

# Subatomic Physics Evaluation Section Annual Report

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## 1. Introduction

The objective of this report is to summarize the activities of the Subatomic Physics (SAP) Evaluation Section during fiscal year 2023-24, including the outcomes of the 2024 competition. This document is made available to the Canadian subatomic physics community.

The Subatomic Physics Evaluation Section (SAPES) is a standing review committee that oversees a suite of programs. Funding for the Subatomic Physics suite of programs has been made through an independent envelope mechanism since 1991. Subatomic Physics Individual and Project Discovery, Research Tools and Instruments (SAP-RTI), and Major Resources Support (SAP-MRS) grant applications are evaluated together by the SAPES. This comprehensive approach is essential given the complexity and inter-dependency of many proposals, which are often linked to international programs and collaborations, and may involve many universities and national laboratories. This approach is also essential for the planning and stability of execution of large-scale and long-term projects, and for maintaining a balance between large projects and the smaller research efforts that are essential to the breadth and future success of the Canadian subatomic physics program. The envelope structure helps the SAPES maintain a balance between operations and capital investments.

The membership of the SAPES is itself substantially international, with approximately half of its members coming from institutions in the U.S. and around the world. This level of international review provides a high degree of scrutiny and validation of the research funded by NSERC.

Despite the increased budget of the SAPES envelope in past years, it has been challenging for the SAPES to financially support the community's short- and long- term objectives at an appropriate and competitive level to ensure the maximum scientific return on investments already made. This is partially due to the internationally recognized excellence of Canadian SAP research leading to increased responsibilities in both national and international experimental projects. The success of the subatomic community in securing infrastructure funding through CFI has also led to increasing demands on the SAP envelope for operational funds.

The Canadian SAP five-year Long-Range Plan (LRP) identifies the community’s scientific and funding priorities and provides guidance to the SAPES’ deliberations. The most recent LRP (2022-2026) report was produced in 2021 and covers the period until 2026 (with a look ahead to 2036).

## **2. SAPES Envelope**

The pressure on the SAP envelope has been building for several years. Substantial investments by the Canadian government in science and technology, such as the Canada Research Chairs (CRC) program, the Canada Excellence Research Chairs (CERC) program, and the Canada First Research Excellence Fund (CFREF) have resulted in the fast growth of the number and the quality of faculty in SAP at many Canadian institutions. The latter increase has, in turn, been accompanied by a substantial growth in the number and quality of graduate students and other highly qualified personnel. As CFREF funding in support of the McDonald Institute has come to an end, further pressure on the funding envelope when the recently hired faculty members begin applying for grants has occurred, as expected.

The SAP community has been effective in making use of CFI’s programs for major capital equipment. This additional source of funding is welcome, but it is important to highlight the fact that it is in turn generating further pressure on the envelope as the latter is the main funding source in support of research-related costs. In recent years, there has been an increase in coordination of efforts between CFI and NSERC to better serve the needs of the SAP community. CFI continues to recruit NSERC Expert Review Committee and SAPES members for their review committees.

A constraint on “opportunity funds” has been raised as a concern in past iterations of the LRP, and the current report recommends continued support through, and growth of, the SAP envelope to ensure Canada remains globally competitive. The share of the envelope committed to the support of research operations does not allow much room for small-scale capital investments that are critical for emerging research endeavors. The recommendation for growing the SAP envelope is then, in part, to ensure sufficient availability of funds for small infrastructure projects and the development of future science opportunities.

Small-scale capital investments by the SAPES are needed both for R&D efforts and to satisfy the capital needs of the smaller programs that are essential for the breadth of the community and the future of Canadian subatomic physics. Due to the long timescale of subatomic physics research programs, some overlap between current and next-generation discovery endeavors is unavoidable if Canada is to continue to play a leading scientific role in next-generation research projects. At a time when Canadian researchers are successfully utilizing the public investments made to date in leading endeavors, it would not be opportune to consider re-allocating a substantial part of the support to these efforts towards small-scale capital investments.

