# aqora

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# Democratizing Quantum Progress: Benchmarks, Datasets, and Challenges

2025

# What is Aqora Today?

Aqora today provides a **quantum community platform** centered around quantum **challenges**, engaging a community of global **quantum experts** to generate, innovate, and bring forth high quality solutions.

**1500+**

**QUANTUM EXPERTS REGISTERED**
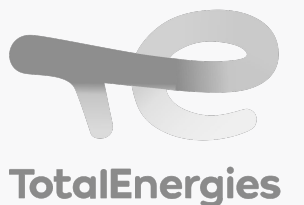
**40+**

**QUANTUM COMPETITIONS HOSTED**

**800+**

**QUANTUM SOLUTIONS SUBMITTED**

# The Quantum Benchmark Landscape Is Fragmented

## ❌ Fragmented Access & Evaluation

- Benchmark code scattered across GitHub, institutional repositories, PDFs
- Little to no standardization across datasets or performance metrics
- Tooling for tracking and comparing results is mostly improvised

## ⚠️ No Central Infrastructure

- Benchmarks are often *one-off efforts*—hard to build upon
- Evaluation pipelines vary by group, stack, or SDK
- Many efforts lack visibility or adoption beyond their initial paper

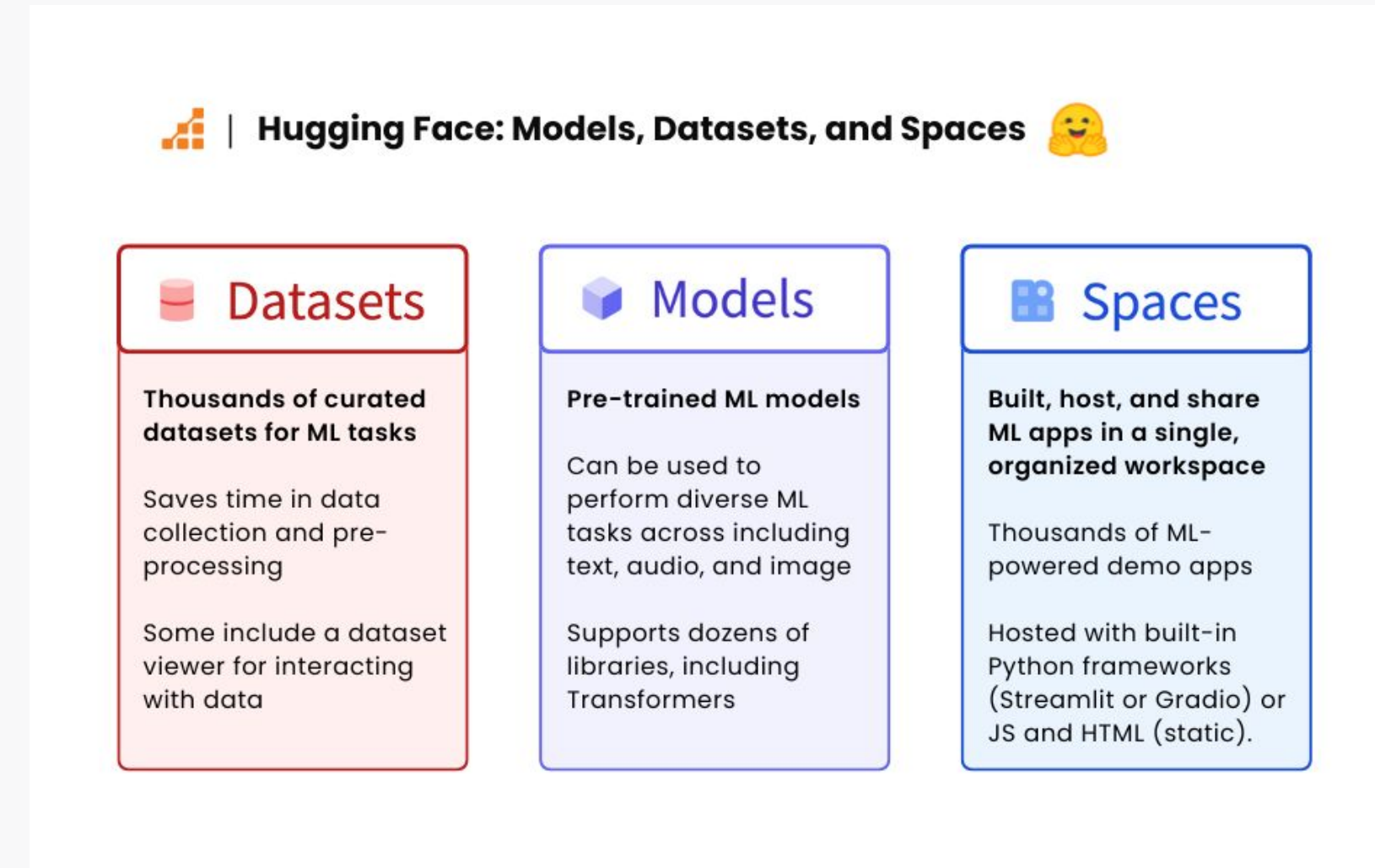📢 **Progress is slowed by fragmentation.**
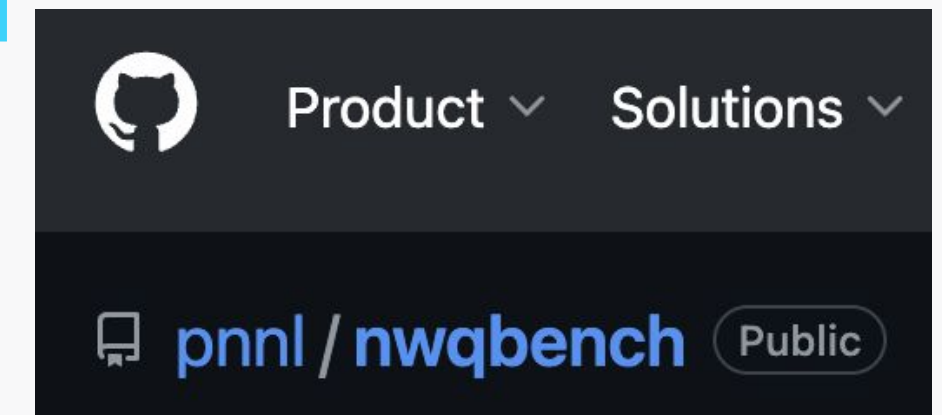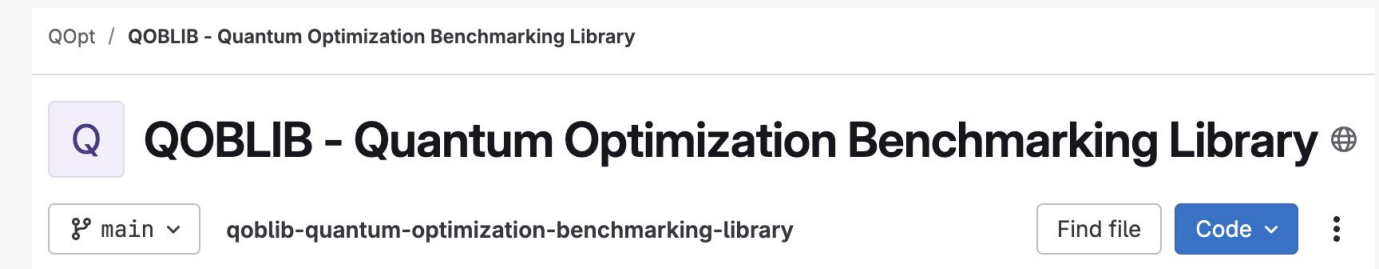
# What's Missing in Quantum Benchmarking Today?

