who manage operations either directly or through designated technical personnel. With cumulative investments exceeding **\$46 million**, the infrastructure is supported through a diverse portfolio of funding sources, including CFI-JELF, CFI-IF, BCKDF, UBC matching funds, and private donations. Geographically, these facilities are distributed across UBC's Vancouver and Okanagan campuses, spanning **8 departments** and multiple research hubs.

The purpose of this report is threefold:

- (1) to clarify the current landscape of UBC's characterization capabilities;
- (2) to highlight the distinctive strengths that underpin our research excellence;
- (3) and to identify strategic opportunities for enhancing our offerings.

We hope that this information can serve as a foundation for future infrastructure investments, training grant applications, and collaborative research initiatives aimed at strengthening UBC's position as a leader in basic and applied scientific research.

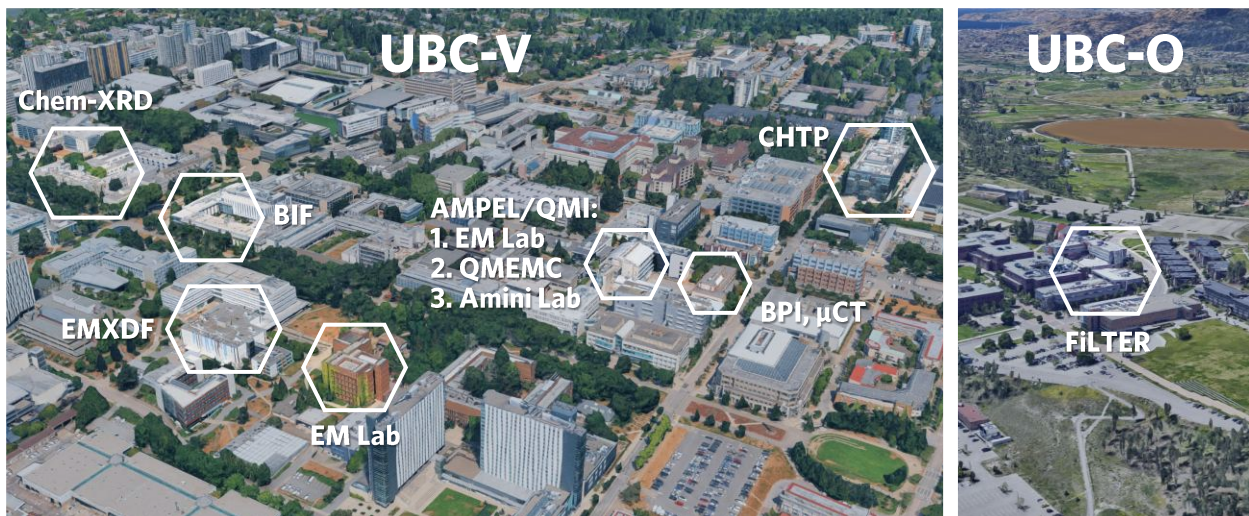


Figure-1: Allied facilities of Characterization@UBC cluster that were surveyed

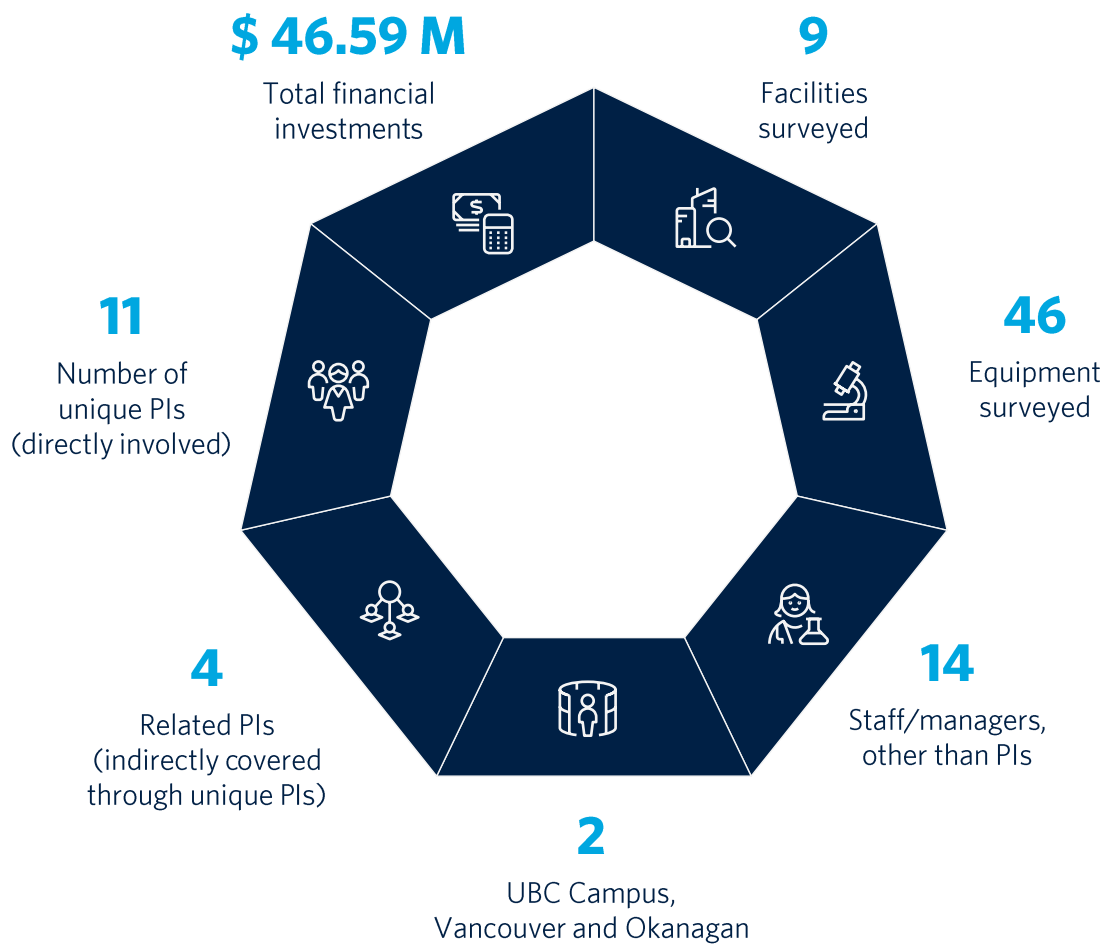
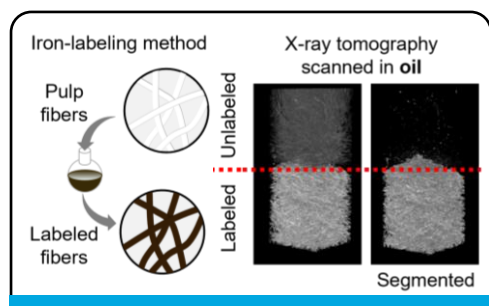


Figure-2: Survey stats at a glance

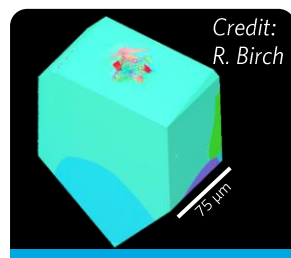
Innovation & impact

“Seeing is believing” has never been more true - or more powerful - than in the world of materials characterization. Across these facilities, we push the boundaries of what can be observed, measured, and understood, turning the invisible into insight and the complex into innovation. The examples highlighted here showcase how our advanced tools and expertise are transforming both science and engineering. But impact extends beyond images and data: it’s reflected in the people we train, the industrial challenges we solve, and the societal needs we help address.



Researchers from Wood Science, the Bioproducts Institute, CHBE, and Mechanical Engineering, together with collaborators at McMaster and in Brazil, have developed new 3D X-ray tomography methods to image pulp fibers, unlocking critical insight for next-generation bioproducts - see [Veiga et al. \(2025\) Tomography of Materials and Structures](#).

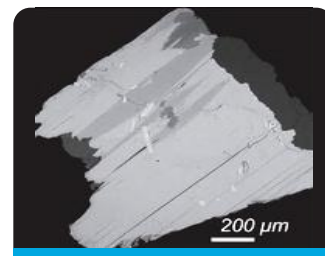
A cross-disciplinary team from Materials Engineering, Chemical and Biological Engineering, and Wood Science harnessed cutting-edge electron microscopy available within the BioImaging Facility and Electron Microscopy Laboratory to engineer advanced nanocellulose composites - see [Oesef et al. \(2025\) ACS Applied Materials & Interfaces](#).



The teams of Warren Poole and Ben Britton, in collaboration with TESCAN, have developed a new protocol for 3D micrometer-scale materials analysis, demonstrated on lightweight alloys for next-generation electric vehicles, using advanced focused ion beam scanning electron microscopy with electron backscatter diffraction in the Electron Microscopy Laboratory. - see [Birch et al. \(2025\) Micron](#).

A team from Earth and Environmental Sciences, working with a UCSB collaborator, used the Fipke Laboratory for Trace Element Research to unlock new mica geochronology insights that sharpen our understanding about shear faults, earthquakes and more.

