Smart-charging & neutral atom QPUs

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Pasqal at a glance

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40+

Clients & Partners

2 QPUs sold via HPCQS framework, activities in 1° countries, and engagements with top cloud distributors.

55+

Patents & Applications

800+ publications

→ 10k

Qubits for 2026-2027

Single shot 1100+ atoms in 2024

260+

Employees

70+PhD
18 nationalities

40

Years

History in quantum technologies

Full-Stack

Quantum HW & SW

Quantum advantage in 2025

Neutral Atom QPUs

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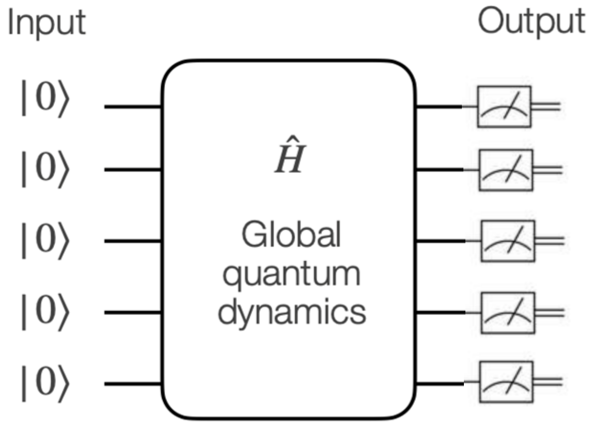
Analog Control

Programming a Hamiltonian sequence

Parameters can be tuned continuously. The Hamiltonian faithfully describes the dynamics of a physical quantum system.



Pros

Naturally implemented in our platform: shine a Rydberg laser on atoms not too far away & *voilà*

Intrinsic high-fidelity

Fast: $\sim 1 \mu s$!

Cons

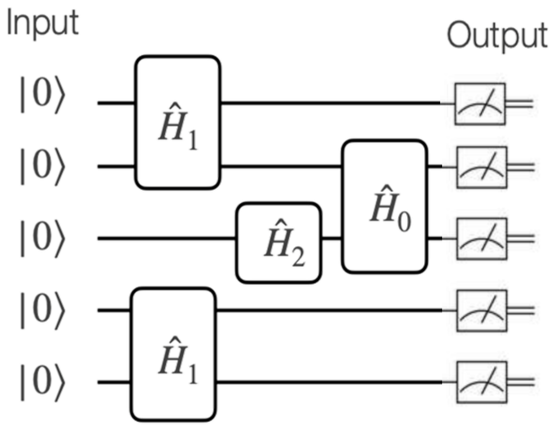
Restrained: cannot do whatever calculation we want

Potentially harder to scale

Gate-based Control

Programming a quantum circuit with digital quantum gates

Elementary operations are discrete digital quantum gates, that can act either on individual qubits, or on several qubits at the same time.



Pros

This is how a classical computer works

Clear path to perform quantum error correction

Cons

Far Far Away

More active control of what happens: **requires exquisite control**

Quantum computing with Rydberg atoms

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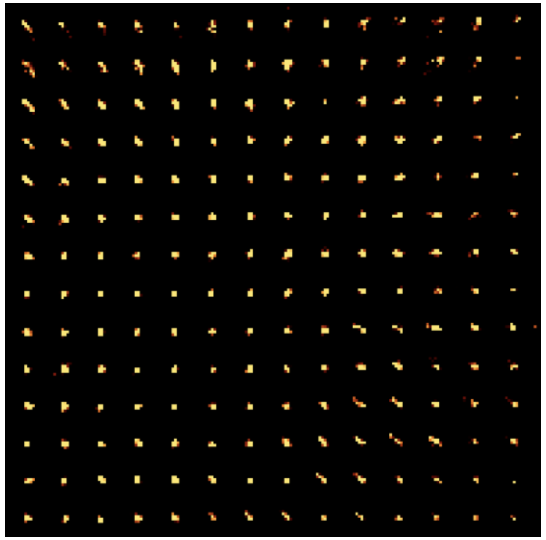
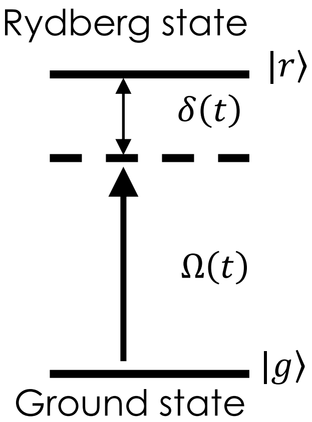
Laser controlled particles + Many body interactions = Quantum dynamics

