

# Subatomic Physics Evaluation Section Annual Report

**Alison Lister, Co-Chair**

University of British Columbia

**Ingo Wiedenhoefer, Co-Chair**

Florida State University

Prepared by: Philip Bale and Kaitlyn Pomykala (Program Officers, SAPES)

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## 1. Introduction

The purpose of this report is to summarize the activities of the Subatomic Physics (SAP) Evaluation Section during fiscal year 2022-23, including the results of the 2023 competition. The report is provided 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.

Budget 2018 represented a historic investment in Discovery research. The profile of ramping up for the SAP envelope, from 2018/2019 to 2021/2022, has now reached an ongoing commitment of \$3,776,309, bringing the total envelope to \$29,159,960 for 2022/2023 and

beyond.

### 3. Update on Covid-19

In response to the growing pressures on the SAP research community caused by Covid-19, NSERC developed general guidelines for consideration of all impacts related to research. On April 9, 2020, NSERC announced that all active Discovery Grants could choose to receive a one-time, one-year extension with funds at their current funding level, including the SAP Individual, Project and SAP-MRS awards. The goal of this funding is to lessen the impact due to Covid-19, and to maintain support for all researchers and highly qualified personnel.

### 4. 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>Mary Convery</b>	Fermi National Accelerator Laboratory	2020-2023	Exp. Accelerator R&D
<b>Carmen Carmona</b>	Pennsylvania State University	2022-2023	Exp. Astroparticle Physics
<b>Paul Garrett</b>	University of Guelph	2019-2020 2021-2023	Exp. Nuclear 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>Alison Lister</b>	University of British Columbia	2019-2021, 2023	Exp. High Energy Nuclear & Particle Physics
<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>Meenakshi Narain</b>	Brown University	2020-2023	Exp. High Energy Physics
<b>Giulia Ricciardi</b>	University of Naples	2022-2025	Th. High Energy Physics

<b>Matthias Schindler</b>	South Carolina University	2021-2024	Th. Nuclear Physics
<b>Pedro Vieira</b>	Perimeter Institute	2020-2023	Th. Particle Physics
<b>Ingo Wiedenhoever (Co-Chair)</b>	Florida State University	2020-2023	Exp. Nuclear Physics
<b>Albert Young</b>	North Carolina State University	2020-2023	Exp. Nuclear Physics, Strongly Interacting Matter (IEP)

The Co-Chairs would like to 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 wish to 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, Mary Convery, Paul Garrett, Alison Lister, Ingo Wiedenhoever, Albert Young, and Pedro Vieira 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), Kaitlyn Pomykala and Philip Bale (Program Officers), and Kevin Lapointe (Manager).

## **5. Pre-Competition Meetings**

Once membership has been 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.

As in previous years, the SAPES members were given a CIMP-IPP jointly prepared document on 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 held a final Calibration session prior to competition week to provide the SAPES with mock reviews.

\*Note: NSERC contacted past applicants to request permission to use their applications for calibration purposes; to ensure a thorough calibration, a diverse set of applications were

selected (subject matter, ratings, team size, etc.)

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

The deadline for the Notifications of Intent to Apply (NOI) for a Subatomic Discovery Grant was August 1, 2022. Programs which require NOIs include SAP Discovery Grants (Individual and Project), SAP-MRS, and SAP-RTI (Category 2 & 3).

When the Notifications of Intent to Apply 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 five external reviewers for each of their assigned proposals. Typically, up to three of the external reviewers can be chosen from the list of suggested reviewers on the Notification of Intent to Apply. 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.

## **7. Pre-Competition**

For any SAP Project grant applications requesting more than an average of \$1M per year, as well as any SAP-RTI (Category 3) applications, an ad-hoc expert review can be held. Additionally, NSERC reserves the right to hold an ad-hoc review for any other grant application that they deem necessary. During this year's competition cycle, two expert reviews were conducted, for the Gamma-Ray Spectroscopy at ISAC and Global Argon Dark Matter Program projects. Full reports with recommendations, including budget recommendations were prepared for the SAPES. The reports, without the budget recommendations, were sent by NSERC to the applicants prior to Large Project Day. The reports with the budget recommendations are then provided to the applicants alongside the results of the competition. These Expert Review reports were sought in place of external reviewer reports.

As a kick-off to competition week, on Sunday, February 19, 2023, the SAPES met for Large Project Day (LPD). This session allowed the SAPES 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.

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 three observers in attendance

for the presentations and Q&A were the directors of the CINP and IPP, and a representative from CFI. Collaborations invited to present were: Gamma-Ray Spectroscopy at ISAC, Global Argon Dark Matter Program, SuperCDMS, SNO+, Hyper-Kamiokande, PICO, Belle-II, TUCAN, and IceCube.

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.

