Subatomic Physics Evaluation Section Annual Report

Jeffery Martin, Co-Chair
University of Winnipeg

Ingo Wiedenhoever, Co-Chair
Florida State University

Prepared by: Philip Bale and Kaitlyn Pomykala (Program Officers, SAPES)
June 2022

1. Introduction

The purpose of this report is to summarize the activities of the Subatomic Physics (SAP) Evaluation Section during fiscal year 2021-22, including the results of the 2022 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.

Another unique strength of the SAPES is the extent to which it solicits reviews by international experts of the highest caliber. Most large Project, SAP-RTI and SAP-MRS grants are separately reviewed by ad-hoc or standing committees of experts drawn from institutions both international and Canadian. These committees perform scientific, technical, and budgetary evaluations, and produce reports which provide valuable input to the SAPES for its assessment of the grant applications. Additionally, the SAPES selects a substantial proportion of international external reviewers for each Individual and Project grant proposal. Finally, 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 comes to an end, further pressure on the funding envelope when the recently hired faculty members begin applying for grants may occur.

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. CFI continues to recruit NSERC Expert Review Committee and SAPES members for their review committees. 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.

A constraint on "opportunity funds" has been raised as a concern in past iterations of LRP, and the current report recommends continued support through, and growth of, the SAP envelope to ensure Canada remains globally competitive in the field. 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 time-scale 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.

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.

NSERC also recognizes that research activities may be delayed as a result of Covid-19. Because of this, universities were given the ability to approve time extension requests up to 12 months for grants with an end date between February 1, 2020 and March 31, 2021 inclusively. The purpose of this was to allow grant holders to continue spending grant funds beyond the end of their award duration. In response to potential delays in research, NSERC decided to automatically provide additional 12-month extensions to grant recipients who request them due to Covid-19, regardless of whether they have received a previous time extension of any length for any reason.

NSERC has developed general guidelines for the consideration of Covid-19-related impacts on research, aiming to provide direction on how to describe these impacts in an application and information on how to consider these impacts when reviewing contributions to research and training and/or research and training plans.

For the second year in a row, due to circumstances related to Covid-19, NSERC made the decision to hold competition week (February 21 - 25) virtually. This adjustment, to have all reviews take place by videoconference, was made to ensure the effective and timely delivery of the 2022 competition. Typically, competition week is the only time when the SAPES meets in person throughout the year, but this year, all meetings related to competition were conducted virtually.

Given the ongoing nature of the Covid-19 extensions being offered, NSERC will continue to monitor the impact and pressure they may have on the SAP envelope. In addition to the budgetary pressures, NSERC acknowledges the continual ramifications on contributions to research and training plans within the SAP community. We are aware that the impacts of the Covid-19 pandemic on research productivity and training are not equal for all members of the research community. Certain identity factors are associated with greater impacts for some

individuals (e.g., gender, race, Indigenous identity, geographic location, rurality, disability, age, socioeconomic status, career stage, family responsibilities, etc.). NSERC strives to meaningfully address equity, diversity, and inclusion (EDI) considerations within the SAP community, to best respond to ongoing impacts.

4. SAPES Membership

This year's SAPES comprised 13 members, including four theorists.

Name	Institution	Term	Expertise
Mary Convery	Fermi National Accelerator Laboratory	2020-2023	Exp. Accelerator R&D
Andrzej Czarnecki	University of Alberta	2021-2022	Th. High Energy Physics
Paul Garrett	University of Guelph	2019-2020 2021-2023	Exp. Nuclear Physics
Nikolina Ilic	University of Toronto	2018-2021	Exp. Particle Physics
Georgia Karagiorgi	Columbia University	2019-2022	Exp. High Energy Physics, Neutrino properties
Jeffery Martin (Co-Chair)	University of Winnipeg	2016-2018 2021	Exp. Nuclear Physics
David Morrissey	TRIUMF/ University of Victoria	2021-2024	Th. Particle Physics
Meenakshi Narain	Brown University	2020-2023	Exp. High Energy Physics
Matthias Schindler	South Carolina University	2021-2024	Th. Nuclear Physics
Pedro Vieira	Perimeter Institute	2020-2023	Th. Particle Physics
Ingo Wiedenhoever (Co-Chair)	Florida State University	2020-2023	Exp. Nuclear Physics
Alexander Wright	Queen's University	2019-2022	Exp. Particle Astrophysics
Albert Young	North Carolina State University	2020-2023	Exp. Nuclear Physics, Strongly Interacting Matter (IEP)