- see [Larson et al. \(2025\) Geostandards and Geoanalytical Research](#).



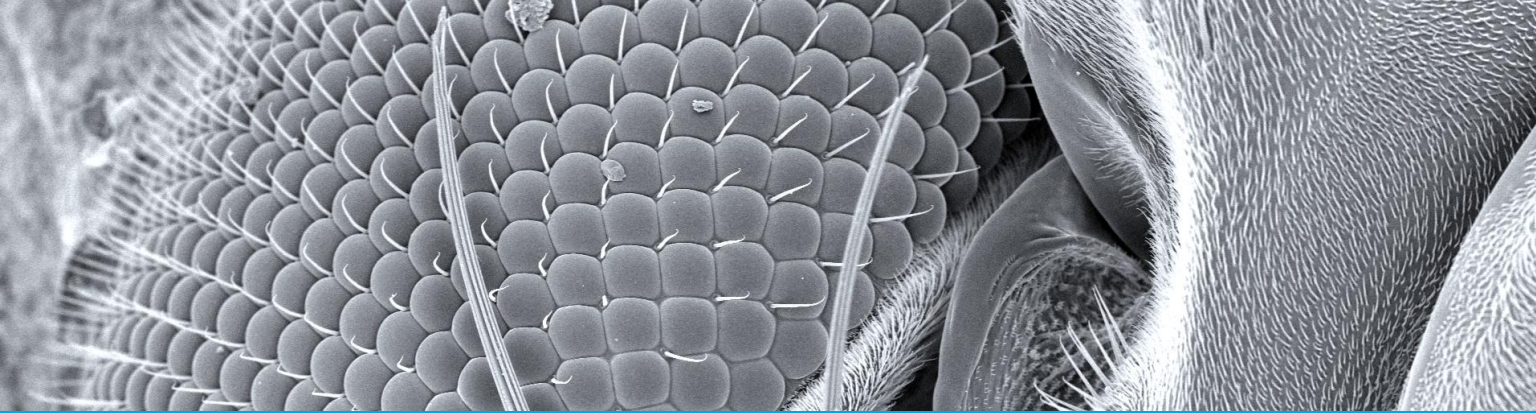


Image: Eye region of a mosquito, captured on a table-top SEM, Phenom XL, EM Lab

Background & survey methodology

First, facilities under the umbrella of the cluster were identified by the management team, with input from all the cluster members. Next, a series of questions were established to collect information and a spreadsheet was created to capture the information in a uniform format. Information for the inventory was collected by directly contacting, or where possible, visiting the Principal Investigators (PIs), lab managers, and/or key research staff associated with individual facility. The survey was designed to capture a wide range of essential details for each instrument, including its technical specifications and capabilities, commission year, operational status, maintenance structure, access and training procedures, total purchase cost envelope and associated funding source. The compiled information was further reviewed by the PIs before becoming a part of the main database spreadsheet. All collected information was consolidated into a main database spreadsheet, which serves a cluster asset and the foundational dataset for this report's analysis.

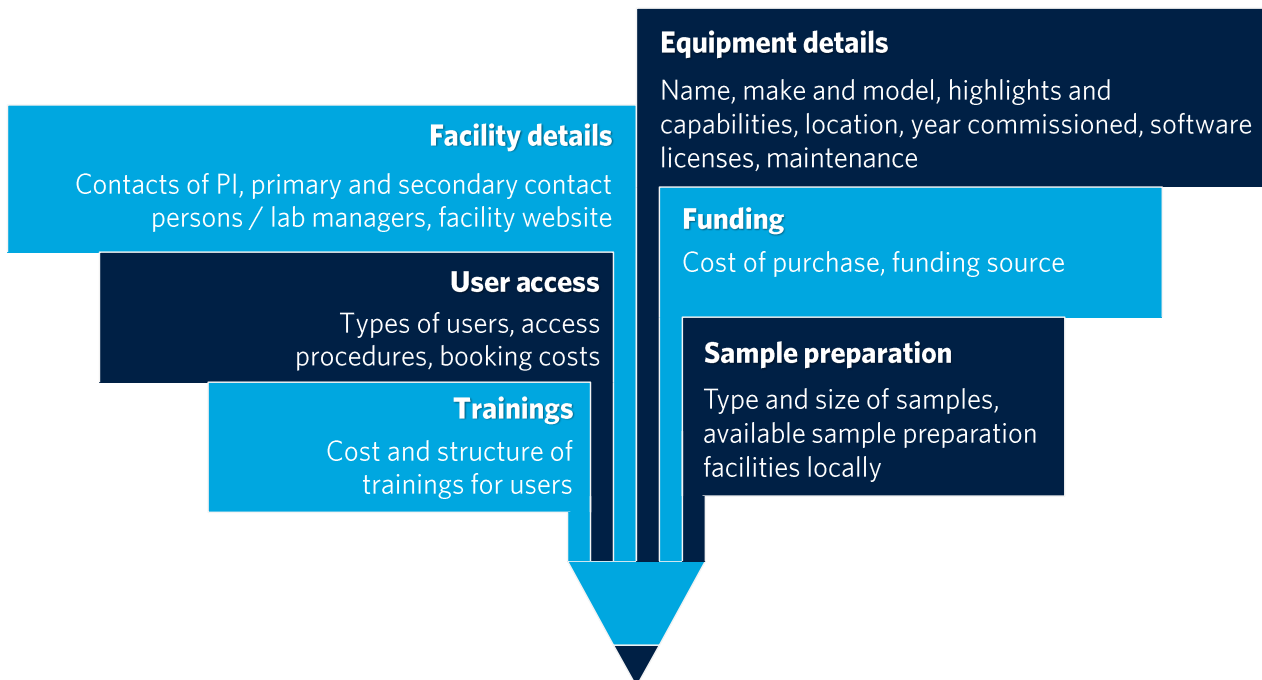


Figure-3: Major categories surveyed

Summary of findings

1. Equipment types, cost and year of investment

The data is presented in five-year increments, with capital spend shown for each period, reflecting the timing and scale of equipment investments across facilities within the cluster. Here, we can observe significant recent investment in characterization equipment which is motivated by community need, as well as innovative avenues of research at UBC.

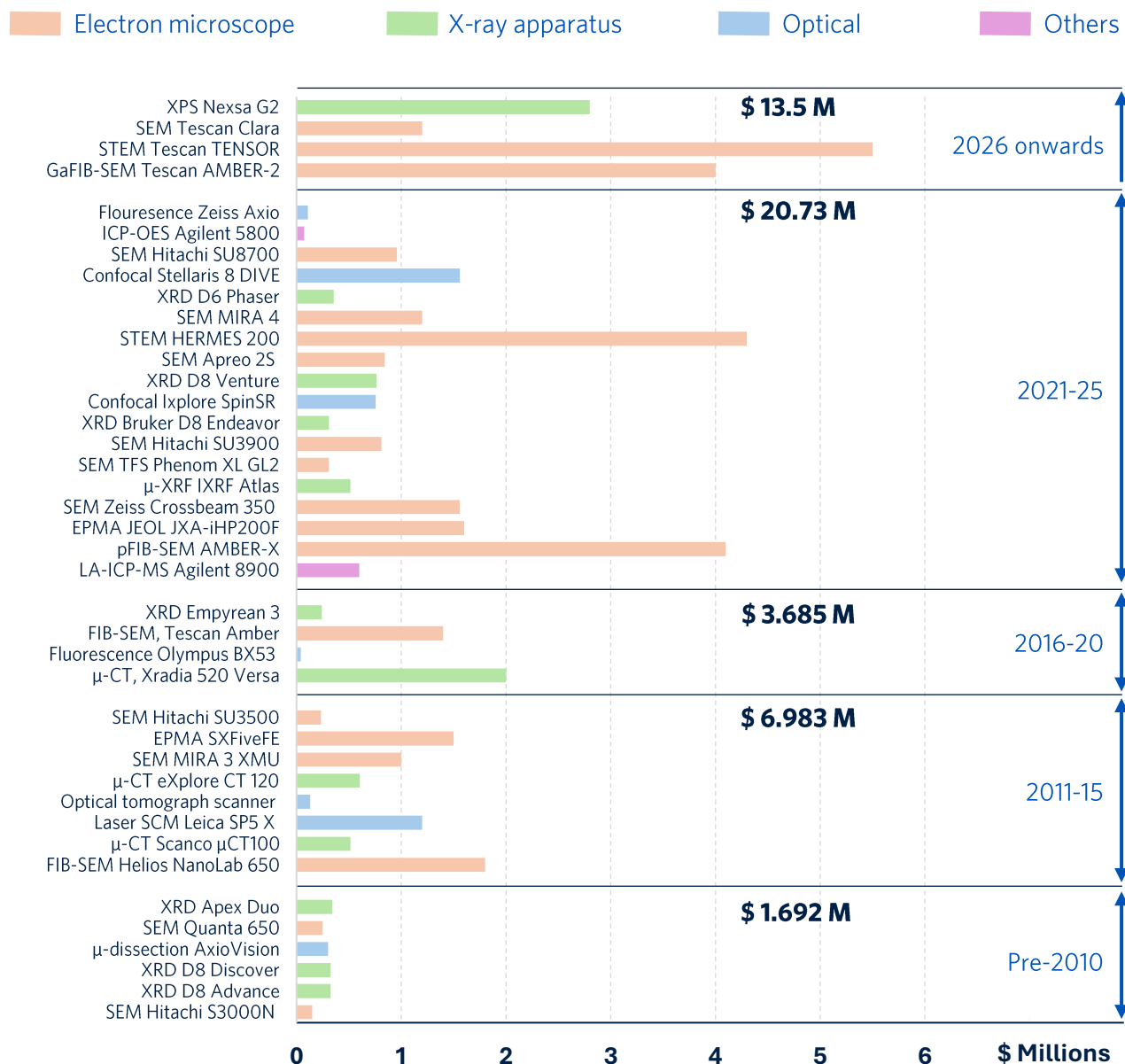


Figure-4: Equipment within facilities associated with the cluster, separated into 5-year timelines, colored by equipment type. **Note that these figures reflect the overall cost of the instrument.**