### 3. SAPES Membership

This year's SAPES comprised 15 members, including five theorists.

Name	Institution	Term	Expertise
<b>Thomas Brunner</b>	McGill University	2022-2025	Exp. Neutrino & Particle Physics
<b>Maxime Brodeur</b>	University of Notre Dame	2024-2026	Exp. Low Energy Nuclear Physics
<b>Maria Chamizo-Llatas</b>	Brookhaven National Laboratory	2024-2026	Exp. Accelerator R&D
<b>Barbara Erazmus</b>	Centre national de la recherche scientifique	2024-2026	Exp. Nuclear & Particle Physics
<b>Alexandros Gezerlis</b>	University of Guelph	2022-2025	Th. Nuclear Astrophysics
<b>Roxanne Guenette</b>	University of Manchester	2022-2025	Exp. High Energy Physics
<b>Rituparna Kanungo</b>	Saint Mary's University	2024-2027	Exp. Nuclear Physics, Nuclear Reactions
<b>Nikolina Ilic</b>	University of Toronto	2021-2024	Exp. Particle Physics
<b>David Morrissey</b>	TRIUMF/ University of Victoria	2021-2024	Th. Particle Physics
<b>Giulia Ricciardi</b>	University of Naples	2022-2025	Th. High Energy Physics
<b>Matthias Schindler</b>	University of South Carolina	2021-2024	Th. Nuclear Physics
<b>Gordon Semenoff</b>	University of British Columbia	2024-2026	Th. Quantum and Field Theory
<b>Timothy Sumner</b>	Imperial College of London	2024-2026	Exp. Astroparticle Physics, Dark Matter
<b>Michel Vetterli</b>	Simon Fraser University	2024-2026	Exp. High Energy Physics
<b>Albert Young</b>	North Carolina State University	2020-2023	Exp. Nuclear Physics, Strongly Interacting Matter (IEP)

The Co-Chairs acknowledge the demanding task faced by SAPES members throughout the year, up to and especially through competition week. Long hours of deliberations ensured that each proposal was fairly and consistently evaluated according to the selection criteria. The Co-Chairs also sincerely thank SAPES members for their careful and constructive attitude throughout the competition, and for ensuring the conduct of our many discussions in a pleasant atmosphere. Special thanks also go to this year's retiring members, Nikolina Ilic, David Morrissey, Matthias Schindler, and Albert Young for outstanding service to the Canadian SAP community; it is deeply appreciated.

The Co-Chairs thank NSERC staff for their expert guidance and help in the months leading up to the competition, as well as the long days of competition week: Shashini Jayaratne (Program Assistant), Amélie Champagne and Philip Bale (Program Officers), and Kevin Lapointe (Manager).

#### **4. Pre-Competition Meetings**

Once membership is finalized, NSERC schedules orientation and calibration sessions through the competition year. These sessions, held between September and January, are opportunities for the SAPES to familiarize themselves with NSERC policies and procedures, the Canadian funding landscape, and tasks leading up to and including competition week.

Each year, the SAPES members receive a jointly prepared CINP-IPP document explaining the context of the Canadian research environment. The document provides details about, and an overview of, the roles that various Canadian funding agencies play in supporting subatomic physics research. The document further provides information about the structure and different options for Canadian M.Sc. and Ph.D. programs, followed by details about the regional differences in the training of Highly Qualified Personnel (HQP). This document helps members, specifically international ones, orient themselves to the Canadian funding landscape.

NSERC organizes a final Calibration session before the competition week to provide the SAPES with mock reviews. NSERC contacts past applicants to request permission for using their applications for calibration purposes. To guarantee a thorough calibration process, NSERC selects a diverse range of applications, taking into account various factors such as subject matter, ratings, team size and more.

#### **5. Application Process (NOI + Full app)**

The deadline for the Notifications of Intent to Apply (NOI) for a Subatomic Discovery Grant was August 1, 2023. Programs which require NOIs include SAP Discovery Grants (Individual and Project), SAP-MRS, and SAP-RTI (Category 2 & 3).

