

Building quantum systems atom-by-atom

Hannes Bernien

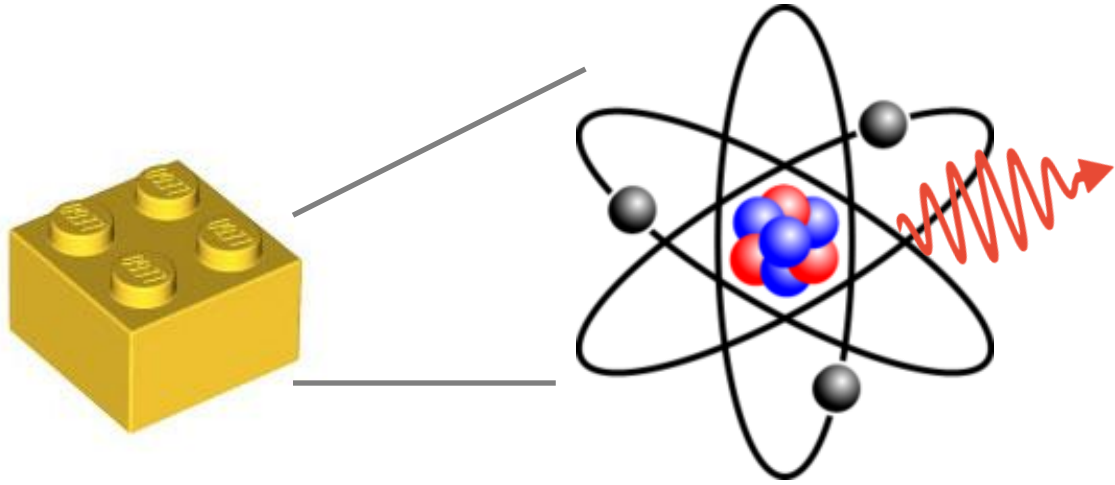
University of Innsbruck/IQOQI

Previous University of Chicago

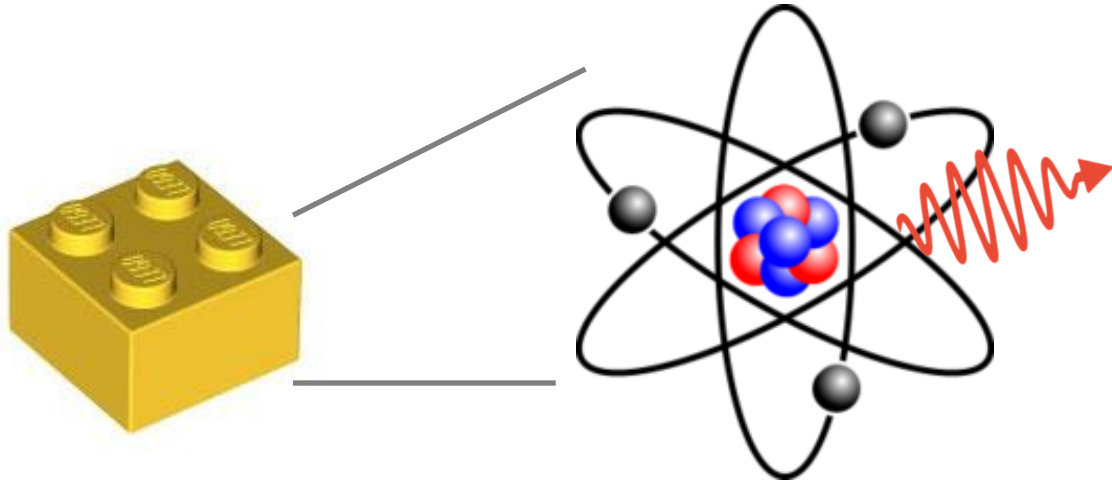
The atom as the perfect building block for quantum systems



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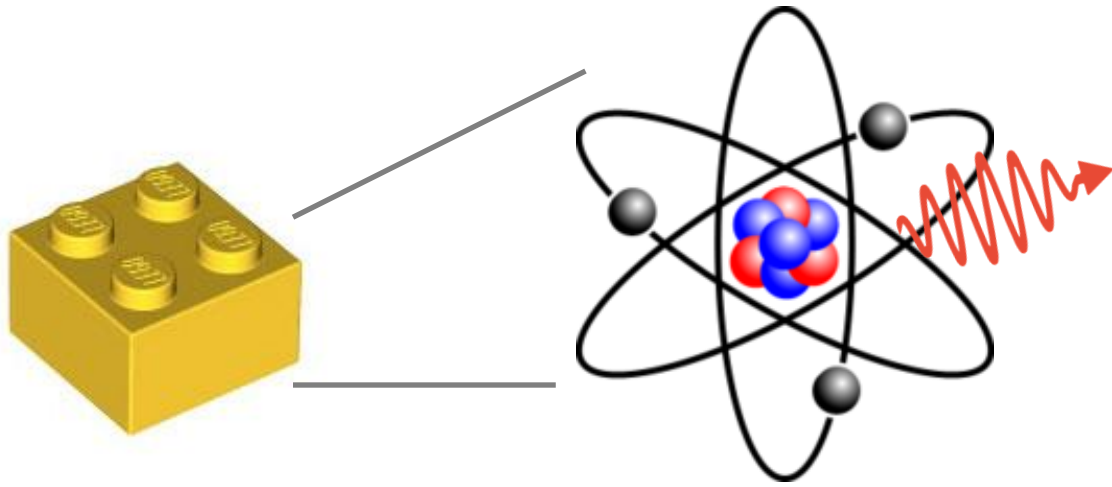


The atom as the perfect building block for quantum systems



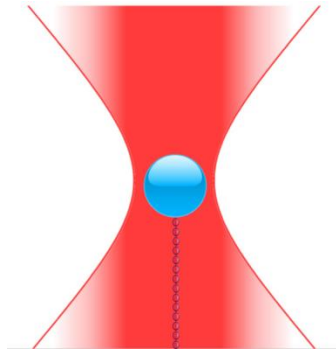
- Long coherence times
- Well developed toolbox: manipulation, detection, interactions
- Indistinguishable
- Efficient photonic interfaces

The atom as the perfect building block for quantum systems



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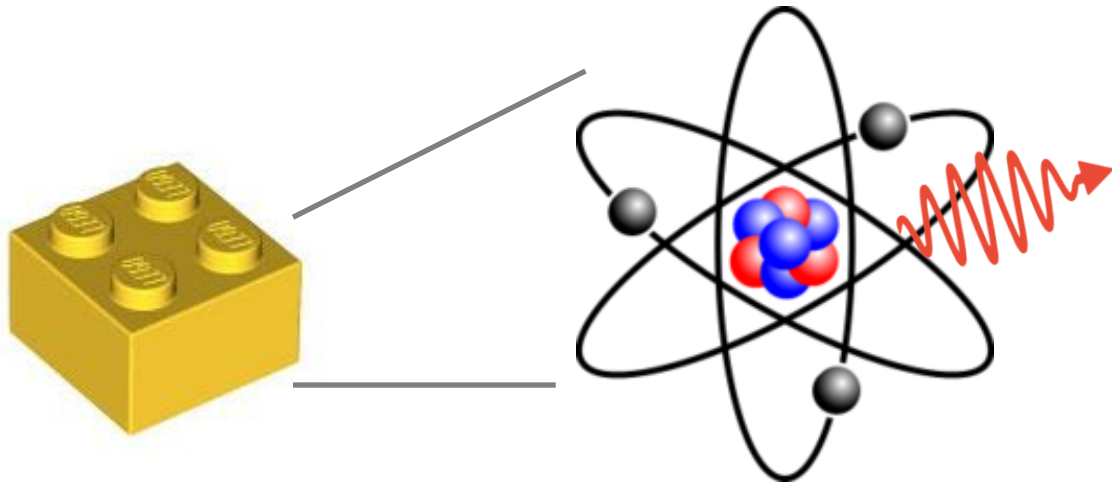
How to catch a single atom?



