Subatomic Physics Grant Selection Committee (GSC-19) Annual Report

John Martin, Chair GSC-19
IPP/University of Toronto
April 2007

I. Introduction

This report summarizes the activities of the subatomic physics Grant Selection Committee (GSC-19) during the second half of the fiscal year 2006-07, together with the results of the February 2007 competition. The report is provided for information to both NSERC's Committee on Grants and Scholarships (COGS) and the subatomic physics community.

GSC-19 is unique among NSERC's GSCs since its funding is made through an envelope mechanism. Individual and Group Discovery, Project, Research Tools and Instruments (RTI), and Major Resources Support (MRS) grant applications are assessed together by GSC-19. This is crucial due to the large-scale and long-term projects characterizing the Subatomic Physics field, and the high degree of inter-connection and collaboration among scientists and their support personnel in numerous universities and national laboratories. The envelope system facilitates decision making in the context of future projections and planning, so that decisions that are made in any given year don't compromise our longer-term goals. In particular, it helps the GSC to keep a reasonable balance between operations and capital. In 2007, a new long-range plan was developed by the community through an exercise separate from the GSC activities. It was made available to the Committee to help guide its deliberations. The plan's stated top priorities are ATLAS, ISAC, SNO/SNOLAB, T2K, and a program which maintains breadth. Several funding scenarios over 10 years were examined in the document.

The pressure on our envelope has been building for the last several years. As in other fields funded by NSERC, there has been a tremendous revitalization of faculty at Canadian universities in the last several years, from renewal due to a large wave of retirements and the influx due to the CRC program. The result has been a large increase in the number of young energetic faculty and an even larger increase in the number of graduate students who have been attracted to research by this new faculty complement. These people are highly engaged in research and need strong funding to reach their potential. Large demands on the budget are coming from several growth areas, including the ISAC program at TRIUMF (particularly ISAC-II, which accelerated its first beams this year), the ATLAS program at the LHC, which will see first collisions sometime in the next year, and the experimental program at the new CFI-funded SNOLAB, which begins operations this year. Unfortunately, government funding through NSERC has not kept pace with these extraordinary developments. Over the last 5 years, the ratio of the amount of money available to the amount requested in the annual GSC-19 competition

has fallen by about 40 percent and, in the 2007 competition, the Committee faced the daunting prospect of being able to fund only 46% of the total requested amount.

II. Committee

GSC-19 consists of 12 members, including 3 theorists. One of the experimentalists, Marielle Chartier from Liverpool was unable to join the Committee for her second year, since she was expecting a baby at the time of the competition. She was replaced by Cornelius Beausang from Richmond. For this year, other new members were Howard Trottier from Simon Fraser and Greg Landsberg from Brown. The makeup of the Committee is presented below. The Committee members worked extremely well together this year, and despite the difficult circumstances, were able to take important decisions after constructive discussions and debates. The Chair would like to thank the members for their dedicated efforts in a collegial atmosphere.

It is a pleasure also to thank the NSERC staff for their expert guidance and help in the months leading up to the competition and during the competition itself: Samir Boughaba, Team Leader, Michèle Beaudry, Program Officer, back with GSC-19 after a few years on other assignments, and Isabelle Blain, Vice-President, Research Grants & Scholarships, who joined the Committee for several important discussions. Jean-Claude Kieffer, Director, INRS Énergie, Matériaux et Télécommunications, was the new Group Chair for Physics and he attended most of our competition sessions. His wise advice throughout was appreciated. Dr. Kieffer indicated to the Chair that he was impressed by the high level of the physics discussions in GSC-19 and the informed critical assessments of the applications and budgets during our deliberations.

Name	Organization	Final Year
Georges Azuelos	Université de Montréal – TRIUMF	(2008)
Cornelius Beausang	University of Richmond	(2007)
Cliff Burgess	McMaster University – Perimeter Institute	(2007)
Stéphane Coutu	Pennsylvania State University	(2007)
Roy Holt	Argonne National Laboratory	(2008)
Byron Jennings	TRIUMF	(2008)
Greg Landsberg	Brown University	(2009)
Karol Lang	University of Texas at Austin	(2008)
John Martin (Chair)	University of Toronto	(2007)
Allena Opper	George Washington University	(2007)
Kumar Sharma	University of Manitoba	(2007)
Howard Trottier	Simon Fraser University	(2009)

III. Policy Meeting and Site Visits

The Committee members visit Canadian institutions on typically a 3-year rotation. In mid-October 2006, the Committee visited the University of Victoria, TRIUMF, the University of British Columbia and Simon Fraser University. The Sunday before the visits was devoted to a policy meeting, at which issues relating to the 2007 competition were discussed, including the recently released final version of the Long Range Plan. At each institution visited, the meeting first began with presentations by the Chair, who summarized some of the discussion at the policy meeting and provided information on the evaluation process of grant applications, and by Michèle Beaudry, who provided the audience with recent news from NSERC. This was followed by sessions with presentations by the research teams, including general discussions with the GSC. These sessions are not intended to be a vehicle for grant evaluation. There were also meetings with university administrative officials and with graduate students and post-doctoral fellows. At TRIUMF, a general talk was given by the Director, after which the Committee had an impressive and informative tour to many of the experiments and laboratories.

A brief informal report on each visit was prepared by Canadian members of the Committee. These reports will be available for future Committees. During the visit to the University of British Columbia, we were asked if these reports could be made available to the institutions visited. Since these visits are only meant to gather information informally about the research groups that are visited and not to assess them, NSERC and GSC-19 have decided not to release the reports.

IV. Pre-Review Process

When the Form 180s are received, each application is assigned to first and second internal reviewers, who are Committee members with the most appropriate expertise. The first reviewer is then required to recommend five external referees for each of his/her assigned applications. Up to two of the external referees could be chosen from the list of suggested referees on the Form 180. It is in the applicant's interest to suggest referees who are not in conflict of interest according to NSERC's guidelines.

