



Status of the McDonald Institute and its future role in the Canadian Astroparticle Physics Landscape

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Queen's University
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Arthur B. McDonald
Canadian Astroparticle Physics Research Institute



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Outline

- Introduction to MI
- The ‘now completed’ CFREF award
 - Status
 - Accomplishments
 - Criticisms
- The ‘current’ “NSERC-MRS” award
 - Funding Status
 - Current Mission
 - Thoughts on the Collaboration with NSERC/CFI and alignment with SAP LRP
 - Transition to priority driven support

The role of the McDonald Institute over past 10 years of CFREF funding

Originally a partnership of 8 Universities and 5 institutes, the Institute was funded in 2016 for 63.7 M\$ over an initial 7 years

The McDonald Institute **connects and supports astroparticle physics research all across Canada** with a focus on R&D efforts at Universities.

The Institute also provides the community with professional and administrative support with expertise in education/outreach, communications, hqp recruitment, retention and training, EDII best practices etc All important aspects of big science that are difficult to include at the individual project level.



Now a partnership of 11 Universities and 6 institutes with funds flowing through NSERC



University
of Victoria



SIMON FRASER
UNIVERSITY



Université de
Sherbrooke



CITA | ICAT

Canadian Institute for
Theoretical Astrophysics L'institut Canadien
d'astrophysique théorique