Arthur Ashkin

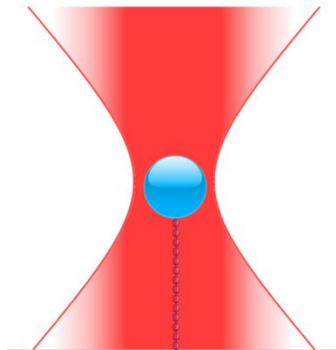


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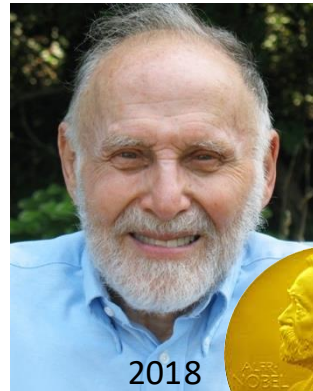


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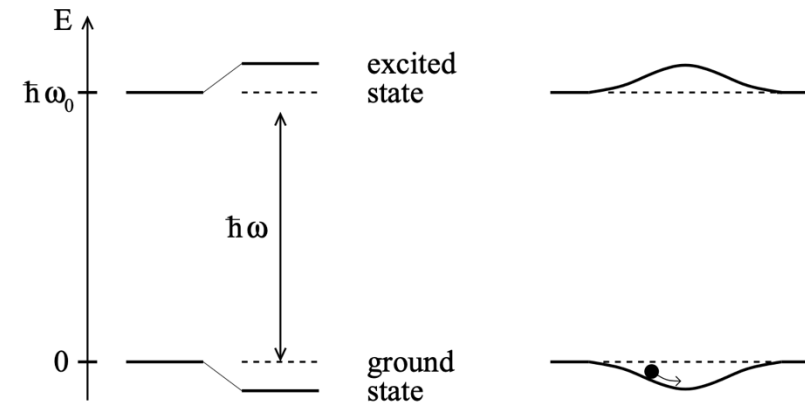
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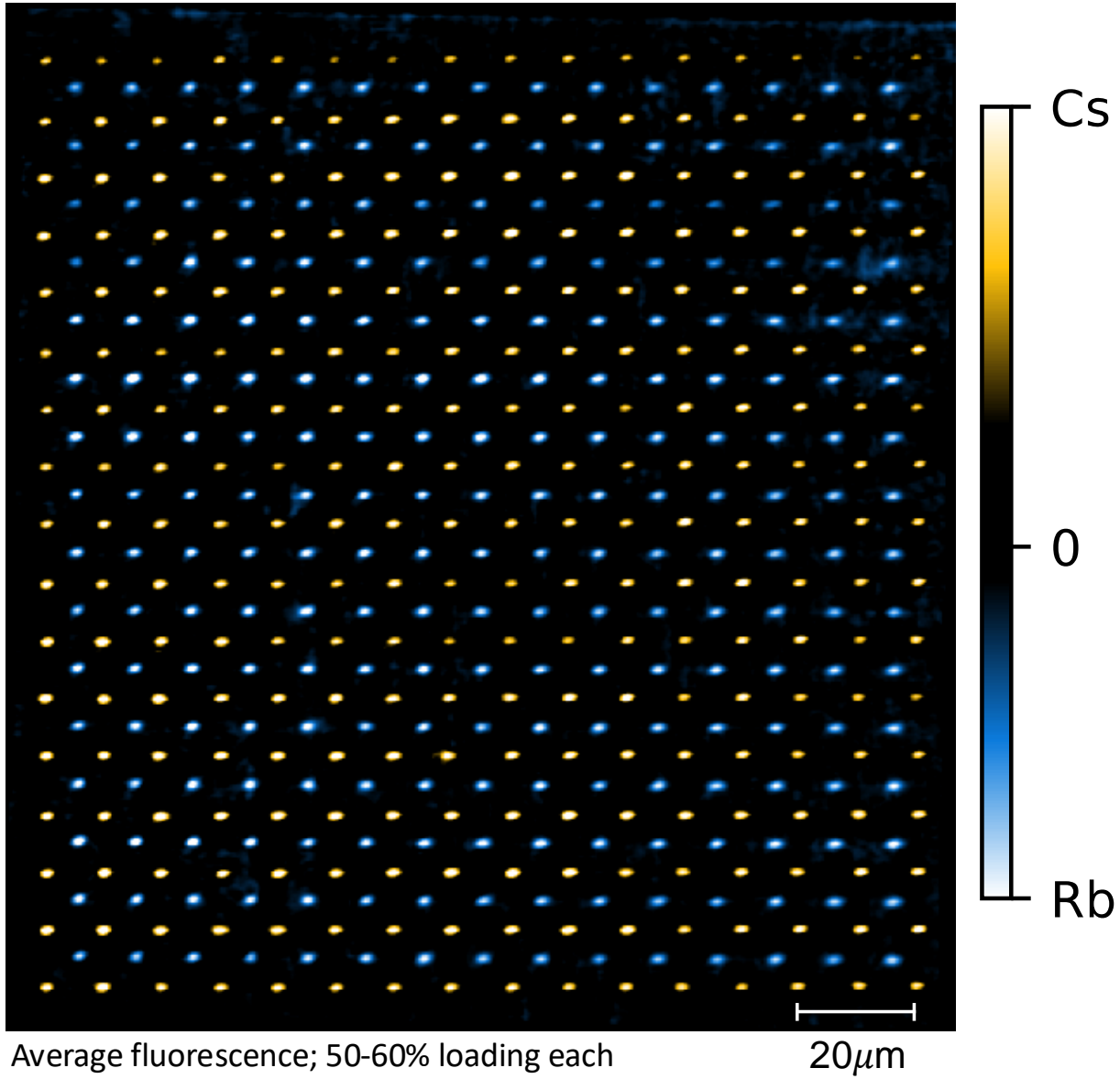


