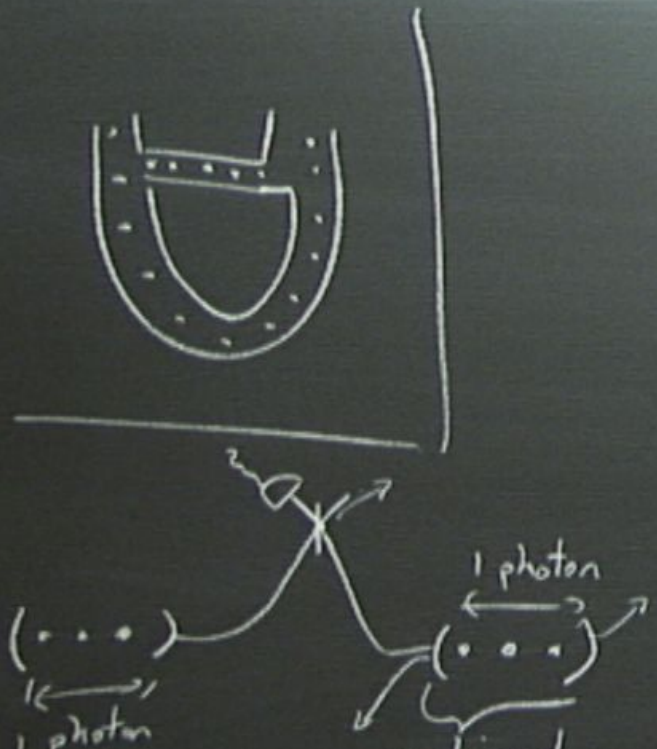
Title: Quantum Information Review - Lecture 4

Date: Feb 17, 2011 09:00 AM

URL: http://pirsa.org/11020036

Abstract:



optical cavities

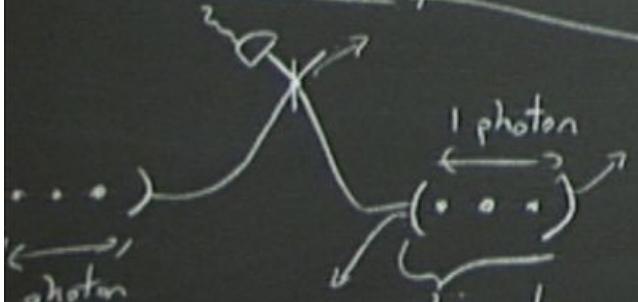
Superposition $|01\rangle + |10\rangle$

can put into ions in traps

Liquid-state NMR: Each molecule is a quantum computer.

Qubits are nuclear spins.

Interact w/ in a molecule, but we turn them off w/ RF pulses.



Superposition $|01\rangle + |10\rangle$

can put into ions in traps

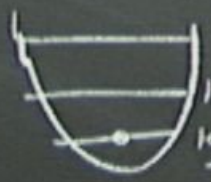
At room temperature, polarizations $\sim 10^{-4}$ or 10^{-6} $\Rightarrow$ pseudopure states

ach molecule
tum computer.
nuclear spins.
in a molecule,
sn then off
w/ RF pulses.

At room temperature, polarizations $\sim 10^{-4}$ or 10^{-6} $\Rightarrow$ pseudopure states

Quantum Dots:

Well of "artificial



$|0\rangle$ & $|1\rangle$

But spin & much more electron in $|0\rangle = |\downarrow\rangle$, $|1\rangle = |\uparrow\rangle$

semiconductor atom"

Could use $|g\rangle$ & $|e\rangle$ as

– decohere fast.