V. Chairs' Meeting

The annual Chairs' meeting was held on November 19, 2006. In this meeting, each GSC Chair reviews all of the applications to his/her GSC to ensure that (i) each application has a suitable set of external reviewers and (ii) each application is being reviewed by the most appropriate GSC. There are usually only a few applications that fall at the boundary between GSC-19 and other Committees. In each case, a meeting involving the Chairs of GSC-19 and the alternate GSC, the Physics Group Chair, and the NSERC Team Leader(s) and Program Officer(s) is convened. A decision on which GSC should review the application is made based on an assessment of which Committee has the most relevant expertise. This year, no application moved into or out of GSC-19, but we

requested and received consultations from GSC-17 on two applications and GSC-08 on one application.

During the meeting, several other tasks were completed. The complete list of external referees was established and the list of grant applications needing a site visit was finalized. The Chair identified the projects to be invited to Large Projects Day and organized the agenda for that day.

This year, NSERC has embarked on a process to review the GSC structure. Dr. Andrew Woodsworth has been hired to spearhead this effort. He and Isabelle Blain made presentations at the Chairs' meeting and fielded questions and comments. They pointed out that the system has "worked very well in the past, but we must ensure that this structure provides for a sound and fair environment for the review of applications in all areas, including those that have recently emerged and may overlap, or fall between, traditional disciplines. Additionally, the structure should allow for growth in the number of applicants, which will soon exceed the ability of the current system to handle the load. Accordingly, we now must review the structure and possible changes in consultation with NSERC's community. This consultation is an extremely important part of the process." The Chair submitted a response to several questions from Dr. Woodsworth in December. It is likely that other Committees will be more affected by the outcome of the review than GSC-19, but our community should stay involved as the review develops. This is further discussed in the Policy Issues section at the end of this report.

VI. Review Committees

Several large projects that submitted applications to this year's competition were reviewed during the fall of 2006 and early January 2007. The reviews were carried out by *ad hoc* or standing Committees of experts, and typically lasted one to one-and-a-half days to allow more in-depth evaluations of the projects than what is possible by the review of the written applications. Full reports with recommendations, including budget recommendations, were prepared for the GSC. The reports with the budget recommendations excised were sent by NSERC to the project collaborations. The projects reviewed were SNO+, DEAP, ATLAS, SNOLAB (MRS for operations) and BABAR. There were also reviews of TIGRESS and T2K by their standing Committees, although the groups were not up for renewal of their operating grants. Finally, there was an NSERC review of the Perimeter Institute, as required by the Memorandum of Understanding that was signed between NSERC and PI at the time of the 2002 flow-through grant (outside GSC-19's envelope). This review was combined with a review mandated by Industry Canada. The GSC Chair attended all reviews as an ex-officio member, except for the Perimeter review, T2K and BABAR, where he was represented by Byron Jennings (PI) and Karol Lang. Several other GSC-19 members participated in the other reviews as full members: Con Beausang for TIGRESS, Karol Lang for SNO+ and DEAP, Stéphane Coutu for ATLAS, Kumar Sharma for SNOLAB, Allena Opper for T2K and BABAR. The Chair also attended the TRIUMF ACOT meeting in December.

VII. Large Projects Day

The agenda for Large Projects Day, which was held on February 5, 2007, is attached as Appendix 1. It was an unusually full day, and presentations had to be squeezed for time in order to fit everything in. The day began with *in camera* presentations by IPP's Director William Trischuk, TRIUMF's scientific Director Jean-Michel Poutissou and Perimeter Institute's Executive Director Howard Burton to provide the Committee with the perspective of their respective communities. At the beginning of the open session, the Chair made a few remarks about the context of this year's competition. Then the Principal Investigators made presentations and answered questions previously submitted by the GSC. This year, the projects were ATLAS, T2K, QWEAK, BABAR, SNOLAB, SNO+, DEAP and EXO. Near the end of the day, the Committee had an in-camera phone conference with Jane Kirkwood and Yassar Muttaqi from Ontario's Ministry of Research and Innovation (MRI) to gain insight into the possibility of partial funding of SNOLAB's operations and experiments through their granting processes. This was very helpful. Finally, the Committee had a session with Isabelle Blain for further input from, and questions to, NSERC.

VIII. Financial Circumstances for the Competition

The funds available to the Committee at the beginning of the competition are shown in Table 1. The base budget from year to year maintains a flat profile. This year marked the final increment related to the 2002 Reallocations Exercise and added $86K to the budget. Despite the fact that NSERC injected about $5.7M of new funds into the Discovery program for new applicants, this was unfortunately not sufficient to match the significant increase in the number of applications. The share for GSC-19 (based on the number of new applicants applying as individuals and within projects) was $117K, nowhere near the amount required to satisfy the needs of the 15 new applicants in the competition. Our share of an increase in the NSERC MRS budget added $64K to the budget and an RTI adjustment added another $46K. The latter could have been higher if more of the equipment requested in project grants had been applied for separately as RTI grants, and this important point will be addressed below in the Policy Issues section. The envelope also received a payment of $75K as part of NSERC's 2005 decision with respect to a contribution towards ATLAS cost-to-completion. After subtracting the $13.948M committed in previous competitions, $9.447M was available for the 2007 competition.

This year, GSC-19 received 65 applications. These proposals requested a total of $20.441M for the fiscal year 2007-08. Thus the projected average funding rate for the competition was only 46%, which, while perhaps not unprecedented, was certainly dire. For comparison, the funding rates for the years 2002 to 2006 were 79%, 58%, 55%, 58%, 60%, respectively.

The competition budget unfortunately fell into the worst scenario of the Long Range Plan, which is given in Table 4 of that document. This scenario has flat funding for the subatomic physics envelope and includes SNOLAB operations within the envelope. The consequences of this scenario were examined by the Long Range Planning Committee,

and their conclusions can be summarized briefly by a quote from a presentation by that Committee's chair, Ken Ragan, in 2006: "a crippled Canadian SAP community, unable to exploit even our own world-class facilities. Many new arrivals would probably leave the field or leave the country."