2018

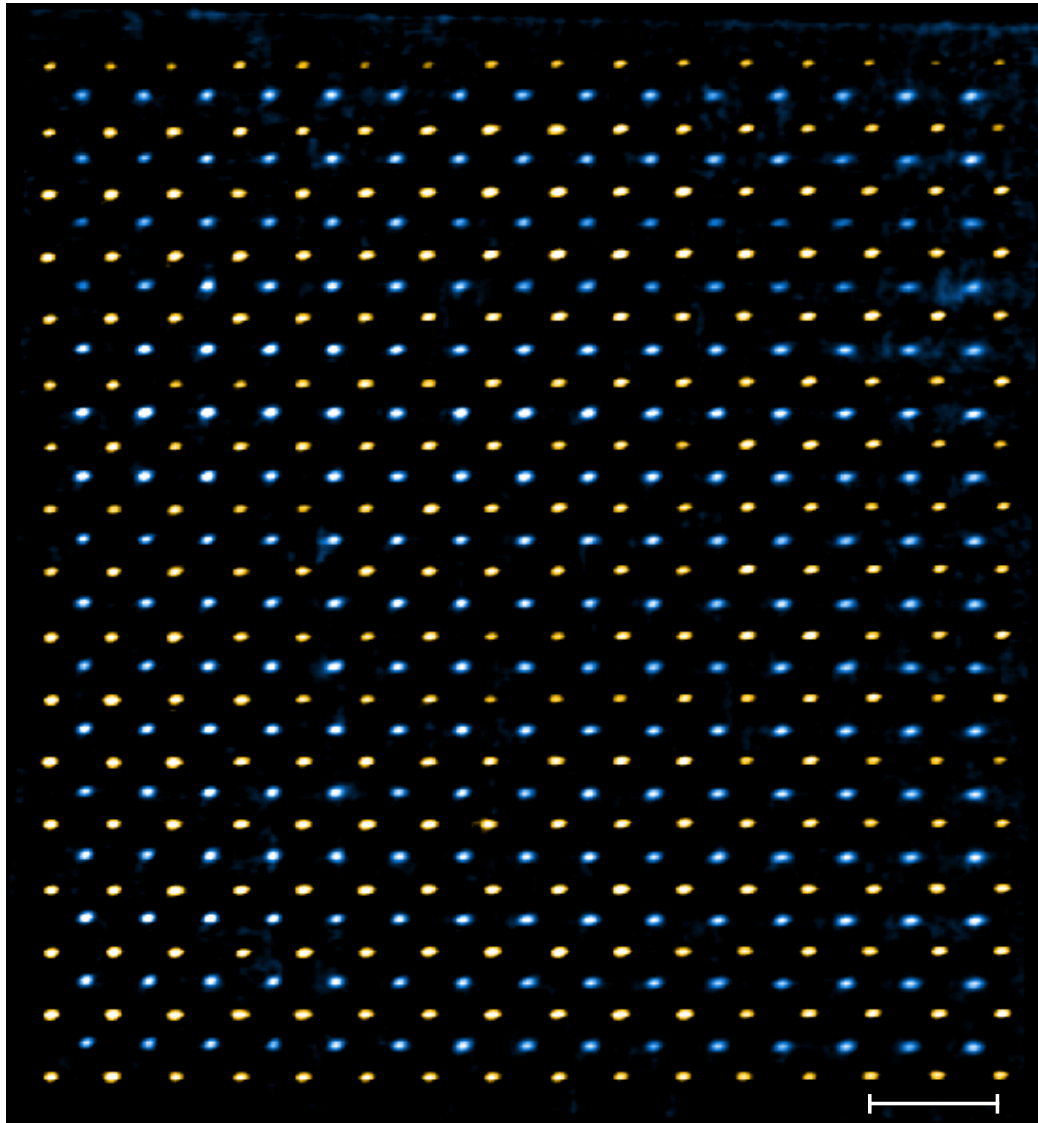


Grimm et al. AAMOP 42, 95 (2000)

A dual-species 512 site atom array

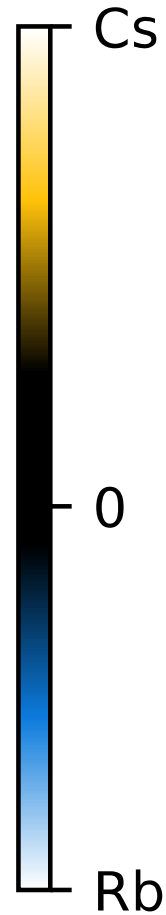


A dual-species 512 site atom array

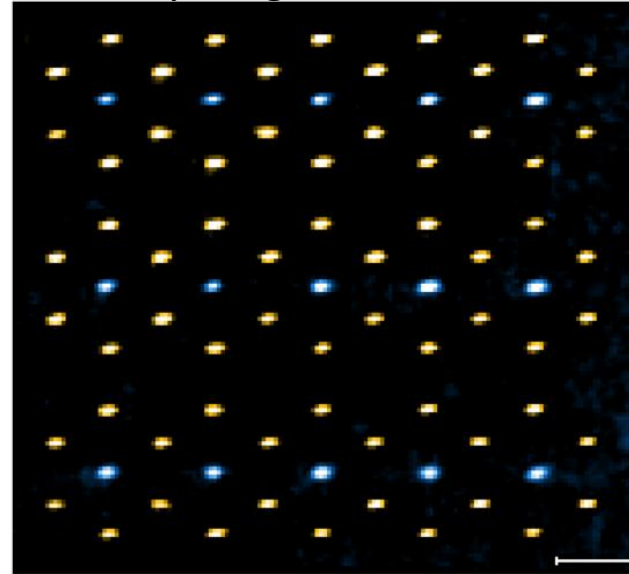


Average fluorescence; 50-60% loading each

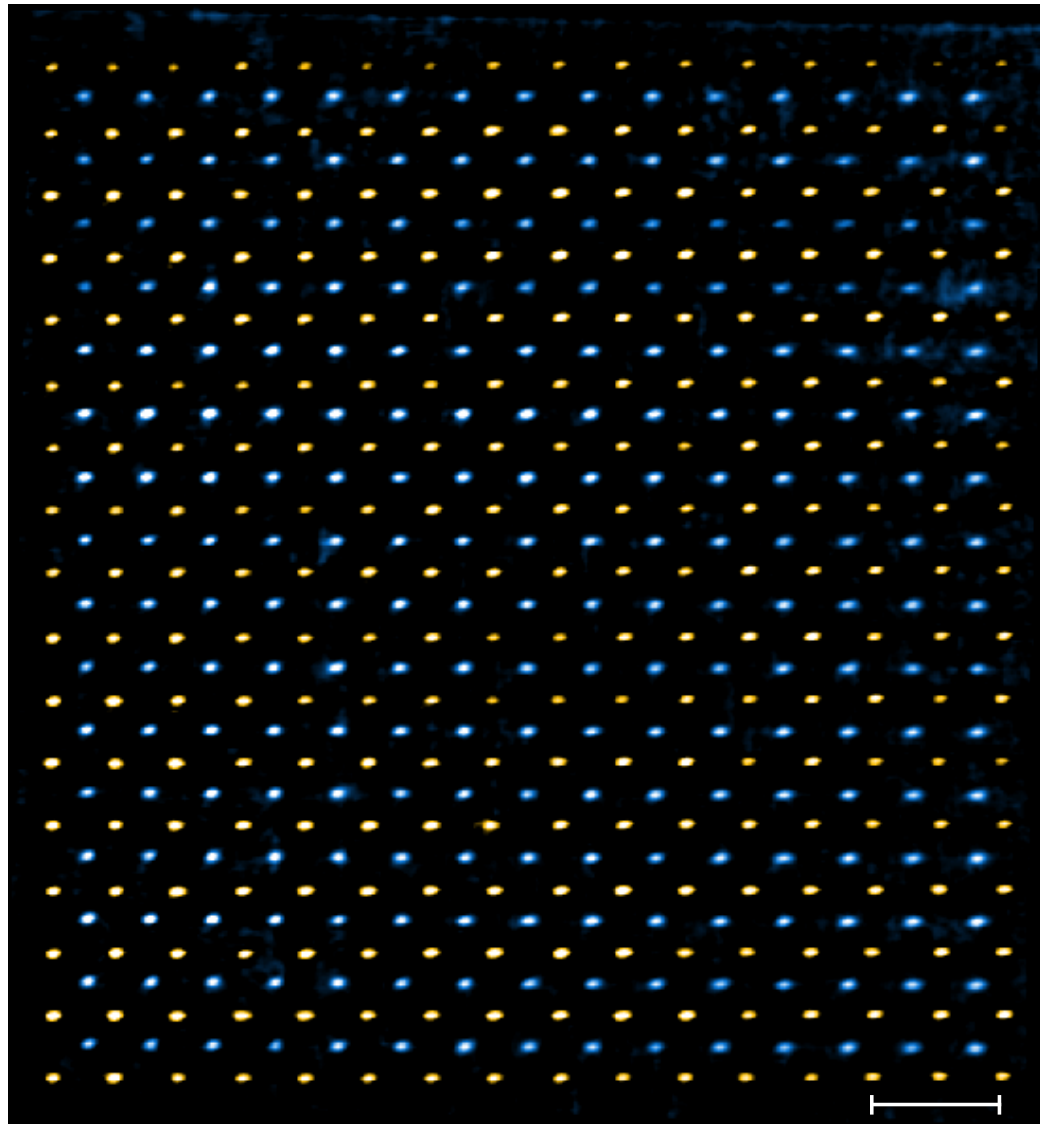
20 μ m



Arbitrary 2D geometries:

