

Metriq: A web platform and community for quantum technology benchmarks

Nathan Shammah

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TERATEC TQCI Seminar, Reims

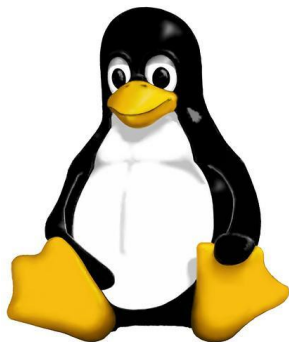
June 4, 2024



Outline

- Introduction to Unitary Fund
- Motivation for open benchmark platform
- Introduction to Metriq
- Metriq community
- Open Quantum Benchmarks Committee

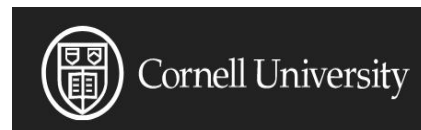
Open Source Software Needs Institutional Support



"\$5Bn in contributed development costs"



>56M wiki pages, 309 languages



Open-access archive for >2M scholarly articles

Mission

Unitary Fund is a 501(c)(3) non-profit whose mission is to create a quantum technology ecosystem that benefits the most people. We believe that expanding the pool of people working on quantum technologies is a way to ensure that the benefits of these tools are widely, swiftly, and equitably distributed.

Vision

We work to create a more inclusive quantum, open source community by supporting new and innovative projects, while also researching and developing tools to further accelerate a quantum technology ecosystem for all.

We do three main things

Microgrants

- We run a microgrant program to fund explorers across the world to work on quantum technologies. **100+ teams across 27 countries.**

Research

- We do our own research to help the ecosystem as a whole. For example, we are developing (1) **mitiq (100k+ downloads; 90+ citations)**, an open source compiler for error-mitigated quantum programming, and (2) **metriq**, an open community platform for sharing quantum tech benchmarks.

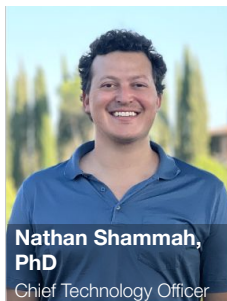
Community

- We host an open source quantum tech community (**3k+ open quantum tech developers**) that runs hackathons, community surveys and events.

The Team



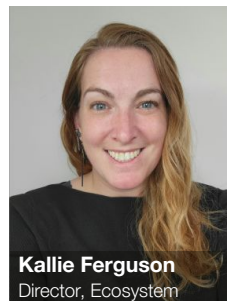
William Zeng, PhD
President



Nathan Shammah, PhD
Chief Technology Officer



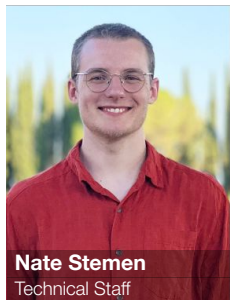
Ben Castanon
Chief of Staff



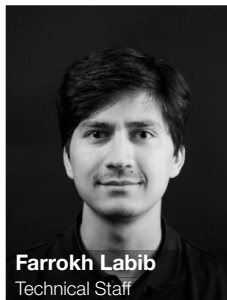
Kallie Ferguson
Director, Ecosystem



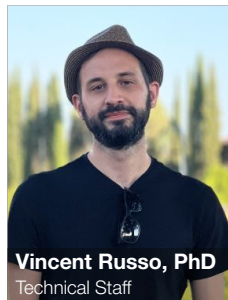
Misty Wahl
Technical Staff



Nate Stemen
Technical Staff



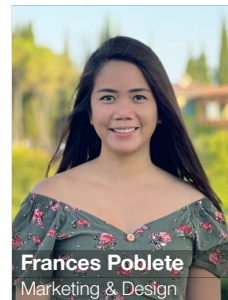
Farrokh Labib
Technical Staff



Vincent Russo, PhD
Technical Staff

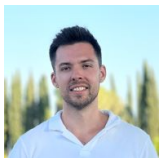


Dan Strano
Technical Staff



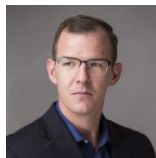
Frances Poblete
Marketing & Design

Board of Directors



President. Partner at Quantonation. Fmr. Head of Quantum at Goldman Sachs and product/sw lead at Rigetti. Oxford quantum algorithms PhD.