Ensuring the Longevity and Impact of Core Research Infrastructure

The funding profile of major capital equipment reflects broader trends in long-term asset management and future investment planning. For newer instruments purchased through CFI funds, operations and maintenance are typically supported through capital allocations and the Infrastructure Operating Fund (IOF), which provides roughly 30% of the federal investment (about \$3M in this case) for staffing, consumables, and service contracts.

While core instruments (e.g., electron microscopes) may last 15 years or more, subsystems such as detectors often become obsolete in a decade. Proactively assessing instruments over 15 years old is therefore essential to balance operational costs, functionality overlap, and replacement priorities.

For complex or recently acquired equipment, service contracts can be cost-effective and ensure high uptime, rapid repair responses, and consistent performance. These agreements are especially valuable when sustained funding is available.

As instruments age, manufacturer support often ends – e.g. seven years after a product line’s final sale. In parallel, control systems face software and hardware obsolescence risking reliable access to parts and cybersecurity concerns (e.g., Microsoft Windows 10 support ended in 2025).



Image: A retired Zeiss SEM, now replaced by a TESCAN MIRA in the EM Lab

Older pieces of equipment also carry hidden costs. Newer systems frequently feature ease of use enhancements, automated and perhaps machine-learning-based alignment, and better interoperability with analysis tools, improving efficiency and user training relevance.

Regular equipment renewal ensures dependable access for users and mitigates the reputational and scheduling risks associated with extended downtime, particularly for specialized instruments. Furthermore, near ‘like with like’ replacement often reduces building renovation costs and risk.

For sustainable facility operations, financial and funding constraints often prevent facilities from building reserves for major repairs, which can vary widely in cost - from \$10k to over \$500k for critical detectors, or partial instrument re-builds.

2. Facility investment and funding sources

Here we explore infrastructure investments by facility and instrument category, revealing that electron microscopes dominate total investment within the surveyed data - especially in the EM Lab, QMEMC, EMXDF and FiLTER - while X-ray apparatus and optical equipment are concentrated in specific facilities (e.g., Chemistry's XRD and optical setups in BIF/CHTP).

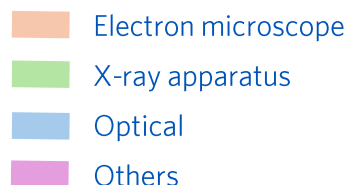


Image: Bruker D8 Venture XRD, Chemistry dept.

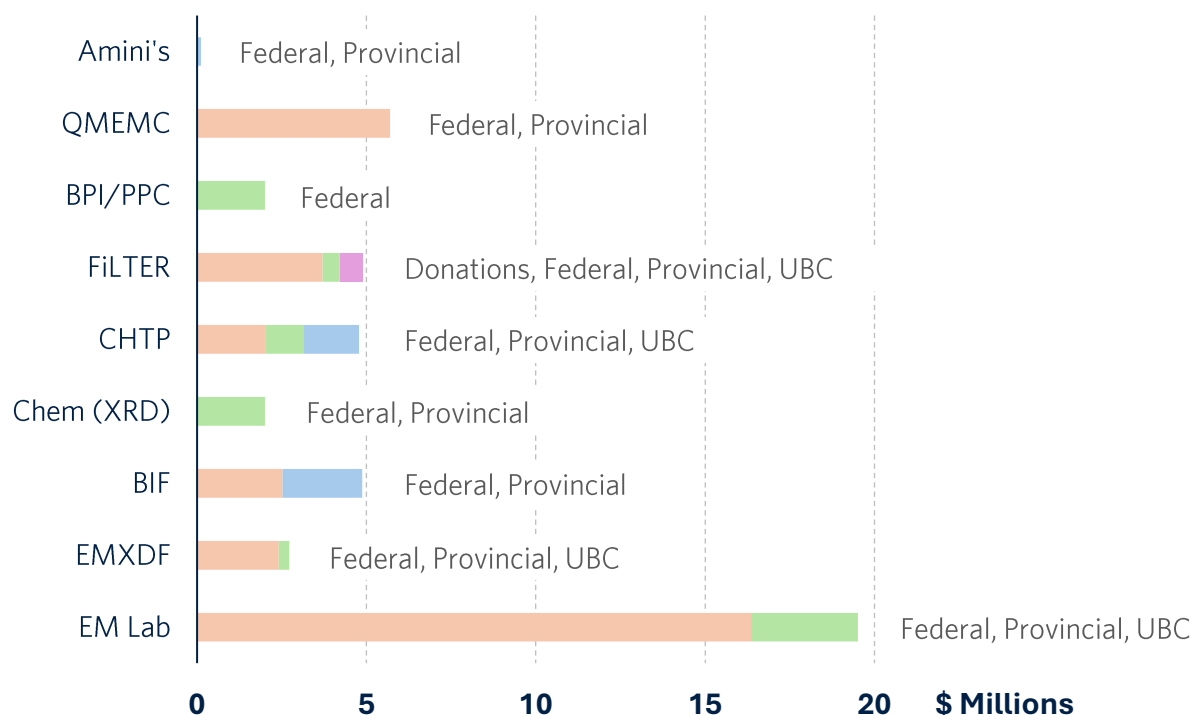


Figure-5: Type of instruments and funding source in each facility, colored by equipment type