When the NOIs are received, NSERC, in consultation with the Co-Chairs, assigns each application to an internal reviewer, who is the SAPES member with the most appropriate expertise, carefully considering the balance of workload among all the members. In the case of SAP Discovery grant applications (Individual and Project), the first reviewer is asked to recommend 5 external reviewers for each of their assigned proposals, all of whom are contacted unless conflicts of interest are identified. Members generally select a substantial fraction of external reviewers who are from outside Canada. This year, 92% of applications received 2 or more external reviewer reports. External reviewer reports are not typically sought for SAP-RTI or SAP-MRS grant applications.

Once all full applications are received, NSERC, in consultation with the Co-Chairs, assigns five internal reviewers to each application.

## **6. Pre-Competition**

As a kick-off to competition week, on Sunday, February 18, 2024, the SAPES met for Large Project Day (LPD). This session allowed the SAPES members to hear presentations from applicants of SAP Project grant applications requesting an average of \$500,000 per year or more. These large proposals are typically complex, with extensive budgets, international commitments and project planning timelines which go far beyond those of smaller scale grant applications. These presentations provide important updates on circumstances that may have changed since the applications were submitted and address budgetary priorities.

All presentations by applicants of collaborations submitting Large Project applications were conducted *in camera* with the SAPES. Applicants made their presentations and answered questions previously submitted by NSERC and the members. The two observers in attendance for the presentations and Q&A were the directors of the CINP and IPP. Collaborations invited to present were: DUNE, Canadian Collaboration for Integrated Detector Development, ALPHA, NEWS-G, and IceCube/P-ONE.

In a separate “Canadian Context” session, the SAPES met management representatives from the Canada Foundation for Innovation (CFI), the Canadian Institute of Nuclear Physics (CINP), the Institute of Particle Physics (IPP), the Perimeter Institute, SNOLAB, McDonald Institute, and TRIUMF. The primary objective of this session is to ensure that all members have a comprehensive understanding of the Canadian funding landscape.

## **7. 2024 Competition**

At the beginning of competition, taking into account on-going commitments from previous competitions, \$3.6M was available for the 2024 competition. This year, the SAPES received 52 applications, with the total funds requested for competition year CY2024 amounting to \$11.4M, allowing for a funding rate of 32%. This extremely low funding rate is directly attributable to the loss of support that some projects were receiving from the McDonald Institute with the shortfall being requested from the SAP funding envelope. NSERC was able to add an additional \$2.45M to the 2024 SAP competition budget which was equivalent to the amount needed to cover the funded SAP COVID grant extensions. As a result, the competition budget and funding rate in CY2024 were \$6M and up to 53%. For comparison, the funding rates for the years 2018 to 2023 were 74%, 64%, 56%, 40%, 64% and 60% respectively.

The funds available to the SAPES at the beginning of competition are shown in Table 1.