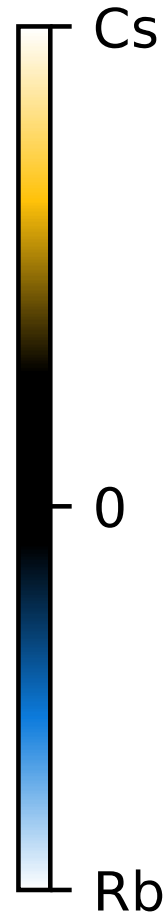


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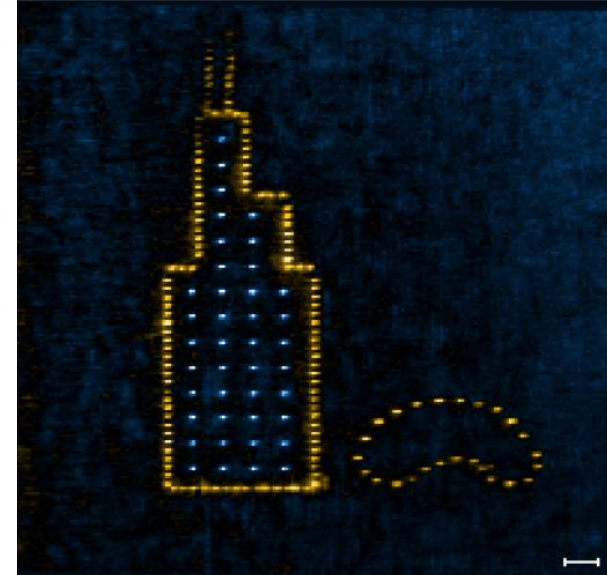
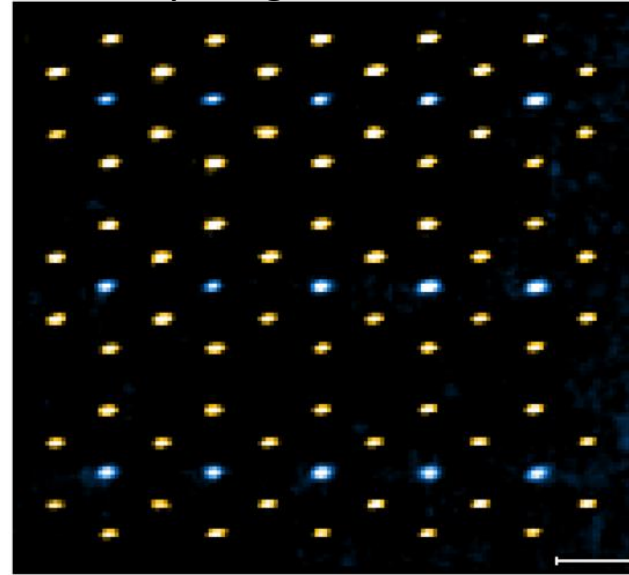


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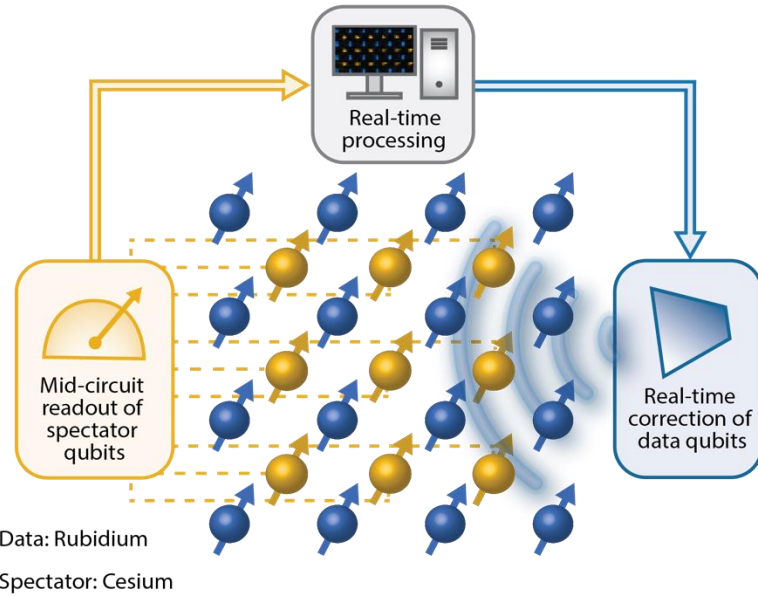
Arbitrary 2D geometries:



What is good for?

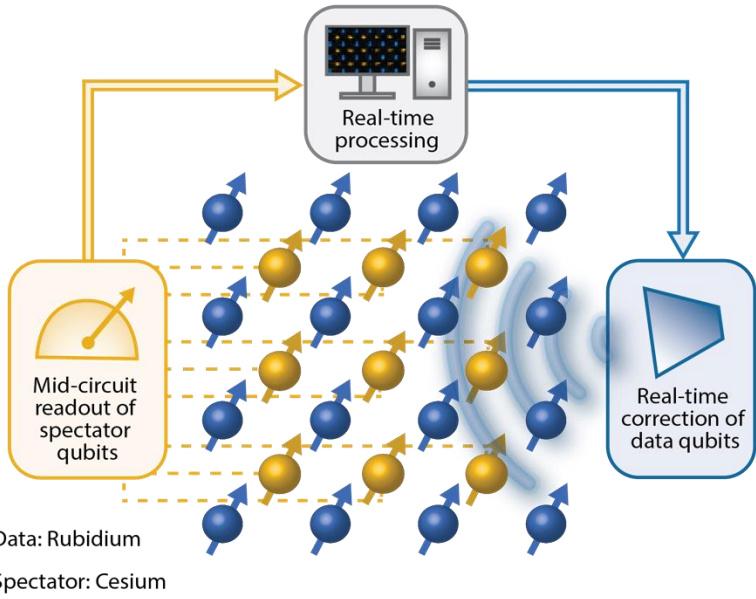
What is good for?

Quantum computers

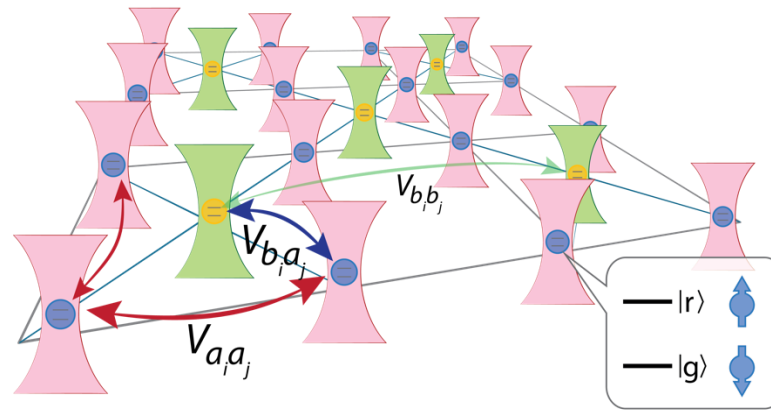


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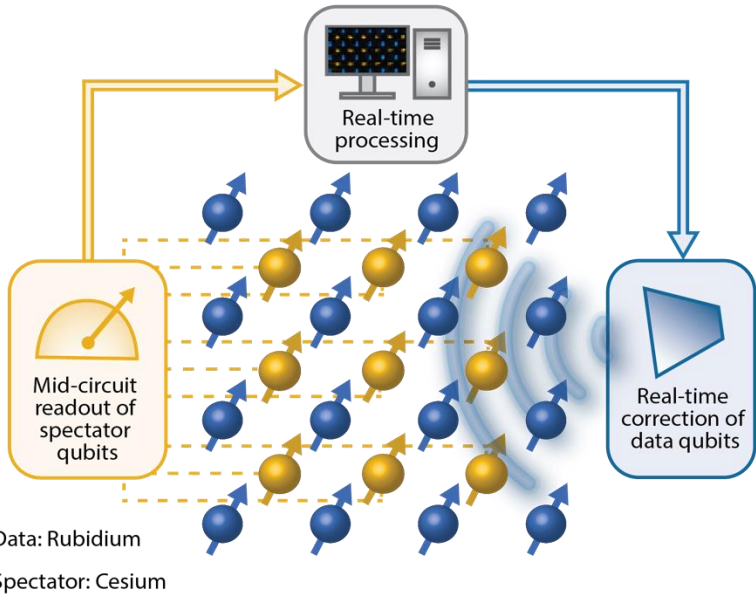


