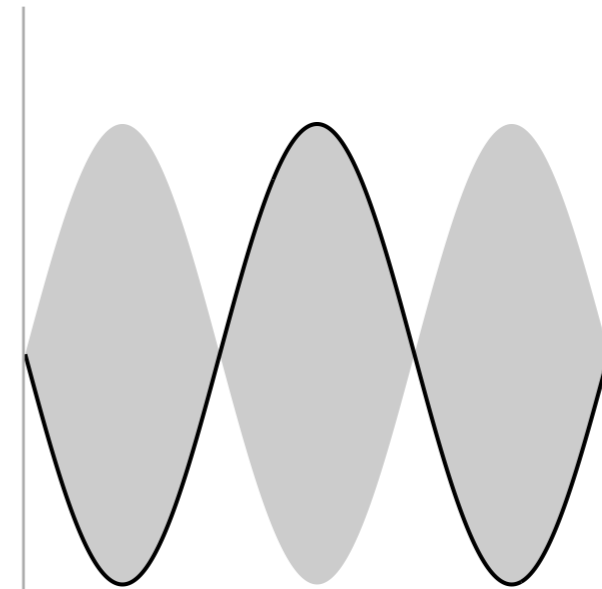


Atomic traps & quantum dots

Guitar waves

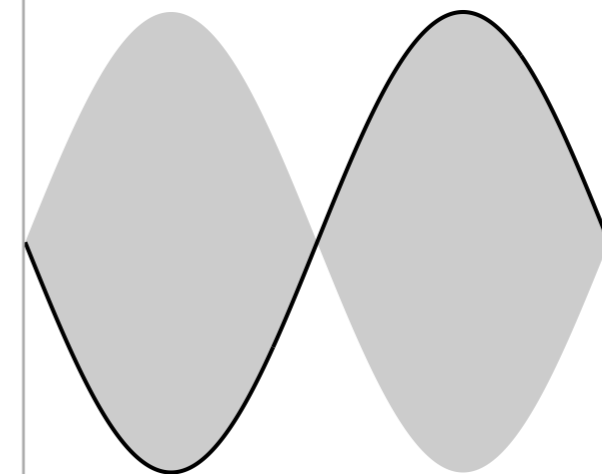
- Really any uniform trap of a line-like wave

