



Nobel laureate stresses need to fund big science

Keynote: "The science of SNO and SNOLAB", Opening Speech by Dr. Arthur McDonald

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Speaker: Dr. Arthur McDonald, Director, Sudbury Neutrino Observatory; Professor Emeritus, Queen's University; Nobel Prize Winner for Physics (2015)

Takeaways and recommendations

- ✓ Big science facilities need ongoing funding for operations, maintenance and research
- ✓ Back big science initiatives with "natural" advantages
- ✓ Allow federal labs to conduct both basic and applied research
- ✓ Canada Foundation for Innovation a proven model for funding big science facilities
- ✓ Involve industry where appropriate, but not at expense of basic science

Canada has much to brag about, says Dr. Arthur McDonald, the country's newest Nobel Laureate. Our scientific citations rank above the international average, we're global leaders in fields like neutrinos and dark matter, and our research community, with help from funding bodies like the Canada Foundation for Innovation (CFI), has built some of the world's most impressive big science facilities, including the Sudbury Neutrino Laboratory (SNOLAB).

That support paid off handsomely in 2015 with the joint awarding of the 2015 Nobel Prize in Physics to McDonald and Japanese physicist Takaaki Kajita for the discovery of neutrino oscillations, which show that neutrinos have mass. This changed the basic understanding of physics for these fundamental particles. Just weeks after the Nobel announcement, the SNO team received another prestigious award: the 2016 Breakthrough Prize in Fundamental Physics.

"We were successful with our experiment because of the effort of many people from institutions," McDonald told CSPC delegates. "We started with about 16 people but ended up with 274 authors on all our papers, and also **tremendous support from all our (funding) agencies.**"

McDonald said SNOLAB scrambled to find its initial funding prior to the formation of CFI in 1997. That changed by 2003 when CFI launched a peer-reviewed competition that enabled his lab "to put forward our best ideas and have them reviewed by our peers".

CFI evaluates applications based on a rigorous merit-based expert review process. A CFI review committee also meets with big science facilities twice a year to ensure scientific excellence, responsible stewardship and accountability. McDonald described it as "a good model for major science" facilities. However, he expressed concern about the stagnant growth in NSERC discovery grants. Having the equipment and facilities means little unless you have the technicians, graduate students and post-docs to run the experiments. Programs like the Canada Research Chairs have helped, but he said **a "cradle to grave" approach is needed that includes funding for capital, operations, maintenance and the actual research.** He would like to see operational funding on par with what's provided for capital costs.

"We can't just give the capital and somehow we'll figure out later where the operating is going to come from because that gets us in a lot of trouble."

CFI currently has two mechanisms for supporting operations and maintenance of major science facilities: the Major Science Initiatives Fund and Infrastructure Operating Fund.

McDonald said it's important that countries devote a percentage of their science spending to large-scale projects "where you really can address things that are of substantial scientific importance". This means **investing in areas where Canada has a "natural advantage"**. For example, the SNOLAB had access to Vale's Creighton 2 km-deep nickel mine in Sudbury and \$300-million worth of heavy water on loan from Atomic Energy of Canada and Ontario Power Generation.

Early support for SNOLAB was also provided by the National Research Council, something that likely wouldn't happen today with the NRC's increased focus on large-scale, business-driven research projects, as opposed to basic science.

"It's important for there to be not such an absolute statement about 'thou shalt not do anything other than applied science when you're dealing with national laboratories'," said McDonald. "There's an advantage to these sciences being connected with innovation and an advantage to the whole community to have (these) facilities plugged in broadly across the community."

McDonald insisted there is a role for industry partnerships, but cautioned that R&D could be overlooked and killed in the process of relying too much on industry support. **"A combination of the two (public and private) is what's important in terms of being able to be innovative"**.

Looking ahead, McDonald said SNOLAB is continuing its work with a new generation of experiments, including more sensitive neutrino projects, searches for the elusive dark matter in the galaxy, and new research threads in genomics and mining innovation.