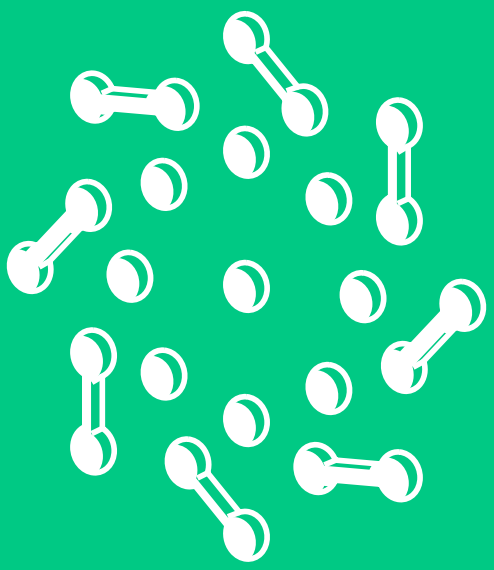
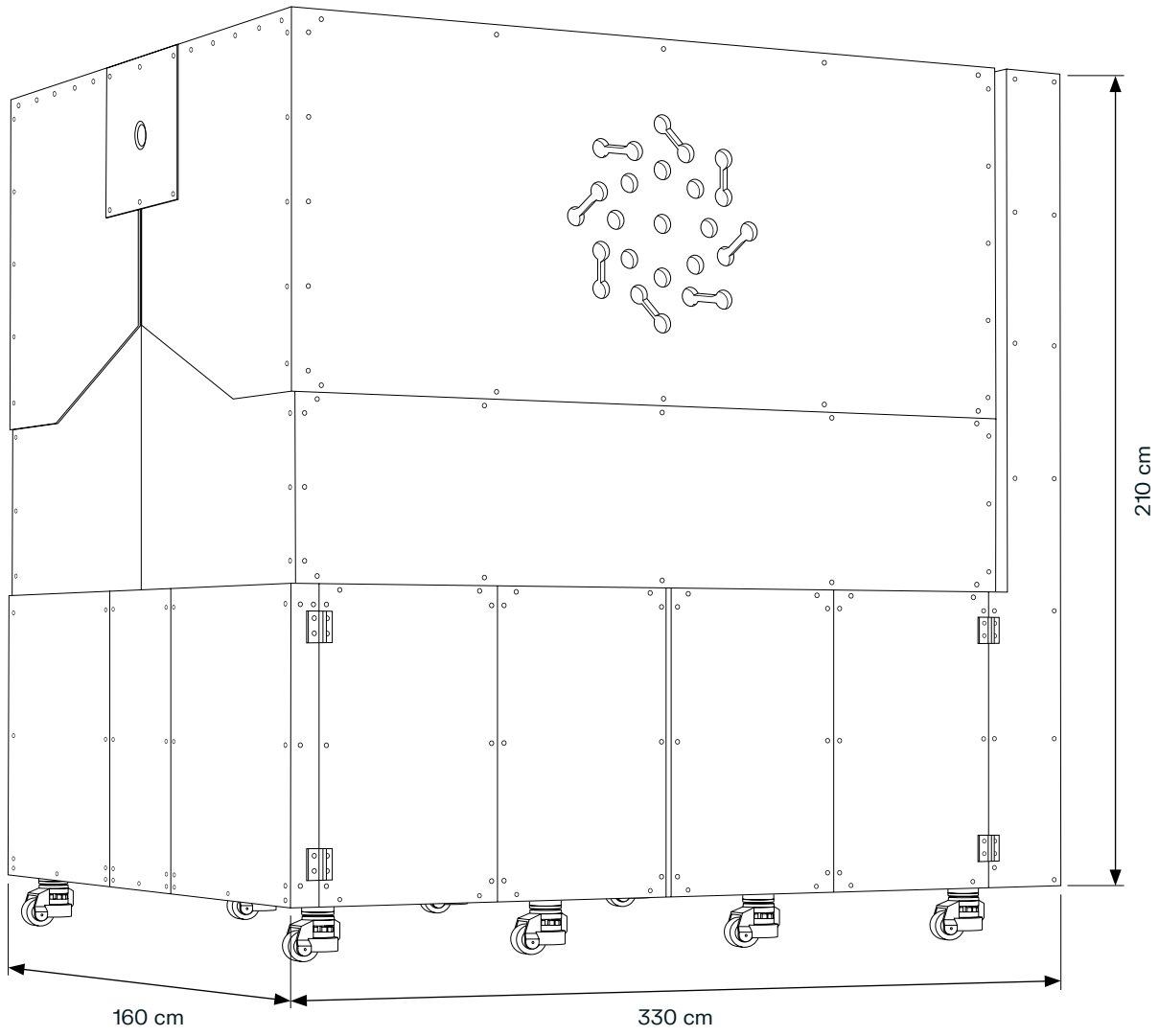
Pasqal

