



The Quantum-Ready Handbook

Get more out of your GPUs today while preparing for tomorrow's quantum advantage – a Practical Guide to quantum-inspired engineering workflows

Featuring examples and workflows built on BQPhy[®] QuantumNOW[™]

Table of Contents

Chapter 01	
The "Classical Ceiling"	01
Chapter 02	
Quantum-Inspired vs. Pure Quantum	02
Chapter 03	
The 3 Pillars of Speed	04
Chapter 04	
Sector Proof Points	06
Chapter 05	
The "Quantum-Ready" Checklist	07
Conclusion and Next Steps	
Don't Wait for the Future. Build It	08
Results and Scientific Literature	
Not Convinced yet ?	09

Why wait for Quantum Computing Hardware?

Traditional simulation algorithms, often developed decades ago, may not be optimized for current-generation HPC and GPU architectures.

BQP's quantum-powered simulation and digital twin platform, BQPhy®, includes two solvers: QuantumNOW™ and QuantumMAX™ (R&D). Together, they help engineering teams extract significantly greater performance from existing classical HPC infrastructure.

Available today, the QuantumNOW™ solver improves GPU utilization and computational efficiency—without requiring quantum hardware.

Achieve 10x–100x* speedups on existing infrastructure today, while positioning simulation and digital engineering workflows for exponential acceleration as quantum hardware matures.



Traditional simulation algorithms, often developed decades ago, may not be optimized for the intricate challenges of modern engineering.

The Bottleneck

Legacy solvers assume a different compute architecture. Never designed for solving present day, complex engineering problems

The Result

- Adding more hardware yields diminishing returns.
- Optimizing the engine around an algorithm designed decades ago.
- Simulation time, compute cost, and design precision all plateau together.

The Opportunity with QuantumNOW™

"QuantumNOW" means optimizing current algorithms in the simulation workflow and extracting more from existing hardware.

BQPhy®QuantumNOW™ harnesses quantum computing principles to unlock the full compute power of today's existing HPC infrastructure, giving you more output with the same resources.

DID YOU KNOW?

10x Faster Results on Current HPC

BQPhy® QuantumNOW™ delivers 10x faster simulation results compared to legacy methods – without new hardware.

Quantum-Inspired vs. Pure Quantum

A Quick Reality Check

- Quantum-inspired algorithms run on classical hardware (GPUs/CPU) today—no quantum processors or error correction required. In contrast, quantum-native approaches require specialized, scarce, and error-prone hardware.
- Quantum-native computing promises exponential speedups, but only when quantum hardware reaches sufficient maturity—likely 5–10+ years away
- Quantum-inspired algorithms integrate seamlessly into existing HPC workflows through MATLAB Toolboxes, Python, APIs, SDKs, Julia, and C++. They are drop-in compatible and deliver high-performance metaheuristic search acceleration, typically providing 10–100× speedups*.

Drive higher throughputs on GPUs and HPC infrastructure with QuantumNOW™

The Technology

BQP operates on two tracks:

Track	What It Means	Where It Runs
BQPhy QuantumNOW™	QuantumNOW™ combines optimization and Physics-AI to accelerate CFD-driven engineering.	Existing classical infrastructure
BQPhy QuantumMAX	Quantum Native Algorithms for solving large scale Partial Differential Equations(PDE) in CFD	Quantum Hardware

The QuantumNOW™ Optimization Solver brings quantum-inspired computational methods to existing GPU and HPC infrastructure, helping engineering teams solve complex, nonconvex optimization problems more efficiently while remaining fully compatible with today's computing environments without changing existing workflows.

The "NOW" Factor

BQP supercharges current HPC infrastructure with quantum-inspired solvers to accelerate complex system optimization, simulations and AI/ML optimization.

It enables companies to achieve 10x–1000x faster performance today without waiting for fault-tolerant quantum hardware

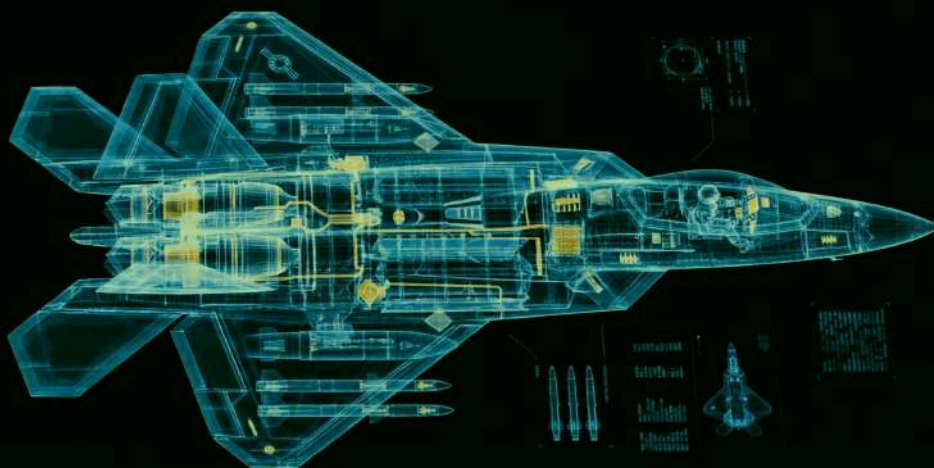
Access BQPhy® QuantumNOW™ from Your Stack