New



CIFAR
CANADIAN
INSTITUTE
FOR
ADVANCED
RESEARCH



Carleton
UNIVERSITY



INSTITUTE OF
PARTICLE
PHYSICS



Laurentian University
Université Laurentienne



McGill



PERIMETER
INSTITUTE



THE UNIVERSITY
OF BRITISH COLUMBIA



UNIVERSITY OF
ALBERTA

Université
de Montréal



UNIVERSITY OF
TORONTO

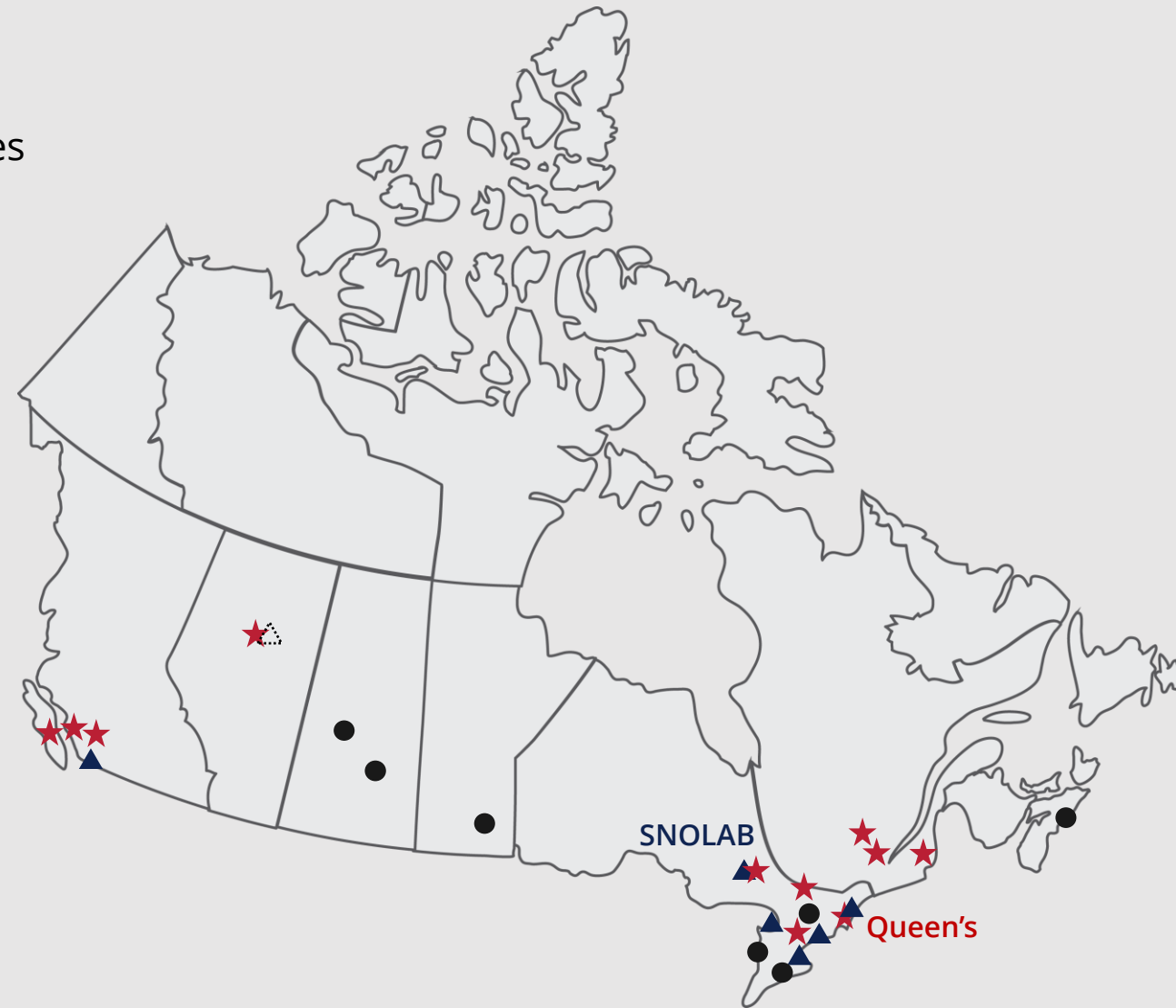


CANADA
FIRST
RESEARCH
EXCELLENCE
FUND

A Canadian Partnership

- Hosted at Queen's:
- Canada-wide scientific effort leveraging world-class facilities
- SNOLAB – Premier underground facility in the world

★ 11 Universities	▲ 6 Institutes	● Collaborators
Alberta	CIFAR	McMaster
Carleton	CITA	Regina
Laurentian	IPP	Saskatchewan
McGill	PI	Waterloo
Montreal	SNOLAB	Winnipeg
Queen's	TRIUMF	York
Sherbrook		Dalhousie
Simon Fraser		
Toronto		
UBC		
Victoria		



Focus: The Institute was initially created with a focus on ensuring Canadian scientists were leading in the science that benefits from having the premier underground facility, SNOLAB, in their backyard.

Physics objectives focus on:

- Dark Matter
- Fundamental Properties of neutrinos
- Neutrinoless double beta decay
- Multi-messenger Physics

In addition to SNOLAB we also now benefit from the underwater facilities at Ocean Networks Canada.



CFREF main project dates:

- January 2015 Initial Idea, to create a center focused on supporting Canadian participation on SNOLAB physics
- September 2016 Launch of CFREF – Known as CPARC for 1st few years. 63.7 M\$
- May 2018 Re-branded as McDonald Institute
- September 2023 Original end date from CFREF. All funds received.
- Then we received:
 - One year extra for “spend down”
 - 18 month “Covid Extension”.
- September 2025 Our Targeted end-date for all spending (gave us a 6 month buffer)
- September 2026 Last annual report due

CFREF Funding Status

- 100 % of all funds spent.
- Financial reports audited and approved.
- After 63.7 M\$ in funding, reconciliation against all invoices and bills agrees to about 1\$
- Finance and audit committee commends the MI financial team, along with Queen's and our partners on the robustness, clarity, and transparency of our financial reporting.
- Exit survey with CFREF completed in June 2026.
- Last step is to submit final annual report (thanks to everybody that filled the survey out to help collate the data we need for reporting).

CFREF Highlight: Capacity Building:

- 15 new Faculty in cross-disciplinary positions hired directly by McDonald Institute.
- This spawned about 14 more faculty positions to build on these groups.
- There has been a significant shift of researchers, previously in more adjacent fields, more directly into astroparticle physics. Over 80 faculty members across Canada have had significant engagement with MI during the CFREF period.
- Initiated substantial growth in astroparticle physics theory
- Many hundreds of HQP supported across Canada
- We supported (with SNOLAB) 5 faculty members at Laurentian when LU became insolvent.
- New arrivals: Ana Botti (UdeM)
Kyle Leach (Queen's)
- One CERC already established (SFU) and another pending results (Queen's)

Example of growth in field

- **SuperCDMS**

- Research Faculty originally supported completely by MI:
 - Miriam Diamond (Toronto)*
 - Alan Robinson (Montreal)
 - Wolfgang Rau (TRIUMF)

Plus at Toronto*:

- Pekka Sinervo
- Ziqing Hong

Support for SuperCDMS at UBC, TRIUMF, Toronto, Montreal, Queen's. This has been very important as with the current geo-political situation, the Canadian teams were taking on a disproportionate share of the infrastructure installation at SNOLAB.

