A Pre-Budget Submission to the HOUSE OF COMMONS STANDING COMMITTEE on FINANCE

Executive Summary

With the goals of increasing the competitiveness of Canadian businesses, providing opportunities for highly trained Canadians to pursue innovative careers, providing world-leading research infrastructure to support highly skilled communities and to enable leading Canadian researchers to drive an internationally competitive knowledge economy, the Canadian Association of Physicists offers the following recommendations:

Recommendation 1: That the government continue to increase the base budgets for the granting councils and the Indirect Cost of Research program at levels that compensate for the effects of inflation, including increases in costs associated with infrastructure and research personnel.

Recommendation 2: That annual funding of NSERC Postgraduate Scholarship and NSERC Postdoctoral Fellowship programs be increased by $38 million, phased in over 3 years, to a level that can support at least 3000 Postgraduate Scholarships and at least 350 Postdoctoral Fellowship awards per year to keep pace with the growth of industrial and academic needs for new highly qualified personnel.

Recommendation 3: That NSERC funding be increased by at least $1.5 million per year for 4 years so that 2015 levels of support for the Research Tools and Instruments (RTI) program can be sustained as the planned increase in funding for the NSERC Discovery Grant program is cycled through the next 4 returning researcher cohorts.

Recommendation 4: That a long-term commitment be made to CFI and to an expanded Major Science Initiative (MSI) program to support access to and renewal of Canada's large- and medium-scale national research facilities in a coordinated and excellence-driven manner.

Recommendation 5: That the base budget for TRIUMF, Canada's national laboratory for particle and nuclear physics, be supplemented by approximately $68 million over five years to enable it to realize the vision outlined in its Five-Year Plan including completion of the Advanced Rare Isotope Laboratory.

Background and Justification for recommendations:

The Canadian Association of Physicists (CAP), with 1700 members, is Canada's national association for physicists working in industry, academia and government. In its vision statement, the CAP strives to unleash the full potential of physics and physicists for the benefit of Canada. Our recommendations

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address four of the key focal themes identified by the House of Commons Standing Committee on Finance, namely:

2. Supporting families and helping vulnerable Canadians by focusing on health, education and training
3. Increasing the competitiveness of Canadian businesses through research, development, innovation and commercialization
4. Ensuring prosperous and secure communities, including through support for infrastructure
6. Maximizing the number and types of jobs for Canadians.

Canada's international competitiveness and capacity for sustained innovation depend on the continued and balanced support of research spanning the spectrum from pure research programs, with long-term objectives, to more targeted projects with near-term applications. The core element of Canada's leadership in discovery-driven research is NSERC's Discovery Grants program. Its continued effectiveness depends on its being funded at a level that, at minimum, counters recent erosion by inflation. Measures that help sustain or enhance Canada's capacity to innovate and compete internationally clearly impact a number of the key theme areas. The recommendations presented below are shaped by considering how to maximize: the impact of public funding in research; the economic benefits of training highly qualified personnel; and the well-being of Canadians.

Recommendation 1:

The 2014 Federal Budget proposed an increase of $46 million per year to the granting councils, of which $15 million per year was allocated to NSERC and $9 million per year was allocated to the Indirect Costs Program. The CAP strongly endorses this initiative. Indeed, one of the most important determinants of effective academic/private sector knowledge transfer is the quality and breadth of the research that is pursued in academic settings and the transfer of highly qualified personnel trained in this environment to the private sector. Canada's capacity to innovate and compete internationally is dependent on this ongoing knowledge transfer. While highly-targeted research can address specific issues in existing commercial enterprises, it is the fundamental research, characterized by longer timelines and unexpected discoveries, that can generate unanticipated new technologies and approaches that provide transformative solutions to existing problems.

> ***Recommendation 1:*** *That the government continue to increase the base budgets for the granting councils and the Indirect Cost of Research program at levels that compensate for the effects of inflation including increases in costs associated with infrastructure and research personnel.* (*addresses themes 3 and 4)*

Recommendation 2:

One of the most important elements of Canada's innovation landscape is the transfer of knowledge and skills from academic research environments to the private and government sectors via the flow of highly qualified trainees into non-academic careers. A sense of the impact of highly qualified trainees on the economy can be seen in a recent Statistics Canada report entitled *Expectations and Labour Market Outcomes of Doctoral Graduates from Canadian Universities* (www.statcan.gc.ca/pub/81-595-m/81-595-m2011089-eng.pdf). For example, this study of 2005 doctoral graduates trained in computer, mathematics and physical sciences indicates that only 56% were employed in Educational Services while the rest were employed in many other sectors of the economy. Studies by the American Institute of Physics of 2009 and 2010 doctoral graduates in physics and a 2001 report by the Institute for Employment Studies to the Engineering and Physical Sciences Research Council of the UK (www.employment-studies.co.uk/pdflibrary/1417phys.pdf) found similar trends. These results reflect the value that the quantitative and analytical skills acquired by trainees in these areas can bring to activities well outside of their specific academic disciplines. It is important to note that the economic impact of highly-trained individuals extends beyond their own employment to the stimulation and creation of employment for others through the innovation and international competitiveness that they bring to the private sector.

The *Organization of Economic Co-operation and Development* (*OECD*) *Science, Technology, and Industry Scoreboard 2013* (dx.doi.org/10.1787/sti_scoreboard-2013-en) states that "An economy's ability to encourage research affects its capacity to create new knowledge and stimulate innovation. Increasing specialization and rapid growth in scientific production have made research professionals with advanced research degrees the cornerstone of modern science and innovation systems worldwide". The same report, quoting from the *OECD/UNESCO Institute for Statistics/Eurostat data collection on Careers of Doctorate Holders 2010*, indicates that Canada, with 8.2 doctorate holders per thousand population, trails countries like Switzerland (25), Germany (14), the United States (13.5), Great Britain (12.4), and Israel (9.7).