Use BQPhy® QuantumNOW right inside MATLAB, Python, or your own platforms and start running high-performance simulations with minimal setup.

- Toolbox for MATLAB: Call BQPhy® solvers directly from MATLAB with an auto-configured toolbox
- Python SDK: Plug BQPhy® into Python workflows using a native SDK for quick experiments and batch runs.
- BQPhy APIs (BQPhy®): Integrate BQPhy® via secure REST APIs with bearer tokens for reliable system-to-system access

[Access BQPhy® QuantumNOW](#)

The runway is NOW.



The 3 Pillars of Speed

BQPhy® QuantumNOW™ accelerates engineering workflows across three distinct dimensions. Each pillar addresses a specific bottleneck – and all three work together.

PILLAR 1 Faster Convergence

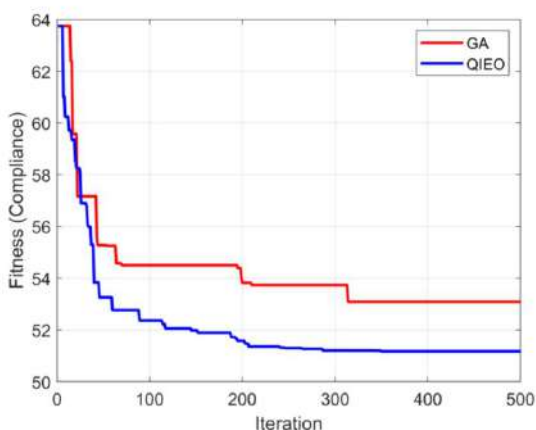
BQPhy®'s QuantumNOW™ Solver: Explained

At the core of the BQPhy® platform, the QuantumNOW™ solver combines population-based metaheuristic algorithms with quantum-inspired evolutionary techniques to accelerate optimization. By balancing global exploration and local exploitation, it efficiently navigates complex problem spaces and converges to high-quality solutions.

For engineering optimization, QuantumNOW™ solves complex nonconvex design, decision-making, and scheduling challenges across simulation-driven workflows. For AI applications, it replaces traditional optimizers such as ADAM with a quantum-inspired evolutionary approach, enabling better exploration of solution spaces, faster training, improved model accuracy, and more reliable convergence.

Application in the Real World:

- Airfoil Optimization: Up to 90% fewer iterations than a Genetic Algorithm (GA).
- Airline Gate Scheduling: Up to 3× faster convergence to a conflict-free schedule for 50 flights, 20 gates, and a 2-hour operating window.
- Structural Optimization: Up to 6% greater weight reduction than classical methods without compromising performance.



DID YOU KNOW?

4x

4x Faster Convergence

QIO reaches optimal solutions in one-fourth the iterations of classical genetic algorithms on non-convex, non-separable design problems.

PILLAR 2 Global Optimization

Technology Behind QuantumNOW™ Solver: Quantum-Inspired Optimization (QIO)

Classical optimization methods often find a good solution. QIO is designed to search more effectively for the best possible solution.

Instead of evaluating one design path at a time, QIO explores many potential solutions simultaneously using quantum-inspired search techniques. It continuously generates, evaluates, and refines candidate designs, balancing broad exploration with focused improvement until the optimization objectives are met.

This approach helps engineering teams identify higher-performing solutions across complex design spaces that are often difficult for traditional optimization methods to navigate.

Test Function	QIEO Iterations	GA Iterations	Improvement
Ackley	100	2,000	20x fewer
Rosenbrock	200	1,000	5x fewer
Rastrigin	100	200	2x fewer

PILLAR 3 Reduced Compute

Technology: Quantum-Inspired Solvers

The most expensive part of CFD and FEA isn't the physics – its the number of iterations, and time taken per iteration that slows the processing. This is where BQPhy® makes a massive difference.

BQP's quantum-inspired solvers accelerate these systems significantly compared to classical approaches.