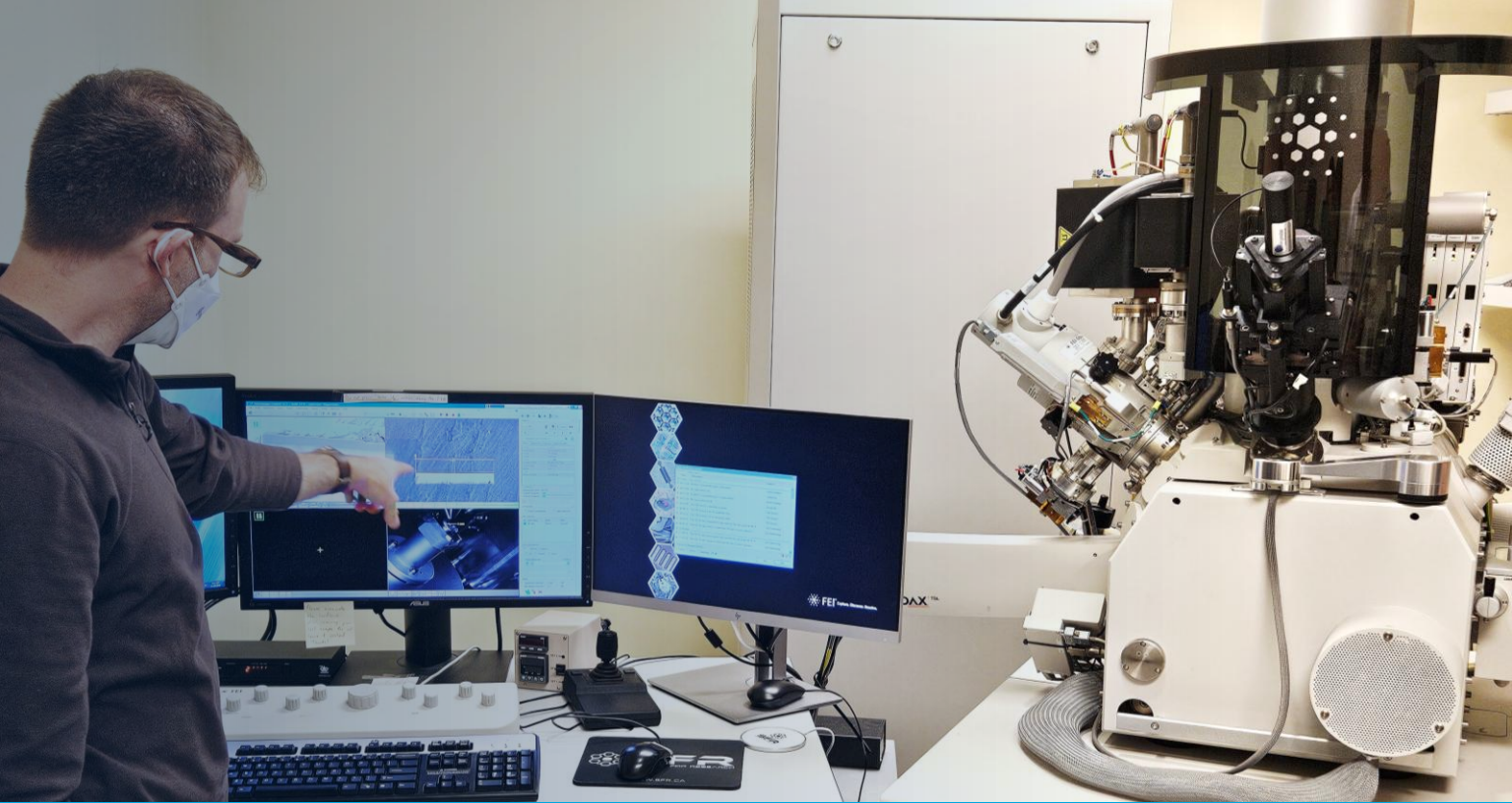


Image: FIB-SEM Helios NanoLab 650, CHTP

To help understand the shape of investment within the portfolio, with regards to replacement of equipment or further funding opportunities, we performed a cost analysis of individual equipment which reveals a distribution across price brackets and the funding envelope. In our data, only four instruments fall under the RTI threshold of less than \$150,000. However, we recognize that we have not captured many of the ancillary equipment items within our facilities, such as sample preparation equipment. Exploring smaller investments like these will form an aspect of the future work for the cluster.

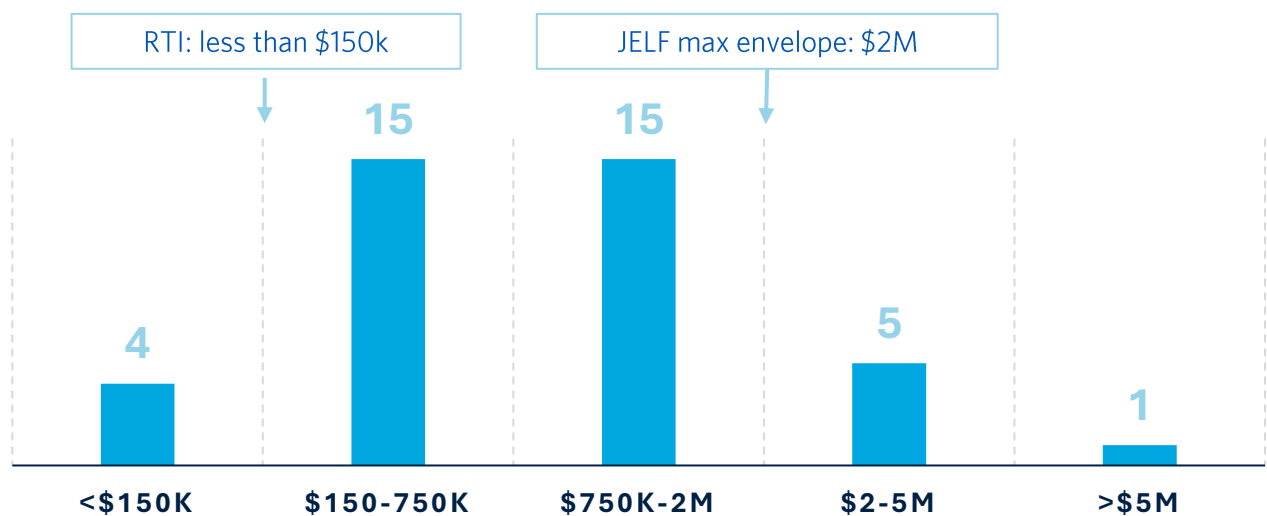


Figure-6: Individual equipment cost brackets



Image: STEM NION HERMES 200, QMEMC

If we explore funding for each instrument type by reported funding stream, we reveal that the combined investment of both federal and provincial funding is essential for the health of our state-of-the-art research infrastructure. Most of our assets have been procured using multiple funding streams, including core UBC funds. Remarkably donations are also important for our research excellence - for example, the FiLTER facility is supported by a donation from Charles E. Fipke and a gift made in memory of S. Postman.

Note: Funding could not be identified for two of the 46 pieces of equipment surveyed.

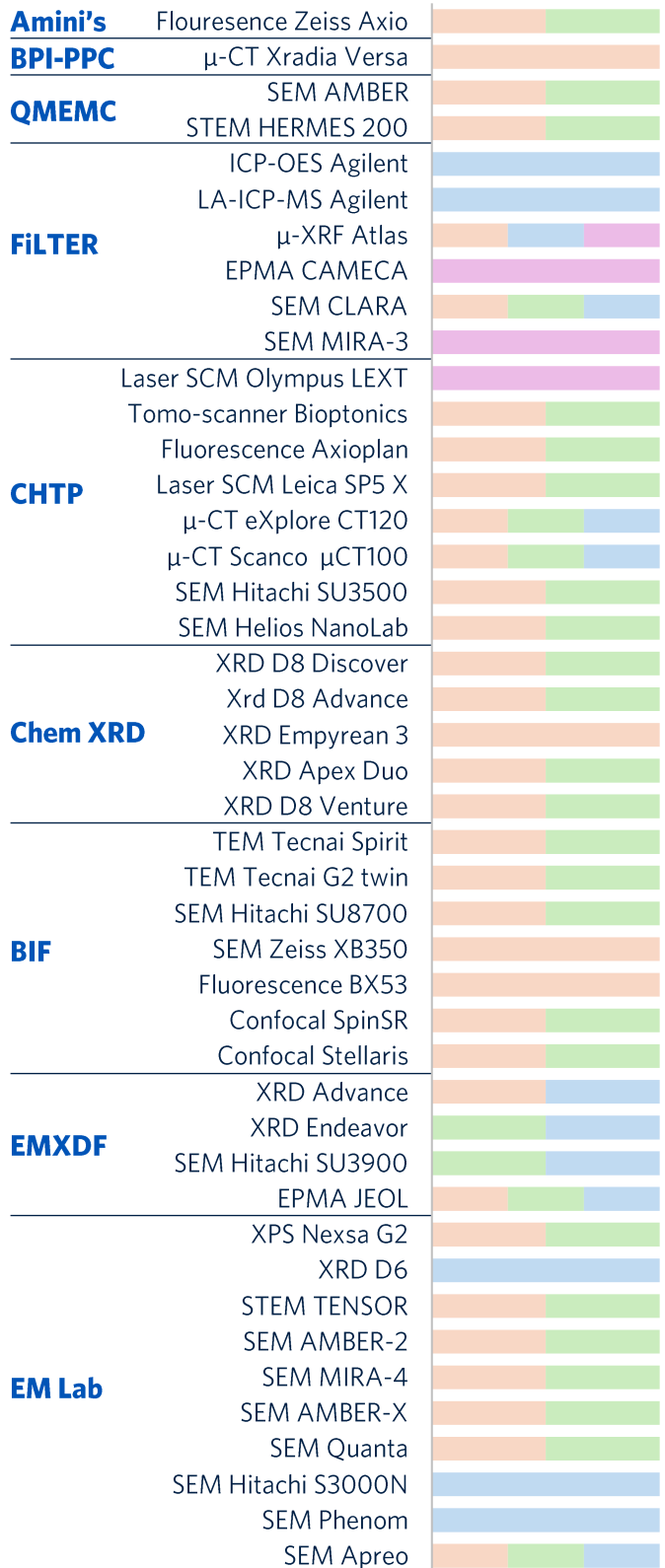


Figure-7: Facility wise equipment distribution, colored by their funding sources

3. Sample preparation facilities

Facilities were asked to link sample preparation equipment that was locally available with the equipment, and this highlighted a range of highly specialized tools as well as more generally available methods. At first glance this may seem like duplication, however we anticipate that a deeper diver will reveal that there may be reasons for local sample prep, specialized configurations, or simply a volume-based approach that justifies these needs. More than 75% of the equipment has local sample preparation, although some facilities require the sample to be prepared at user end.