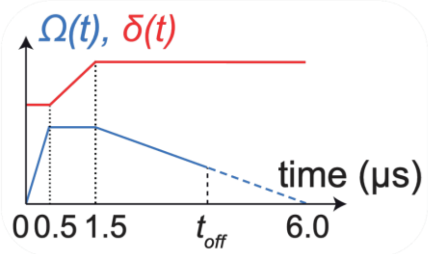


$|\psi(t=0)\rangle = |g \dots g\rangle$

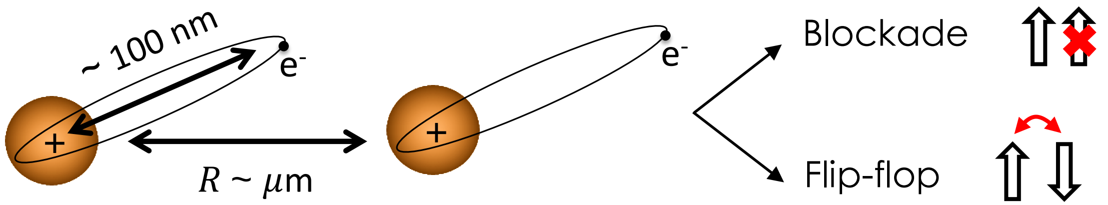
Laser addressed transitions

$$H = H_{\Omega,\delta}(t) + H_{dd}(\boldsymbol{r})$$

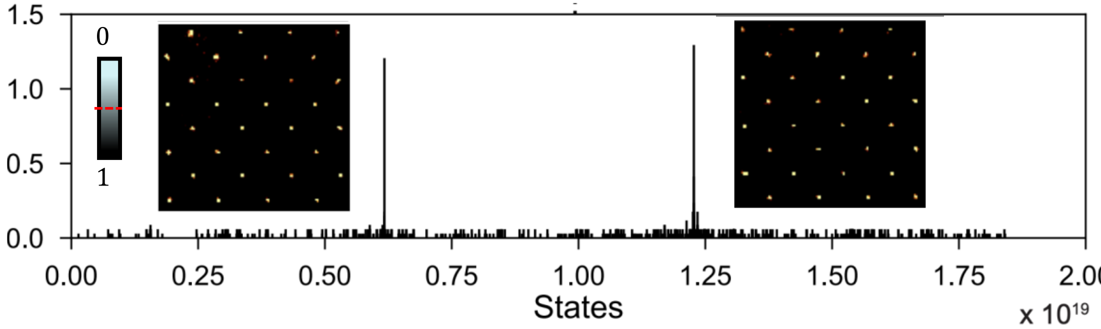




Dipole-dipole interactions



$|\psi(t=T)\rangle$



Scheduling to MIS problem

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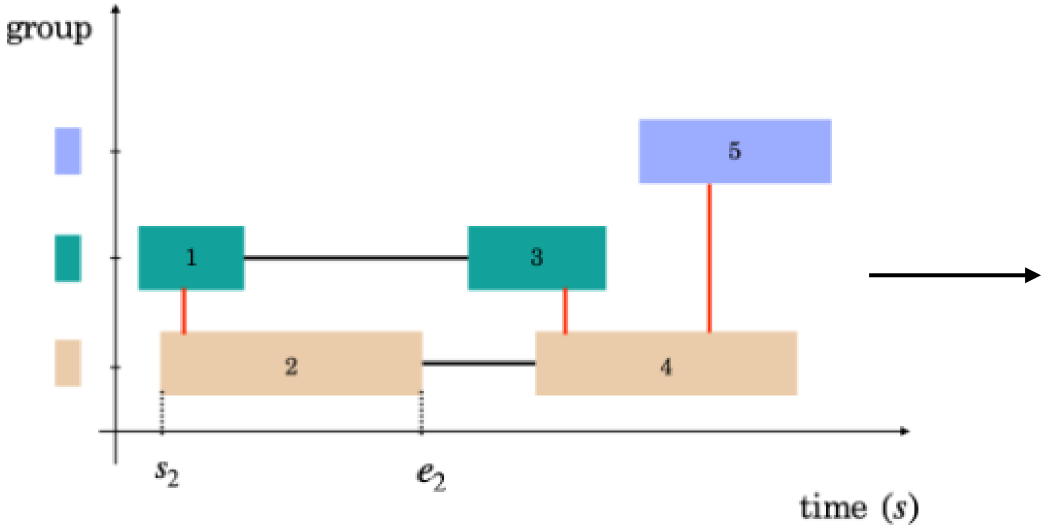
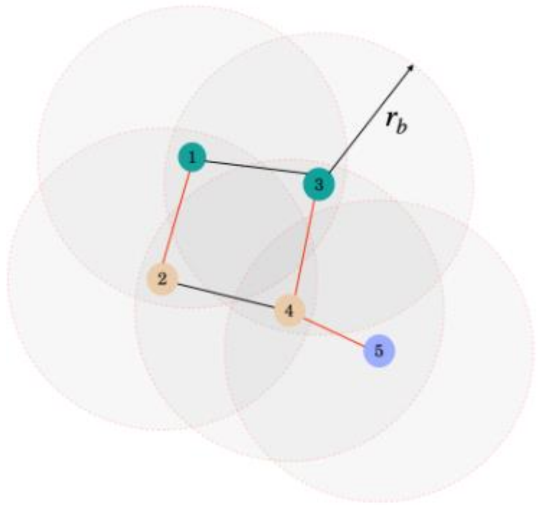
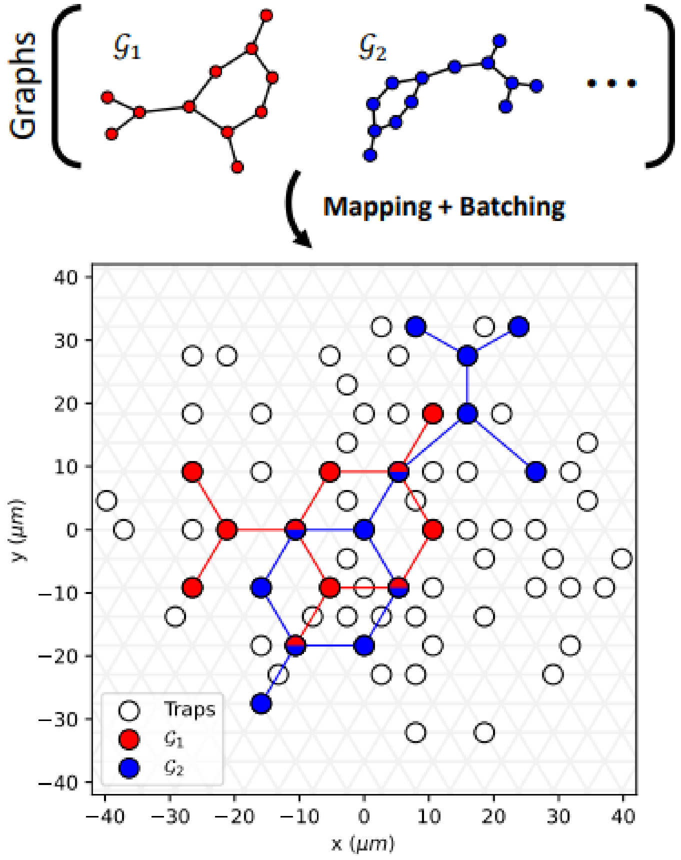
Optimal scheduling of load time intervals within groups [1]

We are given a set of load tasks represented by **intervals**, each of them belonging to a **group** (fleet, operator, etc.)
We aim to select a subset of these loads such that:

1. At most one load in each group is selected for completion *[no group is over-represented]*
2. The number of non-overlapping tasks is maximized *[minimizing completion time]*







[1] Dalyac *et al. EPJ Quantum Technology* 8.1 (2021): 12.