William Zeng, PhD



Secretary. Quantum Applications Architect at IBM Quantum and Policy Hackers Fellow at the Lincoln Network. PhD in quantum computing from the University of New Mexico (2018).

Travis Scholten, PhD



COO & Co-Founder, Convergent Research, which incubates new kinds of transformative research institutions.

Anastasia Gamick



CTO and Head of the Technical Staff. Managing Director, Unitary Fund France. QuTiP admin. PhD in Physics from Univ. of Southampton.

Nathan Shammah, PhD



Treasurer. Co-founder and managing partner at Quantonation. PhD in Quantum Physics from Ecole Polytechnique.

Christophe Jurczak, PhD



Fmr. Director, IBM Quantum & Qiskit Community.

Liz Durst

UF Supporters

Core members (2023)

IBM Quantum

scientifica
venture capital

Supporting members (2023)

agnostic

aws

cisco

DoraHacks

PASQAL

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leap^w

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- Microsoft
- Cambridge Quantum Computing
- Classiq
- IQT Labs
- Rigetti
- Zapata Computing
- QCWare
- quantumcomputing.com
- QuEra
- Riverlane
- Xanadu
- Strangeworks
- PLOS
- Steve Willis & NYC Quantum Meetup
- EeroQ
- Q-CTRL
- BlueQubit
- John Hering
- Jeff Cordova
- Nima Alidoust
- Travis Humble
- George Umbrurescu
- Michał Stęchły
- Terrill Frantz
- Konstantin Vinogradov
- Jordan Rule
- Greg Ramsay
- Peter Johnson
- Guillaume Verdon
- Rishi Sreedhar
- Travis L. Scholten
- Amir Ebrahimi
- Jens Koch
- Christophe Jurczak
- Angelo Danducci II
- Will Zeng

Small microgrants => big impact



100 projects

26 countries, 4 continents
20+ publications
2 venture funded startup
> 30 open source libraries
> 20 new folks FT in the field

Open source **metrics**:

> 1000 stars
> 500 forks

\$300k

“Unitary Fund was a very important achievement on our first steps of starting the Gate42 QC initiative in Armenia. Armenia, via Unitary Fund was first time marked on the QC world map!”

— Hakob Avetisyan (now teaching the first quantum computing course in Armenia)

unitaryHACK: Supporting quantum open-source projects

May 29- June 12, 2024



**Empower
Quantum .**

Contribute to the open quantum ecosystem,
level your skills, and get rewarded!

> > > > >

<https://unitaryhack.dev/>

>

800+ participants
50 projects
+200 bounties
\$20k+ rewards

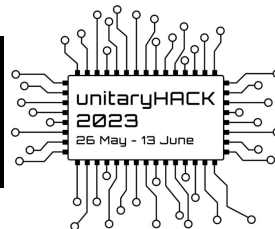
2021



2022



2023



unitaryHACK: Discover bounties & in-person meetups

Qadence

💰 \$500 up for grabs! 😊

- \$100 | [Enhance] Add 'backend' argument to product_state
- \$100 | [Refactoring] Avoid calling block to tensor on diagonal Hamiltonians
- \$50 | [Refactor] Better use of projectors
- \$150 | [Feature] Add checkpoint_best_only in train_grad
- \$100 | [Performance] Expand PyQComposedBlock to 2 qubit gates

Perceval

💰 \$500 up for grabs! 😊

- \$200 | QASM to linear optics circuit converter
- \$200 | Create a Perceval - PennyLane plugin
- \$100 | Heralds out of their box

qBraid-SDK

💰 \$275 up for grabs! 😊

- \$150 | Convert OpenQASM 3 program to specified basis gate set
- \$75 | NetworkX Out, Rustworkx In: Unleash the Speed
- \$125 | Challenge Accepted: Boost Our Code with CPython!
- \$75 | Implement tests for IonQ runtime provider
- \$75 | Expand IonQ provider runtime to supported gates

Join an in-person Hackday!

