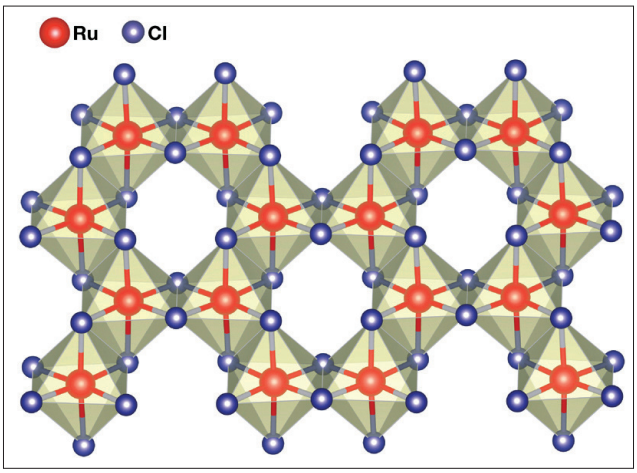
# Science advocacy drives passage of US National Quantum Initiative Act

The key role of science advocacy in driving important legislation has been recently illustrated by the passage of the US National Quantum Initiative Act (NQI). Signed into law by President Trump on December 21, 2018, the legislation was promoted and informed by a range of scientists and scientific societies, including the Materials Research Society (MRS).

"Beginning in the summer of 2018, MRS worked closely with [US] House Science Committee staff as the bill was beginning to take shape," says Damon Dozier, MRS Director of Government Affairs. According to Dozier, in addition to helping shape the language of the bill, part of that work included providing recommendations on quantum science experts to testify before the House Science Committee and working with Senate staff as they took up the House version of the bill.

"In addition to the Hill advocacy taken up by both staff and volunteers, MRS members sent countless letters to Congress supporting the legislation through Materials Voice [the MRS letter campaign program]," Dozier says. This support was part of a chorus of voices from the scientific community that engaged with legislators in both major political parties to help write and usher this bill through Congress and presidential approval to become law.

The bill directs the president to implement an NQI program, which includes defining a 10-year plan to coordinate and accelerate federal efforts on quantum information science (QIS) and technology applications. The new law also calls for the development of a QIS workforce pipeline, directs the federal government to partner with industry and universities to maximize QIS knowledge and resources, acknowledges existing federal investments in QIS, and calls for a boost in funding for quantum information science and technology. The authorized funding comes in at just over $1.2 billion for the first five years, spread across the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and the Department of Energy (DOE).




Honeycomb crystal structure of the candidate quantum spin liquid α-$RuCl_3$. While theoretical studies are being conducted on quantum liquid spins, experimental studies remain difficult. Image courtesy of Arnab Banerjee, Oak Ridge National Laboratory.

Acknowledging QIS programs that already exist in NIST, the bill calls for continued support and expansion, including the creation of a quantum consortium "of stakeholders to identify the future measurement, standards, cybersecurity, and other appropriate needs for supporting the development of a robust quantum information science and technology industry in the United States." The bill authorizes funding of up to $80 million annually for five years (starting in fiscal year 2019) for NQI-related activities within NIST.

NSF had already identified the "Quantum Leap" as one of its 10 "Big Ideas" in 2017 for future investment, and the NQI Act supports this by directing NSF to carry out a program of basic research and education in QIS. In addition, the bill instructs NSF to establish between two and five QIS centers, called "Multidisciplinary Centers for Quantum Research and Education." The centers are authorized at up to $10 million for five years (starting in fiscal year 2019), with the option to renew.

Like NIST and NSF, DOE R&D in QIS pre-dates the NQI Act, but is now slated to grow over the next decade. The bill directs DOE to carry out a basic research program in QIS that includes training for undergraduate and graduate students across seven fields. Materials science and engineering is one of these seven fields, and in January, DOE announced plans to provide $45 million for chemical and materials research in QIS. The bill also directs DOE to establish between two and five "National Quantum Information Science Research Centers" and authorizes up to $25 million annually for each center for five years. Like the NSF centers, the authorizations for the DOE centers start in fiscal year 2019 and can be renewed after the initial five-year period.

"Passage of the National Quantum Initiative Act will impact many subdisciplines within materials science, including everything from the way we characterize materials, to measuring new properties, and ultimately how we can realize new architectures that combine our knowledge pools to address the challenges of tomorrow," says Idaho National Laboratory materials researcher Jeffery Aguiar.