<b>SUBATOMIC PHYSICS ENVELOPE</b> <b>MULTI-YEAR COMMITMENTS BY CATEGORY</b> <b>Competition 2024</b>					
	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>
RTI - COMMITTED	\$157,500				
RTI - 2023 Competition	\$1,739,344	\$200,000	\$0		
<b>RTI - TOTAL</b>	<b>\$1,896,844</b>	<b>\$200,000</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
THEORY - COMMITTED	\$3,237,300	\$1,671,200	\$1,174,000	\$738,000	
THEORY - 2024 Competition	\$1,294,210	\$1,337,286	\$1,342,232	\$1,388,440	\$1,371,099
<b>THEORY - TOTAL</b>	<b>\$4,531,510</b>	<b>\$3,008,486</b>	<b>\$2,516,232</b>	<b>\$2,126,440</b>	<b>\$1,371,099</b>
EXP OPS** - COMMITTED	\$20,666,105	\$6,859,830	\$296,005	\$177,000	\$135,000
EXP OPS - 2024 Competition	\$7,606,415	\$8,285,049	\$8,117,512	\$563,167	\$524,675
<b>EXP OPS - TOTAL</b>	<b>\$28,272,520</b>	<b>\$15,144,879</b>	<b>\$8,413,517</b>	<b>\$740,167</b>	<b>\$659,675</b>
MRS - COMMITTED	\$2,703,917	\$427,393	\$434,115	\$449,465	\$110,545
MRS - 2024 Competition	\$769,646	\$840,096	\$361,653	\$369,356	\$376,103
<b>MRS - TOTAL</b>	<b>\$3,473,563</b>	<b>\$1,267,489</b>	<b>\$795,768</b>	<b>\$818,821</b>	<b>\$486,648</b>
TOTAL - COMMITTED	\$26,764,822	\$8,958,423	\$1,904,120	\$1,364,465	\$245,545
TOTAL - 2024 Competition	\$11,409,615	\$10,662,431	\$9,821,397	\$2,320,963	\$2,271,877
<b>GRAND TOTAL</b>	<b>\$38,174,437</b>	<b>\$19,620,854</b>	<b>\$11,725,517</b>	<b>\$3,685,428</b>	<b>\$2,517,422</b>
<b>TOTAL ENVELOPE</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>
<b>COMPETITION BUDGET</b>	<b>\$6,026,238</b>				
<b>AVAILABLE</b>	<b>-\$5,383,377</b>	<b>\$9,539,106</b>	<b>\$17,434,443</b>	<b>\$25,474,532</b>	<b>\$26,642,538</b>

Table 1. Overall budget available as presented before Competition 2024

Of the 53 applications received, the breakdown was as follows: 20 Project, 18 Individual, 9 SAP-RTI (Category 1), 2 SAP-RTI (Category 2/3), and 4 SAP-MRS applications.

The first day of competition began with a brief introduction to the virtual environment. The SAPES then started Round 1 and proceeded to review all applications, with 5 reviewing members to an application.

After Round 3 concluded, the SAPES recommended total funding of \$5.9M from the envelope, from a total request for \$11.41M, leading to a funding rate for this year's competition to be 52%. This total commitment represents an amount that is greater than the annual envelope, which was possible due to unspent funds from the previous year and additional funds transferred to the envelope to cover the equivalent amount of the 2024 funded COVID grant extensions. The remaining \$131,432 will be added to the SAP envelope for CY2025. The SAPES' final multiyear budget, broken down into equipment, theory, and experimental operating allocations is shown in Table 2, while Table 3 gives the percentage share of the envelope in theory, equipment, and operations over the period from 2019 through 2024.