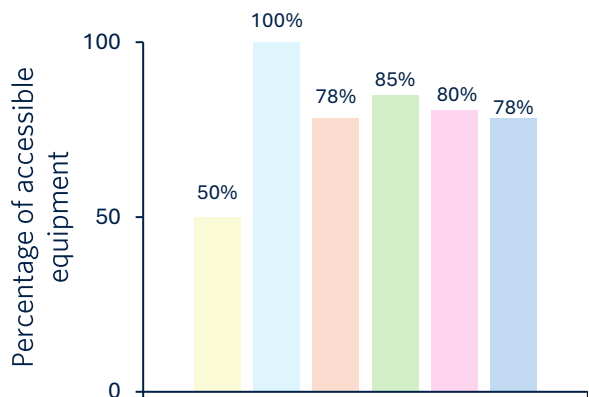
●	EM Lab
●	EMXDF
●	CHTP
●	FiLTER
●	QMEMC
●	BIF

Table-1: Grouped representation of sample preparation facilities in the cluster

Grinding / Polishing	● ● ● ●	Mounting, grinding and polishing machines
	● ● ●	Vibratory polisher
	● ● ●	Broad/Precision ion beam polishing
	●	Jet electro polish system (TenuPol)
Surface coating	● ● ● ● ●	C
	● ●	Cr
	● ● ●	Au/Pd
	● ● ●	Au
	● ● ●	Ir
	● ● ●	Pt/Pd
	●	Al
	● ●	Pt
	●	Pd
	Cleaning	● ● ●
● ● ●		Plasma cleaning
●		UV based cleaner
Drying / Cryo prep	● ●	Critical point dryer
	●	Cryo-transfer workstation
	●	Vitrobot and AFS2 (freeze-substitution)
	●	High-pressure freezer
Powder processing	●	Spray dryer (for XRD sample prep)
	●	Micronizing mill
Special	●	Ultramicrotomes and vibratome sectioning
	●	Centrifuge
	●	Laminar flow hood
	●	Hotbloc for acid digestions (ICP sample)
	● ● ●	FIB-SEM for preparing lamella

4. Types of users

For each piece of major equipment, the facilities were asked to provide an indication of the types of users who can directly use the equipment. We can imagine that a highly specialized piece of equipment could only be used by specialized operators, while others may be accessible to a wide range of users after sufficient training. Across the surveyed facilities, equipment access is strongly concentrated among graduate students and postdocs and PI-led research, with nearly all instruments available to these groups. Undergraduate access is selective, typically limited to teaching-oriented instruments, while many advanced systems are restricted to trained or supervised users. External and industry use is possible for many pieces of equipment, but this varies due to the equipment age, scope and volume of use



- Undergrad
- Grad / Postdocs
- PI-led research
- Trained users from other UBC research groups
- Industrial clients
- External users from other academic institutions

Amini's	Flourescence Zeiss Axio	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	BPI-PPC	μ-CT Xradia Versa	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
QMEMC	SEM AMBER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	STEM HERMES 200	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FILTER	ICP-OES Agilent	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	LA-ICP-MS Agilent	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	μ-XRF Atlas	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	EPMA CAMECA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM CLARA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	SEM MIRA-3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Laser SCM Olympus LEXT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Tomo-scanner Bioptonics	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	μ-dissection AxioVision	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Fluorescence Axioplan	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
CHTP	Laser SCM Leica SP5 X	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	μ-CT eXplore CT120	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	μ-CT Scanco μCT100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Hitachi SU3500	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Helios NanoLab	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Chem XRD	XRD D8 Discover	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Xrd D8 Advance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	XRD Empyrean 3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	XRD Apex Duo	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	XRD D8 Venture	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
BIF	TEM Tecnai Spirit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	TEM Tecnai G2 twin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Hitachi SU8700	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Zeiss XB350	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Stereo SZX10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Fluorescence BX53	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Confocal SpinSR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	Confocal Stellaris	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	EMXDF	XRD Advance	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		XRD Endeavor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
SEM Hitachi SU3900		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
EM Lab	EPMA JEOL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	XPS Nexsa G2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	XRD D6	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	STEM TENSOR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM AMBER-2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
EM Lab	SEM MIRA-4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM AMBER-X	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Quanta	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Hitachi S3000N	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Phenom	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SEM Apreo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Figure-8: Equipment colored by their (current) types of users

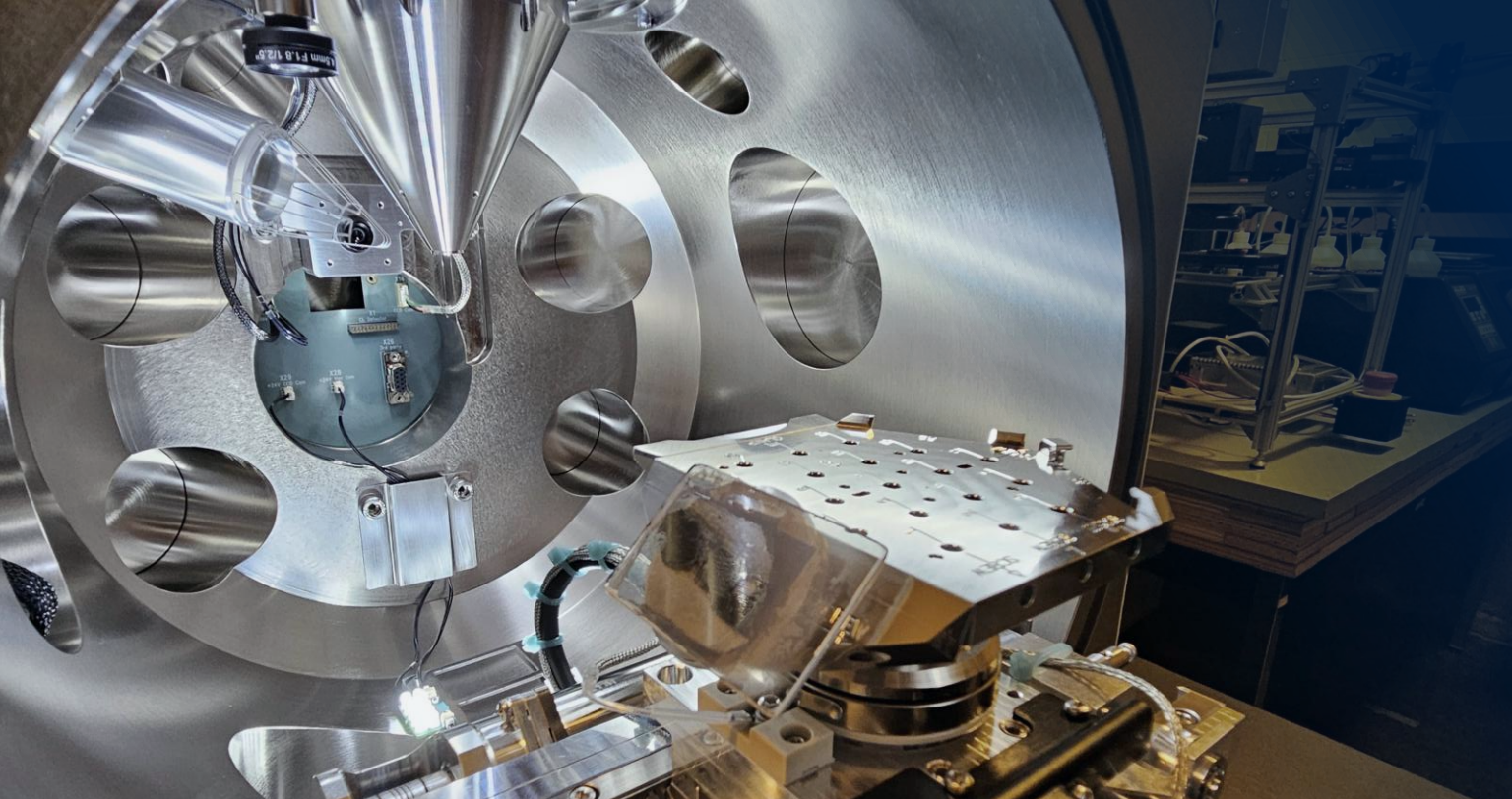


Image: Thermo Fischer Scientific Apreo-II SEM, EM Lab

5. Equipment maintenance

The high value of the equipment surveyed, and its broad potential impact on our research, prompted us to ask facilities how this infrastructure is maintained. Across the cluster, ongoing maintenance is widely recognized as a major challenge within the current funding ecosystem.

The survey indicates that most equipment is either maintained directly by UBC (35%) or covered by a warranty and service contract (31%). The latter is predominantly associated with equipment acquired after 2021, while 15.2% of equipment currently operates without any warranty or service contract.

We can imagine that given the scale of recent investments, the long-term model for maintenance and technical support is likely to become a significant concern for all facilities. Framing maintenance as a strategic priority will be essential for sustaining capabilities, informing future infrastructure investments, and supporting discussions around operating funds and shared service models at UBC.

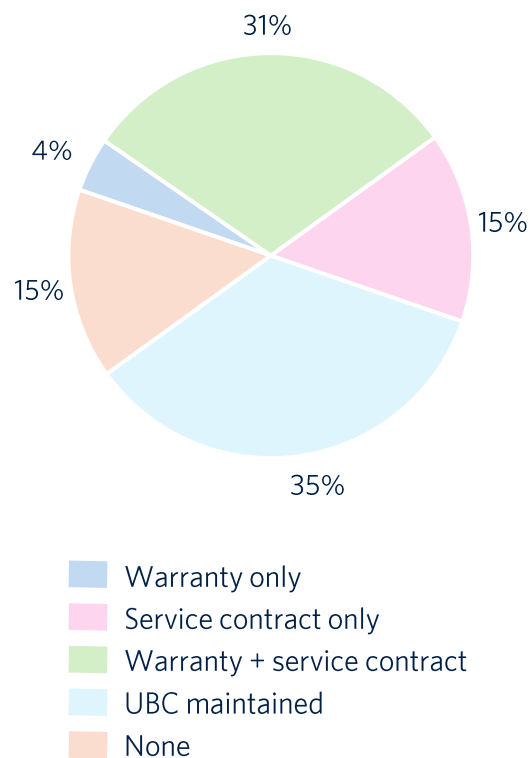


Figure-9: Exploring instrument maintenance approaches across the facilities

6. Complementary capabilities of the scanning electron microscopes in the cluster

Research-intensive universities like UBC rely on a diverse portfolio of complementary instruments, where apparent duplication often reflects the need to handle high demand combined with our need to support specialized applications and workflows that sustain international competitiveness.

