OUR QUANTUM COMPUTING ROADMAP

WHITEPAPER FULL ROADMAP

Alice & Bob builds **Fault-Tolerant Quantum Computers** with **cat qubits**.
This is our path to achieving useful quantum computing **by the end of the decade.**

// MILESTONE 1

MASTER THE CAT QUBIT

First, we have created the **best single cat** qubit ever. Protected from bit-flips.

1 Herd the Cats

Consistently **create reliable cat qubits**, improving innovation speed with our DeepTech Motion cycle.

2 Achieve Record Bit-Flip Protection

Extend our cats' **bit-flip lifetime**. Our latest processor achieved the world record of **7 minutes**.

3 Run Cat Qubit Operations

Develop cat qubits operations: **state preparations**, bit and phase **measurements**, and the **Z gate**.

BOSON 4

2024 COMPLETE

Cat Qubits	1
Logical Qubits	0

// MILESTONE 2

BUILD A LOGICAL QUBIT

We are building an **error-corrected logical qubit** using the repetition code to correct phase flips.

1 Mirror the Phase

Develop the **bias-preserving CNOT.** This two-qubit gate mirrors the phase of one cat to another.

2 Count the Flips

Design a **strong X measure**, to determine if and where a phase-flip has occurred, then correct it.

3 Link the Qubits

Connect each cat to two neighbors, **(degree-2 connectivity)** forming a line to run the repetition code.

HELIUM

WE ARE HERE

Cat Qubits	12-18
Logical Qubits	1
Clock Speed (μs)	1.5
Logical Error Rate	10^{-2}

// MILESTONE 3

FAULT-TOLERANT QUANTUM COMPUTING

Our computers will perform **error-corrected operations**, between **error-corrected qubits**.

1 Connect Logical Qubits

Connect logical qubits, form a **degree-3 hexagonal network**, where each cat has three neighbors.

2 Double the Density

Leverage **3D fabrication techniques** like flip-chip technology to put more qubits on each processor.

3 Run a First Logical Gate

Develop the **logical CNOT gate** for error correction to run on multi-logical-qubit processors.

LITHIUM

Cat Qubits	48
Logical Qubits	4
Clock Speed (μs)	0.8
Logical Error Rate	10^{-3}

// MILESTONE 4

UNIVERSAL QUANTUM COMPUTING

We will develop all fundamental operations required for our computers to **run any algorithm**.

1 Create Magic States

Develop **magic state factories** to run logical **Toffoli gates** and complete our universal gate set.

2 Correct Errors, Live

Introduce a **fast 'live decoder'** so that errors are corrected **during algorithm execution**.

3 Build the Quantum Firmware

Manage the **vast number of instructions** on larger processors introducing the firmware layer.

BERYLLIUM

Cat Qubits	250
Logical Qubits	5
Clock Speed (μs)	0.8
Logical Error Rate	10^{-4}

// MILESTONE 5

USEFUL QUANTUM COMPUTING

We will scale our computers to the size needed to **solve meaningful problems** for society.

2030
START OF THE QUANTUM ERA

1 Top-up Hardware Efficiency

Reach the **mathematical limits of hardware efficiency**, with **LDPC** error correction codes.

2 Switch Qubits

Develop tunable couplers, switches, to selectively control which qubits interact with each other.

3 Improve Enabling Technologies

Optimize the quantum computers' **hardware**, reducing **footprint**, **energy** use and **complexity**.

GRAPHENE

BY **2030**

Cat Qubits	2000
Logical Qubits	100
Clock Speed (μs)	1
Logical Error Rate	10^{-6}

ALICE & BOB