electron is isolated

ground state

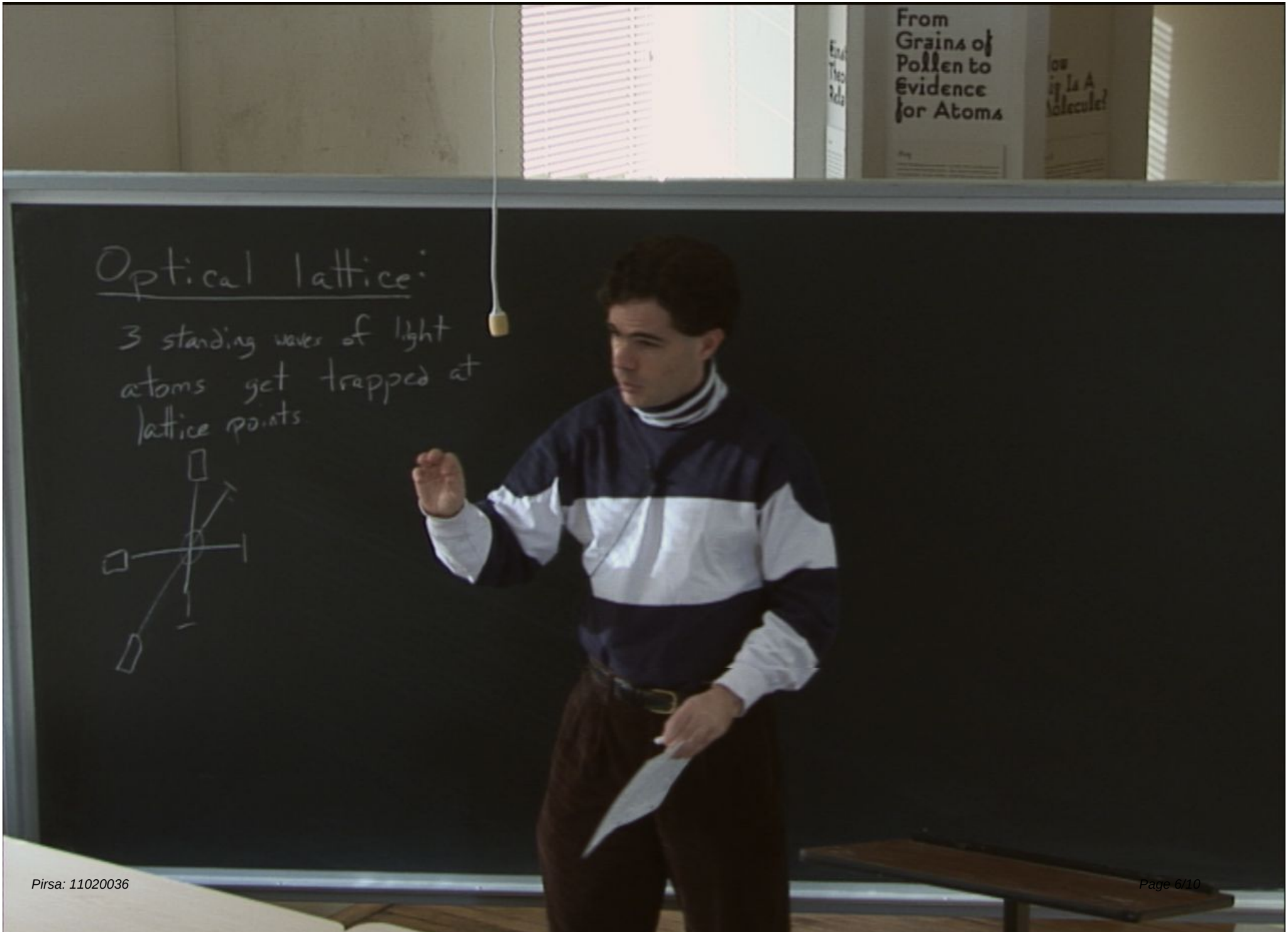
Optical QC:

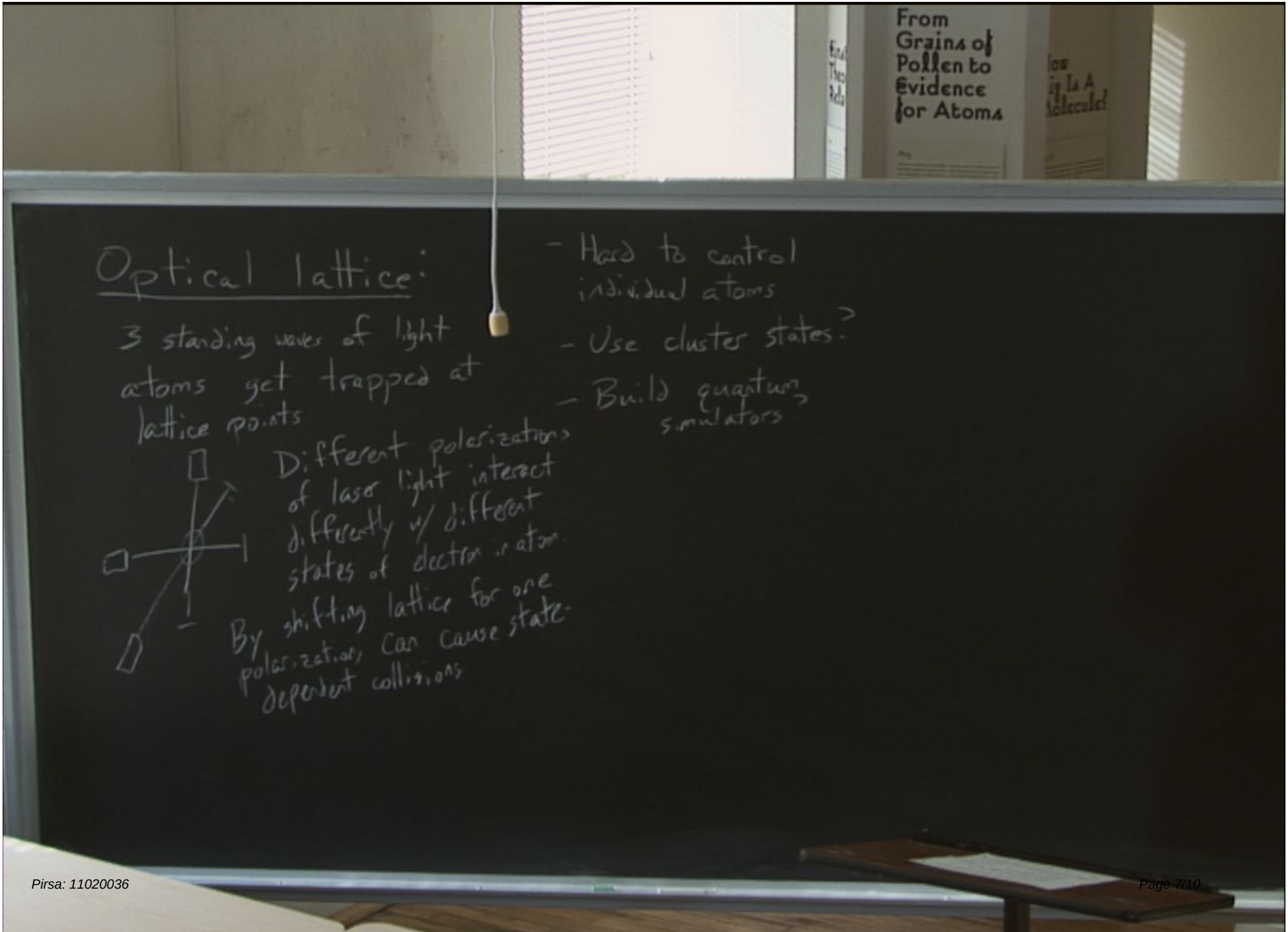
Qubits are photons.

Linear optics manipulations

- To get a universal set of quantum gates, one option is to use non-linear optics.
- Can do universal QC w/ linear optics using measurement & feedback.
- Cluster states (one-way QC):
  Create big entangled state - doesn't depend on computation
  Do a series of single-qubit measurements (adaptively)
  ⇒ can get universal QC

Need:
① accurate source of single photons
② high-quality photodetectors


From Grains of Pollen to Evidence for Atoms
Optical lattice:
3 standing waves of light
atoms get trapped at
lattice points


From Grains of Pollen to Evidence for Atoms
Optical lattice:
3 standing waves of light atoms get trapped at lattice points
Different polarizations of laser light interact differently w/ different states of electron in atom
By shifting lattice for one polarization, can cause state-dependent collisions
- Hard to control individual atoms
- Use cluster states?
- Build quantum simulators?

ce:

light

pped at

ent polarizations

r light interact

tly w/ different

of electron in atom.

lattice for one

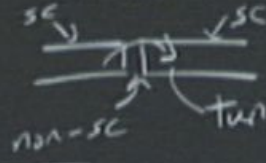
can cause state

collisions

- Hard to control individual atoms
- Use cluster states?
- Build quantum simulators?

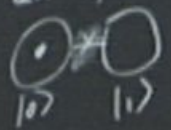
Superconductors:

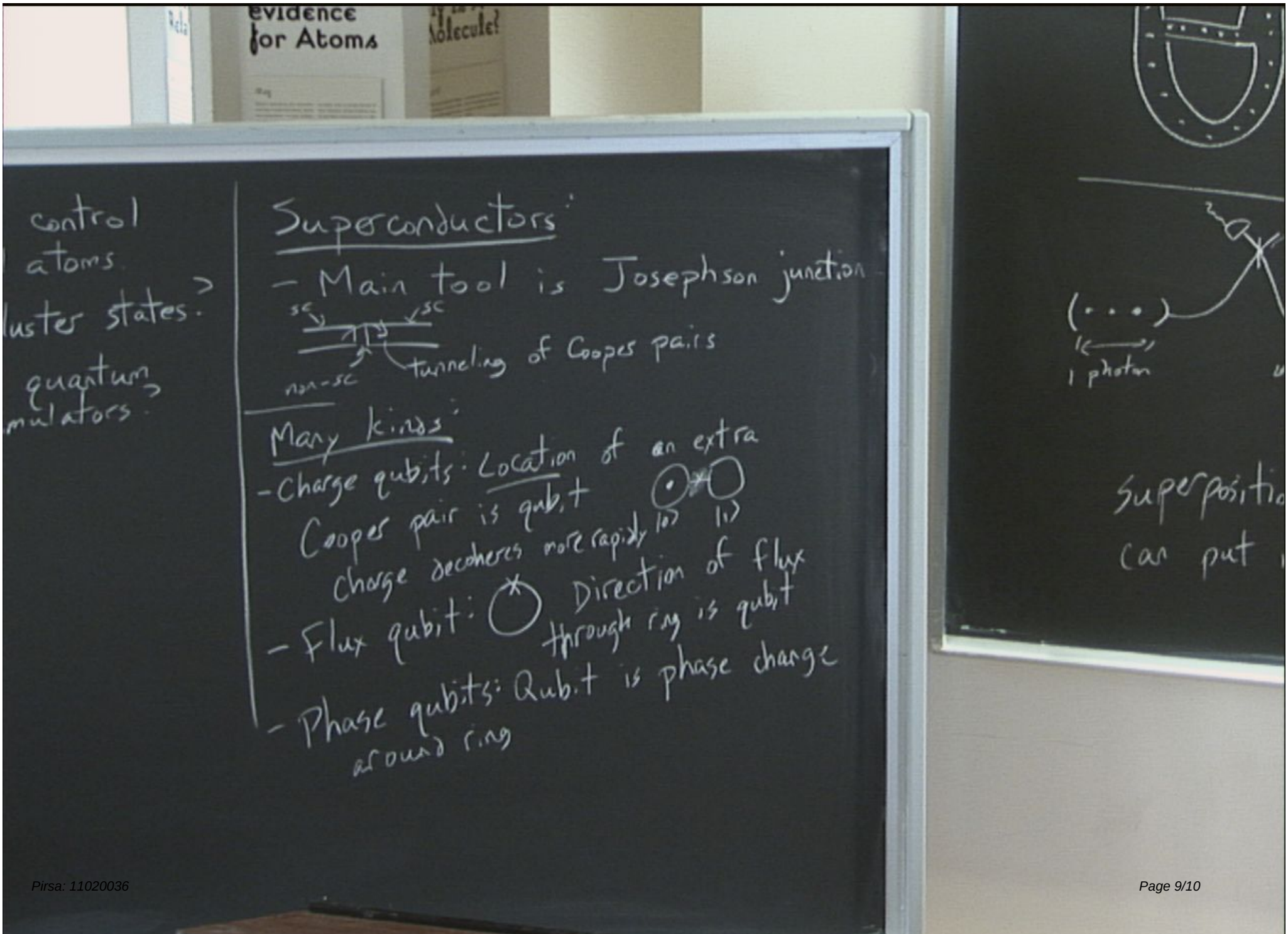
- Main tool is Josephson junction



Many kinds:

Charge qubits: Location of an extra Cooper pair is qubit




evidence
for Atoms
Molecule?
control
atoms
luster states?
quantum
mulators?
Superconductors:
- Main tool is Josephson junction
sc
sc
non-sc
tunneling of Cooper pairs
Many kinds:
- Charge qubits: Location of an extra
Cooper pair is qubit
Charge decoheres more rapidly
|0⟩
|1⟩
- Flux qubit: Direction of flux
through ring is qubit
- Phase qubits: Qubit is phase change
around ring
1 photon
Superpositio
can put

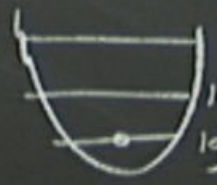
Two qubit gates done use Josephson junctions which act non-linear inductors

- Put superconducting wells in microwave waveguides.

Can interact superconducting qubits w/ RF field

Quantum

Well of "artificial



|0⟩ & |1⟩

But spin of much more

electron in

|0⟩ = |↓⟩, |1⟩

For two-qubit

Pauli exclusion