- May 31: Aalto University CS in Helsinki starting at 18:00 for 24 hours. Pizza available!
- May 31: Auditorio Raúl J. Marsal, Ciudad Universitaria, UNAM in Mexico City at 16 HRS UTC-6
- June 11: University of Washington HUB 145 from 9 am to 5 pm, food will be available!

<https://unitaryhack.dev/>

Problem Domain

- Why do we want to benchmark?

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“How does QC Platform X running Software Stack Y perform on Workload Z and how has that changed over time?”

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Answer the question:

“How does QC Platform X running Software Stack Y perform on Workload Z and how has that changed over time?”

- What makes a good benchmark?
 - Reproducible¹
 - Scalable²
 - Application-centric²
 - Hardware-agnostic²

¹Dasgupta, Samudra, and Travis S. Humble. "Characterizing the stability of nisq devices." *2020 IEEE International Conference on Quantum Computing and Engineering (QCE)*. IEEE, 2020.

²Martiel, Simon, Thomas Ayrat, and Cyril Allouche. "Benchmarking quantum co-processors in an application-centric, hardware-agnostic and scalable way." *arXiv preprint arXiv:2102.12973* (2021).

Metriq's purpose

- We can answer the question: *How does QC Platform X running Software Stack Y perform on Workload Z, and how has that changed over time?*
- Developers and companies can submit benchmarking results frictionlessly, via web form or Python client, which wrap our REST API.
- Metriq will become a focal point for a large number of short-term and long-term benchmarking efforts sprouting up in the quantum ecosystem.
- Reproducibility of benchmarking results in the space will become a habit.
- The long-term cost of deploying quantum computing will go down.