<b>SUBATOMIC PHYSICS ENVELOPE</b> <b>MULTI-YEAR COMMITMENTS BY CATEGORY</b> <b>Competition 2024</b>					
	2024	2025	2026	2027	2028
RTI - COMMITTED	\$157,500				
RTI - 2024 Competition	\$568,656	\$200,000			
<b>RTI - TOTAL</b>	<b>\$726,156</b>	<b>\$200,000</b>			
THEORY - COMMITTED	\$3,237,300	\$1,671,200	\$1,174,000	\$738,000	
THEORY - 2024 Competition	\$854,150	\$854,150	\$843,500	\$782,500	\$774,500
<b>THEORY - TOTAL</b>	<b>\$4,091,450</b>	<b>\$2,525,350</b>	<b>\$2,017,500</b>	<b>\$1,520,500</b>	<b>\$774,500</b>
EXP OPS** - COMMITTED	\$20,666,105	\$6,859,830	\$296,005	\$177,000	\$135,000
EXP OPS - 2024 Competition	\$4,162,000	\$4,172,000	\$4,030,000	\$210,000	\$210,000
<b>EXP OPS - TOTAL</b>	<b>\$24,828,105</b>	<b>\$11,031,830</b>	<b>\$4,326,005</b>	<b>\$387,000</b>	<b>\$345,000</b>
MRS - COMMITTED	\$2,703,917	\$427,393	\$434,115	\$449,465	\$110,545
MRS - 2024 Competition	\$310,000	\$130,000	\$132,500	\$136,000	\$138,500
<b>MRS - TOTAL</b>	<b>\$3,013,917</b>	<b>\$557,393</b>	<b>\$566,615</b>	<b>\$585,465</b>	<b>\$249,045</b>
<b>TOTAL - COMMITTED</b>	<b>\$26,764,822</b>	<b>\$8,958,423</b>	<b>\$1,904,120</b>	<b>\$1,364,465</b>	<b>\$245,545</b>
<b>TOTAL - 2024 Competition</b>	<b>\$5,894,806</b>	<b>\$5,356,150</b>	<b>\$5,006,000</b>	<b>\$1,128,500</b>	<b>\$1,123,000</b>
<b>GRAND TOTAL</b>	<b>\$32,659,628</b>	<b>\$14,314,573</b>	<b>\$6,910,120</b>	<b>\$2,492,965</b>	<b>\$1,368,545</b>
<b>TOTAL ENVELOPE</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>	<b>\$29,159,960</b>
<b>COMPETITION BUDGET</b>	<b>\$6,026,238</b>				
<b>AVAILABLE</b>	<b>\$131,432</b>	<b>\$18,607,919</b>	<b>\$22,249,840</b>	<b>\$26,666,995</b>	<b>\$27,791,415</b>

Table 3. Breakdown of multiyear commitments at the end of the 2024 competition

### **Subatomic Physics Evaluation Section** **Evolution of Envelope's Shares**

	2019	2020	2021	2022	2023	2024
<b>Theory</b>	13%	11%	13%	13%	13%	13%
<b>RTI</b>	3%	2%	2%	1%	0%	2%
<b>Total Research Ops</b>	84%	86%	86%	86%	88%	85%
<b>Exp. Ops</b>	74%	76%	76%	77%	77%	76%
<b>MRS</b>	10%	10%	10%	9%	10%	9%

Table 2. Envelope share in theory, experimental operations, and equipment, 2019-2024

## 8. EDI information

NSERC is acting on the evidence that equity, diversity, and inclusion (EDI) strengthen the scientific and engineering community and the quality, social relevance, and impact of research. Increasing diversity and gender equity in the research enterprise are key priorities in NSERC's current strategic plan, and therefore we have begun integrating EDI considerations into its policies, processes, indicators of excellence and evaluation criteria. NSERC encourages all applicants to explain their process of identifying, recruiting and selecting research personnel based on EDI best practices as one means to enhance excellence in research, training and outreach. The SAPES was guided on how to evaluate EDI in the Excellence of the Researcher/Collaboration, by looking at past contributions; the Merit of the Proposal, where applicants are expected to describe considerations in their research design; and in Contributions

to the Training of HQP. In this section, applicants are required to describe EDI considerations in their future approaches to recruitment, training, and mentoring, but also are asked to describe specific actions implemented in support of EDI in their past trainings of HQP. Through these actions, NSERC is hoping to develop the inclusive culture needed for research excellence and to achieve outcomes that are rigorous, relevant, and accessible to diverse populations.

The SAPES cannot stress enough the importance and value for applicants to have considered EDI through all stages of their research process, including, but not limited to, a well thought through, personalized, and comprehensive research training plan.

## **9. Data management plan (DMP) pilot information**

Research data management is increasingly recognized as a component of research excellence and many funders around the world are implementing data management requirements that include Data Management Plans. A data management plan (DMP) is a living document, typically associated with an individual research project or program that consists of the practices, processes and strategies that pertain to a set of specified topics related to data management and curation.

The Tri-Agency Research Data Management (RDM) Policy was introduced in 2021, and CIHR, SSHRC, and NSERC are gradually integrating it into their practices. The DMP was not part of the scoring or the formal evaluation of the proposal this year; reviewers, however, were invited to provide feedback to applicants and NSERC staff this year, in order to refine the DMP requirements for future years.