*New Group in Astroparticle Physics at University of Toronto enabled by CFREF

Advancing the science:

Funds from MI are used to accelerate/amplify the impact of NSERC supported research programs, mainly by supporting personnel to work on these projects. Engineers, pdfs, students, project managers....

	2016	2026
Deap	Started cooling	Main Science complete. Completed upgrades. In operation again
SuperCDMS	Completed run in Soudan. Planning to relocate to SNOLAB	In commissioning phase. Base temperatures acheived
News-G	A concept. Exploring approval with SNOLAB	In Operation
PICO	Running with PICO 60	Running with PICO 40 RSU and main components of PICO-500 assembled
SNO+	Cavity fill just starting	In Phase 2 of operations (water,scintillator). Te purification testing underway for phase 3
nEXO	Running at WIPP with EXO-200, thinking about nEXO	Original design essentially complete. Merging with XLZD for dark matter (and 0vBB if possible)
Halo	Running already by 2012	Launched SNEWS. Still running well

Not part of the APP in Canada scope, or some not even a concept, in 2016 but on the agenda now: SBC, P-ONE, Darkside, ARGO, Ricochet, CUTE, HyperKamiokande, GW (LIGO/LISA) ...

Criticisms:

As the MI has evolved from a grass roots idea, we have a better sense of what technologies are most likely to succeed at probing new physics sensitivities, and a better sense of community priorities. In the original CFREF days there was a lot of discretionary funding support flowing to the partners. Criticisms leveled at MI included:

- Just another funding agency. Too much discretionary funding, not enough direction.
- This also made it hard to work with NSERC and CFI in terms of providing them with details on which programs were going to be supported.

We are slowly changing this through a more top-down approach, well defined priorities, and allocation of resources predominantly in support of the priority program.

- My vision is to have MI move towards a model wherein the Institute adopts and supports key priority programs at levels commensurate with their established priority.
- We are collecting the data we need to share with NSERC on program support levels, and are thinking about ways to help support priority applications requesting major CFI infrastructure .

The McDonald Institute Relunched.

To compete with international peers, we need to have the resources to be able to step up and accept major responsibility for the creation of significant elements of the experimental program.

MI will enable scientists (largely at the Universities) to take leading roles on major international programs with the support required to:

- to do the necessary R&D to develop detector concepts,
- to engineer, build, commission and test demonstrator modules,
- fabricate final detector components for delivery to experimental site,
- liaise with engineering teams at host facilities to help ensure smooth integration and safe installation/operation

Relaunched McDonald Institute NSERC-MRS Scope:

- Significant new element. **Integrated Project Delivery Centre (IPDC)**. The distributed engineering and technical staff (17 FTE spread across hubs in Montreal, Kingston, Ottawa, Edmonton, Vancouver/Victoria) which support the major R&D efforts. Resources are allocated on priority basis on advice from allocation committee. (See talk by Koby)
- **Pooled Funding**: Available on competitive basis to support HQP (postdocs, graduate students, summer students) and new initiatives. Several application rounds already completed:
 - 47 HQP supported through pooled funding program so far. New competitions on the way.
- **Regular funding** through inter-institutional agreements
 - 75 HQP supported through funds to partner Institutions. (SNAP shot of Q4 Jan – March 2026)
 - Plus 4 HQP working on astroparticle physics related STEM curriculum development in Faculty of education at Queen's.
- **Special programs**
 - Engineer in training program
 - Early career researcher support. Visitor exchanges
 - EDII special initiatives, recruitment strategies
 - Education in STEM
 - Education and Outreach
 - Tech development:

NSERC-MRS Funding Status. 45.5 M\$ award

NSERC treating as two separate entities due to the way they received the funding notices from ISED.

