



NATIONAL SCIENCE FOUNDATION
2415 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22314

NSF 22-092

Dear Colleague Letter: Enabling Quantum Computing Platform Access for National Science Foundation Researchers with Amazon Web Services, IBM, and Microsoft Quantum

June 3, 2022

Dear Colleagues:

The field of quantum computing has witnessed substantial progress in recent years, with the development of next-generation quantum processors in the 50- to 100-qubit range and beyond. Realizing the promise of such processors requires significant capacity-building to prepare the next generation of quantum researchers and users. In light of the quantum-computing developments in the private sector as well as the opportunity for further innovation in the academic setting, the National Science Foundation, in conjunction with Amazon Web Services (AWS), IBM, and Microsoft, is coordinating the availability of cloud-based access to quantum-computing platforms in order to advance research and build capacity in the academic setting. More information about the platforms is available at the following company websites.

- Amazon Braket: <https://aws.amazon.com/braket/>
- IBM Quantum: <https://www.ibm.com/quantum-computing/>
- Microsoft Quantum: <https://azure.microsoft.com/en-us/services/quantum/>

With this Dear Colleague Letter (DCL), NSF's Directorate for Computer and Information Science and Engineering (CISE), the Directorate for Mathematical and Physical Sciences (MPS), the Directorate for Engineering (ENG), and the Directorate for Technology, Innovation and Partnerships (TIP) notify the research community of their intention to support supplemental funding requests for currently active NSF awards to enable use of these quantum-computing platforms. NSF's supplemental funding will include support for graduate students as well as fees to work on these hardware and software quantum platforms.

TOPICS AND SCOPE:

This DCL is part of an experimental effort to build capacity among active NSF awardees, and their graduate students, to enable innovation in quantum computing. The community of CISE, ENG, MPS, and TIP researchers who are not already leveraging such platforms are a particular focus for this DCL. Furthermore, publication and dissemination of research-relevant experiments, code, and tutorials through GitHub and other public repositories are strongly encouraged to ensure benefit for the broad academic community.

Supplemental funding requests will be limited to research activities in the following research areas:

- Quantum algorithms and their experimental realization;
- Quantum compiler and run-time infrastructure design;
- Fault-tolerant computing and other methods to boost the performance of existing quantum-computing hardware;
- Benchmarking of architectures, systems, algorithms, and scalable error-correction techniques;
- Quantum simulations, optimizations, cryptography, and machine learning; and
- Demonstrations of feasibility for applications of quantum algorithms.

Each PI should describe in the supplemental funding request how the work of the graduate student(s), in combination with quantum cloud platform access, will build upon and extend research activities beyond those described in the original award. Additionally, PIs should describe any prior use of such platforms, and how the requested supplemental funding will build upon that prior use.

CLOUD-CONNECTED QUANTUM RESOURCES:

NSF-funded Principal Investigators (PIs) are required to provide the anticipated annual and total costs for accessing the desired quantum computing resources, based on pricing currently available from the public cloud computing providers mentioned below.

AWS: The pricing policy for the use of the AWS cloud service Braket, which provides access to Rigetti and ionQ universal gate-based quantum computers and D-wave adiabatic quantum computing, is available at <https://aws.amazon.com/braket/pricing/>. For additional guidance on estimating costs with Braket, PIs may contact AWS directly at the email below.

IBM: IBM provides no charge access for its smaller quantum systems. The pricing policy for use of larger quantum systems can be found at <https://cloud.ibm.com/catalog/services/quantum-computing>.

Microsoft: Microsoft provides an Azure-based cloud service to access both software-optimization and quantum-hardware solutions through an expanding partner ecosystem and through a variety of programming frameworks, including Q#, Qiskit, and Cirq. The hardware

solutions are provided by Azure through IonQ and Quantinuum, while special quantum-inspired optimization solutions are provided through Toshiba, 1Qbit, and Microsoft. (<https://azure.microsoft.com/en-us/services/quantum/#product-overview>). Pricing for gate-based quantum computer hardware provided by IonQ and Quantinuum can be found at <https://docs.microsoft.com/en-us/azure/quantum/pricing>, while pricing for Microsoft Quantum Impact Optimization (QIO) can be found at <https://azure.microsoft.com/en-us/pricing/details/azure-quantum/>.