| Need | Status | Today's Reality |
|---|---|---|
| Central repository of quantum benchmarks | 🟡 | Some curated lists exist, but they stop at definitions, not execution or validation |
| Standardized datasets for fair comparisons | ❌ | Often live in private repos or supplement PDFs, rarely reused |
| Transparent, verifiable leaderboards | ❌ | No consistent way to compare algorithm performance over time |
| Runtime-tested submissions (sim & QPU) | ❌ | Benchmarks rarely come with executable environments or result validation |
| Incentivized contribution framework | ❌ | No feedback loops or visibility for contributors outside narrow circles |
| Collaborative platform across roles (industry, academia, startups) | 🟡 | Limited to hackathons or project-specific alliances—no persistent home |

in AI: **kaggle**      🤗 **Hugging Face**

# Aqora's Vision: One Unified Platform for Quantum Progress

- Share and discover benchmark **datasets**, **solutions**, and **results**
- Reuse building blocks across the quantum software stack
- Submit to challenges and compare via transparent **leaderboards**
- Integrate with real hardware and simulators for fair evaluation
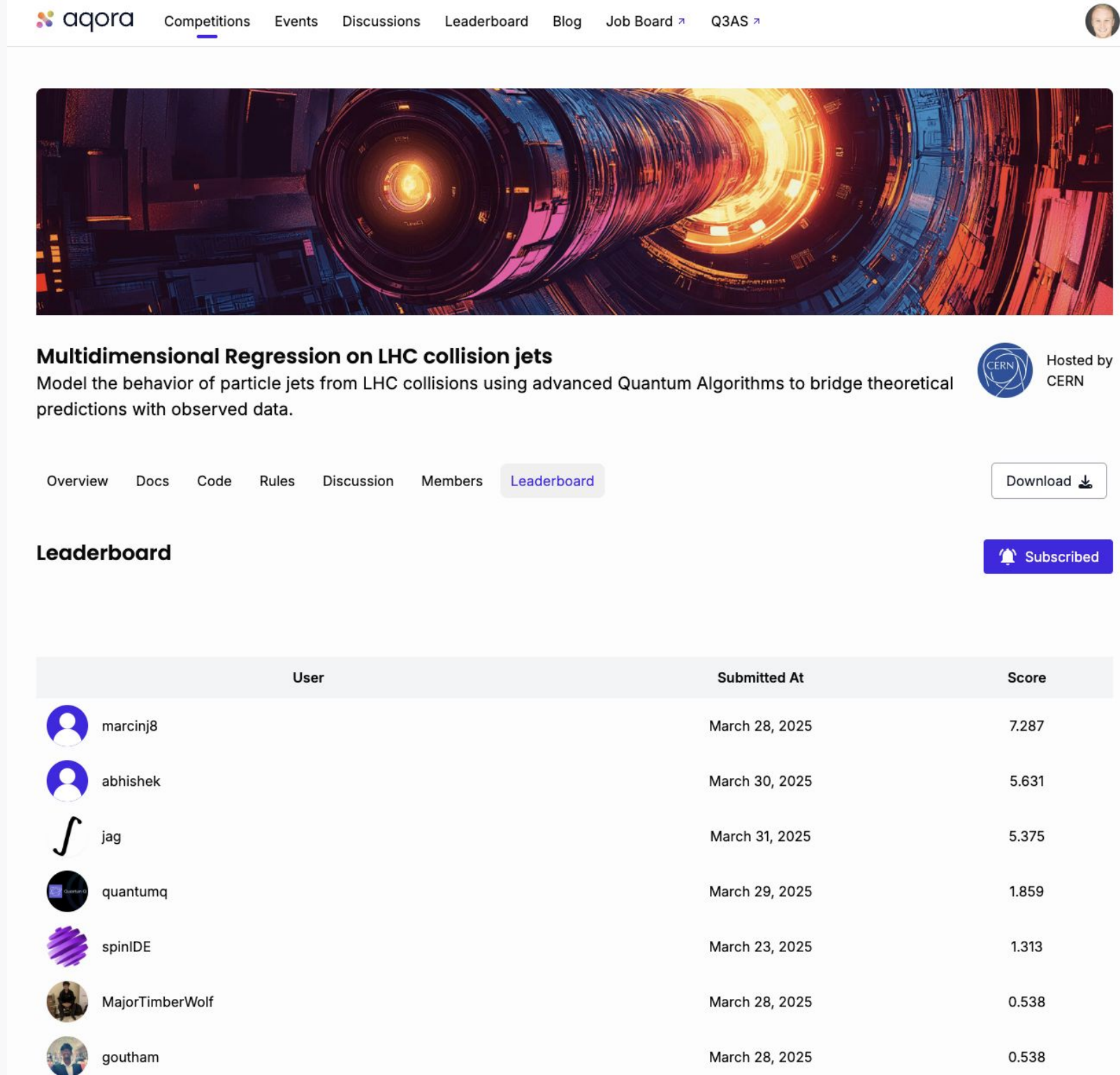- Foster a collaborative, reproducible, and competitive ecosystem