Quantum simulators

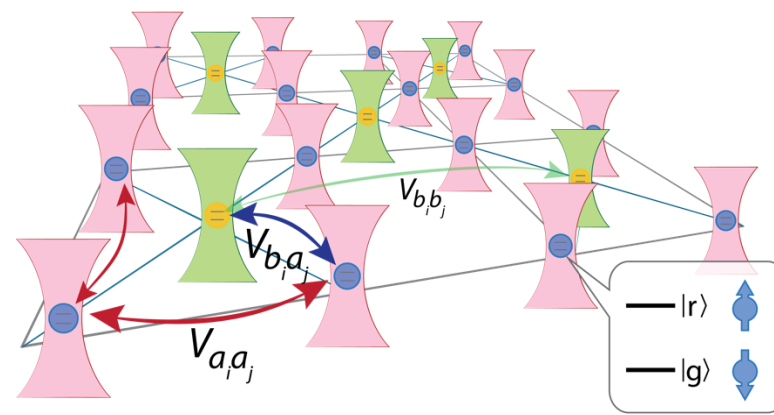


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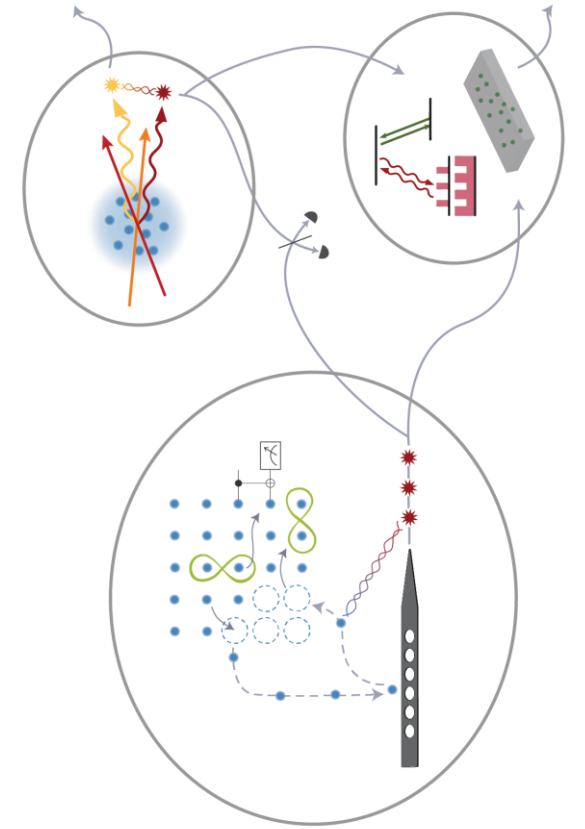
Quantum computers