2007 Competition - Subatomic Physics Envelope Budget
Beginning of Competition

(millions of dollars)

Budget Item	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Base Budget	20.665	20.665	20.665	20.665	20.665	20.665	20.665
Cumulative Permanent Additions:							
New Applicants[1]	1.250	1.505	1.622	1.622	1.622	1.622	1.622
Reallocations[2]	0.287	0.373	0.459	0.459	0.459	0.459	0.459
Transfers[3]	0.000	0.000	0.064	0.064	0.064	0.064	0.064
Temporary Transfers:							
ATLAS Cost-to-Completion	0.750	0.075	0.075	-0.300	-0.300	-0.300	0.000
SRO Contribution	-0.137	-0.137	0.000	0.000	0.000	0.000	0.000
From other GSCs	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Forward-Borrow	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Fiscal Year	22.933	22.481	22.885	22.510	22.510	22.510	22.810
Actual Spending	22.517	22.433					
Carry-forward	0.416	0.464					
Commitments[4]			-13.948	-6.708	-1.550	-0.997	
RTI budget adjustment[5]		0.118	0.046				
Available for Spring Competition			9.447				

[1] *The allocation for new applicants past FY2007 is not known at this time.*
[2] *FY 2007/08 is the last year for the 2002 reallocations exercise.*
[3] *$64,000 were added to the envelope as a result of the $1M increase to the general MRS budget (6.4%).*
[4] *Commitments as per February 05, 2007.*
[5] *The RTI budget adjustment is made using year-end funds. It is continuously adjusted up to the end of March as year-end funds become available.*

Table 1. Overall budget available at the beginning of the competition

IX. The Competition

The competition took place over five days from February 6 to 10, 2007. After discussing the funding situation just described, the Committee proceeded to review the applications in the usual way, but with the realization that a severe approach to funding allocations would have to be taken. In Round 1 of the review, each application was presented by the first reviewer followed by additional comments and/or a presentation from the second reviewer. These reviewers were designated by the Chair well before the competition and were asked to carry out an independent in-depth review of the application and present budget recommendations, taking into account the comments of external reviewers and the recommendations of the site visit review Committees mentioned earlier (when applicable). The application was then discussed by the whole Committee and rated against the NSERC criteria: excellence of the proposal, excellence of the researcher(s),

contribution to the training of HQP, and need for funds. Taking the results of the ratings into account, the Committee then decided whether to recommend funding the application, the funding duration, and the level of funding to recommend. The ratings and funding recommendations were determined by secret electronic voting. Members in conflict with any particular application left the meeting room before it was discussed, and never learned, even by the end of the competition, the final result for that application. After the experimental Project, Individual and Group grants were reviewed, the Committee split into two sub-Committees to review, in parallel, the theory and RTI + MRS applications. It was forbidden for members to keep a cumulative total of the recommended awards in order not to bias the reviews of applications discussed near the end. A few applications were flagged as we went along and were re-discussed at the end of Round 1. Applications could be flagged by members if they thought some aspect of the discussion and decision had been inadequately or unfairly resolved.

As mentioned earlier, there is a possibility of partial funding from Ontario for SNOLAB's operations and the SNO+ experiment. For this reason, Yassar Muttaqi of Ontario's Ministry of Research and Innovation joined the Committee in person to observe the Round 1 reviews of the applications submitted for SNOLAB and SNO+. The Committee was most appreciative of the interest shown by Ontario in the peer review process and deliberations of GSC-19 with respect to these projects. The final results of the competition for SNOLAB and SNO+ have been communicated to MRI.

At the end of Round 1, despite its severity, the Committee had spent about $2M more than the allowed budget. Since the Committee awards multi-year grants, it was necessary to look ahead to future years, and the situation looked equally grim. Every year, the Committee has to make sure that the future level of commitments for operations (Individual, Group, Project, and MRS grants) is such that an adequate level of funds remains available in forthcoming years for capital investments. After taking into account a conservative estimate of funds that would be awarded to the Individual and Project grants that are expected to submit renewal applications in the 2008 competition and adding this to the funds recommended in Round 1 and committed from previous competitions, it was clear that there would be almost no funds available for new equipment for fiscal year 2008-09.

One of the large contributing factors to the budget overrun was a two-year MRS grant awarded to SNOLAB in Round 1, with the second year funding being contingent on a successful application to Ontario for matching funding. The Committee reached the conclusion that it would actually be impossible to fund the second year of SNOLAB operations from GSC-19 and still leave sufficient equipment and operations funding for 2008-09. It was found that even a SNOLAB operations grant for 2007-08 could not be fit into the budget without unacceptably damaging other highly meritorious research programs, including programs in which Canada has already heavily invested. This conclusion is similar to that reached by the Long Range Planning Committee, but now seen in the stark reality of this year's funding competition. Nevertheless, the GSC recognized the necessity to provide financial support to SNOLAB for 2007-08 while

other funding sources are sought. Lack of support this year would have been devastating to SNOLAB's start-up plans.

At this point, after discussing various unpalatable options, the Committee took the exceptional decision to forward-borrow $1.2M from its future years' budget. NSERC had decided earlier that we would be allowed to forward-borrow up to this amount, based on the extraordinarily low projected funding rate for 2007-08 at the beginning of the competition.

After this decision, the Committee was still $800K over budget for 2007-08. In order to balance the Committee's budget for 2007-08 and ensure that a reasonable amount will be available for capital investments in 2008-09, the recommendations of Round 1, including that for SNOLAB operations, had to be re-examined in Round 2. Awards were further reduced to much less than optimal level, in a procedure which took into account the scoring results of Round 1 and the Long Range Plan priorities. The Committee was finally able to balance its budget without overly compromising the program, while still providing a one-year grant to SNOLAB as a demonstration of its strong support for SNOLAB's scientific potential.

X. End of Competition Results

The Committee's final multiyear budget levels are shown in Table 2, while the multiyear breakdown of theory, experimental operating, MRS, and capital allocations is given in Table 3. The Committee prepared a short "B-list" of equipment requests which could not be funded during the competition. Fortunately, by the end of the fiscal year, NSERC was able to increase the RTI adjustment to the envelope from $46K to $126K. This was sufficient to cover the entire B-list and leave a positive balance of $13K for next year.