| 📊 | Hugging Face: Models, Datasets, and Spaces 🤗 |

| 🗄 Datasets | 🧊 Models | ⬛ Spaces |
|---|---|---|
| **Thousands of curated datasets for ML tasks** | **Pre-trained ML models** | **Built, host, and share ML apps in a single, organized workspace** |
| Saves time in data collection and pre-processing | Can be used to perform diverse ML tasks across including text, audio, and image | Thousands of ML-powered demo apps |
| Some include a dataset viewer for interacting with data | Supports dozens of libraries, including Transformers | Hosted with built-in Python frameworks (Streamlit or Gradio) or JS and HTML (static). |

Think: **kaggle** & 🤗 **Hugging Face** for Quantum

# How It Works – Aqora's Current Quantum Challenge Community Infrastructure

🛠️ Core capabilities:

- **Notebook templates** for structured submissions

- **CLI tools** for local testing and environment setup

- **Automated evaluation** against defined metrics

- **Version-controlled submissions**, including code and results for verification

🔁 Everything is transparent, timestamped, and leaderboard-tracked.

# Example Use Case Challenges on Aqora: Real-Life Applications of Quantum Solutions



`Finished` `Pharmacy`

**Clinical Trial Optimization**

Optimize clinical trials based on the Mayo Clinic dataset



`Finished` `Finance`

**QNNs for Stock Price Trend Prediction**

Develop quantum neural network models using PyTorch to predict stock price trends based on limit order book data.



`Finished` `High Energy Physics`

**Multidimensional Regression on LHC collision jets**

Model the behavior of particle jets from LHC collisions using advanced Quantum Algorithms to bridge theoretical predictions with observed data.

- engaging a global audience
- improving over existing results
- ongoing innovation cycle

**Challenge**
= **Benchmark** + Timeline + Prices
= **Dataset**(s) + **Metric**(s)

# Why Benchmarks Matter: From IMAGNET to Nobel Prize in Chemistry in AI

- **ImageNet (2009–2012)**
  → Public leaderboard + dataset sparked the deep learning boom (e.g., AlexNet)
  → Benchmarks created a flywheel of iteration and innovation

- **CASP → AlphaFold → Nobel-level impact**
  → Decades-long protein folding benchmark (CASP)
  → DeepMind used it to train & validate AlphaFold
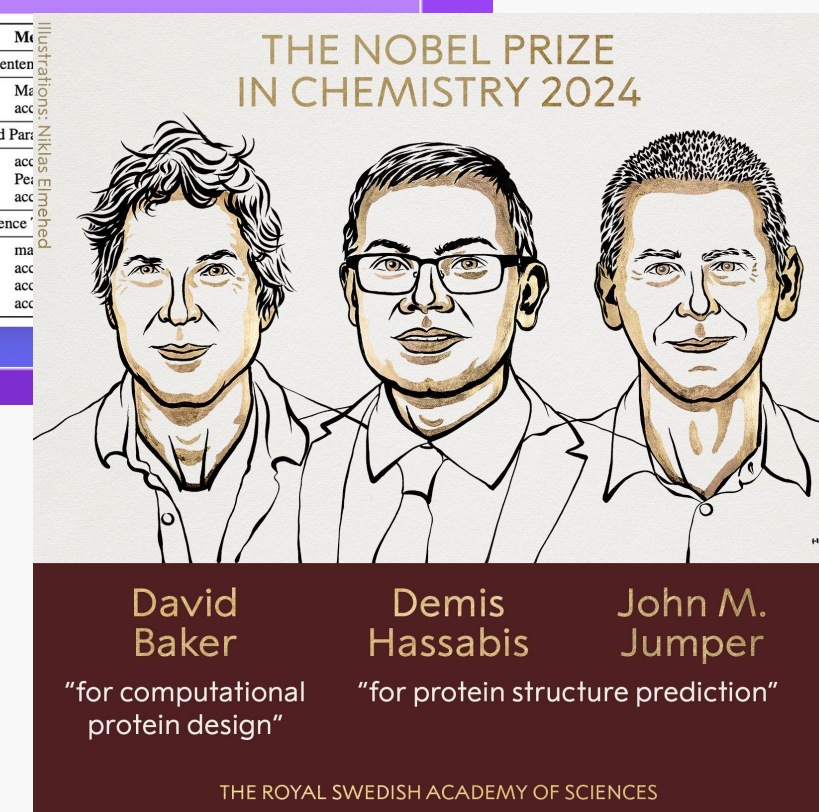  → Enabled breakthroughs recognized by the 2024 Chemistry Nobel Prize