## 8. 2023 Competition

At the beginning of competition week, taking into account on-going commitments from previous competitions, \$10.7M was available for the 2023 competition. This year, the SAPES received 47 applications, with the total funds requested for competition year CY2023 amounting to \$17.76M, allowing for a possible funding rate of 60% for FY2023. For comparison, the funding rates for the years 2017 to 2022 were 57%, 74%, 64%, 55%, 42%, 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 2023</b>					
	2023	2024	2025	2026	2027
RTI - COMMITTED	\$119,910	\$157,500	\$0	\$0	
RTI - 2023 Competition	\$537,923	\$0	\$0	\$0	
<b>RTI - TOTAL</b>	<b>\$657,833</b>	<b>\$157,500</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
THEORY - COMMITTED	\$3,078,200	\$1,824,300	\$978,200	\$551,000	\$115,000
THEORY - 2023 Competition	\$1,213,866	\$1,326,583	\$1,343,633	\$1,316,183	\$1,278,572
<b>THEORY - TOTAL</b>	<b>\$4,292,066</b>	<b>\$3,150,883</b>	<b>\$2,321,833</b>	<b>\$1,867,183</b>	<b>\$1,393,572</b>
EXP OPS** - COMMITTED	\$13,273,330	\$10,450,105	\$505,830	\$120,005	
EXP OPS - 2023 Competition	\$15,431,229	\$17,313,082	\$14,709,826	\$471,315	\$470,080
<b>EXP OPS - TOTAL</b>	<b>\$28,704,559</b>	<b>\$27,763,187</b>	<b>\$15,215,656</b>	<b>\$591,320</b>	<b>\$470,080</b>
MRS - COMMITTED	\$2,440,500	\$820,000	\$0	\$0	
MRS - 2023 Competition	\$577,267	\$606,543	\$628,205	\$649,005	\$670,425
<b>MRS - TOTAL</b>	<b>\$3,017,767</b>	<b>\$1,426,543</b>	<b>\$628,205</b>	<b>\$649,005</b>	<b>\$670,425</b>
TOTAL - COMMITTED	\$18,911,940	\$13,251,905	\$1,484,030	\$671,005	\$115,000
TOTAL - 2023 Competition	\$17,760,285	\$19,246,208	\$16,681,664	\$2,436,503	\$2,419,077
<b>GRAND TOTAL</b>	<b>\$36,672,225</b>	<b>\$32,498,113</b>	<b>\$18,165,694</b>	<b>\$3,107,508</b>	<b>\$2,534,077</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>AVAILABLE</b>	<b>-\$7,060,285</b>	<b>-\$3,338,153</b>	<b>\$10,994,266</b>	<b>\$26,052,452</b>	<b>\$26,625,883</b>

Table 1. Overall budget available as presented before Competition 2023

Of the 47 applications received, the breakdown was as follows: 21 Project, 19 Individual, 2 SAP-RTI (Category 1), 1 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 \$10.7M from the envelope, from a total request for \$17.76M, causing the funding rate for this year’s competition to be 60%. Prior to competition, a decision was made to target a funding rate similar to historic averages in order to manage future budget pressures. This total commitment represents an amount that is greater than the annual envelope, which was possible due to unspent funds from the previous year. The remaining \$71,733 will be added to the SAP envelope for CY2024. 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 2017 through 2023.

<b>SUBATOMIC PHYSICS ENVELOPE</b>					
<b>MULTI-YEAR COMMITMENTS BY CATEGORY</b>					
<b>Competition 2023</b>					
	2023	2024	2025	2026	2027
<b>RTI - COMMITTED</b>	\$119,910	\$157,500	\$0	\$0	
RTI - 2023 Competition	\$0	\$0	\$0	\$0	
<b>RTI - TOTAL</b>	<b>\$119,910</b>	<b>\$157,500</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>THEORY - COMMITTED</b>	\$3,078,200	\$1,824,300	\$978,200	\$551,000	\$115,000
THEORY - 2023 Competition	\$623,000	\$623,000	\$623,000	\$623,000	\$623,000
<b>THEORY - TOTAL</b>	<b>\$3,701,200</b>	<b>\$2,447,300</b>	<b>\$1,601,200</b>	<b>\$1,174,000</b>	<b>\$738,000</b>
<b>EXP OPS** - COMMITTED</b>	\$13,273,330	\$10,450,105	\$505,830	\$120,005	
EXP OPS - 2023 Competition	\$9,529,000	\$9,826,000	\$6,354,000	\$176,000	\$177,000
<b>EXP OPS - TOTAL</b>	<b>\$22,802,330</b>	<b>\$20,276,105</b>	<b>\$6,859,830</b>	<b>\$296,005</b>	<b>\$177,000</b>
<b>MRS - COMMITTED</b>	\$2,440,500	\$820,000	\$0	\$0	
MRS - 2023 Competition	\$476,267	\$502,543	\$429,115	\$435,865	\$451,245
<b>MRS - TOTAL</b>	<b>\$2,916,767</b>	<b>\$1,322,543</b>	<b>\$429,115</b>	<b>\$435,865</b>	<b>\$451,245</b>
<b>TOTAL - COMMITTED</b>	\$18,911,940	\$13,251,905	\$1,484,030	\$671,005	\$115,000
TOTAL - 2023 Competition	\$10,628,267	\$10,951,543	\$7,406,115	\$1,234,865	\$1,251,245
<b>GRAND TOTAL</b>	<b>\$29,540,207</b>	<b>\$24,203,448</b>	<b>\$8,890,145</b>	<b>\$1,905,870</b>	<b>\$1,366,245</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>AVAILABLE</b>	<b>\$71,733</b>	<b>\$4,956,512</b>	<b>\$20,269,815</b>	<b>\$27,254,090</b>	<b>\$27,793,715</b>

Table 2. Breakdown of multiyear commitments at the end of the 2023 competition

	2018	2019	2020	2021	2022	2023
<b>Theory</b>	13%	13%	11%	13%	13%	13%
<b>RTI</b>	1.2%	2.5%	2.0%	1.7%	0.9%	0.4%
<b>Total Research Ops</b>	86%	84%	86%	86%	86%	88%
<b>Exp. Ops</b>	77%	74%	76%	76%	77%	78%
<b>MRS</b>	10%	10%	10%	10%	9%	10%

*Table 3. Envelope share in theory, experimental operations, and equipment, 2018-2023*

## 9. 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.