It was decided to spread the reimbursement of the forward-borrowed amount of $1.2M in annual instalments of $300K over the next four years. The entire subatomic physics community will thus participate in this exceptional effort. This year's cohort and the cohorts that will be applying to the GSC in the next 4 years are financially affected by the decision.

It can be seen that the new equipment allocation this year was only $342K. In fact, it was predicted in the 2006 Chair's Report that "the funds available next year for new equipment will only be about $250K". We were able to more than meet that target in part due to the year-end RTI adjustment. Large requests for capital for SNOLAB experiments could not be granted this year, but the Committee was able to fund, even if not fully, an urgent request from T2K for front-end electronics, as well as other smaller RTI requests.

While the projected budget of $6.36M for the 2008 competition seems low at first glance, the main reason for this is that there will be few large operating grants up for renewal next year. The Committee estimated that with this budget, there will be adequate funds for new equipment so that the annual commitment level for equipment of $4.0±0.5M could be maintained.

2007 Competition - Subatomic Physics Envelope Budget End of Competition							
(millions of dollars)							
Budget Item	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Base Budget	20.665	20.665	20.665	20.665	20.665	20.665	20.665
Cumulative Permanent Additions:							
New Applicants[1]	1.250	1.505	1.622	1.622	1.622	1.622	1.622
Reallocations[2]	0.287	0.373	0.459	0.459	0.459	0.459	0.459
Transfers[3]	0.000	0.000	0.064	0.064	0.064	0.064	0.064
Temporary Transfers:							
ATLAS Cost-to-Completion	0.750	0.075	0.075	-0.300	-0.300	-0.300	0.000
SRO Contribution	-0.137	-0.137	0.000	0.000	0.000	0.000	0.000
From other GSCs	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Forward-Borrow	0.000	0.000	1.200	-0.300	-0.300	-0.300	-0.300
Total Fiscal Year	22.933	22.481	24.211	22.210	22.210	22.210	22.510
Actual Spending	22.517	22.433	24.662				
Carry-forward	0.416	0.464	0.013				
Commitments				15.262	4.825	1.677	0.680
RTI budget adjustment[4]		0.118	0.126				

[1] *The allocation for new applicants past FY2007 is not known at this time.*

[2] *FY 2007/08 is the last year for the 2002 reallocations exercise.*

[3] *$64,000 were added to the envelope as a result of the $1M increase to the general MRS budget (6.4%).*

[4] *The RTI budget adjustment was made using year-end funds. It has been continuously adjusted up to the end of March as year-end funds became available.*

Table 2. Multi-year budget summary at the end of the competition

END OF 2007 COMPETITION MULTI-YEAR COMMITMENTS BY CATEGORY					
	2007	**2008**	**2009**	**2010**	**2011**
EQ - COMMITTED[1]	$3,363,541	$2,482,844	$800,000	$800,000	
EQ - NEW	$342,308	$130,000			
EQ - TOTAL	**$3,705,849**	**$2,612,844**	**$800,000**	**$800,000**	
THEORY-COMMITTED	$2,478,250	$1,841,000	$1,050,000	$497,000	
THEORY - NEW	$824,000	$824,000	$824,000	$532,000	$532,000
THEORY - TOTAL	**$3,302,250**	**$2,665,000**	**$1,874,000**	**$1,029,000**	**$532,000**
EXP OPS[2] - COMMITTED	$6,374,500	$2,522,250			
EXP OPS - NEW	$7,790,000	$7,157,500	$2,127,500		
EXP OPS - TOTAL	**$14,164,500**	**$9,679,750**	**$2,127,500**		
MFA/MRS - COMMITTED	$1,731,500	$161,500			
MRS - NEW	$1,758,000	$443,000	$323,000	$148,000	$148,000
MRS/MFA - TOTAL	**$3,489,500**	**$604,500**	**$323,000**	**$148,000**	**$148,000**
PAYMENT OF FORWARD BORROW		**$300,000**	**$300,000**	**$300,000**	**$300,000**
TOTAL - COMMITTED	**$13,947,791**	**$7,007,594**	**$1,850,000**	**$1,297,000**	
TOTAL - NEW	**$10,714,308**	**$8,854,500**	**$3,574,500**	**$980,000**	**$980,000**
GRAND TOTAL	**$24,662,099**	**$15,862,094**	**$5,424,500**	**$2,277,000**	**$980,000**
ENVELOPE BY END OF COMPETITION	**$24,675,380**	**$22,223,281**	**$22,210,000**	**$22,210,000**	**$22,510,000**
AVAILABLE	**$13,281**	**$6,361,187**	**$16,785,500**	**$19,933,000**	**$21,530,000**

[1] *The committed amount for equipment includes the $300,000 to be paid by the envelope to NSERC's main RTI program as a reimbursement of the payment NSERC made towards ATLAS' Cost-to-Completion.*

[2] *EXP OPS = Experimental Operations*

Table 3. Breakdown of multi-year commitments.

XI. Recommendations to NSERC's MRS and DAS Committees

This year, NSERC received two large applications for theory institutes to be judged in the main MRS competition. As part of the review procedures of the MRS Grant Selection Committee (GSC-1051), GSC-19 was asked for consultation and spent considerable time reviewing these applications. Written recommendations were sent to the MRS Committee, which met in early March.

This year, NSERC established a new program, the Discovery Accelerator Supplements (DAS) program. Its objective is to provide substantial and timely resources to outstanding researchers who have a well-established research program and who are at a key point in their careers at which they can make, or capitalize on, a significant breakthrough, but who are being held back by insufficient funds. The selection of supplement recipients will be made in conjunction with the review of Discovery Grant applications by a multidisciplinary Grant Selection Committee (GSC-1058). GSC-19 was asked to nominate one applicant to the 2007 DAS competition that will be held during this spring. The DAS program is aimed at individual and group grants, and was announced after grant requests had been submitted. Most of our experimental applicants didn't qualify, since they were co-applicants on Project grants. Nevertheless, after the review of individual and group grants, the Committee members were asked to identify outstanding applicants who met the DAS selection criteria and could be nominated. Three applicants were put forward, representing a mix of experimentalist(s) and theorist(s). Each potential applicant was then discussed (with members in conflicts outside the room) and rated on a scale of 1 (outstanding) to 5 (not recommended). Starting from the 2008 competition, in order to allow researchers who are on project grants to be considered by GSC-19 for the DAS program, a procedure has been presented by NSERC and accepted by the Committee. This procedure is discussed in the Policy Matters section.