- First two years (18.2 M\$) received. Nominally April 2024 – March 2026 but with extra year spend down at NSERC we are budgeting this April 2024 – March 2027
- Final three years (27.3 M\$) has also been reviewed, approved and received. Budgetted ~ April 2027 – March 2030 including the one year spend down.
- NSERC formally expects us to budget 9.1 M\$/a but we will be ramping up over the entire period.

	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
First 2 years	0	9.1	9.1			
Final 3 years				9.1	9.1	9.1

Basic Program support (snapshot from Q4 Jan – Mar 2026)

Program	UG	MSc	PhD	PDF	RS	Eng/tech	EIT	Admin	Total
Theory	2	2		1					5
PICO				1					1
HK			1						1
SuperCDMS		1		7.7	.75				9.45
Tech Dev				1		4			5
IPDC						22			22
LAr	1		1	1	2	5.7		2	12.7
SBC				1		.5			1.5
P-ONE						.5			0.5
SNO+						.3	2		2.3
Sensei		1							1
XLZD	1		3						4
CUTE					.25				.25
Ricochet	2								2
LIGO				1					1
Mathusla				.3					.3
Other						2		4	6
Total	6	4	5	14	3	35	2	6	75

Integrated Project Delivery Centre

A well identified gap in the Canadian astroparticle physics ecosystem is the lack of engineering and technical resources at the Universities. Such a resource:

- Will enable Canadian researchers to take on major leadership responsibilities within large international collaborations to deliver significant components of those projects. Hence elevating the stature of the Canadian contributions.
- Will provide a blend of technical skills accessible to the entire community where having all those skills locally would be impossible.
- Allows the community to retain the expertise in underground physics while the various projects move through the typical life cycles of design, fabrication, and commissioning where significant engineering resources are most needed.

Engineering and Technical Staff in the IPDC

Queen's	Koby Dering P.ENG	Mechanical, Structural, Process, PM, Technical Director
	Jonathan Corbett P.ENG	Cryogenic, Mechanical
	Mackenzie Dean	Mechanical
	Armin Mir	Mechanical
	Nicholas Moss	Mechanical
	Jeff Kingma	Machinist
	Robert Gagnon	Research Technologist
Carleton	Farrokh Rad P.ENG	Project Management
	Ryan Crampton P.ENG	Design Engineer
	John Sosiak	Lab Management
Alberta	Michael Rangen	Electronics Technologist
	Steve Perricone	Mechanical
McGill	Naman Walia	Mechanical, Cryogenic
Montreal	Mathieu Lauren ++	Research Scientist
UVIC	Sam de Jong	Detector Technologist
SFU	Chris Ng	Mechanical
TRIUMF++	Leanne Beet	Facility Manager
	Roger Brammall	Electronics Engineer in Training
	Benjamin Smithers	Detector Scientist
	James Nikkel	Research Scientist



Managing the IPDC

- Relevant proposals are first reviewed by a “Project Feasibility Committee” with appropriate engineering and technical expertise to evaluate the technical feasibility of the request. This may involve some iteration with the proponents.
- The “Resource Allocation Committee” evaluates the scientific merit and alignment of feasible proposals and makes a recommendation on the appropriate level of support.
- First round of applications has been received, (with some notable absences).
 - PFC has completed their review.
 - The RAC has met once and will meet again in early to mid August to finalize.

Highest MI Priorities (in no particular order)

- **XLZD/nEXO2.0** amalgamation.
 - Potentially best of both worlds if $0\nu\beta\beta$ comes together with dark matter. New ideas emerging daily.
 - Excellent potential home at SNOLAB. (But other labs are interested too)
 - Ready made second phase with xenon enrichment.
 - Capturing imagination of scientists, and agencies are willing to explore.
- **SNO+**
 - Must load with Te to 0.5%. (The main focus of MI support for SNO+ along with recent engineering effort to fix leak). Still very competitive.
- **SuperCDMS**
 - In the process of commissioning. Reached temperature. Chasing usual sources of noise, thermal leaks....
 - After decades of effort, on the verge of exciting new physics results. A must complete
- **Darkside 20**
 - Need to complete: Enormous Canadian investment to construction phase. Follows from successful DEAP program in Canada. Excellent PSD demonstrated.
- **Theory**
 - Modest amounts of support leads to big impact, connected vibrant community.