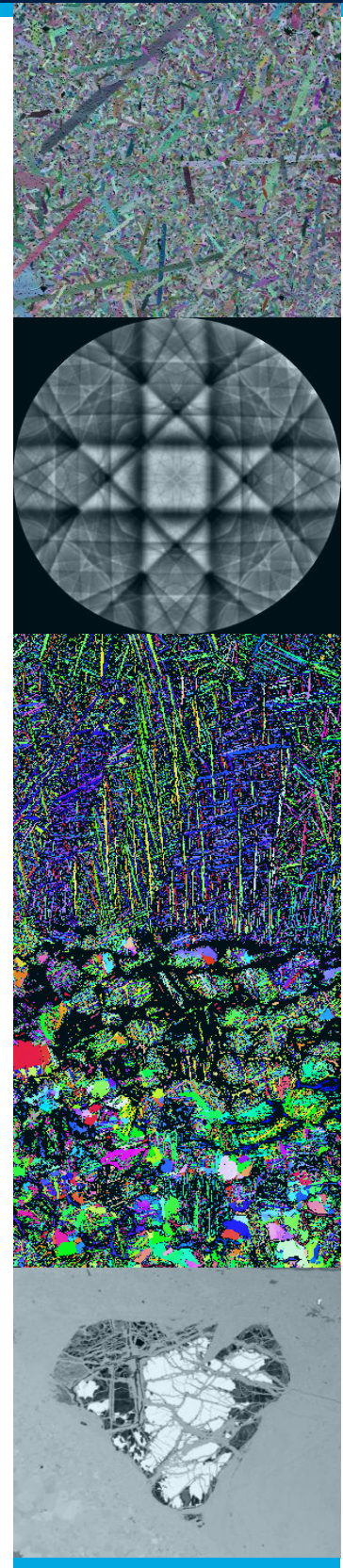
Within this cluster, as an example the scanning electron microscope (SEM) is a workhorse for materials characterization, combining high-resolution imaging, flexible sample handling, and multiple analytical signals in a single, accessible platform. By rastering a focused electron beam over the surface, the SEM reveals microstructure, topography, composition, crystallography, and even electrical behavior from the millimeter down to the nanometer scale. For example, coupling the SEM with a focused ion beam (FIB) creates a “nano-scalpel” for site-specific sample preparation and 3D tomography, further enhanced by a gas injection system (GIS) for in situ deposition, welding, and device-editing workflows.

Other specializations may include a field emission (FEG) SEMs which extend performance with higher resolution and analytical capability, supporting techniques such as EDS for chemistry, EBSD for crystallography, and ECCI for defect imaging.

Additional modes - including STEM-in-SEM for nanometer-scale analysis, cathodoluminescence (CL) for optoelectronic and mineral characterization, cryo- solutions for biological samples, and low-vacuum or environmental operation for uncoated, beam-sensitive, or hydrated specimens - allow these instruments to address an exceptionally wide range of materials problems.

Other instrument configurations also exist, such as the ‘tabletop’ variants (e.g. TS Phenom) which can be very easy to use for outreach and teaching, as well as complimenting optical microscopy and answering many routine research questions.

We provide an indicative listing of our capabilities in Table 2 and Figure 10.



Images: A collection of micrographs and experimental outputs from electron microscopy

Table-2: Comparison of capabilities of SEMs in the cluster

Name	Facility	FEG	EDS	EBSD	FIB	GIS	STEM	CL	ECP/ ECCI	Low Vac.	Cryo mode
TS Apreo-2S	EM Lab	✓	✓	✓					✓	✓	
TS Phenom XL	EM Lab		✓							✓	
Hitachi S3000N	EM Lab		✓							✓	
TS Quanta	EM Lab		✓							✓	
TESCAN AMBER-X	EM Lab	✓	✓	✓	✓	✓	✓		✓	✓	
TESCAN MIRA-4	EM Lab	✓					✓		✓	✓	
TESCAN AMBER-2	EM Lab	✓			✓	✓	✓		✓		
Hitachi SU3900	EMXDF		✓					✓		✓	
Zeiss Crossbeam 350	BIF	✓	✓		✓	✓				✓	✓
Hitachi SU8700	BIF	✓	✓				✓			✓	
FEI Helios NanoLab	CHTP	✓		✓	✓	✓	✓				
Hitachi SU3500	CHTP		✓							✓	
TESCAN MIRA-3	FiLTER	✓	✓	✓						✓	
TESCAN CLARA	FiLTER	✓	✓	✓				✓	✓	✓	
TESCAN AMBER	QMEMC	✓	✓	✓	✓	✓					



Figure-10: Gallery of SEMs in the cluster

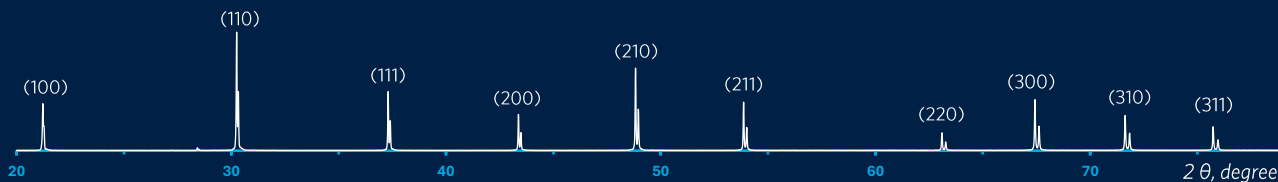


Image: XRD pattern of LaB₆ – sample courtesy of Cole Maws (EMXDF), measured on Bruker D6 Phaser

7. Capabilities of X-ray diffraction instruments associated with the cluster

X-ray diffraction (XRD) is a powerful technique for determining the atomic structure of materials; famously, Rosalind Franklin used it to reveal the double-helix structure of DNA in “photo 51.” At UBC, XRD instruments across Earth, Ocean & Atmospheric Sciences, Chemistry, and Materials Engineering serve as core workhorses for structural analysis, from routine phase identification to advanced studies. The EM Lab uses a D6 Phaser benchtop system for powders and thin films, including undergraduate teaching, while EMXDF operates D8 Endeavor and D8 Advance instruments for high-throughput powder analysis and quantitative Rietveld refinement with Co-K α radiation. The Chemistry XRD facility provides high-intensity systems such as the D8 Venture with silver and copper microsources for single-crystal work, as well as Apex DUO, Empyrean 3, and a specialized D8 Discover with a temperature stage for *in situ* experiments.



Figure-11: Gallery of XRDs associated with the cluster

8. X-ray Tomography Instruments

Advanced non-destructive 3D analysis of materials is performed at UBC, using X-ray tomography apparatus. This can be applied to a range of samples, including live animals, soft materials including bio-products, and structural materials like aluminum for automotive applications

The CHTP operates the Scanco μ CT100, capable of batch processing up to 12 specimens, and the GE TriFoil eXplore CT 120, which is specialized for *in vivo* imaging of small animals with respiratory and cardiac gating.

For engineering materials, the Bio Products Institute (BPI) houses the Zeiss Xradia 520 Versa, which offers sub-micron pixel resolution and includes *in situ* accessories for monitoring samples under tensile or compressive stress