XII. Future Support for SNOLAB Operations

The Committee hopes that the one-year grant to SNOLAB operations, which requested the exceptional decision to forward borrow $1.2M, will be a strong demonstration of the critical scientific importance of SNOLAB for the Canadian and international subatomic physics community and will trigger and enable sustainable financial support, at an optimal level, from other sources. SNOLAB offers to Canada and Ontario a superb and unique scientific opportunity to lead the world community in low-background experiments addressing some of the most fundamental questions of physics. However, the forward-borrowing cannot be repeated in the near future to continue supporting SNOLAB operating costs without jeopardizing the programs of the Canadian subatomic physics community, including the support to fund the capital equipment necessary for SNOLAB experiments. It is the unanimous opinion of the Committee members that the funding for SNOLAB operations in future years must be secured from sources other than GSC-19. The Canadian subatomic physics programs may otherwise suffer irreparable damage.

XIII. Theory

The fractional allocation to theory has increased significantly from 11% to 13.4% of the envelope since 2002. Part of this increase is due to an increased number of funded theorists, but it is mainly due to a large increase in the average theory grant, with a preferential enhancement of the top end of the grant spectrum. A theory increase of this scale was intended, since half of the funds provided to the envelope at the end of the 2002 Reallocations Exercise ($1.845M) were earmarked to "strengthen subatomic physics theory by supporting new researchers and enhancing the research environment". Since this was the last year of the Reallocations Exercise, it was thought to be useful to analyse the details of the evolution of the treatment of theory grants by the GSC. Committee member Cliff Burgess has gone to considerable efforts to do this. Highlights of his report are included here.

Summary of Theory Grants 1996 – 2007

The size of individual theory grants, as well as their overall fraction of the envelope, has changed considerably over the past decade. The following paragraphs are meant to show what happened, its motivation, and to document how the new money has been spent. In summary, the increased allocation of $1.5M since 1996 to theorists, the major part of which has occurred since 2002, has rescued the national subatomic theory program from deep crisis. The distribution of grants shows that the GSC has directed this new spending to support excellence by preferentially funding the top end of the program. This is in accord with NSERC's mandate.

Table 4 summarizes the allocation of theory grants over the years 1996 to 2007. Figure 1 shows details of changes to the grants year by year, while Figure 2 shows the evolution of the distribution of the individual grant levels in $10K bins from 1996 to 2007. The anomalous spike of increased grants in 1998 and 1999 seen in Figure 1 was due to an overall percentage increase in grants in those years.

Several features of the table and figures bear emphasis. In 1996, the top quarter of funded theory grants ranged from $35.7 K to $53 K. As Figure 2 shows in more detail, the bulk of the grants awarded were smaller than these, with the distribution skewed towards smaller grants. The largest expenses charged to these grants are salaries for graduate students and postdoctoral fellows. Since the main competition for the best postdoctoral fellows was with US institutions, competitive postdoctoral salaries had climbed to $40 K and higher by 1996, given the comparatively weak Canadian dollar at the time. The result of this funding situation was a slow decline of the quality of postdoctoral theorists at the top Canadian institutions. This case was made successfully during NSERC's last Reallocations Exercise.

The allocation to theory has increased from $1.756M to $3.302M since 1996 and the average grant has increased by 70%. The bottom row of Table 4 shows how the increases shown in column 3 have been distributed as a function of the sizes of the grants awarded.

While the total numbers of funded theorists grew by 10% between 1996 and 2007, the overall theory budget grew by close to 80%. However, the change in the quartile numbers shows that the strongest increase occurred in the top half of the distribution, with the first quartile growing by 29% while the third quartile grew by 96%. The effect of this infusion of funding on the distribution of grant sizes is seen in Figure 2, which shows the relative decline of the lower-end grants and a clear peak of higher end grants, supporting excellence at the top end of the program. Part of this peak is due to new applicants who started a few years ago and who have recently received higher funding. Thus we are not only funding excellence, we are funding excellent young researchers.

Year	Funded	Total	1st Q	Median	3rd Q	Max	Average
1996	68	1,755,700	17,000	27,000	35,700	53,000	25,819
1997	70	1,744,100	15,000	24,100	35,000	53,000	24,916
1998	68	1,837,440	16,500	26,400	38,500	58,300	27,021
1999	68	1,972,501	17,325	28,875	40,950	57,750	29,007
2000	62	1,920,475	19,635	32,340	42,000	60,000	30,975
2001	68	2,158,285	20,000	33,000	42,000	60,000	31,739
2002	71	2,347,134	22,000	34,125	45,000	62,000	33,058
2003	73	2,619,784	24,000	38,000	47,000	75,000	35,887
2004	75	2,898,684	24,000	40,000	50,000	85,000	38,649
2005	72	2,985,484	24,000	40,000	60,000	85,000	41,465
2006	73	3,159,830	25,000	45,000	63,000	85,000	43,285
2007	75	3,302,250	22,000	45,000	70,000	85,000	44,030
96-07	(+10%)	(+88%)	(+29%)	(+66%)	(+96%)	(+60%)	(+70%)

Table 4: In this table, column 1 gives the allocation year; column 2 gives the number of funded theory applicants; column 3 gives that year's total dollar value of theory grants; columns 4-7 provide the first quartile, median, third quartile and maximum grant of those theory grants which were funded that year; while column 8 gives the average grant, counting only funded grants (column 3 divided by column 2). The final row gives the percent increase of the 2007 entry compared with the 1996 entry, for each column. Zero grants were not counted in these statistics because it was difficult to determine from the information provided whether a theorist was in the competition but not funded, or simply not participating in the competition in a given year.