Technical Overview for Advanced Users Orion Beta

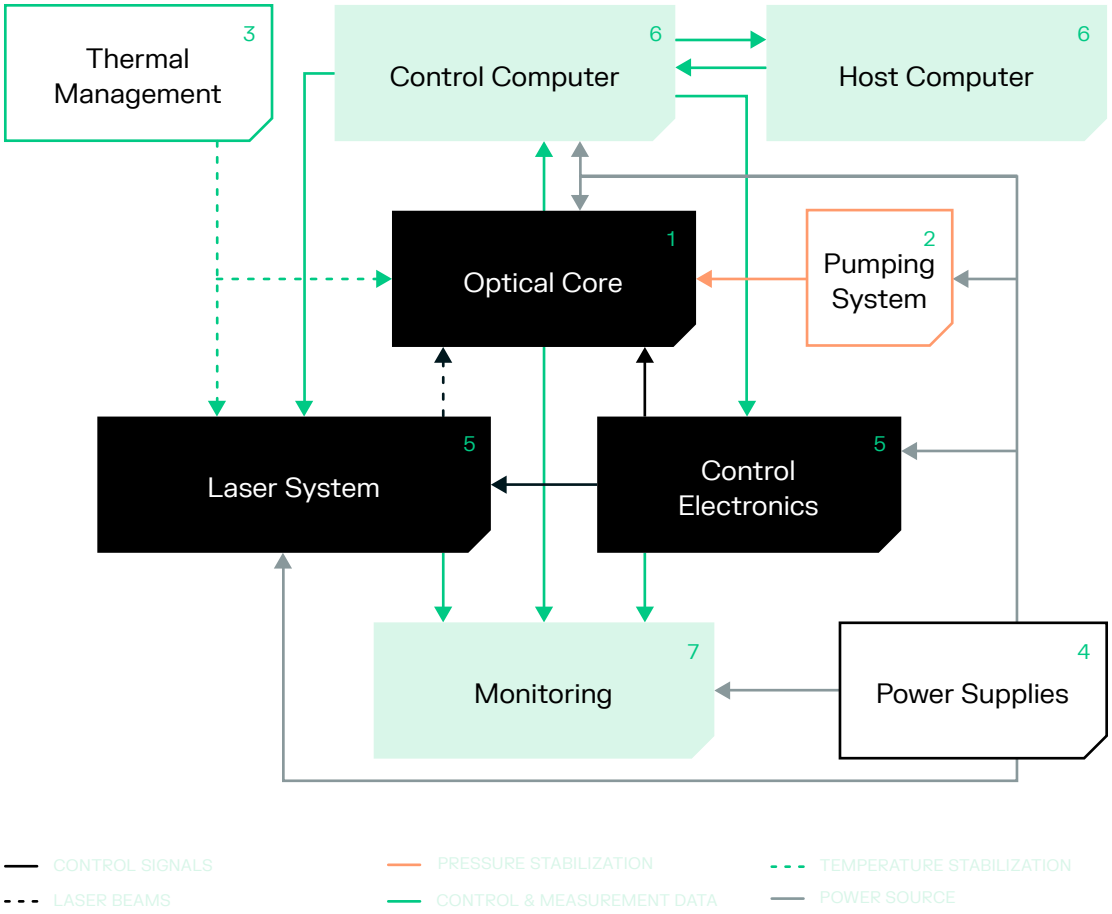


Specifications of Orion Beta, Pasqal's current Quantum Processing Unit (QPU), powered by neutral-atoms technology.

Orion Beta



100	10kW	5	Analog
qubits	Power consumption	Modules	operation



It encompasses the following main building blocks:

1. The “Optical core” system traps and manipulates atomic qubits as quantum registers for processing tasks.
2. The “Pumping system” ensures the ultra-low vacuum level for proper operation of the QPU.
3. The “Thermal Management” system ensures fine thermal management of all the QPU sub-systems.
4. The “Power supplies” system provides power to all the sub-systems.
5. The “Laser System” and “Control Electronics” enable atomic qubit control, including all necessary laser sources, optical benches, and electronics for configuring, manipulating, and reading the quantum register.
6. The “Control computer” manages all operations of the quantum computer and interfaces with the “Host computer,” receiving instructions and sending results.
7. The “Monitoring” system, composed of a broad range of sensors, is used to check the overall sanity of all the sub-systems and to follow the QPU status.

Overview of the technology

The elementary data elements of Pasqal's Quantum Processing Units (QPUs) — quantum bits or qubits — are laser-cooled Rubidium atoms, individually trapped by tightly focused laser beams, called optical tweezers.

The qubits are encoded in the atoms' electronic states by laser beams and then manipulated using lasers.

The interaction of qubits with light enables access to the finest physical parameters, making our quantum processor a unique tool for creating and controlling complex quantum systems.

General

Maximum number of qubits	100
Minimum Effective Computation Repetition Rate Only counting successful computations	0.25 Hz The actual ECRR depends on the number of qubits
Operation Mode	Analog

Atom arrangement

Layout on demand	✓
Minimum atomic distance	5 µm
Maximum radial distance	35 µm
Maximum layout filling fraction:	0.5
Minimum number of traps	10
Maximum number of traps	200

Pulse Sequences

Maximum number of runs per job	500
Maximum sequence duration	6000 ns
Minimum pulse duration	16 ns
Maximum Rabi frequency	2 MHz
Maximum detuning	7.75 MHz

Physical dimensions

Total Dimensions Height x Width x Depth	210 × 330 × 160 cm
Number of modules	5
Dimensions of Hosting Room Height x Width x Depth	270 × 530 × 310 cm
System Weight	2500 kg — 350 kg/m2 on a vibration-isolated floor
Laser Type	Class IV + Laser safety interlock

Environment specifications

Peak power consumption	10 kW
Power supply	1× three-phased line 380V, 2P+N+E 32A
Interfaces (operations / maintenance)	2× ethernet port (RJ45)
Operating Temperature	20-22°C
Ambient air humidity	60% ± 20%
Vibration Isolation	✓
Hydraulic circuit	1× inlet and 1× outlet port Water temperature: 20 — 23°C

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