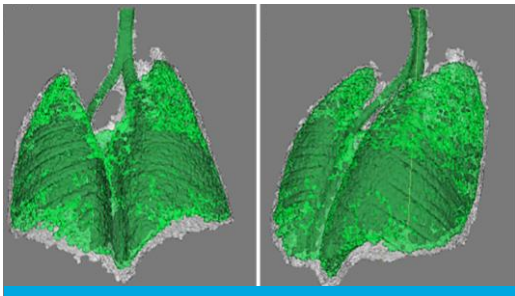


Image: X-ray CT of mouse lungs
Ford et al. (2023) *Journal of Medical Imaging*



Figure-12: Zeiss Xradia 520 Versa μ CT Scanner, BPI



Figure-13: μ -CT *in vivo* scanner, eXplore CT 120, CHTP

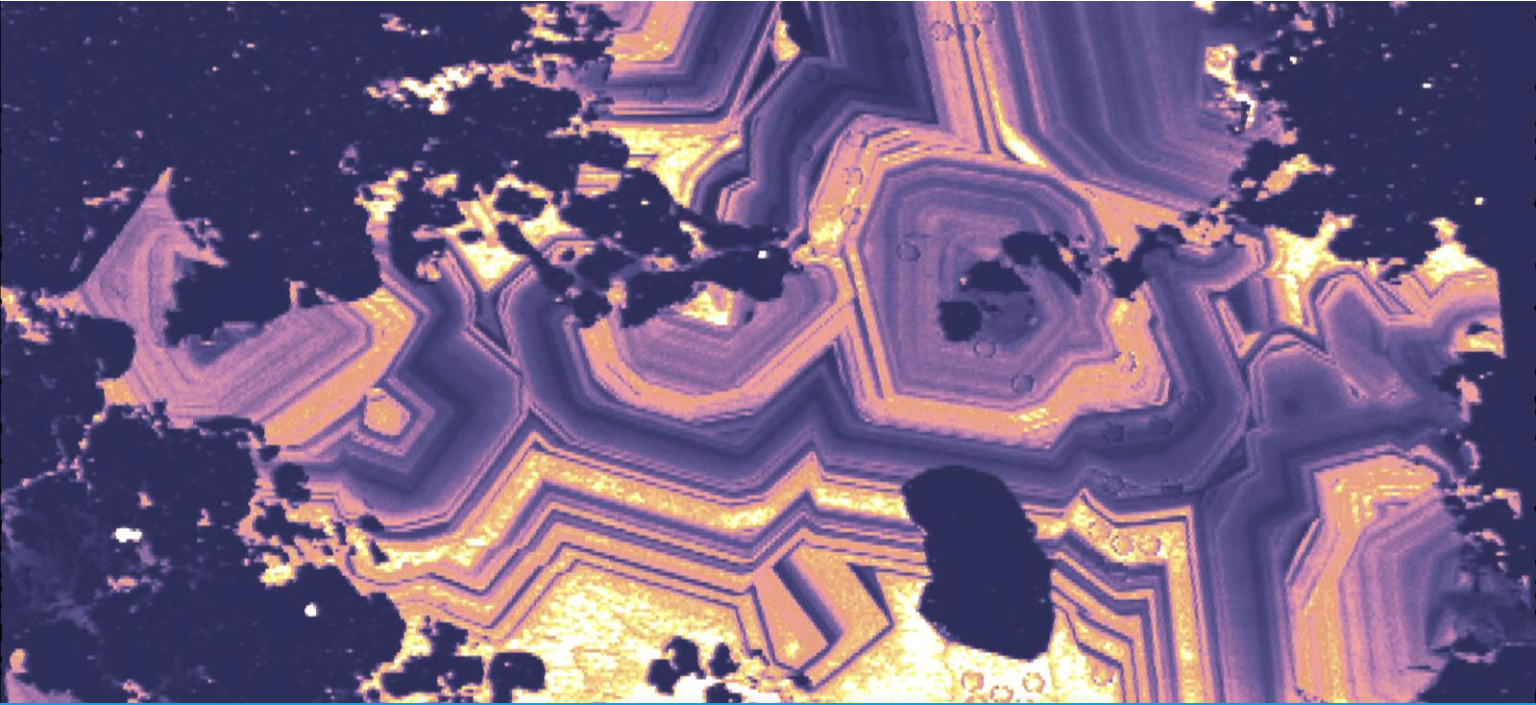


Image: In situ major and trace element mapping through LA-ICP-MS, FILTER, UBC-O

9. Access and Costing

Our survey exercise has begun to unlock a greater understanding of the different funding models, and access costs for the equipment hosted within these facilities. Costing across the cluster typically follows a tiered structure based on the user's affiliation, distinguishing between Academic and Commercial/Industrial rates. Charges are generally calculated based on instrument time (hourly or per-sample) and technician assistance fees if the user is not operating the equipment independently. In 2025, the rates vary significantly by instrument complexity, for example, basic SEM imaging may cost \$40–65/hour for academic users, while higher-end systems like the AMBER-X analytical pFIB-SEM cost more to use as they have more advanced capabilities.

Access to cluster instruments is primarily managed through discussions with local technical staff, or equipment PIs, and then supported with digital portals such as booking.apsc.ubc.ca, app.clustermarket.com, or facility-specific websites like chtp.ubc.ca. Most equipment is available for independent use following mandatory training and safety orientations, though some instruments remain technician-dependent only.

For external or industrial users, access may require direct consultation with facility managers to establish a service agreement.

10. Other facilities & wider access

This Characterization@UBC report examines research facilities that are shared across the university and integrated within the research cluster, typically through leadership or operational management by a cluster Principal Investigator (PI).

It is acknowledged that this report is not comprehensive. Several facilities and instruments relevant to the cluster's areas of focus - principally electron microscopy, X-ray diffraction and tomography, and optical microscopy - are not represented within the report. Examples include specialized instruments located within PI-led laboratories that are primarily used by a single research group for routine or specialized applications and therefore do not operate under a shared-access model. Similarly, equipment situated within dedicated teaching laboratories across both campuses are excluded.

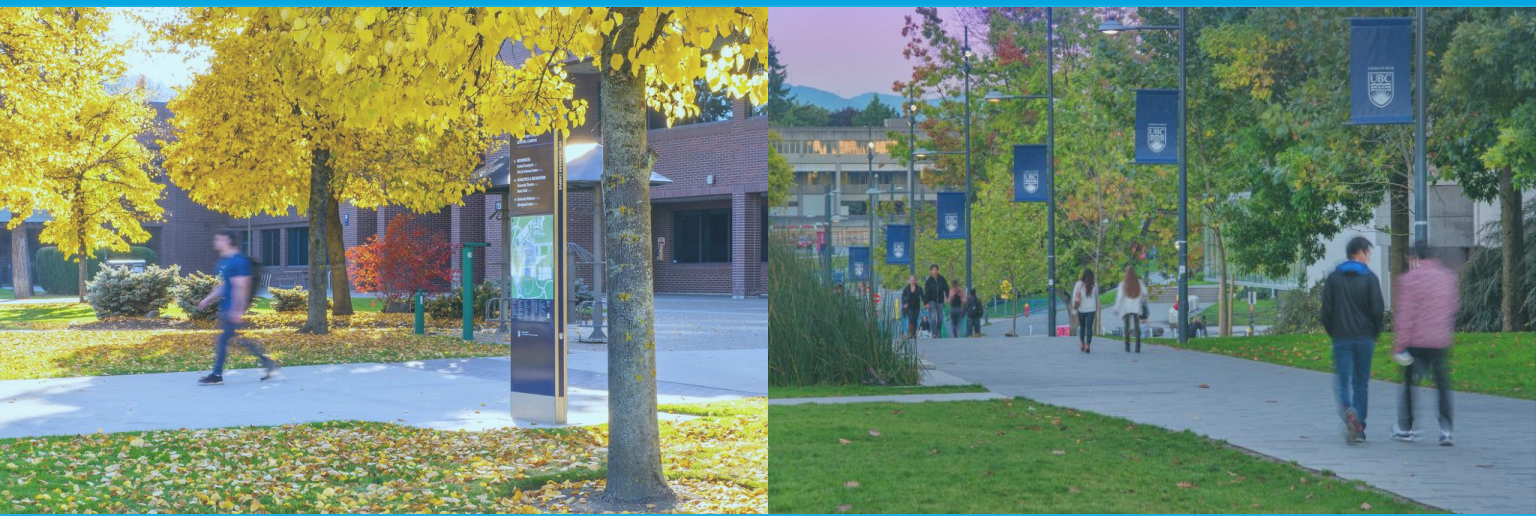


Image credits: (left) Margo Yacheshyn, UBC-O University Relations, (right) Don Erhardt, UBC Brand & Marketing

Furthermore, several major and internationally recognized facilities have been deemed outside the scope of the present survey. These include, for example, facilities within the Faculty of Medicine, such as the [High-Resolution Macromolecular Cryo-EM Facility at UBC](#), and hospital-based resources such as the [BCCHR Imaging Core](#). The Characterization@UBC cluster maintains active collaborations with these groups; for instance, Cryo-EM colleagues contributed to the Fall School.

In addition to directly contacting the individual facilities, information regarding available instrumentation and related activities - particularly for industrial partners seeking to access research infrastructure - may be obtained through the [UBC Imaging Labs Shared Platform](#).