10x

faster overall simulation results on current HPC

Up to 20x

speedup on complex iterative solver tasks

20%

parameter reduction with QA-PINN (less compute per training cycle)

Sector Proof Points



Aerospace & Defense

CFD acceleration • Flight path optimization • Turbomachinery flows

Use Case	Outcome
Flight path fuel savings	4% reduction (across 100 flights across Europe, ~USD 70,000 saved)
Emission reduction	6% decrease (220,000 kg CO ₂ , across 100 flights)
Flight time saved per route	6.5 hrs less (aggregate across 100 flights across Europe)
CFD linear system acceleration	Up to 20x faster



Automotive

Lightweighting • Aerodynamic optimization • Cost reduction

Use Case	Outcome
Control arm topology optimization	3.2x greater weight reduction
Compute resources used	8x less vs. classical
Racecar airfoil shape optimization	18% performance improvement
Racecar airfoil weight reduction for cost saving	40% reduction



Manufacturing & Logistics

Supply chain optimization • Combinatorial routing

Supply chain scheduling is a combinatorial explosion. Classical solvers approximate. They don't optimize.

- ◆ QuantumNOW™ Solver handle multi-variable logistics routing at scale
- ◆ 30% reduction in total shipping costs through optimized routing
- ◆ Timely delivery performance improved through cost-efficient scheduling

The "Quantum-Ready" Checklist

Three steps. No rip-and-replace. No new infrastructure. Deployment in less than 24 hours



Step - 1

Identify the Bottleneck

Ask the right diagnostic question first. Where is your engineering workflow losing time or money?

- Simulation time – CFD/FEA runs taking days instead of hours?
- Compute cost – HPC bills scaling faster than output quality?
- Design precision – settling for 'local best' instead of global optimum?

Your bottleneck determines the customization of BQP's QIO Algorithms



Step - 2

BQPhy® QuantumNOW™ integrates into your existing stack.

Ask the right diagnostic question first. Where is your engineering workflow losing time or money?

Integration Method	Details
MATLAB	Built-in BQPhy® package
Python	Native API integration
Deployment	Browser-based · Cloud · On-premise

No rearchitecting. No migration. No downtime.



Step - 3

Don't buy the outcome. Benchmark it.

BQP offers a commitment-free Proof of Concept (POC) – run BQPhy® QuantumNOW™ against your existing classical baseline on a real problem from your current workflow.

Ask the right diagnostic question first. Where is your engineering workflow losing time or money?

- Define your target problem (CFD, Optimization, Machine Learning)
- Run identical inputs through classical baseline and BQPhy®
- Compare: speed, solution quality, compute cost
- Decision backed by your own data

Don't Wait for the Future. Build It.

The classical ceiling is real. The hardware-scaling plateau is documented. The algorithms running your simulations were not designed for what you're asking them to do today.

Quantum-inspired solvers run on your current HPC. They integrate with your existing tools. And they have been benchmarked against real engineering problems.

How Quantum-Inspired Solvers Perform Compared to Classical Solvers

Metric	Result
<u>QA-PINN CFD Training</u>	25x faster (Reduces training parameters)
<u>Quantum CFD Circuit Compression</u>	100x compression
<u>QIO vs Genetic Algorithm</u>	4x better convergence
<u>Complex Mission Scheduling</u>	2-10x Faster
<u>Airfoil Weight reduction</u>	6% better reduction
<u>Hybrid Quantum Classical Finite Element Methods for structural Impact</u>	Better accuracy at scale (Error rate of 10^{-3})

Take the Next Steps

BQPhy QuantumNOW™ works the way you do. Use it in the cloud, inside MATLAB, with Python, or via secure enterprise APIs.

Schedule a Proof of Concept

See verified performance data across aerospace, automotive, and logistics applications.

Explore Results & Benchmarks

Not Convinced yet ?

Explore how BQPhy® QuantumNow™ solutions drive efficiency, reduce costs, and unlock new possibilities. [Download](#) our detailed case studies that cover our approach, methodology and results



Approach

How quantum-inspired solvers are applied



Methodology

Implementation on GPU/HPC clusters



Results

Measured speedups and accuracy gains

Our methodology is grounded in rigorous, peer-reviewed research. Download our IEEE papers on the links below



Scalability & Performance:

Investigates how QIO leverages GPU parallelization to solve complex, large-scale industrial problems.



Functional Benchmarking:

Provides mathematical proof that GPU-optimized QIO consistently outperforms traditional classical solvers in speed and accuracy.

Paper -1

[Investigation of Performance and Scalability of a Quantum-Inspired Evolutionary Optimizer \(QIEO\) on NVIDIA GPU](#)

Paper -2

[Benchmarking of GPU-optimized Quantum-Inspired Evolutionary Optimization Algorithm using Functional Analysis:](#)

Paper -3

[Design of magnetic lattices with a quantum-inspired evolutionary optimization algorithm](#)