- **Quantum is still pre-ImageNet**
  → First shared tasks, first standard datasets, little reproducibility
  → Progress is hard to measure, talent hard to surface

🔄 **Benchmarks don't just track progress — they accelerate it.**



GLUE Tasks

| Corpus | |Train| | |Test| | Task | Me |
|---|---|---|---|---|
| | | | Single-Senten | |
| CoLA | 8.5k | 1k | acceptability | Ma |
| SST-2 | 67k | 1.8k | sentiment | acc |
| | | | Similarity and Par | |
| MRPC | 3.7k | 1.7k | paraphrase | acc |
| STS-B | 7k | 1.4k | sentence similarity | Pea |
| QQP | 364k | 391k | paraphrase | acc |
| | | | Inference | |
| MNLI | 393k | 20k | NLI | ma |
| QNLI | 105k | 5.4k | QA/NLI | acc |
| RTE | 2.5k | 3k | NLI | acc |
| WNLI | 634 | 146 | coreference/NLI | acc |

THE NOBEL PRIZE IN CHEMISTRY 2024

David Baker — "for computational protein design"
Demis Hassabis — John M. Jumper — "for protein structure prediction"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

# Aqora: One Community Platform for all Stakeholders

👩‍🔬 **Researchers**
Standardized datasets, reproducible leaderboards, and runtime integrations (soon) to benchmark quantum algorithms across SDKs and hardware.

🏭 **Industry & Hardware Vendors**
Trusted benchmarks to evaluate algorithms, vendors, and internal progress grounded in real datasets.
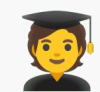
🧑‍🎓 **Students & Talent**
Real-world challenges to build reputation, earn badges, and get noticed. Kaggle-style for quantum.

🔧 **SDK & Tool Developers**
Expose tools to users, compare performance transparently, and integrate into real-world workflows.

# We are Here to Support Your Benchmarking Efforts

📂 **Share Your Datasets**

Make your data reusable with versioning, metadata, and built-in previews.
 → *Turn your research into a benchmark others can build on.*

🧪 **Co-Define Benchmarks**

Help shape transparent, domain-specific benchmark standards.
 → *From siloed efforts to shared evaluation protocols.*

🗣️ **Share Your Needs**

Tell us what infrastructure or support would help your benchmarking workflow.
 → *We're building the tooling so you don't have to.*

⚙️ **Automate Evaluations**

Run comparisons at scale—on simulators or real hardware—with minimal setup.
 → *No more hacked-together scripts and PDFs.*

# Let's Build the Quantum Benchmarking Layer Together

## 🧩 What Aqora offers

- Host your **benchmarks** and **datasets**
- Built-in **leaderboards** and **runtime validation**
- Transparent, reproducible **evaluation** tools

## 🤝 Join us

- Researchers: Turn your work into reusable benchmarks
- Labs & toolmakers: Compare results across SDKs & hardware
- Industry: Evaluate hardware, SDKs, and algorithms on your use case

**Let's do for quantum what Kaggle and Hugging Face did for AI.**

Think: **kaggle** & 🤗 **Hugging Face** for Quantum

## Thank You

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