Vision for Metriq

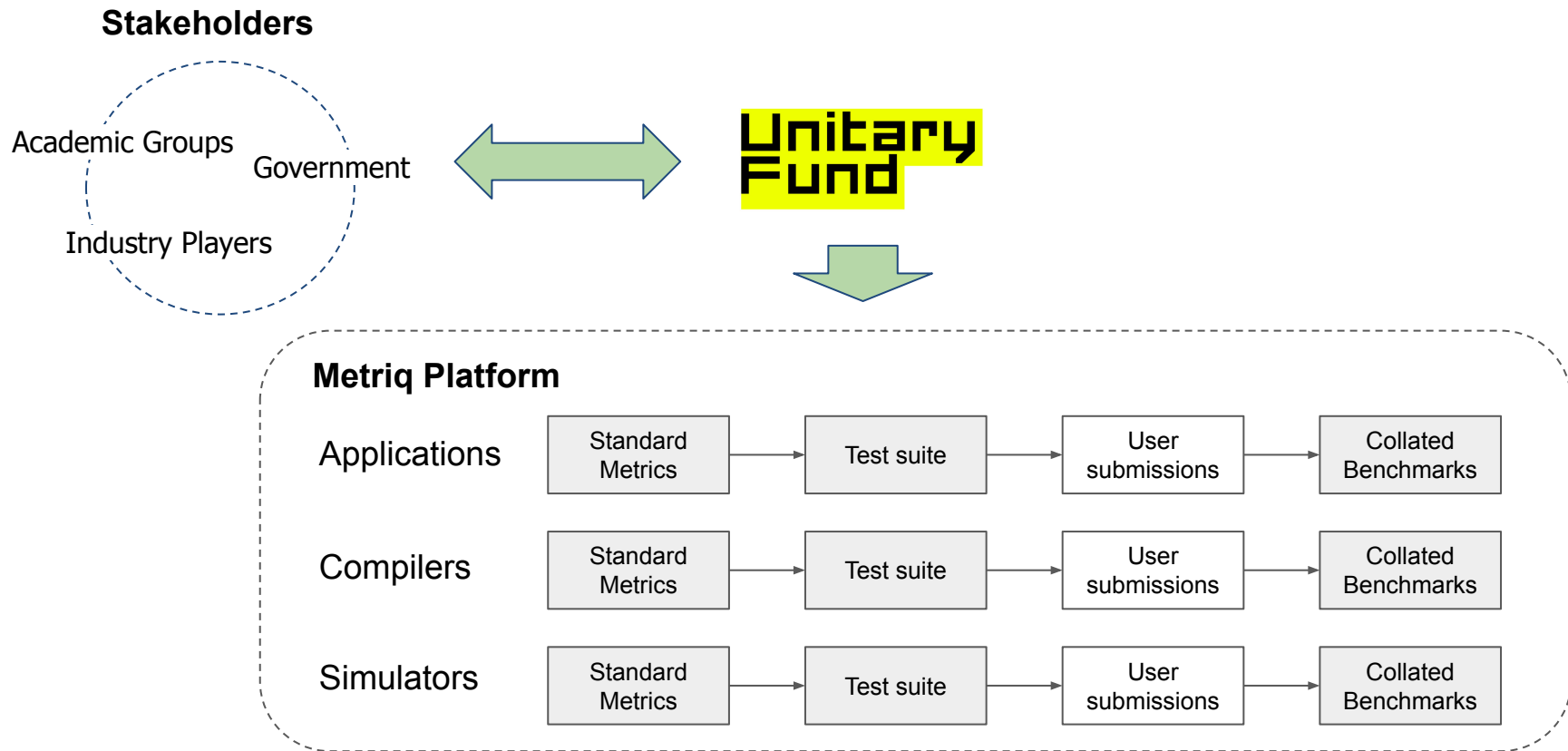
1. Robust FOSS tools ecosystem

The diagram consists of three horizontal bars stacked vertically. Each bar has a colored rounded rectangle on its left side and an empty rectangular box on its right side, connected by a thin line. The top bar is green, the middle is teal, and the bottom is grey. Each bar represents a component of the 'Vision for Metriq'.

2. State-of-the-art results repository

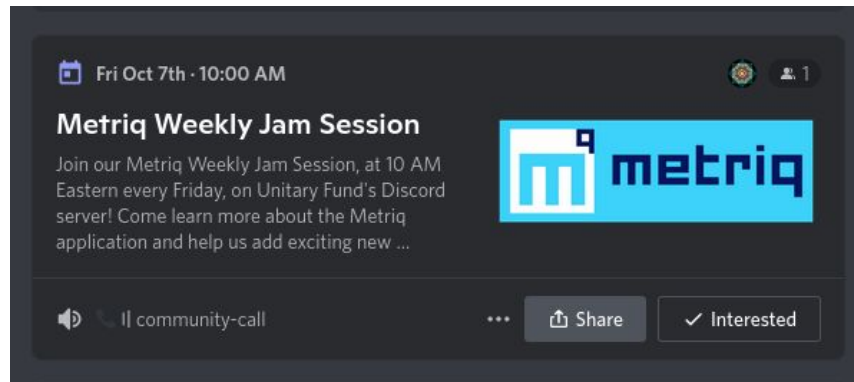
3. Open reproducible benchmarks

Our Vision: the Metriq platform



Metriq: A growing community

- Unitary Fund Discord Server →
- Metriq Hackathon
- Metriq @ [unitaryHACK](#)
- @metriq.info Twitter bot
- “Task of the month” sent to mailing list
- Metriq QxQ internship (2022, 2023) →



Taxonomy

- Submissions - Primary source (URL)
 - Autocompletion from source URL meta tags

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- Platforms - hardware and compiler metadata
 - Extensible properties, with inheritance