3rd harmonic



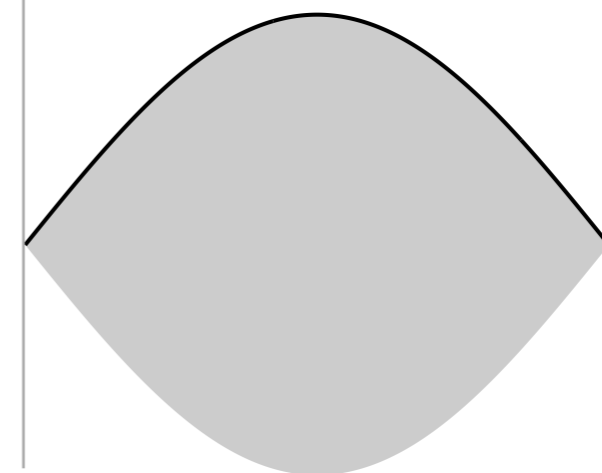
Next-next
lowest energy

2nd harmonic



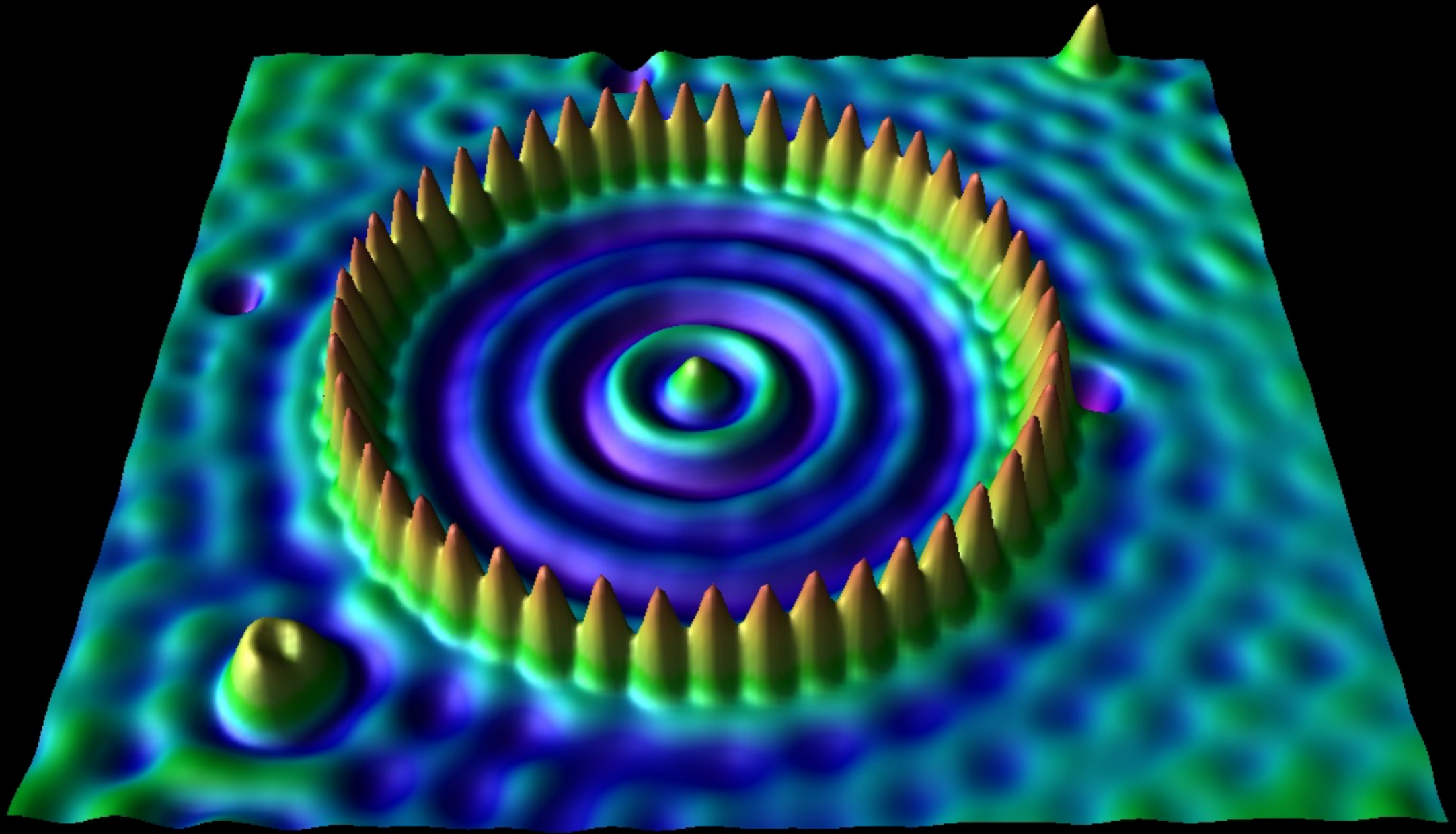
Next lowest
energy

Fundamental

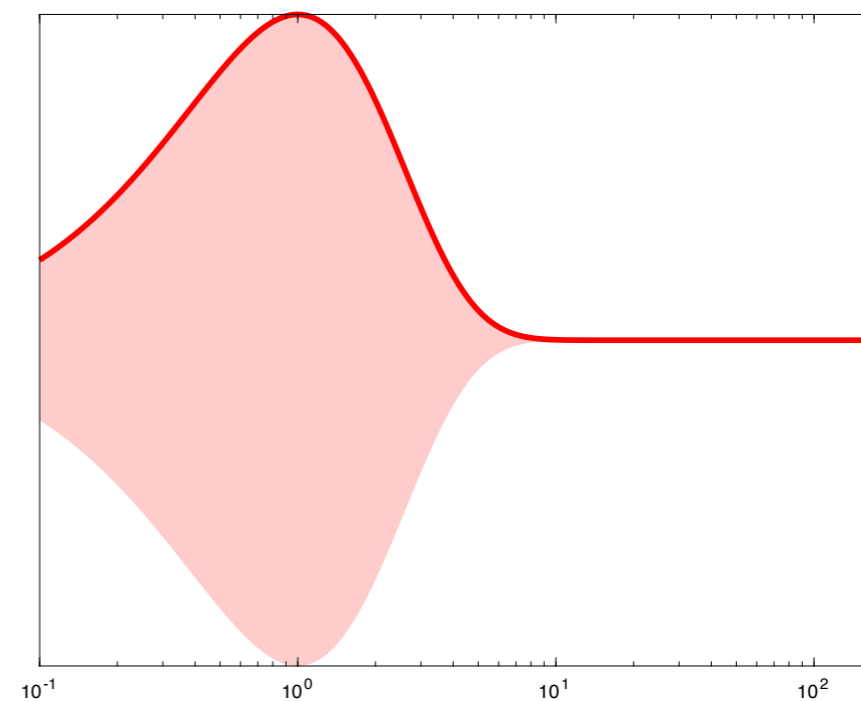