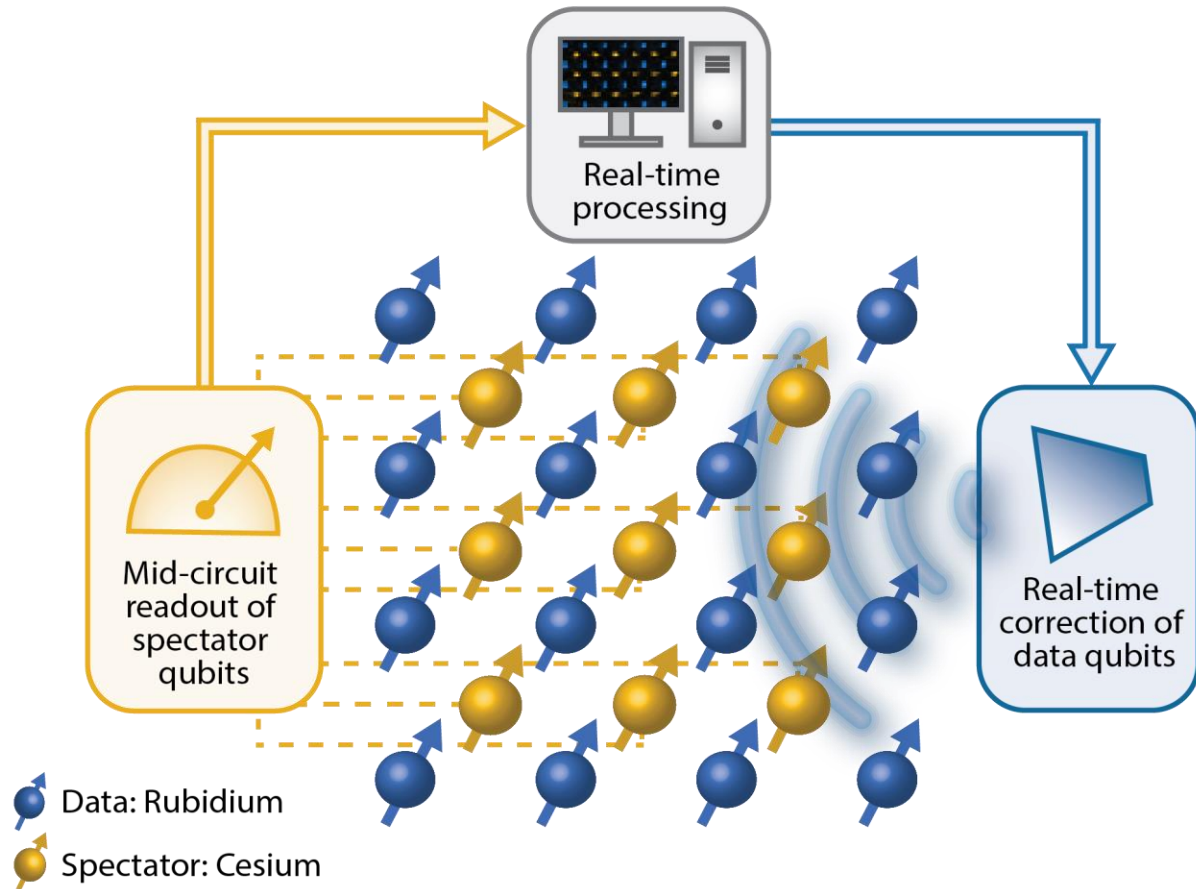
Quantum simulators



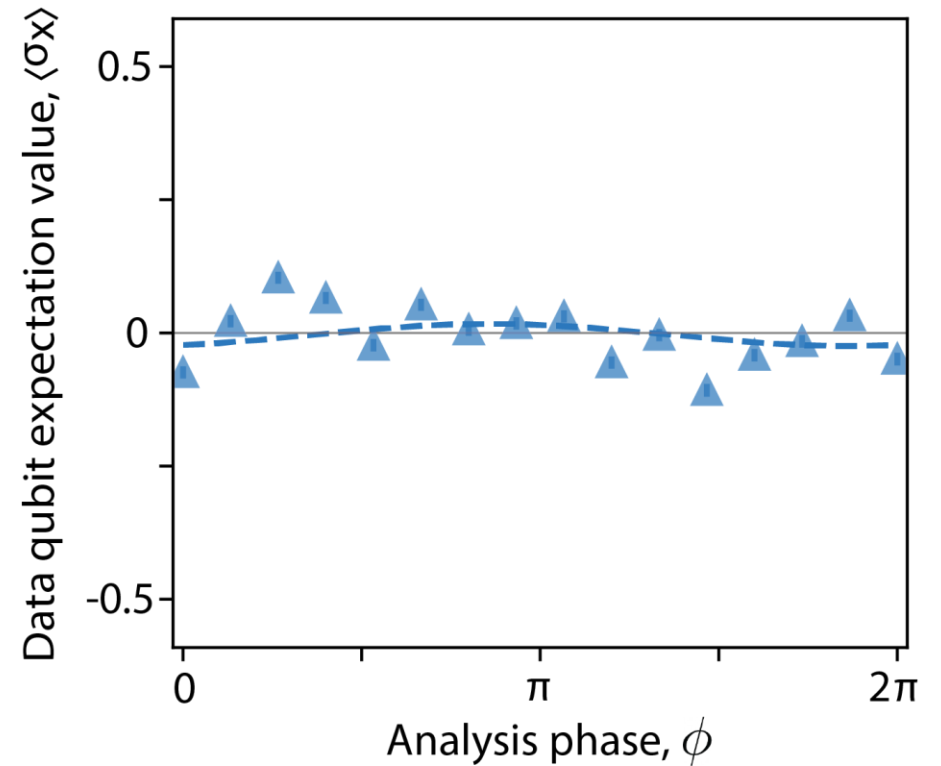
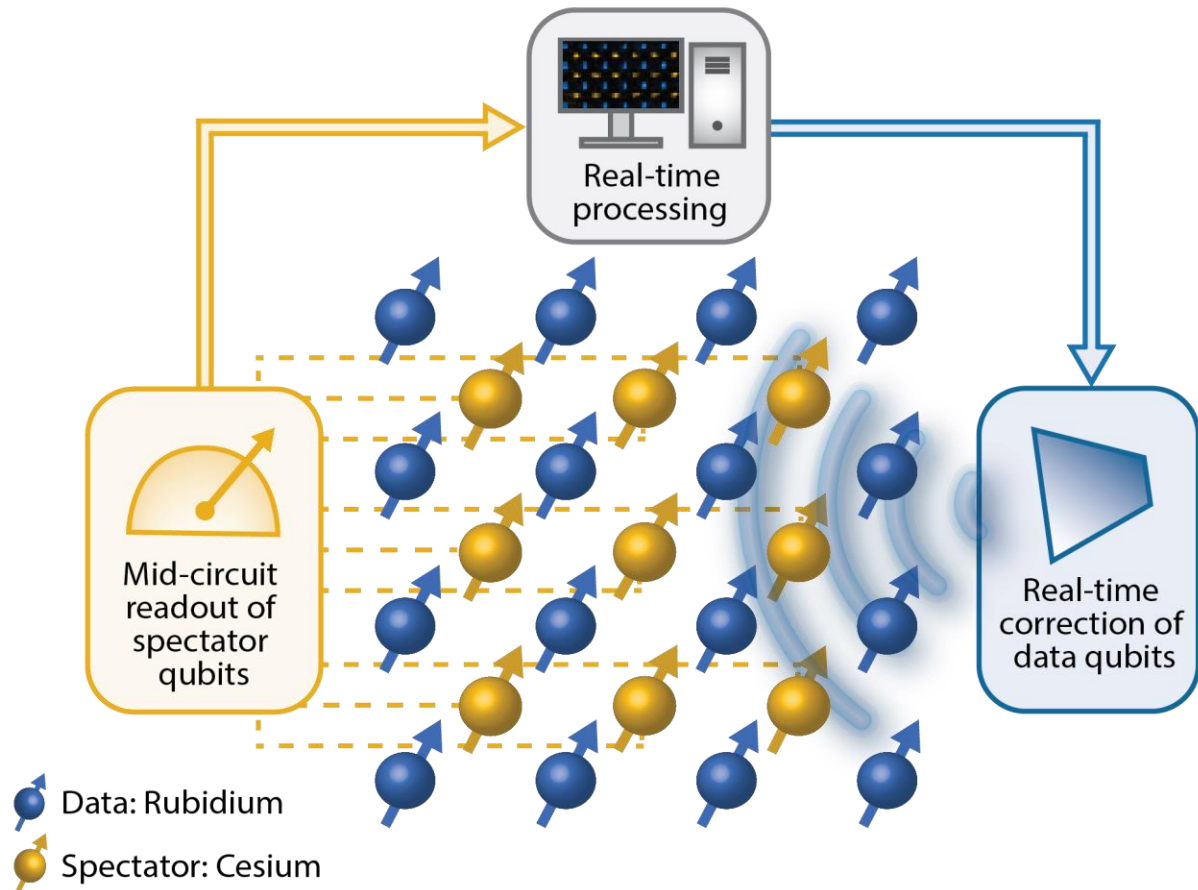