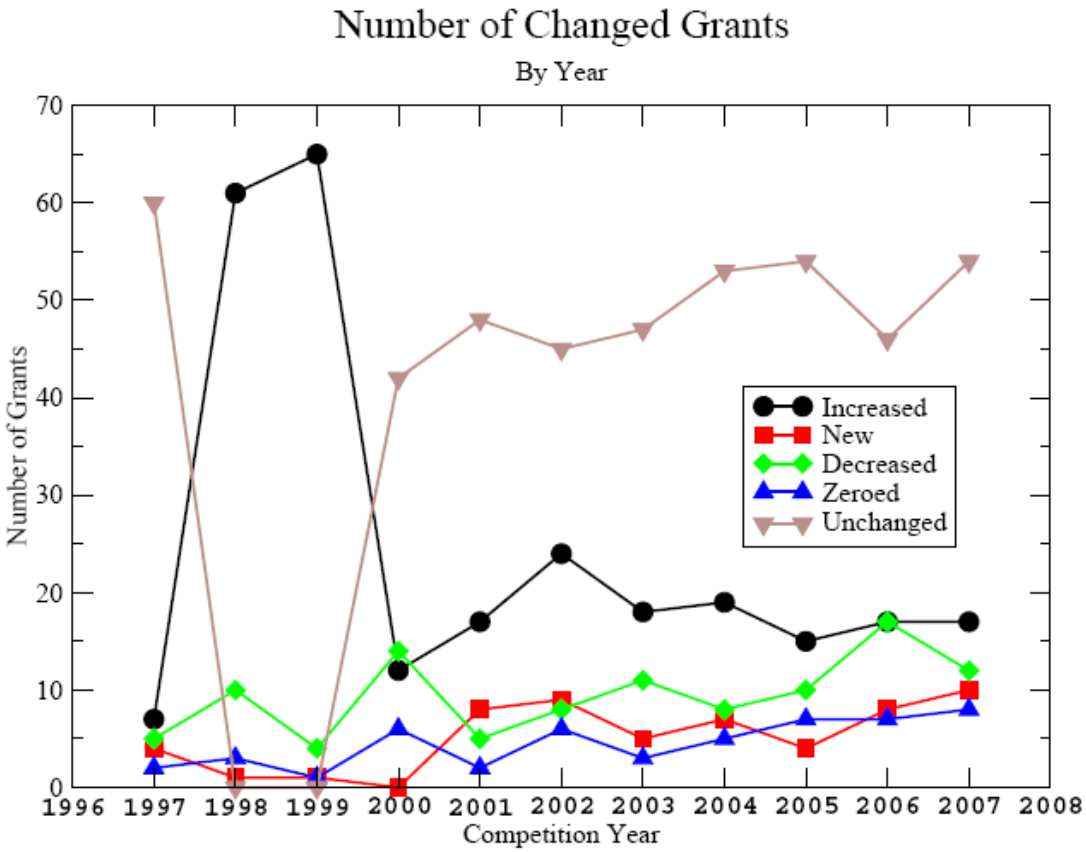

Figure 1: This graph plots the number of theory grants which changed year by year since 1997. Shown in black (●) is the number of grants which increased, in brown (▼) the number which remained unchanged, in green (◆) the number which decreased and in blue (▲) the number which were zeroed. The number of grants awarded to new theorists is shown in red (■). In the years 1998 and 1999 there were overall percentage increases to all the grants.

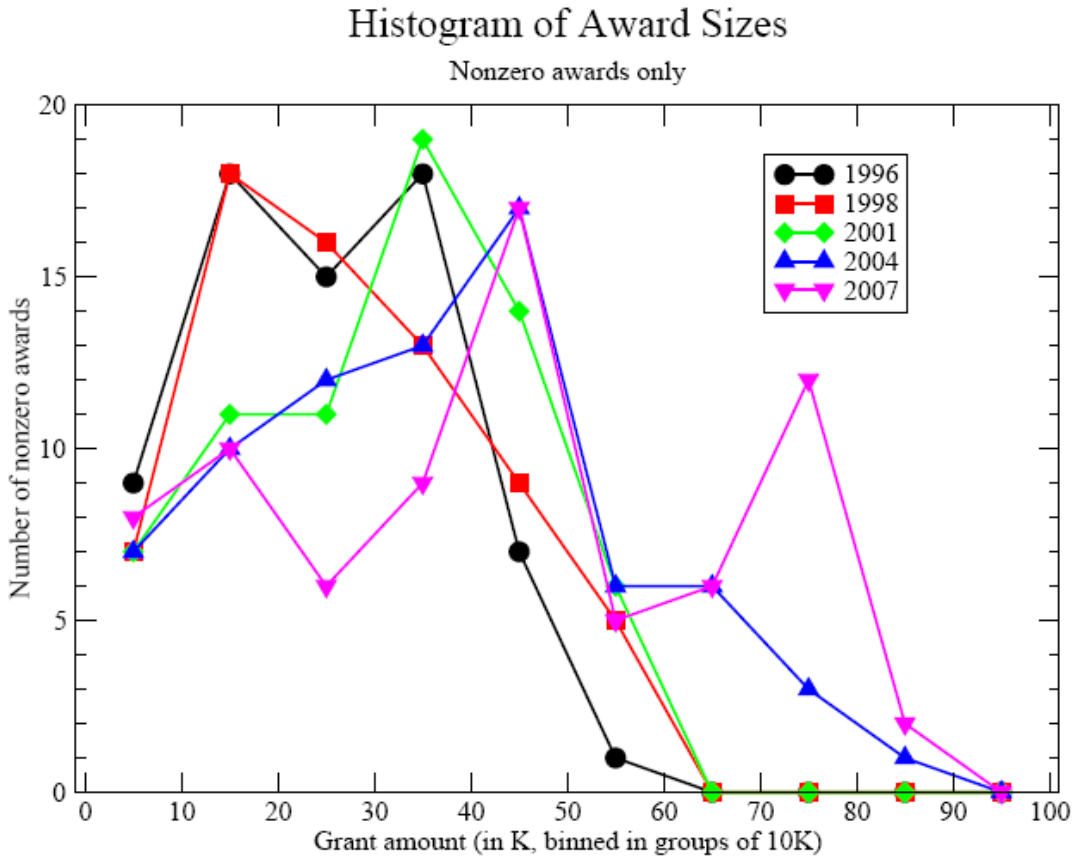

Figure 2: This graph plots the number of funded theory grants in the years 1996 (black, ●), 1998 (red, ■), 2001 (green, ◆), 2004 (blue, ▲) and 2007 (purple, ▼), binned into $10K intervals from $0-10K to $80-90K. Whereas the total number of funded applicants grew roughly 10% in this time, the distribution of grants has been moving away from one which is dominated by small grants (black line), towards a broader distribution with a peak of large grants.