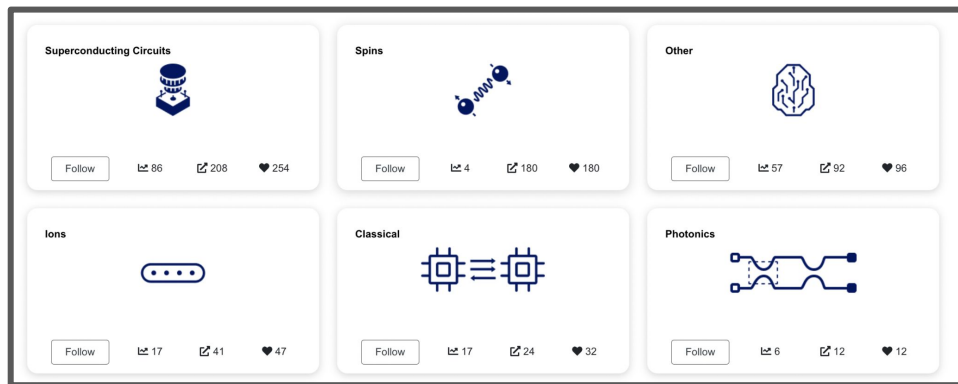
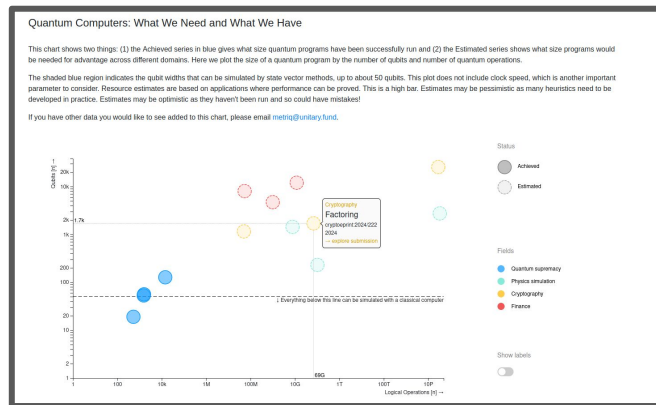
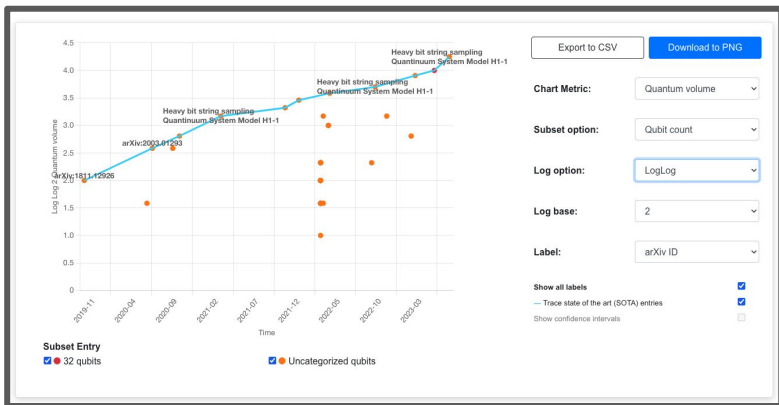
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- Data sets - problem-of-interest metadata
 - Mirror “platforms” design, for “task side” rather than “method side”

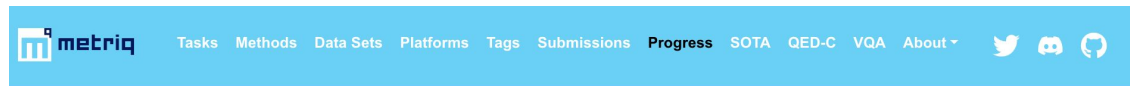
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- **Results - Intersection of all of the above**
 - Metric name and value