Quantum networks



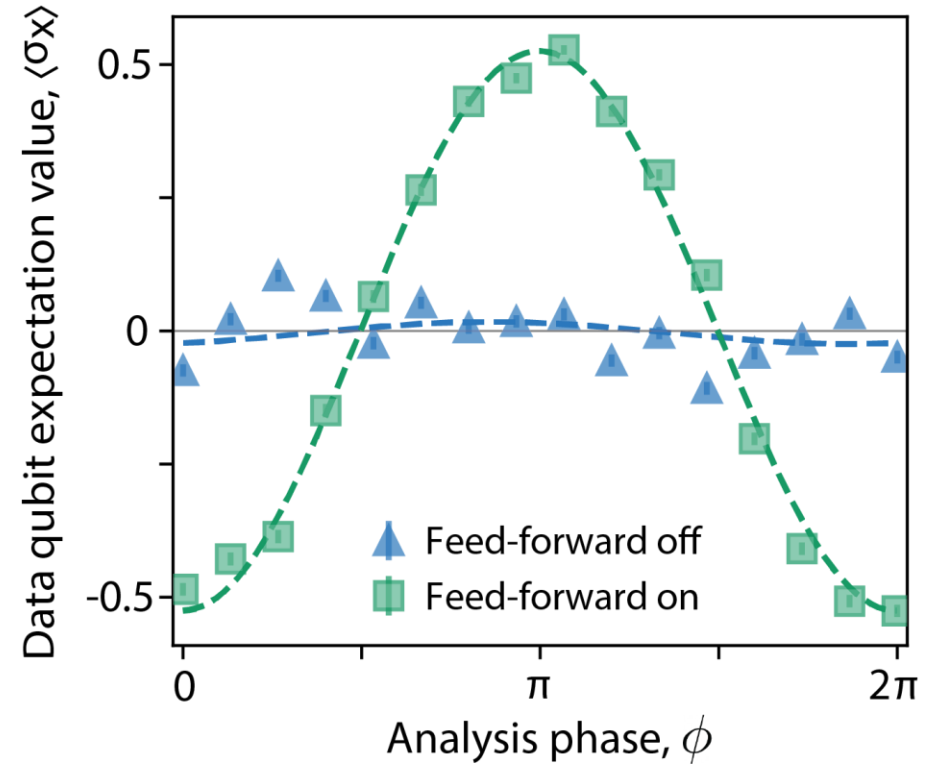
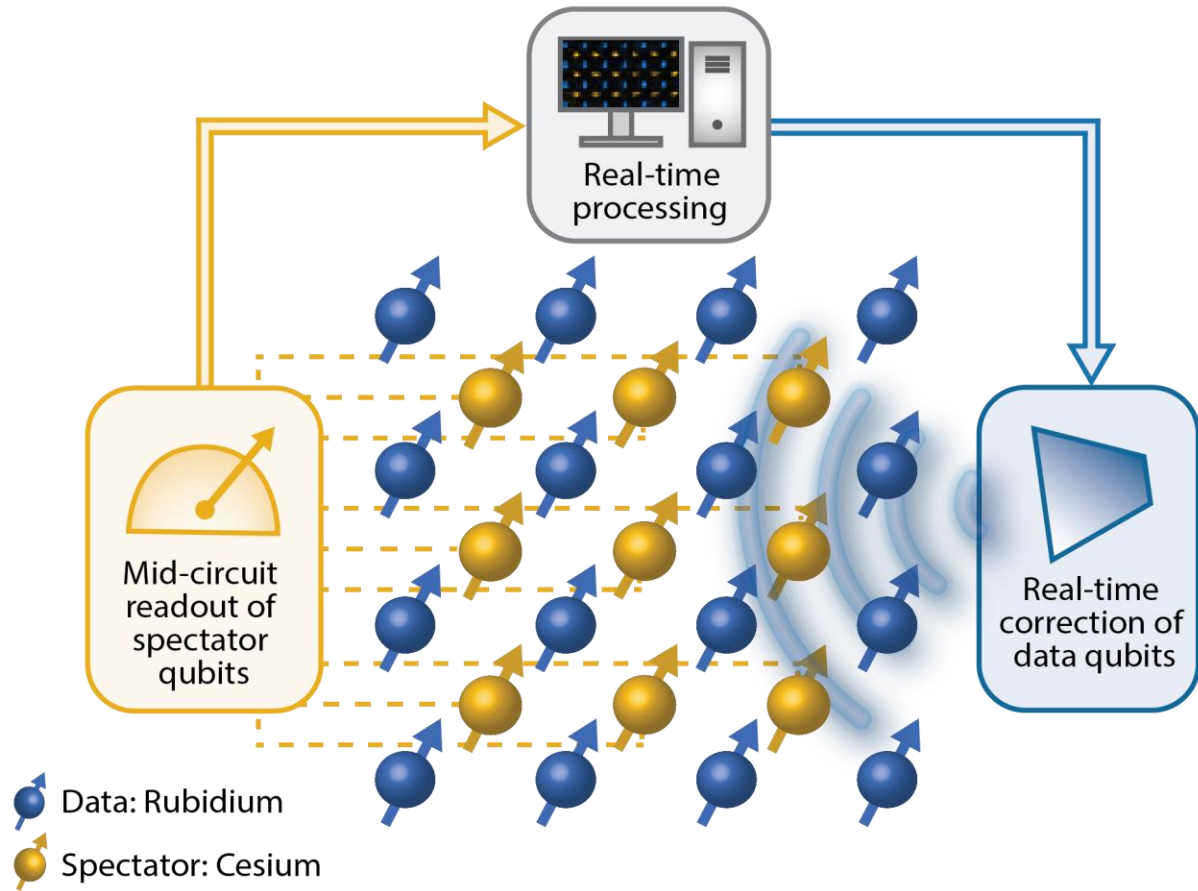
Quantum computers