PIs may, but are not required to, access quantum resources through CloudBank, an external cloud access entity supported by NSF's Cloud Access program. The benefits of using CloudBank include no indirect costs on cloud spend; a multi-cloud, pay-per-use billing model; automated account management; help desk support; and tools to help monitor cloud spend. PIs requesting to use CloudBank will separate their proposed quantum costs from their institutional budget and the total of both may not exceed the budget limit described in this DCL (see below). For example, if a PI wishes to request \$10,000 in quantum computing resources through CloudBank, then their formal budget request should be adjusted accordingly. The \$10,000 in cloud funding is allocated by NSF to CloudBank directly, and thus does not appear in the formal budget request. If PIs decide not to use CloudBank, they must budget the cloud resources as direct costs and will not receive the benefits of CloudBank noted above.

A webinar is also planned by CloudBank on June 17 at 11 am ET/8 am PT to provide an overview and demo that will help PIs and co-PIs become more familiar with CloudBank services. Additionally, platform providers will present their simulation and hardware solutions as well as speak about estimating costs more specifically. To attend this webinar or for any questions on the benefits of CloudBank, PIs are advised to send email to help@cloudbank.org or visit the [FAQ](#) page. The webinar will also be recorded and posted to the CloudBank website afterward.

PIs may also contact the corresponding Point of Contacts (PoCs) below at Amazon Web Services, IBM, and Microsoft Quantum to see if their quantum resources are a good fit for the proposed work or with questions regarding the platform and resources offered and should work with them to secure the letter of support that must be included in the supplemental funding request.

- Sebastian Hessinger, Amazon Web Services, email: hasyseb@amazon.com
- Martin Roetteler, Microsoft Quantum, email: martinro@microsoft.com
- Kayla Lee, IBM, email: kayla.lee@ibm.com

FUNDING REQUEST DETAILS:

The supplemental funding request must not exceed \$50,000, including the costs for the use

of quantum simulators and hardware platforms through CloudBank. The funding may also be used to support students only for a duration of up to one year. The work to be performed on the quantum computing cloud platform should be described in the request.

In the supplemental funding request, PIs must submit a 2-page proposal about their supplementary research along with: (a) documentation detailing the technology (superconducting qubits, trapped ions, silicon spin qubits and/or microwave pulse control) and planned level of cloud resources (e.g., number of hours, number of qubits and the cloud platform(s), number of individual instance of users, and/or other metrics); and (b) a letter of support from one of the three cloud providers indicating commitment on the part of providers that anticipated quantum resources will be available for PI's research group to conduct experiments in a timely manner.

For all NSF awards, grantees must submit annual project reports to NSF as part of the award to which the supplement is attached. In addition to the standard requirements, annual reports must provide a detailed accounting of the project's use of quantum cloud resources and students' time.

Supplemental funding requests pursuant to this DCL are welcome through July 8, 2022, but earlier submissions are encouraged. This opportunity is open to PIs and co-PIs with active awards from the research areas described in this DCL. Requests should be prepared in accordance with the guidance in Chapter VI.E.5 of the [NSF Proposal & Award Policies & Procedures Guide](#) (PAPPG) and submitted electronically via FastLane. NSF will manage the review of supplemental funding requests and the selection of those chosen for award. Amazon Web Services, IBM, and Microsoft Quantum will have no role in the review and selection process, and proposals will not be shared with Amazon Web Services, IBM, or Microsoft Quantum.

NSF will notify PIs selected for funding, at which point PIs should re-engage with CloudBank or as negotiated with the Amazon Web Services, IBM, and Microsoft Quantum PoCs above to begin using the resources described in the proposal.

PIs interested in submitting supplemental funding requests or with questions pertaining to this DCL are strongly encouraged to contact one of the following program directors prior to submitting:

- Almadena Chtchelkanova, Program Director, CISE/CCF, telephone: (703)-292-7498, email: achtchel@nsf.gov
- Richard Dawes, Program Director, MPS/CHE, telephone: (703)-292-7486, email: rdawes@nsf.gov
- Stacey Levine, Program Director, MPS/DMS, telephone: (703)-292-2948, email: slevine@nsf.gov
- Alexander Cronin, Program Director, MPS/PHY, telephone: (703)-292-5302, email:

acronin@nsf.gov

- Dominique M. Dagenais, Program Director, ENG/ECCS, telephone: (703) 292-2980, email: ddagenai@nsf.gov
- Ray Adomaitis, Program Director, ENG/CBET, telephone: (703) 292-8320, email: radomait@nsf.gov
- Pradeep Fulay, Program Director, TIP/ITE, telephone: (703) 292-2445, email: pfulay@nsf.gov

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