XIV. Policy Matters

At the end of the competition, the Committee had a session devoted to policy matters. Some of the key points that arose are summarized below.

Total Resources: It is essential that the community continues to work to increase the total resources available for subatomic physics in Canada. Once again many meritorious research programs had to be funded inadequately, which reduces the potential of our field. In particular this year, an intense effort will be needed to secure long-term

operating funding for SNOLAB, so that the very large capital investment made by the CFI in building the laboratory leads to a vibrant scientific program.

SAP-MRS Awards: The Committee is concerned that the amount of funding available to support infrastructure at the universities has been declining, due to increasing pressure from Project, Group, Individual and RTI applications on the envelope. Highly skilled people are being lost, which is thereby reducing the effectiveness of the experimental groups to do leading-edge research and build and maintain specialized equipment. The community is urged to find ways to collaborate to make the most effective use of the remaining distributed resource of personnel funded by MRS grants. Significant use of the resource by sufficiently large number of users from outside the host institution is among the criteria that are used to assess SAP-MRS applications.

RTI Funding: The community is largely unaware of how the RTI budget adjustment (see Table 1 and Table 2) to the envelope is currently calculated. NSERC has a base target of about 25% for the funding rate in the main RTI competition. GSC-19's share is included in the base budget of the envelope. However, in most years, NSERC finds the resources to increase the RTI budget by using year-end funds that have not been used by other programs. The RTI program is well suited for the use of these one-time funds since, currently, RTI grants outside GSC-19 are one-year awards. By using the year-end funds, the actual funding rate could be brought above the base target. For example, this year it was about 45.5%. This number is calculated by dividing the total RTI budget by the total amount of all RTI requests outside of GSC-19. The GSC-19 adjustment is then calculated by summing the subatomic physics RTI requests and multiplying by the difference between the actual funding rate and the base funding rate. Consequently, we are penalized when our researchers apply for major equipment funding as part of project grants. The community should make every effort to remove substantial equipment items from project grant requests and submit them as separate RTI grant applications. Apart from maximizing the budget available for the competition, this makes the GSC's task easier in its efforts to keep capital and operating funding at appropriate fractions of the envelope.

NSERC Review and GSC Structure Review: Isabelle Blain discussed the ongoing review of the NSERC GSC structure, which was mentioned above in the Chairs' Meeting section. The community will be able to provide input in various forums, such as the CAP meeting and through university deans and vice-presidents who are on the review Committee. The time-scale of the review is 18 to 24 months, so any changes to the GSC structure would be implemented by the 2009 or 2010 competition.

Isabelle also mentioned that Industry Canada has reviewed the Granting Councils, with basically favorable results. There were concerns about the visibility of NSERC and the "high" success rate (applications funded/total applications) in NSERC's Discovery Grants program. NSERC has strongly defended its policy of supporting excellence through a broad research base while providing an appropriate and increased level of support to the most meritorious researchers as well. A high-level international review of

NSERC's Discovery Grants program will be carried out in the fall of 2007 and input will be sought from universities, grant holders and students.

Fall Site Visits: The Committee once again recommended that NSERC continues the fall site visits, which are valuable both for the GSC and the visited institutions. This is a unique opportunity for the many foreign members, and even for many of the Canadian members, to meet the Canadian community and understand the conditions under which they are working. The Committee is planning an ambitious visit to Ontario, Quebec and, for the first time, the Maritimes in the fall of 2007.

Discovery Accelerator Supplements Program: As pointed out above, the DAS program was established in the fall of 2006 to provide additional support to "outstanding researchers who have a well-established research program and who are at a key point in their careers at which they can make, or capitalize on, a significant breakthrough, but who are being held back by insufficient funds". The supplements are valued at $120K over three years. Only Individual and Group grants are eligible and the assessment of the contributions of the individual researchers is made through their Discovery Grant applications (applicants do not apply to the DAS program). It is important to note that most Group grants outside GSC-19 include only a few co-applicants, making the assessment of the individual contributions straightforward. Group grant recipients would be awarded the same amount ($120K over three years for the Group) as individuals.

Since most of our experimental applicants are co-applicants on Project grants, a mechanism had to be put in place to allow them to be considered for the DAS program starting from the 2008 competition. NSERC put forward a document that proposed a mechanism and an accompanying policy. This document was discussed and approved by the GSC. The document is provided in Appendix 2 of this report.

The mechanism would allow Collaborations that are funded through Project grants to put forward outstanding researchers who meet the DAS selection criteria. The accompanying policy states that it will not be possible for researchers, who are part of a Project, to individually apply for a grant that would support their Project-linked activities, except:

(i) When joining an on-going Project in a year where the Project's grant is not up for renewal. This is what has been called a "bridging grant". Its objective is to support the individual researcher until the next Project grant application.

(ii) When identified by the Collaboration as a researcher to be considered for the DAS program.

Attrition: The Committee wants to inform the community about the attrition mechanism since it could increase the pressure on the envelope. Every year, NSERC takes the attrition funds of each GSC and includes it in the general pool of funds (all GSCs). These funds are then used, in conjunction with any new funds (such as the $5.7M that NSERC injected this year), to provide the GSCs with an allocation related to the pressure exercised by the First-Time Applicants. Attrition funds are lost to any particular GSC and are only recovered through the FTA allocation.

Attrition is based on Individual and Group grants. Applicants holding such grants and who are not submitting applications to renew them, while not joining a Project or another Group grant, are considered to be part of the attrition. The awards held by these applicants are included in the general pool of funds. If these applicants apply again in future years, they will increase the pressure on the envelope since they will not carry any returning funds with them.