The Co-Chairs would like to acknowledge the very demanding task faced by SAPES members throughout the year, up to and especially through competition week. Very long hours of deliberations ensured that each proposal was fairly and consistently evaluated according to the selection criteria. The remarkable professionalism and dedication of SAPES members is manifest in the high quality of the Section's recommendations. 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, Andrzej Czarnecki, Georgia Karagiorgi, Jeffery Martin, and Alexander Wright for outstanding service to the Canadian SAP community; it is deeply appreciated.

It is a pleasure for the Co-Chairs to thank NSERC staff for their expert guidance and help in the months leading up to the competition, and during the many long days of competition week: Shashini Jayaratne (Program Assistant), Kaitlyn Pomykala and Philip Bale (Program Officers), Kevin Lapointe (Manager), Alison Janidlo (Deputy Director), Elizabeth Boston (Director, Mathematical, Environmental and Physical Sciences), and Danika Goosney (Vice- President, Research Grants and Scholarships).

5. Pre-Competition Meetings

Once membership has been decided each year, NSERC begins the competition process with an orientation meeting. This is an opportunity for new members to familiarize themselves with NSERC and the SAPES operating procedures, and to be informed of the process leading up to, and including, competition week. During the Policy and Procedure Orientation session held on September 28, 2021, returning members welcomed the opportunity to respond to questions of new members. A Review Orientation session was then held on November 18, 2021, to provide an overview of competition and application review procedures.

As in previous years, the SAPES members were given a CINP-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 Calibration session on February 4, 2022 to provide the SAPES with mock reviews, in preparation for competition week. 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 3, 2021. 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 required 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, 96% 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, three expert reviews were conducted (ATLAS, TITAN, and nEXO). 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 were then be sent to the applicants after the results of the competition are announced.

As a kick-off to competition week, on Sunday, February 20, 2022, the SAPES met for Large Project Day (LPD). This joint information and calibration session was held virtually and allowed the SAPES to hear presentations by 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 ATLAS, TITAN, nEXO, and MOLLER.
In a separate "Canadian Context" session (held in December 2021), the SAPES also 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, TRIUMF, and representatives for the SAP Long Range Plan.

8. 2022 Competition

At the beginning of competition week, taking into account on-going commitments from previous competitions, $11.26M was available for the 2022 competition. This year, the SAPES received 42 applications, with the total funds requested for competition year CY2022 amounting to $15.77M, allowing for a possible funding rate of 71% for FY2022. For comparison, the funding rates for the years 2017 to 2021 were 57%, 74%, 64%, 55%, and 42%, respectively.

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

SUBATOMIC PHYSICS ENVELOPE
MULTI-YEAR COMMITMENTS BY CATEGORY
Pre-Comp 2022

	2022	2023	2024	2025	2026
RTI - COMMITTED	$0	$0	$0	$0	$0
RTI - 2022 Competition Requested	$1,097,189	$119,910	$157,500	$0	$0
RTI - TOTAL	**$1,097,189**	**$119,910**	**$157,500**	**$0**	**$0**
THEORY - COMMITTED	$3,152,300	$2,039,200	$1,273,300	$427,200	$0
THEORY - 2022 Competition Requested	$892,514	$937,242	$1,029,443	$1,077,015	$1,032,258
THEORY - TOTAL	**$4,044,814**	**$2,976,442**	**$2,302,743**	**$1,504,215**	**$1,032,258**
EXP OPS** - COMMITTED	$12,810,507	$1,340,000	$645,000	$387,000	$0
EXP OPS - 2022 Competition Requested	$13,050,958	$12,736,417	$12,734,530	$344,616	$344,166
EXP OPS - TOTAL	**$25,861,465**	**$14,076,417**	**$13,379,530**	**$731,616**	**$344,166**
MRS - COMMITTED	$2,129,215	$1,475,000	$75,000	$0	$0
MRS - 2022 Competition Requested	$729,636	$888,976	$926,929	$0	$0
MRS - TOTAL	**$2,858,851**	**$2,363,976**	**$1,001,929**	**$0**	**$0**
TOTAL - COMMITTED	$18,092,022	$4,854,200	$1,993,300	$814,200	$0
TOTAL - 2022 Competition Requested	$15,770,297	$14,682,545	$14,848,402	$1,421,631	$1,376,424
GRAND TOTAL	**$33,862,319**	**$19,536,745**	**$16,841,702**	**$2,235,831**	**$1,376,424**
TOTAL ENVELOPE	**$29,159,160**	**$29,159,960**	**$29,159,960**	**$29,159,960**	**$29,159,960**
AVAILABLE	**-$4,703,159**	**$9,623,215**	**$12,318,258**	**$26,924,129**	**$27,783,536**