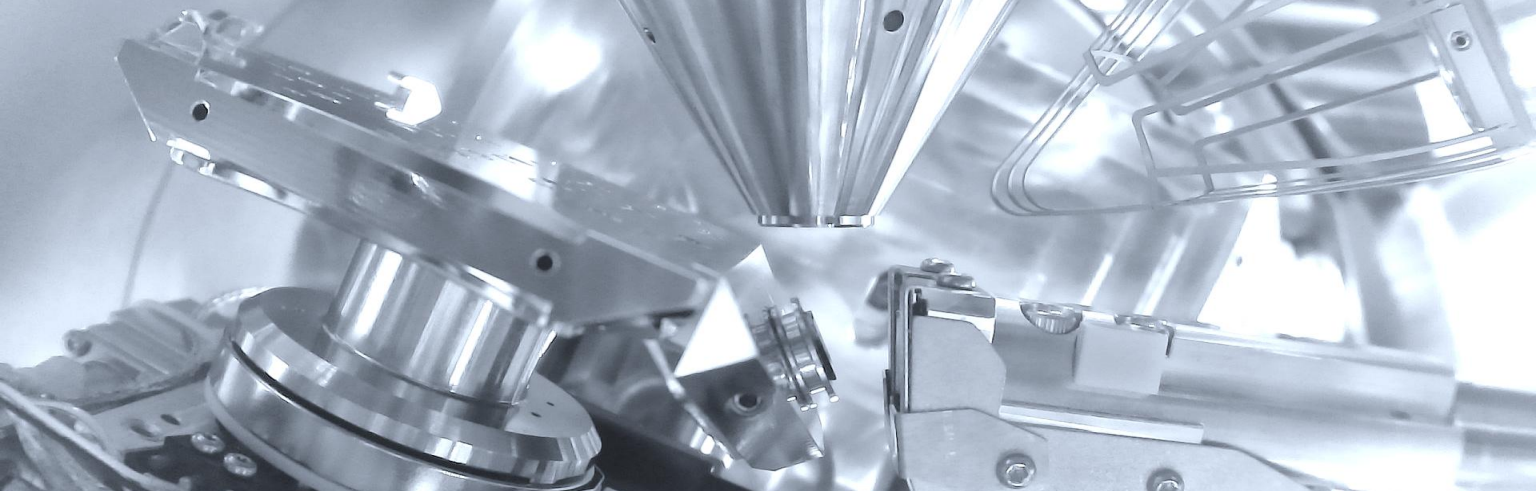


Image: New direct electron detector based EBSD capabilities in SEM

Glossary of acronyms

BCKDF	British Columbia knowledge development fund
BIF	Bio imaging facility
BPI	Bio products institute
BSE	Backscattered electron (detector)
CFI-IF	Canada foundation for innovation - innovation fund
CHTP	Centre for high-throughput phenogenomics
CHBE	Chemical and biological engineering
CL	Cathodoluminescence
EBSD	Electron backscatter diffraction
ECCI	Electron channeling contrast imaging
ECP	Electron channeling pattern
EDS	Energy dispersive spectroscopy
EELS	Electron energy loss spectroscopy
EMXDF	Electron microbeam and X-ray diffraction facility
EOSM	Earth and ocean sciences - main
EPMA	Electron microprobe analyzer
FEG	Field emission gun
FEI	Field electron and ion (company)
FIB	Focused ion beam
FILTER	Fipke laboratory for trace element research
GID	Grazing incidence diffraction
GIS	Gas injection system
HAADF	High angle annular dark field
ICP	Inductively coupled plasma
JELF	John R. Evans leaders fund (in CFI)
LA-ICP-MS	Laser ablated inductively coupled plasma mass spectrometer
LN	Liquid nitrogen
PPC	Pulp and paper centre
SCM	Scanning confocal microscope
SEM	Scanning electron microscope
STEM	Scanning transmission electron microscope
TEM	Transmission electron microscope
TS	ThermoFisher scientific
μ -CT	Micro-computed tomography
VPRI	Vice president, research and innovation
WDS	Wavelength dispersive spectroscopy
XPS	X-ray photon electron spectroscopy
XRD	X-ray diffractometry
XRF	X-ray fluorescence

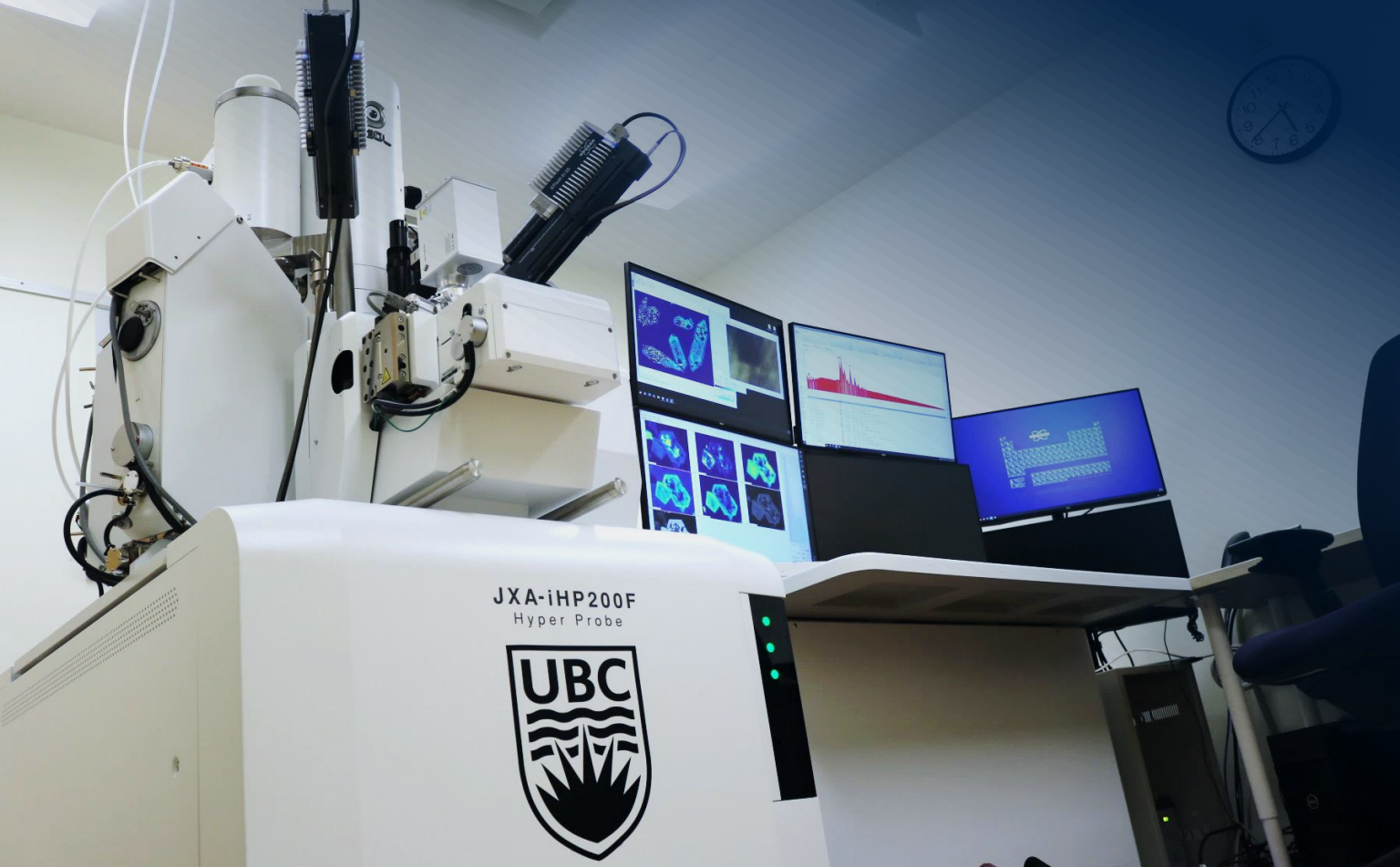


Image: JEOL field emission electron probe microanalyzer (EPMA), EMXDF

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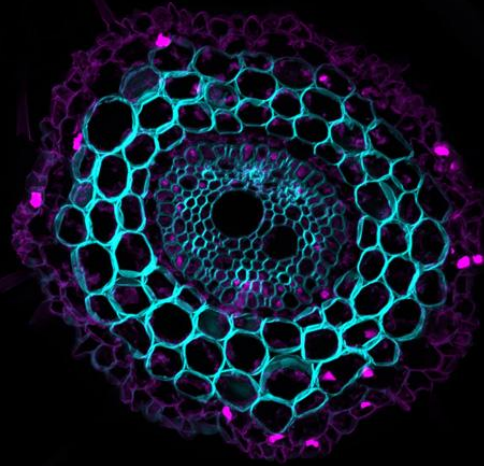


Image: Wheat root cross-section stained with dyes, imaged with the Evident SpinSR microscope in BIF. Credits: J. Zheku, A. Ashraf

Finding out more

Visit the cluster's website to learn more, including contact information and how to join our mailing list: characterization.ubc.ca.

Explore the facility websites directly:

- | | |
|---|--|
| ▪ Bioimaging Facility (BIF) | bioimaging.ubc.ca |
| ▪ Centre for High-Throughput Phenogenomics (CHTP) | chtp.ubc.ca |
| ▪ Electron Microbeam & X-ray Diffraction Facility (EMXDF) | eoas.ubc.ca/research/facilities/epma-xrd |
| ▪ The Electron Microscopy Lab (EM Lab) | emlab.mtrl.ubc.ca |
| ▪ Quantum Matter Institute (QMI) Microscopy Lab | qmi.ubc.ca |
| ▪ Fipke Laboratory for Trace Element Research (FiLTER) | filterubco.ca |
| ▪ Amini Lab | aminilab.mtrl.ubc.ca |
| ▪ X-ray Computed Tomography (X-ray CT) Facility | bpi.ubc.ca/instruments |



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