APPENDIX 1

MEETING WITH THE COLLABORATIONS OF LARGE SUBATOMIC PHYSICS PROJECTS

Monday February 5, 2007
Marriott Hotel
Laurier Room (Lower Level)
Ottawa, Ontario

7h30 - 8h15	Working Breakfast - Committee *in camera*	
8h15 - 8h45	Meeting with IPP (W. Trischuk)	*in camera*
8h45 - 9h15	Meeting with TRIUMF (J.-M. Poutissou)	*in camera*
9h15 - 9h45	Meeting with Perimeter Institute (H. Burton)	*in camera*
9h45 - 10h00	**COFFEE**	
10h00 - 11h00	ATLAS	
11h00 - 11h40	T2K	
11h40 - 12h20	QWeak	
12h20 - 13h00	**LUNCH**	
13h00 - 13h40	BABAR	
13h40 - 14h40	SNOLab	
14h40 - 15h20	SNO+	
15h20 - 15h40	**COFFEE**	
15h40 - 16h20	DEAP	
16h20 - 17h00	EXO	
17h00 - 17h30	Meeting with representative of Ontario's MRI (416-314-0629)	*in camera*
17h30 - 18h10	Meeting with Isabelle Blain	i*n camera*
18h10	Committee *in camera*	

<u>IMPORTANT NOTE</u>: 1 hour presentations: 30 min. of presentation and 30 min. for Q&A.
40 min. presentations: 20 min. of presentation and 20 min. for Q&A.
30 min. presentations: 15 min. of presentation and 15 min. for Q&A.

APPENDIX 2

Memorandum

Date: February 1, 2007

To: Subatomic Physics Grant Selection Committee

From: Samir Boughaba

Subject/Objet: SAP Projects and Discovery Accelerator Supplements program.

Background

The Discovery Accelerator Supplements (DAS) program has been established to provide substantial and timely additional resources to outstanding researchers who have a well-established research program and who are at a key point in their careers at which they can make, or capitalize on, a significant breakthrough, but who are being held back by insufficient funds. The supplements are valued at $120,000 over three years and will provide recipients with additional resources to compete with the best in the world. The supplements may be used to expand the recipient's research group (i.e., students, postdoctoral fellows, technicians), to purchase or to have access to specialized equipment, or for other initiatives/resources that would maximize the impact of their research program.

Only applicants who submit **Individual** and **Group** Discovery grant applications can be nominated to the Discovery Accelerator Supplement. For **Group** grant applications, the groups will be considered on the same basis as individual researchers. They will be awarded the same amount, i.e., $120,000 over three years.

Supplements will be awarded to applicants whose Discovery grants have been recommended for a substantial increase at the time of renewal, or to those who have received a Discovery grant for the first time and meet the objective of the program.

SAP Projects and the DAS Program

Most of the Canadian Subatomic Physics (SAP) experimentalists spend their research careers within Collaborations that are funded through Project grants. Even though the duration of each Project grant is of three years, SAP projects typically span over more than 20 years from the planning phase to the end of the experiments. The activities of the researchers involved in such projects are not of a short-term nature and can be considered as individual research programs that are conducted within long-term discovery enterprises.

The Discovery Accelerator Supplements are targeted towards supporting individual researchers. Moreover, they will be awarded on the basis of the recommendation of a Natural Sciences multidisciplinary Committee, which will assess individual researchers from various disciplines. It is thus not possible to include Project grants in this process. Individual contributions are diluted within the overall Project grant applications and it would be very difficult to assess a researcher's own program and his/her capacity to make a significant breakthrough should he/she benefit from additional financial support.

Proposed Process for SAP's Project Grants

Below, we propose a mechanism that would allow individual experimentalists who are part of Collaborations to be considered for the DAS program. This mechanism could be implemented for the 2008 competition.

1- Any Collaboration applying for a renewal or a new Project grant would identify a member to be considered by GSC-19, alongside all the other individual applications, for the DAS program.

2- For any Collaboration, the identified researcher would submit an **Individual** application **linked** to the same project as that of the Collaboration. This Individual application would be for the same activities as those he/she would carry if included in the Project grant application. Its duration would match that of the Project grant. The Individual application must provide a detailed description of the researcher's activities and the associated financial needs. The identified researcher must not be included in the Project grant application and financial support for him/her must not be requested in the Project grant application.

3- The GSC will review the Individual grant application in conjunction with the Collaboration's Project grant. As for any other Individual grant, it will be assessed on the basis of the usual four evaluation criteria: (i) scientific or engineering excellence of the researcher(s); (ii) merit of the proposal; (iii) contribution to the training of highly-qualified personnel; and (iv) need for funds.

4- The GSC will identify the applications to be nominated for the DAS among all Individual and Group grant applications.

Alongside this proposed process, we recommend that it will not be possible for researchers, who are part of a Project, to individually apply for a grant that would support their Project-linked activities, except:

(iii) when joining an on-going Project in a year where the Project's grant is not up for renewal. This is what has been called a "bridging grant". Its objective is to support the individual researcher until the next Project grant application.

(iv) when identified by the Collaboration as a researcher to be considered for the DAS program.

A Collaboration could identify a group instead of an individual to be considered for the DAS program. In this case, a Group application would have to be put forward to the GSC. Note, however, that for the Discovery Accelerator Supplements, groups will be considered on the same basis as individual researchers. The successful ones will be awarded the same amount, i.e., $120,000 over three years.

APPENDIX 3

Corrections to Annual Report

June 14, 2007

Page 1: Currently reads: “The plan’s stated top priorities are ATLAS, ISAC, SNO/SNOLAB, T2K, and a program which maintains breadth.”

Should read: “The plan’s stated top priorities are ATLAS, ISAC, SNOLAB, T2K, ILC, and a program which maintains breadth and theory.”

Page 12: Currently reads: “While the total numbers of funded theorists grew by 10% between 1996 and 2007, the overall theory budget grew by close to 80%.”

Should read: “While the total numbers of funded theorists grew by 10% between 1996 and 2007, the overall theory budget grew by 88%.”