THE QUANTUM LEAP (QL)

QL Funding[1]
(Dollars in Millions)

	FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request
Stewardship Activities (MPS)	**$30.02**	**-**	**$50.00**
Foundational Activities	**$28.42**	**-**	**$34.36**
BIO	-	-	0.95
CISE	1.87	-	2.00
ENG	4.15	-	1.90
MPS	21.40	-	28.51
OISE	1.00	-	1.00
Total	**$58.44**	**-**	**$84.36**

[1] Funding for QL and QIS overlaps in some areas. Thus, it should not be summed across presentations.

Overview

The QL Big Idea builds upon and extends existing knowledge of the quantum world to observe, interact with, and control, from first principles, the behavior of particles at atomic and subatomic scales. It enables discoveries in both naturally occurring and engineered quantum systems and will develop next generation quantum technologies and devices for sensing, information processing, communications, and computing. These advances will unleash the potential of the Nation's quantum-based scientific enterprise to enhance the Nation's well-being, economy, and security. NSF's investment in QL is aligned with the Administration's Quantum Information Science (QIS) effort as well as Congressional priorities as noted in the National Quantum Initiative (NQI) Act, P.L. 115-368.[1]

In its third year of investment in QL, NSF envisions continuing to advance fundamental understanding of how quantum phenomena at the subatomic scale are manifested at the macroscopic scale. Discovery will lead to new methods of characterization and control, enhance predictive and modeling capabilities, and catalyze new computing, networking, and measurement paradigms. Cross-disciplinary approaches, combining experimentation, computation, and theory, will help to identify the knowledge and skills necessary for the responsible conduct of quantum research to make fundamental advances in quantum science.

Educational research on the learning and teaching of quantum concepts will contribute to the development of the future quantum workforce. QL investments will empower U.S. scientists and engineers to advance quantum technologies and understanding, which will in turn lead to the discovery of novel materials, tools, devices, algorithms, simulations, systems, and programming paradigms, as well as new and creative application domains, along with a quantum-capable workforce. NSF will also broadly engage scientific, engineering, and educational communities to build a human capital foundation in pursuit of a better understanding of quantum phenomena.

Consistent with and crucial to its mission, NSF will form partnerships with other federal agencies, industry, private foundations, national laboratories, and existing centers in order to leverage NSF's investments in QL. NSF coordinates QL activities with other federal agencies through the National Science and

[1] www.congress.gov/115/bills/hr6227/BILLS-115hr6227enr.pdf

Technology Council Subcommittee on Quantum Information Science (SCQIS). NSF also seeks to increase international cooperation with like-minded partners consistent with the SCQIS National Strategic Overview for QIS.[2]

Goals

1. Understand fundamental limitations in time, distance, and scale for entanglement and coherence of quantum states.
2. Learn from quantum phenomena in naturally occurring and engineered quantum systems, including emergent behavior, complexity, the quantum-classical boundary, and theoretical foundations.
3. Galvanize the science and engineering community to enable quantum discoveries, devices, systems, and technologies that surpass classical capabilities.
4. Prepare an effective and diverse workforce to participate in and lead further advancements in quantum science and engineering.

FY 2021 Investments

In FY 2021, QL activities will focus on enabling advances in selected priority areas, building on outcomes from FY 2019 and FY 2020 activities, and adjusting emphases, as warranted, to address new emerging areas. In FY 2019, NSF initiated two center-scale, cross-directorate activities resulting in awards that will continue to receive funding in FY 2021. Awards made through the solicitation, "Enabling Quantum Leap: Convergent Accelerated Discovery Foundries for Quantum Materials Science, Engineering, and Information,"[3] will provide support for accelerated quantum materials design, synthesis, characterization, and translation for quantum devices, systems, and networks. The "Quantum Leap Challenge Institutes (QLCI)"[4] solicitation called for proposals for quantum institutes that will receive the first year of funding in FY 2020. As part of the QLCI solicitation, in FY 2019, NSF also supported conceptualization grants for workshops and related activities that are helping teams to coalesce and develop institute proposals for competition in a second round of review; the institutes selected from the second round will receive the first year of funding in FY 2021. QLCI research will identify and address science and engineering challenges in fundamental at-scale problems in quantum communication, quantum computing, quantum sensing, and quantum simulations.

[2] www.whitehouse.gov/wp-content/uploads/2018/09/National-Strategic-Overview-for-Quantum-Information-Science.pdf
[3] www.nsf.gov/funding/pgm_summ.jsp?pims_id=505504
[4] www.nsf.gov/publications/pub_summ.jsp?org=NSF&ods_key=nsf19559