Characterizing QIS as a "multi-planar problem," Aguiar believes that the establishment of the NQI is a necessary step in driving both investment and coordination because "no one development will take the technology from 'A to Z.'" But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he also points out that it is important to engage the full QIS community—government agencies, national laboratories, universities, and industry—when framing the national strategy around the initiative because understanding what each member can contribute will enable the "most progress in this area on a shortened timeline."

Coordination is a major theme of the bill, which establishes a National Quantum Coordination Office, a Subcommittee on Quantum Information Science, and a National Quantum Initiative Advisory Committee to manage and administer the NQI program. The Coordination Office will oversee implementation of the NQI and is tasked with supporting the Subcommittee and Advisory Committee, serving as the point of contact for the NQI, coordinating efforts and funding activities between government agencies, and conducting public outreach.

The mandated Subcommittee on QIS has already been established (in spring 2018) within the National Science and Technology Council. Jointly chaired by the directors of NIST, NSF, and the Secretary of Energy, the bill requires that Subcommittee membership must include representatives from NIST, NSF, DOE, the National Aeronautics and Space Administration (NASA), the Department of Defense (DoD), the Office of the Director of National Intelligence (ODNI), the White House Office of Management and Budget (OMB), the White House Office of Science and Technology Policy (OSTP), and any other federal department or agency considered appropriate by the president.

The Subcommittee is responsible for establishing the goals and priorities of the NQI program as well as assessing infrastructure needs, the state of the current QIS workforce, the global outlook on QIS R&D, and opportunities for international cooperation. In addition, coordinating QIS research and budgets across federal agencies falls under the purview of the Subcommittee, which is directed to develop a five-year strategic plan and an annual program budget report for the QIS to be submitted to Congress in conjunction with the president's annual budget request.

Lastly, the Advisory Committee must be established by the president and include qualified QIS representatives from industry, academia, and the national laboratories. Tasked with providing independent assessments of trends in QIS as well as progress, implementation, and effectiveness of the NQI, the Advisory Committee is required to submit its findings and recommendations to the president and Congress in a biennial report.

Streamlining QIS R&D is critical because of the possible impacts on both the economy and national security. According to a recent report on quantum computing by the National Academies of Sciences, Engineering, and Medicine, current methods of encryption could be broken in only a few hours by a quantum computer.

"China has long been investing in this space, and the EU has launched a $1.1 billion quantum master plan," says Dozier, adding, "Timing of the bill's passage is vital in terms of America's competitiveness." This is why it is so crucial that scientists engage with policymakers, explains Dozier, saying, "passage of the NQI Act proves that advocacy programs work on a national scale and can affect results within short time frames."

**Jennifer A. Nekuda Malik**

## EU offers roadmap to increase access to scientific results

openup-h2020.eu

The traditional scientific process has long been ruled by the "publish or perish" mantra. This tradition is now shifting, as more research is being made available to a broader audience as part of the move toward open science.

This shift represents a new way of sharing knowledge using digital technologies and new collaborative tools. It has become a core strategy in Europe as a means to disseminate research to a wider audience—a way to boost innovation and competitiveness.

The EU-funded project OPENUP investigated the challenges facing this changing science landscape. For example, the total number of scholarly publications rose by 23% between 2008 and 2014, according to a report by UNESCO. This increase in output and the demand for more open, transparent, and reproducible science has led to changing requirements for those involved in the research process, such as publishers and funders.

OPENUP examined different aspects of open science, such as peer review for conferences, research data, transferring research to the web, and reaching businesses and the public with research output. The project team launched seven pilot projects to validate their initial findings and test various aspects of the academic review cycle in life sciences, social sciences, arts and humanities, and energy. The pilot projects connected targeted research communities, empowering them to apply and adopt innovative open science approaches.

One of the key goals was to develop policy recommendations: five recommendations with specific actions are now being shared widely to be integrated into decision-making processes.

The recommendations include implementing more projects to test open research impacts, creating incentives to strengthen monitoring of innovative research dissemination, training researchers on alternative research impact measurements, giving more support to implementing new policies, and providing further funding for research into the impact open science has on solving gender and diversity issues.

The project launched the OPENUP hub, a collaborative resource that hosts a catalogue of tools and services. "All the information, methods, and tools are freely available to everyone," says Project Research Manager Vilius Stanciauskas from the Public Policy and Management Institute in Lithuania. □



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