Table 1. Overall budget available as presented before Competition 2022

Of the 42 applications received, the breakdown was as follows: 18 Project, 13 Individual, 8 SAP-RTI (Category 1), 1 SAP-RTI (Category 2/3), and 2 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. Continuing from practices started last competition year, NSERC used a five-reviewer model, to further harmonize with the larger DG program and manage the committee members' workload.

After Round 3 concluded, the SAPES recommended total funding of $10.09M from the envelope, from a total request for $15.77M, causing the funding rate for this year's competition to be 64%. Prior to competition, a decision was made to target a funding rate similar to historic averages in order to manage future budget pressures. The remaining $977,517 will be added to the SAP envelope for CY2023. 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 2022.

SUBATOMIC PHYSICS ENVELOPE
MULTI-YEAR COMMITMENTS BY CATEGORY
Competition 2022

	2022	2023	2024	2025	2026
RTI - COMMITTED	$0	$0	$0	$0	$0
RTI - 2022 Competition	$264,974	$119,910	$157,500	$0	$0
RTI - TOTAL	**$264,974**	**$119,910**	**$157,500**	**$0**	**$0**
THEORY - COMMITTED	$3,152,300	$2,039,200	$1,273,300	$427,200	$0
THEORY - 2022 Competition	$528,000	$551,000	$551,000	$551,000	$551,000
THEORY - TOTAL	**$3,680,300**	**$2,590,200**	**$1,824,300**	**$978,200**	**$551,000**
EXP OPS** - COMMITTED	$12,810,507	$1,340,000	$645,000	$387,000	$0
EXP OPS - 2022 Competition	$8,692,447	$9,738,830	$9,805,105	$118,830	$120,005
EXP OPS - TOTAL	**$21,502,954**	**$11,078,830**	**$10,450,105**	**$505,830**	**$120,005**
MRS - COMMITTED	$2,129,215	$1,475,000	$75,000	$0	$0
MRS - 2022 Competition	$605,000	$735,000	$745,000	$0	$0
MRS - TOTAL	**$2,734,215**	**$2,210,000**	**$820,000**	**$0**	**$0**
TOTAL - COMMITTED	$18,092,022	$4,854,200	$1,993,300	$814,200	$0
TOTAL - 2022 Competition	$10,090,421	$11,144,740	$11,258,605	$669,830	$671,005
GRAND TOTAL	**$28,182,443**	**$15,998,940**	**$13,251,905**	**$1,484,030**	**$671,005**
TOTAL ENVELOPE	**$29,159,960**	**$30,137,477**	**$29,159,960**	**$29,159,960**	**$29,159,960**
AVAILABLE	**$977,517**	**$13,161,020**	**$15,908,055**	**$27,675,930**	**$28,488,955**

Table 2. Breakdown of multiyear commitments at the end of the 2022 competition

Subatomic Physics Evaluation Section
Evolution of Envelope's Shares

	2017	2018	2019	2020	2021	2022
Theory	**13%**	**13%**	**13%**	**11%**	**13%**	**13%**
RTI	**2%**	**1%**	**3%**	**2%**	**2%**	**1%**
Total Research Ops	**85%**	**86%**	**84%**	**86%**	**86%**	**86%**
Exp. Ops	**75%**	**77%**	**74%**	**76%**	**76%**	**76%**
MRS	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**

Table 3. Envelope share in theory, experimental operations, and equipment, 2017-2022

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.