NEUTRON SCATTERING IN CANADA IS AT A TURNING POINT

Canadian scientists need access to world-class infrastructure for cutting-edge and globally competitive research. For many physicists this means using the latest developments in neutron scattering instrumentation.

The Canadian neutron scattering community – encompassing 240 researchers and students from over 40 institutions in 8 provinces – is preparing for renewal, by developing new partnerships for accelerated access to the world's best neutron beam facilities and expertise. World leading facilities like the Spallation Neutron Source and the NIST Centre for Neutron Research in the USA, the Institut Laue-Langevin in France, or the European Spallation Source under construction in Sweden, have much to offer Canadian physicists.

This outward look comes after recent developments at Chalk River Laboratories that foreshadow changes to decades of Canadian leadership in neutron scattering. In the 1950s, Bertram Brockhouse pioneered neutron scattering as a scientific tool for probing materials, and shared the 1994 Nobel Prize in Physics with Clifford Shull of Oak Ridge National Lab (USA). Their methods were replicated around the world and led to the global network of about 20 neutron beam facilities today.

Canadian neutron scatterers also made key contributions to the 2016 Nobel Prize in Physics, awarded to American physicists David Thouless, Duncan Haldane, and Michael Kosterlitz for their theories on topological materials. In 1985, Bill Buyers and others at Chalk River first verified the existence of the 'Haldane gap' in one-dimensional chains of magnetic atoms, a key prediction of the theory. Since then, the study of topological materials has come to dominate frontline research in condensed matter physics.

Today, about 130 researchers from other countries use Canada's facilities for their research, despite the fact that the NRU reactor is the oldest major research reactor in the world. Canada is still among global leaders because we continue to push the limits of what we can learn about materials, making contributions to condensed matter physics, health and life sciences, manufacturing of cars and airplanes, and development of clean energy technologies. You can find many case-studies at http://cins.ca/discover.

But now Canada is at a historic turning point, and the need to form closer ties with foreign facilities is more important than ever. The NRU reactor is scheduled to close permanently on March 31, 2018, marking the end of nearly 70 years of Canadian leadership. In the same year, Canada's only official agreement for privileged participation in a foreign source – the USA's Spallation Neutron Source – will expire.

We must forge formal partnerships with foreign facilities quickly for the next decade. These can be centred on contributions to building and operating beamlines, which can then be leveraged to obtain accelerated access to beam time, and technical and travel support. We should also better exploit the McMaster Nuclear Reactor. Although it has low capacity for neutron scattering today, a CFI-funded beamline for Small-Angle Neutron Scattering (SANS) is being constructed for studying soft materials, as many SANS experiments do not need high flux. With further investments, other capabilities can be added, and the reactor's flux and operating cycle increased.

Success of these partnerships will require a unified vision for a post-2018 future to present to government. The vision should reflect a consensus of all those with interest in using neutron beams as research tools, and notably, one that is supported by university leaders as a priority for Canadian research.

Implementing such a vision is critical, to be able to continue the next decade of research, and to retain a large, active community that can pursue a longer term vision for 2030 and beyond.

Despite the $8B invested globally in neutron sources over the last 20 years, total neutron capacity will shrink as aging reactors close. Without further investment before 2030, the Spallation Neutron Source could become the only major source in North America, while in Europe, only

The Canadian Institute for Neutron Scattering is pursuing international partnerships to ensure that Canadians have access to neutron beam facilities, following the expected closure of the NRU reactor in 2018.

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five might remain in operation.[1] Therefore, in the long term Canada should return to the construction and operation of the neutron sources ourselves.

Securing a major investment for the long term – hundreds of millions for a facility focused on neutron beams, or over a billion in a multipurpose NRU-like facility – may be possible when all stakeholders are unified and aligned. One area of emerging alignment, for example, is clean energy technologies: Neutron scattering contributes to advances in nuclear energy along with renewables, and electric or hydrogen-powered vehicles, and Canada has committed to double R&D investment in these areas to achieve the goals of the 2015 Paris Agreement on climate change.[2]

The Canadian Institute for Neutron Scattering is helping coordinate a vision for both time-scales. We're working with several foreign laboratories to construct agreements that provide tremendous scientific incentives for Canadians to conduct their research abroad. For updates on our progress, subscribe at http://cins.ca/.

1. European Strategy Forum on Research Infrastructures. "Strategy Report on Research Infrastructures: Roadmap 2016. http://www.esfri.eu/roadmap-2016

2. http://mission-innovation.net/.

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