Near top MI Priorities

- **P-ONE**
 - Great enthusiasm for neutrino telescope in Canada using Ocean Networks Canada site and infrastructure
 - Adds to the global community, overall sensitivity, complementary sky coverage
 - The collaboration argues it is important to have P-ONE and KM3Net for multi-messenger astronomy with transient events where opacity of earth to high energy neutrinos can be a limitation.
 - Technology is generally understood (to be refined and optimized based on pathfinder strings).
 - MI support generally focused on support for getting first strings built and deployed.
 - Less well aligned to MI mandate. (Originally focused on the connection to SNOLAB)
 - No clear path yet to fully funded km³ array.

Breadth

Experiments which are at the smaller/earlier stage. Important, but feasibility or ability to implement a next step needs to be demonstrated. MI willing to provide **modest support** in the short term. Next phase to be determined based on success at this level. Otherwise, these projects may be sun-set in the eyes of MI.

- **PICO**
 - Imperative that PICO 500 is completed. At this stage construction is nearly complete. Only operational support required.
 - No clear next generation scaleup
 - Possible interest in swapping fluids to push to lower mass WIMP
- **SBC**
 - Small scale demonstrator needs to run its course
 - Possible coalescence of community (PICO/SBC merger) if promise of SBC can be demonstrated.
- **NewsG**
 - Needs to finish operations at SNOLAB. Next phase is 3-m SPC at Boulby. Less connected to MI
- **Super Fluid Helium:** Some interesting developments in using superfluid He as low mass DM detector should be explored

Lower Priorities

Experiments which have limited footprint in Canada, are less well aligned with MI, or not really needing the sorts of resources available from MI. These currently get limited or no funding from MI

- **Legend:** Small footprint in Canada. LNGS siting. SNO+ then Xe based $0\nu\beta\beta$ are priorities.
- **Halo:** Minimal resources needed.
- **DEAP 3600:** Important to finish but completion of DEAP has minimal or no resource cost to MI
- **KDK+:** Fundamental measurement of K decay, but not requiring SNOLAB, underground resources.
- **DUNE:** Longer time scale than HK, less Canadian footprint, not so well aligned with MI
- **Skipper CCDs:** Very interesting project, but small footprint in Canada as yet.
- **Mathusla:** Not well aligned with MI for deep underground low background expt. No clear path to funding required. Limited existing support internationally.

Other Priorities

Experiments which have a high scientific impact but are less well aligned with MI and are not using Canadian facilities will be supported strategically to boost Canadian opportunities to lead on some of the scientific output.

- **Hyper-Kamiokande:** A very exciting, accelerator based, neutrino oscillation experiment in Japan. Very likely to be operation in the next couple of years and with Juno should make defining measurements of neutrino/PMNS matrix parameters, (mass hierarchy, CP phases, precision mixing angles....). Very strong Canadian contributions. Should be a key element of the SAP LRP but not so well aligned to MI mandate. A natural follow on from SNO, T2K etc. Modest support to help maintain Canadian Leadership.
- **LIGO/LISA GW:** Interesting to MI (not of relevance to SAP LRP) as a global success story with connections to multi-messenger physics. Very modest support to amplify Canadian contributions

A word on Sustainability

- The conversation around the Major Research Framework (MRF) has gone a little quiet, although we know CFI is in conversation with ISED.
- In my view, a complete MRF in support of astroparticle physics in Canada requires cradle to grave oversight with funding outside the standard funding agency programs, and would include:
 - Support for **facilities** (like SNOLAB and TRIUMF)
 - Support for **institutes supporting the Research and Development** of projects destined for said facilities where support required for Canadian participation and leadership is at a level well beyond the capacity of standard funding streams. This would include the McDonald Institute
 - Support for **project infrastructure** at a scale that exceeds the capacity of CFI and NSERC. (>100 M\$ price tags)
 - Flexibility in the look and feel of MRF for each. One size does not fit all. Matching programs should not be required. CFI with current rules is not a good fit for many facilities.
- We need to think about a new campaign already, pushing for support through the MRF, applying for a next round of CFREF, NFRF, philanthropy....



Arthur B. McDonald
Canadian Astroparticle Physics Research Institute



Thank You