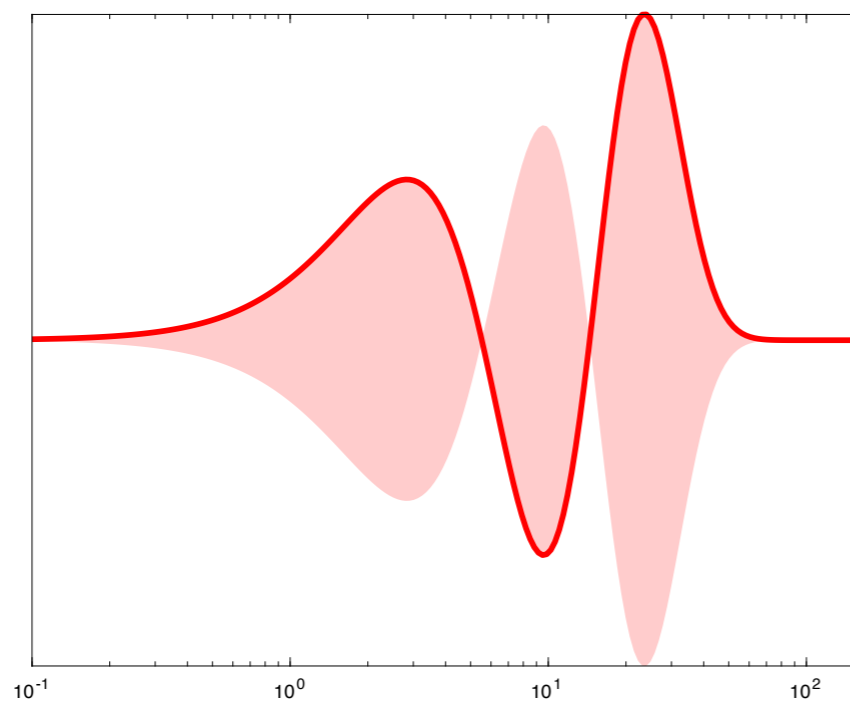
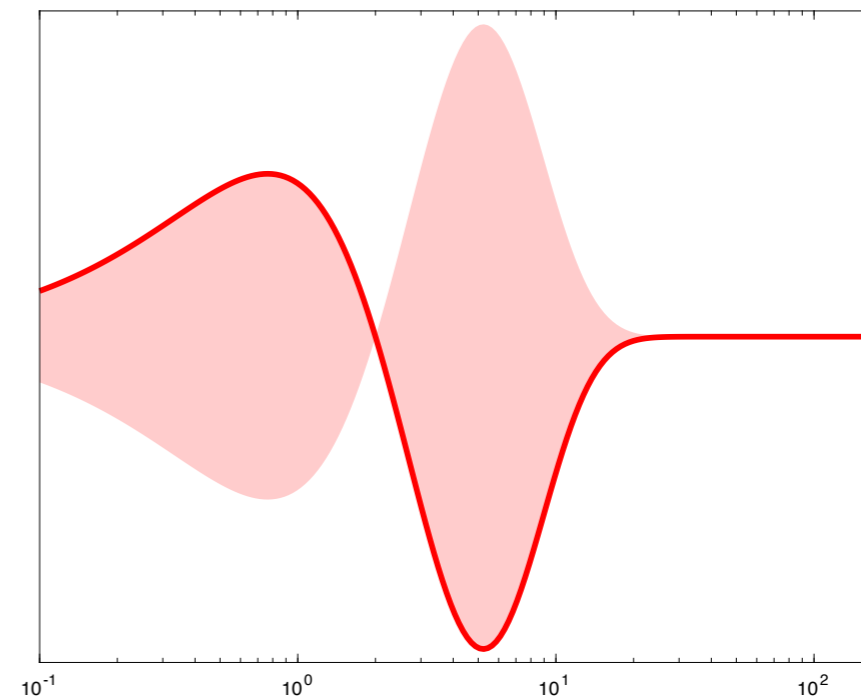
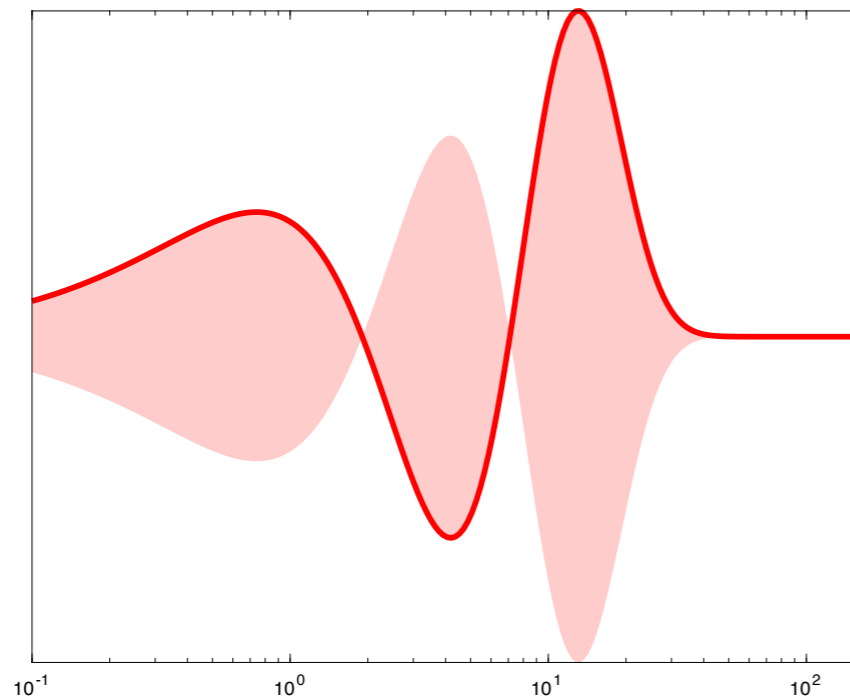