Hardware results

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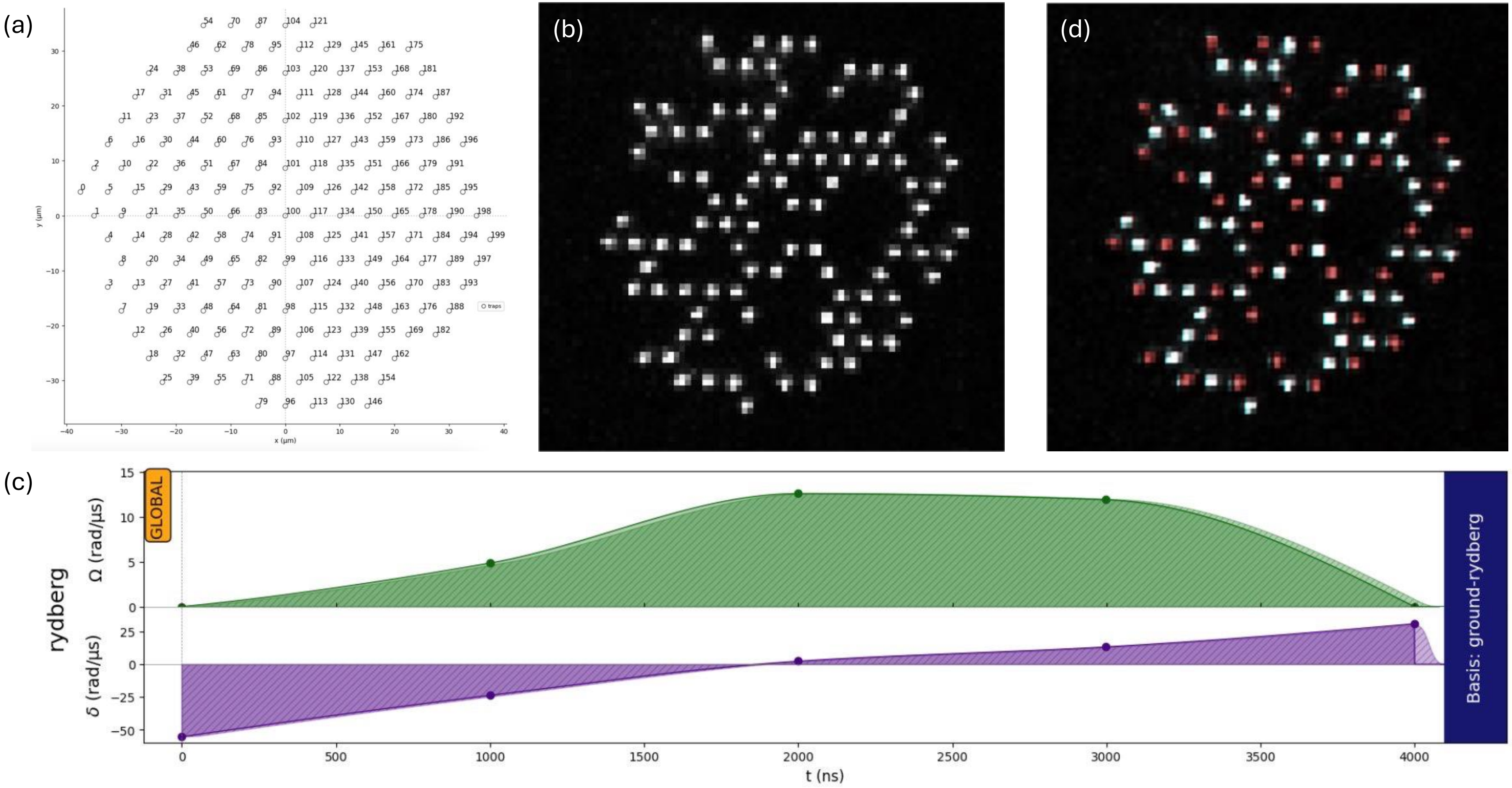

Conclusion

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- Two stylized problems have been investigated from the field of smart-charging of electric vehicles in this collaboration between EDF and Pasqal
- Quantum hardware-efficient implementations have been proposed, investigated and implemented on a real world EV charging dataset (of 2250 instances).
- Quantum algorithms obtain high approximation ratio coherently.
- Hardware implementation confirm predicted precision rates through simulations.
- More efficient hybrid (quantum-classical) approaches are in line for testing which promise an actual performance gain as compared to best-in-class classical approximative methods.
- Distributed QC can be leveraged to encode a new range of hybrid architectures.

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