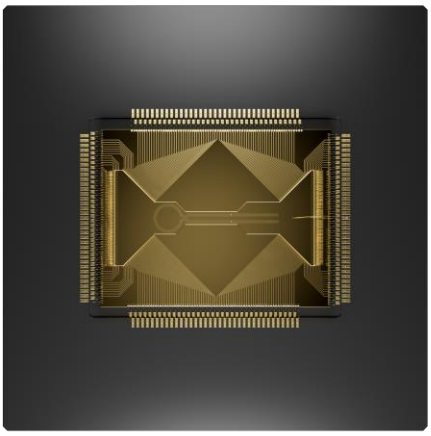
QUANTINUUM



Quantinuum Helios Product Data Sheet

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- TABLE OF CONTENTS

INTRODUCTION 3

FEATURES 3

SPECIFICATIONS 3

SYSTEM OPERATION 4

INTRODUCTION

This Product Data Sheet covers all features and characteristics of **Quantinuum Helios.**

FEATURES

- N ≥ 98 $^{137}Ba^{+}$ qubit trapped-ion based quantum computers
- All-to-all connectivity
- Laser based quantum gates
- Quantum charge-coupled device (QCCD) architecture with eight gate zones in a trap consisting of a single circular storage ring and two linear gating sections
- Eight gate zones for parallel single quibit operations and four parallel gate zones for two qubit operations
- Ultra-low crosstalk with mid-circuit measurement conditioned circuit branching
- Qubit reuse after mid-circuit measurement
- Native gate set: single-qubit rotations, two-qubit ZZ gates, arbitrary-angle ZZ gates
- Long T2 coherence times (~seconds)
- Real-time conditional logic execution
- Junction transport and random qubit access
- Capable of performing real-time error correction

SPECIFICATIONS

Table 1 lists the specifications for Quantinuum Helios quantum computers. Machine-specific data can be found in the Quantinuum Hardware Specifications repository.

Table 1 Quantinuum Helios Specifications

System Fundamentals		
Parameters	**typ**	**max**
General		
Qubits	98	
Connectivity	All-to-all	
Parallel two-qubit operations	4	
Errors		
Single-qubit gate infidelity	3×10^{-5}	20×10^{-4}
Two-qubit gate infidelity	8×10^{-4}	20×10^{-4}
State preparation and measurement (SPAM) error	3×10^{-4}	20×10^{-4}
Memory error per qubit at average depth-1 circuit	5×10^{-4}	10×10^{-4}
Mid-circuit measurement cross-talk error	5×10^{-4}	20×10^{-4}

SYSTEM OPERATION

Quantinuum Helios operates on qubits implemented through atomic hyperfine states of $^{137}Ba^{+}$. Helios has 98 physical qubits (ions) that move, individually or in pairs, between eight interaction zones where all quantum operations (initialization, measurement, single-, and two-qubit gates) are performed using lasers. By rearranging the physical location of the qubits, a two-qubit gate can be performed on any arbitrary pair, giving the system all-to-all connectivity. Additionally, because there are multiple interaction zones, multiple quantum operations may be performed in parallel.

Although the qubits are all identical, there may be differences in the errors associated with quantum operations depending on the location, i.e., interaction zone, in which the quantum operations take place, independent of the specific qubits that are in that location. However, the location for each quantum operation is determined by the compiler and may vary even for similar circuits, as each circuit is optimized to minimize the number of transport operations and the time required to run the circuit. The typical infidelities reported on this product data sheet are an average over all operational zones, with the minimum and maximum spanning both the difference between zones and the day-to-day variation.

More details as well as a user guide can be found at: Quantinuum documentation.