Lowest
energy

Quantum corral

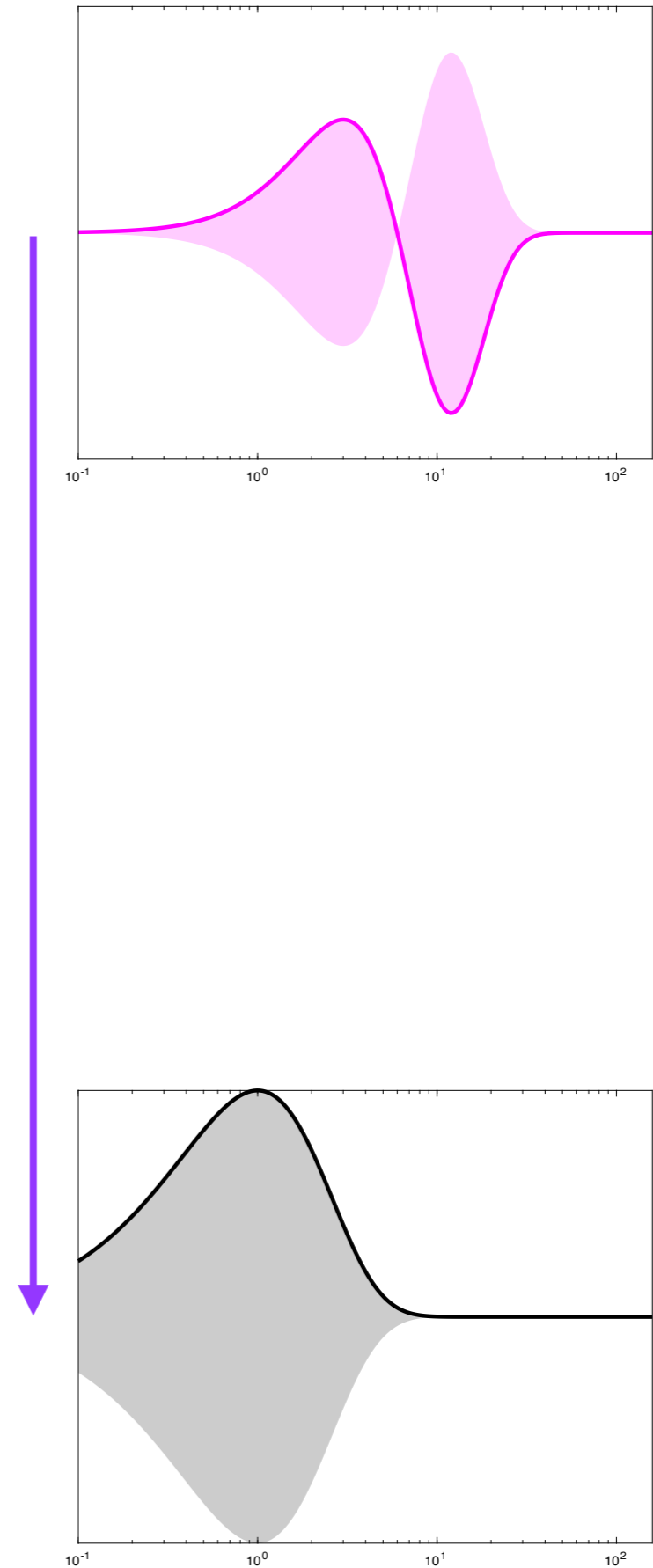


4 waves



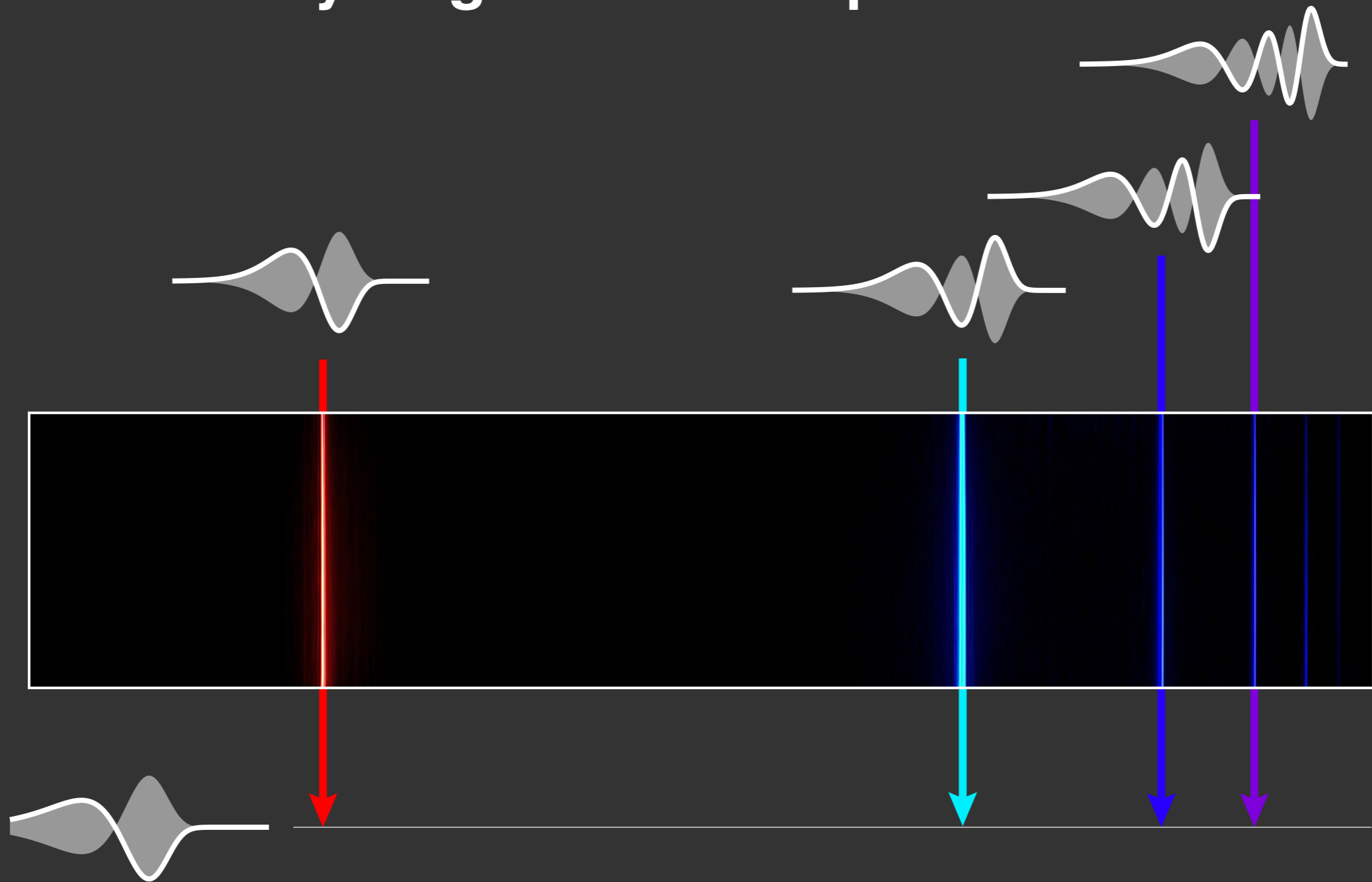
Making light

- We don't see the electron waves, or what energy they have
- When an electron jumps down from one wave to another, it creates a photon with the energy ***difference***.