In Canada, the training of highly qualified personnel (HQP) in science is supported by programs that fund trainees directly (the NSERC Undergraduate Student Research Award [USRA] program, a number of postgraduate scholarship [NSERC PGS, Alexander Graham Bell Canada Graduate Scholarships, Vanier Canada Graduate Scholarships] programs and postdoctoral fellowship [NSERC Postdoctoral and Banting Postdoctoral] programs), and programs in which there is a training component (the NSERC Discovery Grant Program and the NSERC CREATE Program). However, an analysis of NSERC data indicates that the numbers of merit-based NSERC Postgraduate Scholarships and Postdoctoral Fellowships awarded have reached critically low values that are not keeping pace with the growth of industrial and academic needs for these HQP. For example, comparing between 2010 and 2014, there was a drop from 2520 to 1510 post-graduate awards offered and a decline from 286 to 130 post-doctoral awards offered. In particular, the number of post-doctoral awards is slipping far below Canada's HQP needs: in academia alone,

approximately 400 full-time university teachers were appointed in engineering, math, and science in 2010-2011 (as reported in the 2012-2013 Canadian Association of University Teacher's Almanac). It is the CAP's position that direct support for highly qualified trainees must be given a very high priority, and that we must close the gap in training HQP between ourselves and our OECD competitors. These HQP will be Canada's scientific and engineering leaders in the future, and increasing the number of merit-based awards back to 2010 levels will help keep a sufficient number of the best and brightest Canadian trainees in Canada.

> ***Recommendation 2:*** *That annual funding of NSERC Postgraduate Scholarship and NSERC Postdoctoral Fellowship programs be increased by $38 million, phased in over 3 years, to a level that can support at least 3000 Postgraduate Scholarships and at least 350 Postdoctoral Fellowship awards per year to keep pace with the growth of industrial and academic needs for new highly qualified personnel. (addresses themes 2, 3, 4, and 6)*

Recommendation 3:

NSERC has recently indicated that the $15 million annual increase to its base funding announced in the 2014 Federal Budget will be phased in over five years to augment its Discovery grant budget. In the interim, a portion of the new funding will supplement the NSERC PDF program and the NSERC Research Tools and Infrastructure (RTI) Program. This demonstrates NSERC's appreciation of both the critical importance of increasing the number of directly-supported highly qualified trainees and the necessity of providing the most up to date tools to support the research environment. While the longer term need for HQP training is addressed in our Recommendation 2, it is also important that a strong and sustained RTI program be maintained. The ability to renew essential equipment and acquire new equipment to take advantage of new research opportunities in an excellence-based peer-reviewed competition is essential in order to maximize the effectiveness of our research infrastructure.

> ***Recommendation 3:*** *That NSERC funding be increased by at least $1.5 million per year for 4 years so that 2015 levels of support for the RTI program can be sustained as the planned increase in funding for the NSERC Discovery Grant program is cycled through the next 4 returning researcher cohorts. (addresses theme 3)*

Recommendations 4 and 5:

A key to attract and retain the best research talent is the development, maintenance, and access to regional and national shared facilities that are competitive with the best in the world. Large-scale science infrastructure is particularly vital to building and sustaining Canada's capabilities in the physical sciences and also leads to spin off research and innovation communities. Canada benefits from the effective utilization of large national research facilities such as TRIUMF, the Canadian Light Source, the Canadian Neutron Beam Centre at the NRU research reactor, SNOLAB, NRC's astronomy facilities as well as smaller specialized research Centres, networks of materials characterization facilities and high

performance computational facilities. These are engines for discovery and they drive technological innovation. Sustained governmental investment not only yields scientific results, but also produces tangible economic and social impacts.

Utilizing such facilities in a way that maximizes their effectiveness requires long term planning, coordinated strategies for renewal, and a coherent program to support access to the facilities by Canadian researchers and their international collaborators. The CFI Major Science Initiatives (MSI) program which, in part, mitigates the loss of support from NSERC's Major Resources Support program, is recognized by CAP as a very positive development that should be sustained and expanded to enable effective and full realization of the benefits derivable from Canada's investment in large-scale research infrastructure.

Support for Canada's large-scale facilities was demonstrated in the 2014 Federal Budget, which announced a commitment of $222 million over five years to support TRIUMF's core operations and work towards realizing the vision outlined in its Five-Year Plan 2015-2020. CAP recognizes the value and impact of the research taking place at TRIUMF and supports the laboratory's effort to unlock new high-value opportunities in materials science, isotope production, and nuclear medicine. With a modest additional investment, TRIUMF will help Canada seize a competitive advantage in these areas and ensure the timely completion of the Advanced Rare Isotope Laboratory (ARIEL). This will generate social and economic outputs that improve the lives of Canadians, especially through advanced nuclear medicine.

> ***Recommendation 4:*** *That a long-term commitment be made to CFI and to an expanded MSI program to support access to and renewal of Canada's large- and medium-scale national research facilities in a coordinated and excellence-driven manner. (addresses themes 4 and 6)*
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> ***Recommendation 5:*** *That the base budget for TRIUMF be supplemented by approximately $68 million over five years to enable it to realize the vision outlined in its Five-Year Plan including completion of the Advanced Rare Isotope Laboratory. (addresses themes 4 and 6)*