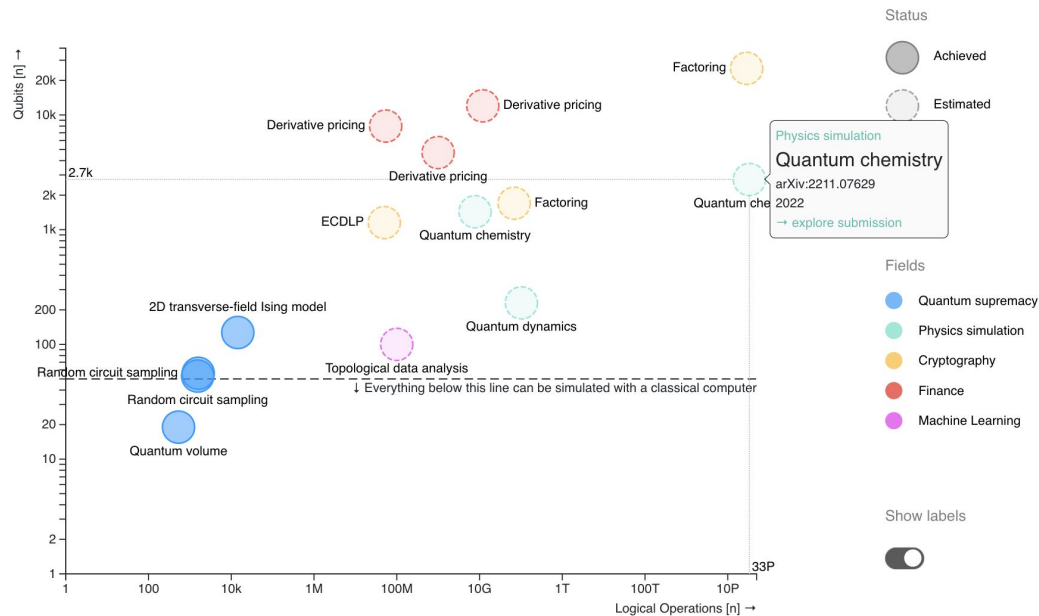
We built Metriq to make the benchmarks people are running legible.



Progress chart



Quantum Computers: What We Need and What We Have



Longer term impact

1. Reproducibility

- Develop a metric testbed through an online facility. Testing new algorithms automatically (continuous integration, cloud-based, HPC-integrated).

2. Open access & contributions

- Provide a framework accepting submissions not only of algorithms but of new metrics, aiming at being embraced by the quantum community.

3. State-of-the-art

- Accelerate academic research, upgrading the taxonomy of reported results, now locked in review papers' tables.
- Live, explorable, up-to-date data.

Governance

- Metriq is open to anyone with a source URL
- Openness allows a range of result qualities
- Users of Metriq express a desire for formal peer review of results
- Open Quantum Benchmark Committee will vet results
- Please volunteer as a Metriq referee!

Open Quantum Benchmarks Committee Members

- Open call for applications, Jan 30, 2024 - Mar 1, 2024
- First meeting held on April 12, 2024

1. **AJ Rasmusson**, Indiana University
2. **Amit Jamadagni**, Leibniz Supercomputing Centre
3. **Andrea Giachero**, University of Milano Bicocca
4. **Eduardo Henrique Matos Maschio**, Pasqal
5. **Frederic Barbaresco**, THALES
6. **Justin Gage Lietz**, NVIDIA
7. **Luke Govia**, IBM Quantum
8. **Olivia Di Matteo**, University of British Columbia
9. **Paul Nation**, IBM
10. **Ryan Hill**, qBraid Co.
11. **Shannon Whitlock**, University of Strasbourg
12. **Yi-Ting Chen**, Amazon



Open Quantum Benchmarks Committee

- Committee divided in Subcommittees:
 - Applications
 - Compilers
 - Hardware
 - QEC & Error Mitigation
 - Simulators
- First actionable objective: Identify 2-3 metrics for state-of-the-art page
- Would like to be involved? Drop us a line metriq@unitary.fund

QED-C benchmarks <> Metriq: Pipeline



Because evolution is unitary.

► Automatically running QED-C benchmarks on Metriq

2023-02-28
Metriq Team

We are excited to announce the integration of an automated pipeline to add state-of-the-art benchmark from the Quantum Economic Development Consortium (QED-C) into Metriq, the open platform that makes transparent, accessible benchmarks available to everyone in the quantum computing community.

unitary.fund/posts/2023_metriq_qedc

Conclusions

- Unitary Fund supports open source and open hardware in quantum tech
- Metriq is an open platform and community for benchmarking quantum computing
- Metriq already contains over 1400 submitted papers and results
- Metriq provides an editable taxonomy of results
- Open Quantum Benchmarks Committee has been set up to drive taxonomy
- Unitary Fund team will keep performing first-hand benchmarking

Thank you!

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Metriq
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