Hydrogen Spectrum

Hydrogen Balmer Spectrum



Spectra of elements



Hydrogen



Sodium



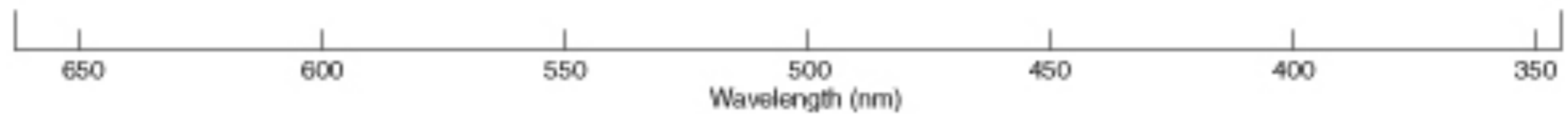
Helium



Neon



Mercury

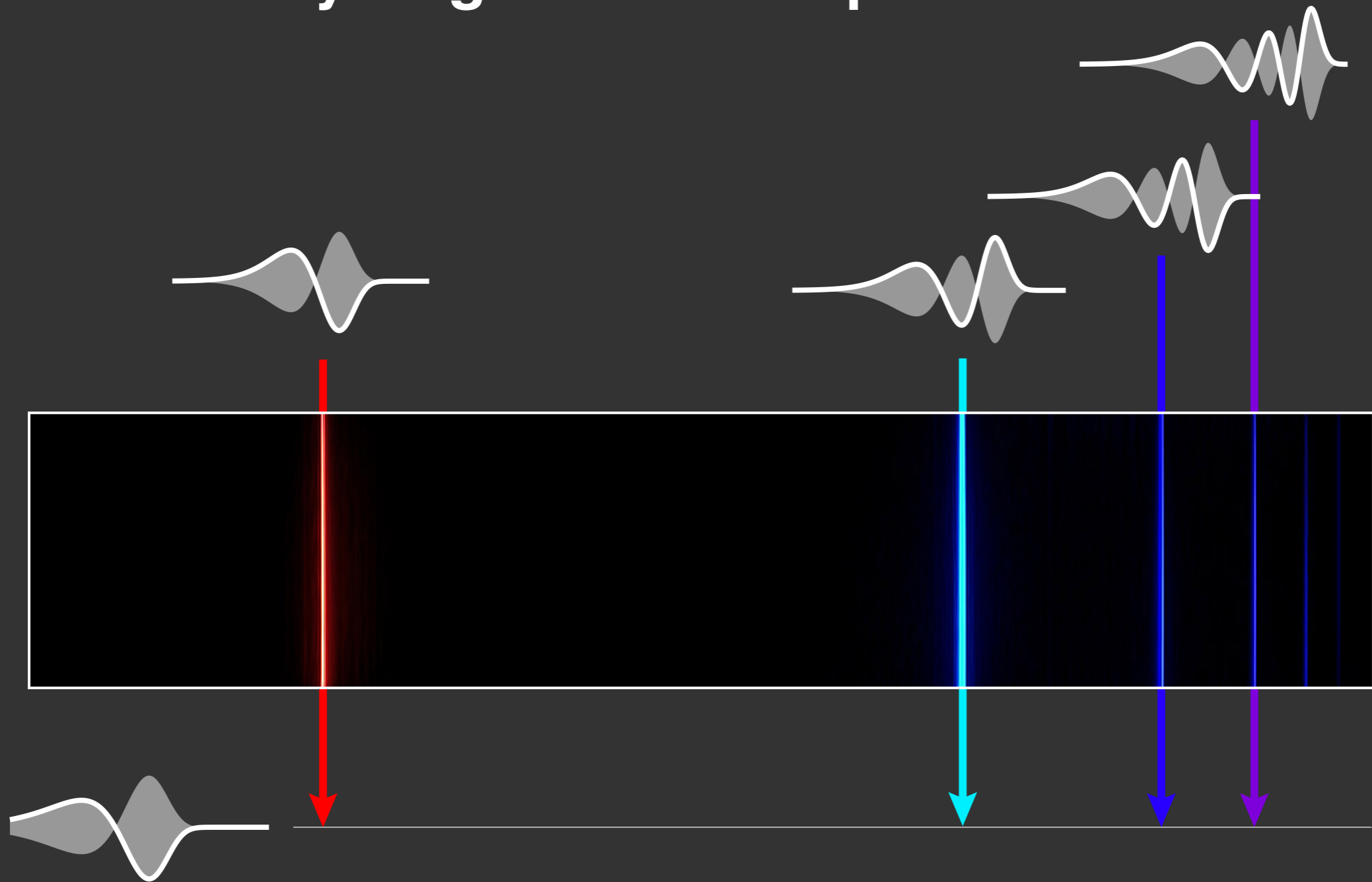


Jumping down the stairs

- Can't see energy levels
- We can 'listen' to how far the electrons jump
- Figure out stair spacing

Hydrogen Spectrum

Hydrogen Balmer Spectrum



It get's complicated...

- Hydrogen has 1 electron around 1 proton
- Iron has 26 electrons, and every electron feels every other electron
- 325 terms in the math...

Every atom has a fingerprint

- The lines emitted by an element are unique
- Helium discovered in on the sun ***before*** being found on earth

