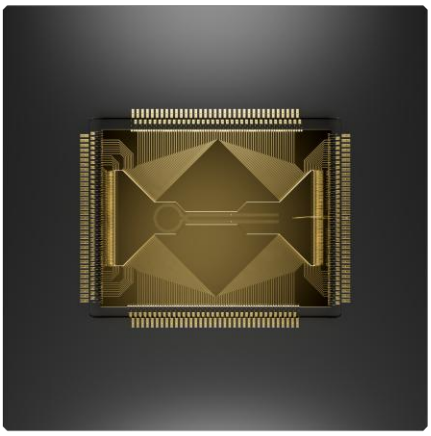
QUANTINUUM



Quantinuum Helios Product Data Sheet

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- TABLE OF CONTENTS

INTRODUCTION 3

FEATURES 3

SPECIFICATIONS 3

SYSTEM OPERATION 4

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INTRODUCTION

This Product Data Sheet covers all features and characteristics of **Quantinuum Helios, Powered by Honeywell.**

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 state preparation & measurement (SPAM) 1-qubit operations and four gate zones for 2-qubit operations
Ultra-low crosstalk with mid-circuit measurement conditioned circuit branching
Qubit reuse after mid-circuit measurement
Native gate set: 1-qubit rotations, 2-qubit ZZ gates, parameterized-angle ZZ gates
Long T2 coherence times (~seconds)
Real-time integer and floating point arithmetic
Real-time boolean logic
Real-time arbitrary control flow
Junction transport and random qubit access
Capable of performing real-time error correction

SPECIFICATIONS

Table 1 lists the specifications for Quantinuum Helios. Machine-specific data can be found on the Performance Validation document and Quantinuum Hardware Specifications repository. The "*Typical*" column specifies the most representative infidelities during machine operation. The "*Max*" column specifies an upper bound on infidelities during machine operation. It is unlikely the infidelity during machine operation will be higher than the specified Max infidelity.

Table 1 Quantinuum Helios Specifications

System Fundamentals		
Parameters	**Typical**	**Max**
General		
Qubits	98	
Connectivity	All-to-all	
Two qubit quantum logic zones	4	
Errors		

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1-qubit gate infidelity	0.3×10^{-4}	2×10^{-4}
2-qubit gate infidelity	8×10^{-4}	20×10^{-4}
State preparation and measurement (SPAM) error	5×10^{-4}	20×10^{-4}
Memory error per qubit at average depth-1 circuit	6×10^{-4}	10×10^{-4}
Mid-circuit measurement cross-talk error[1]	0.5×10^{-4}	7×10^{-4}

1. Mid-circuit Measurement cross-talk error is a global representation across the Helios trap.

• SYSTEM OPERATION

Quantinuum Helios, Powered by Honeywell, 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, 1-qubit and 2-qubit gates) are performed using lasers. By rearranging the physical location of the qubits, a 2-qubit gate can be performed on any arbitrary pair, giving the system all-to-all connectivity.

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.

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

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