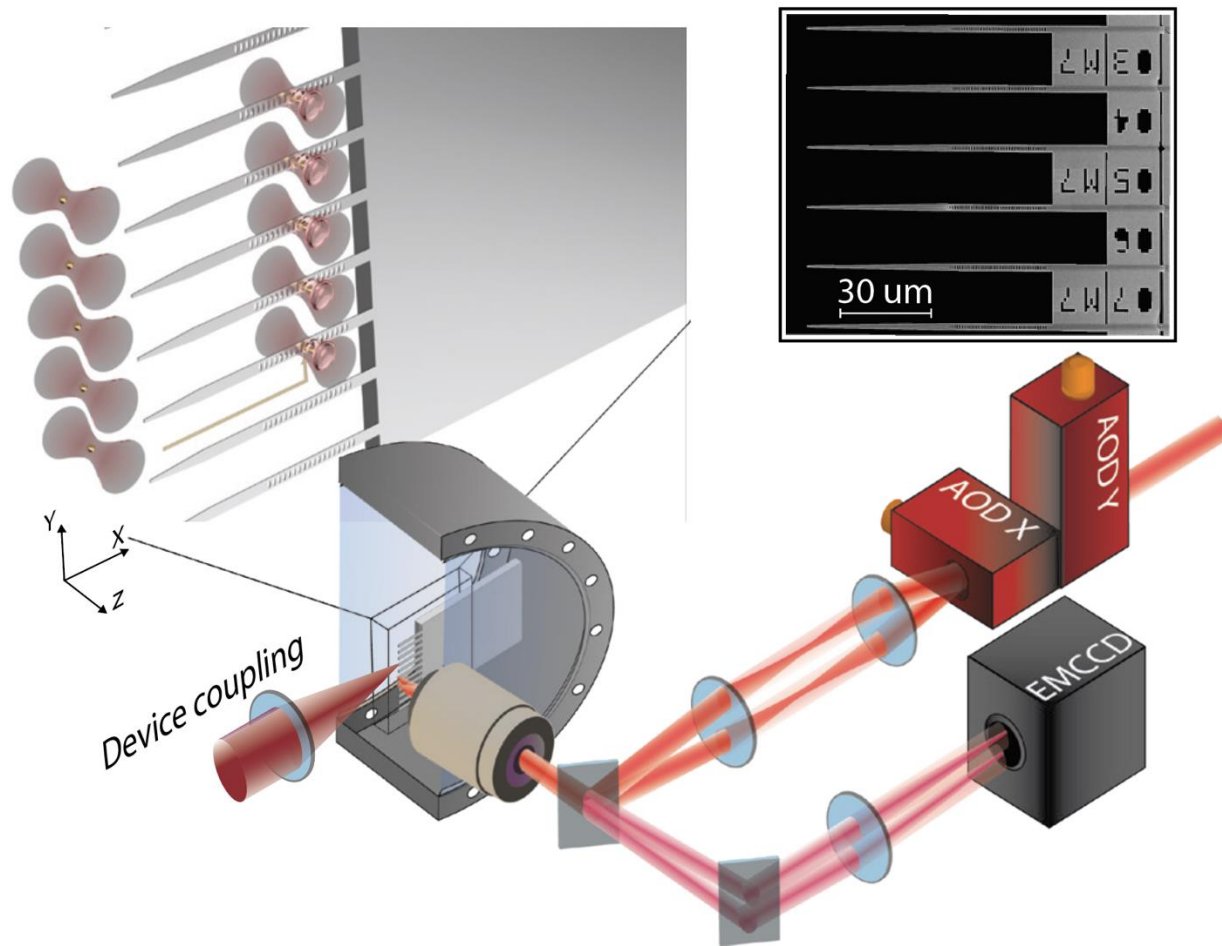
Quantum computers



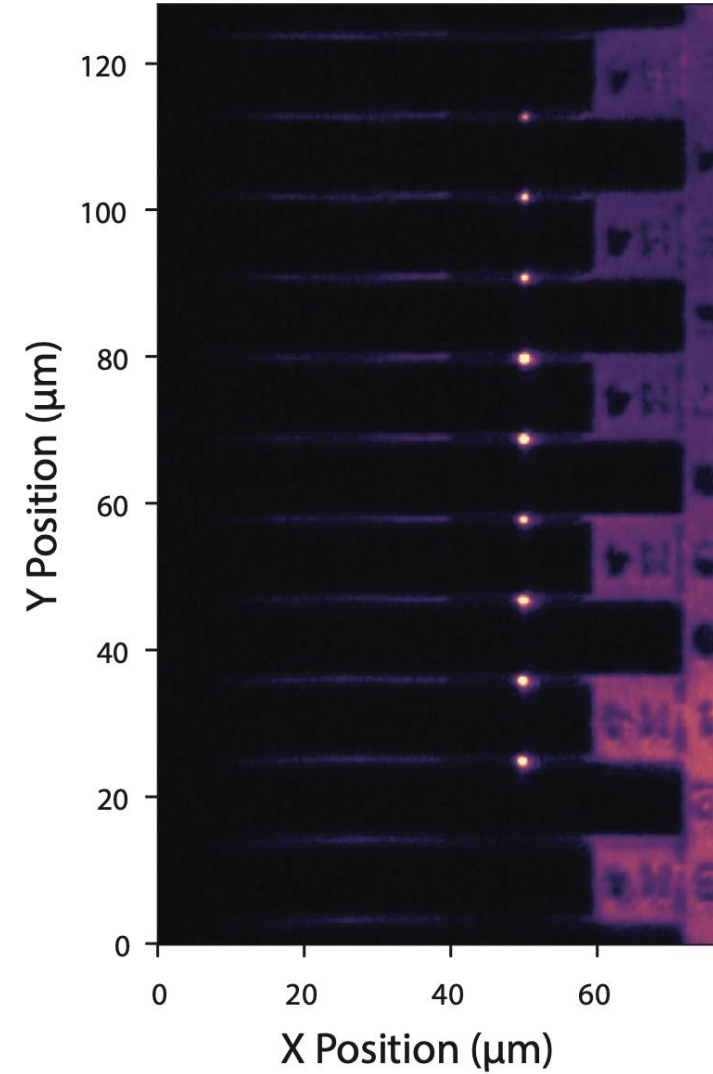
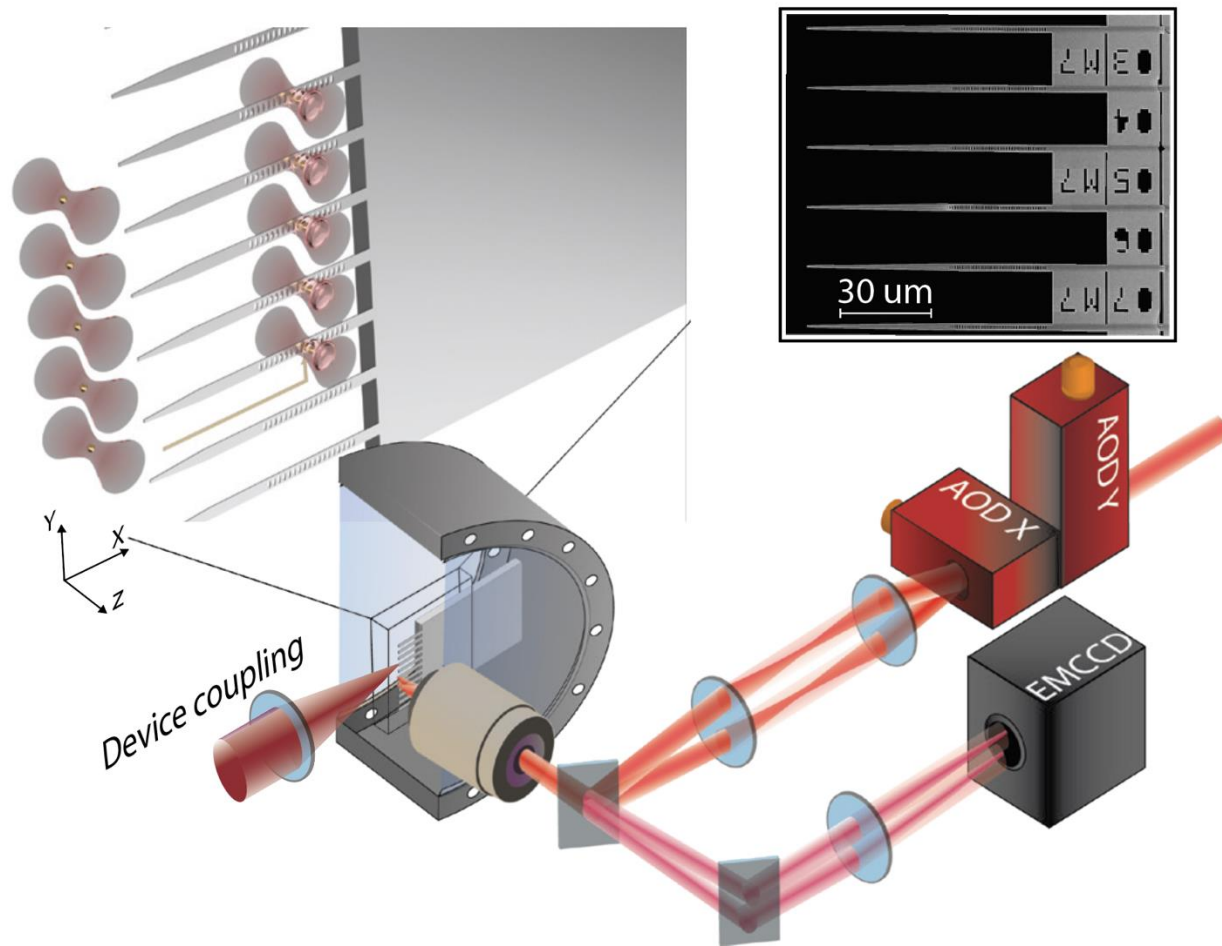
Quantum computers



Quantum networking



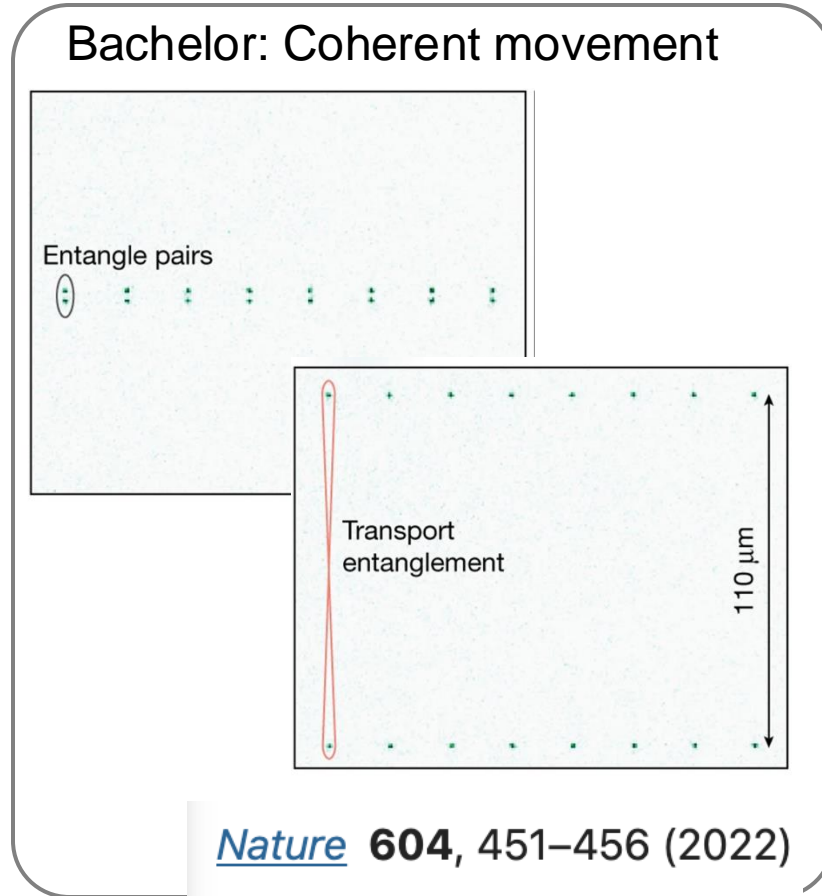
Quantum networking



Possible projects

Interested? => Hannes.Bernien@uibk.ac.at

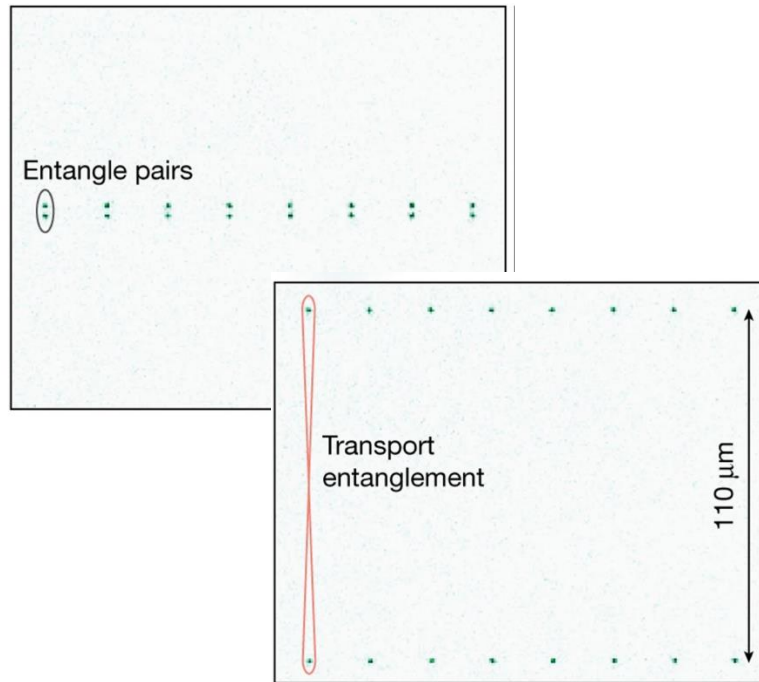
Possible projects



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Possible projects

Bachelor: Coherent movement



Nature **604**, 451–456 (2022)

Master:



Shoot lasers at atoms

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