Spectra of elements



Hydrogen



Sodium



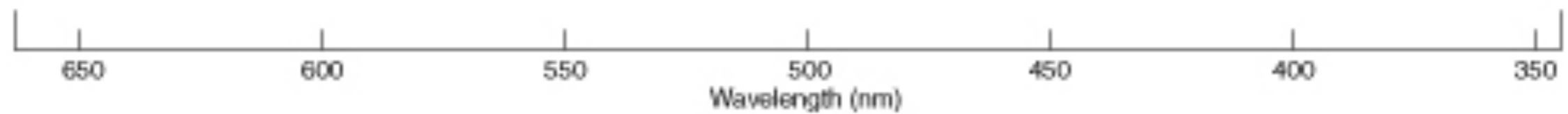
Helium



Neon



Mercury

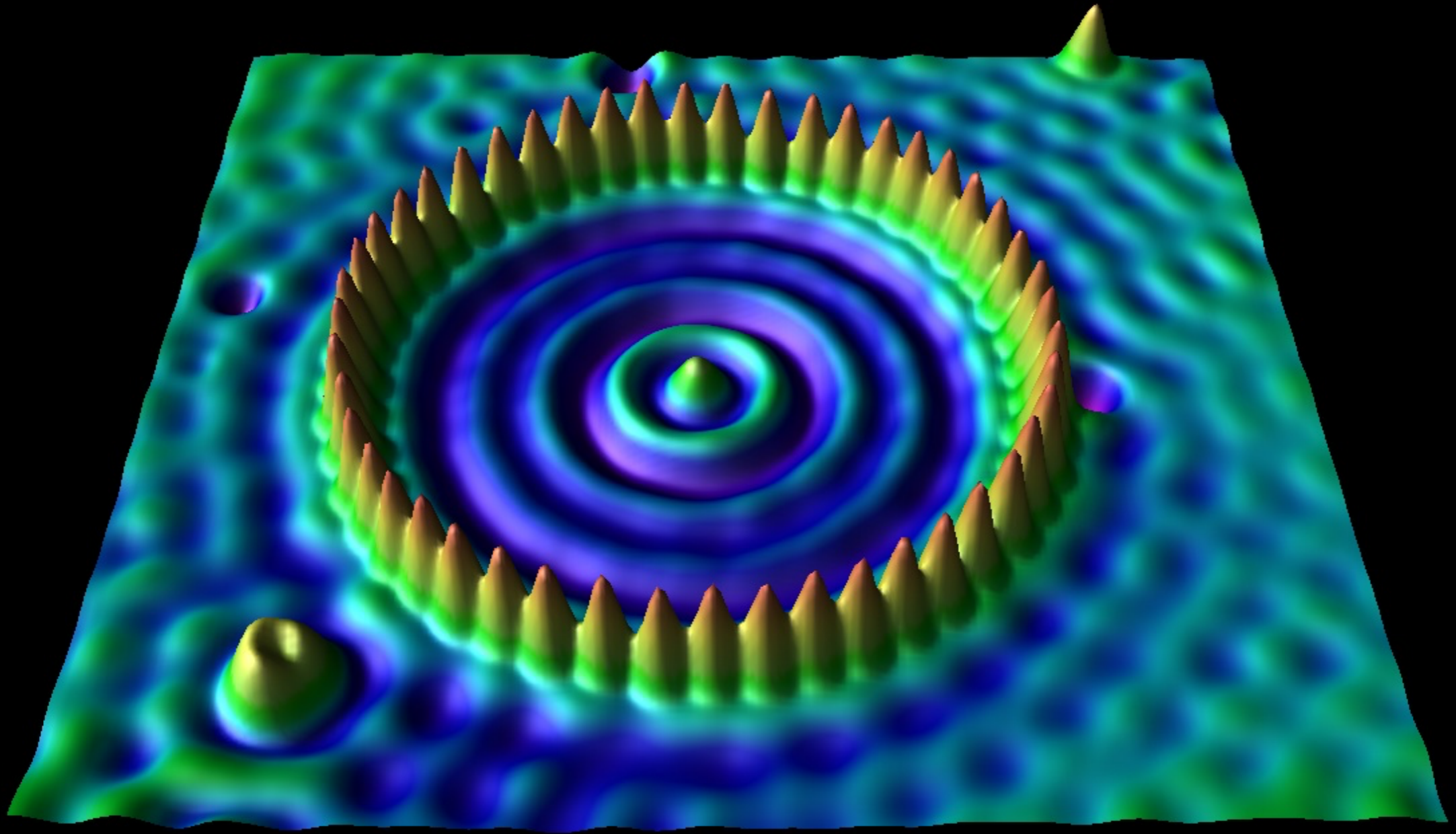


Quantum dots

Natural electron traps (atoms & molecules)

- Finding a particular color means finding the right trap
- Scavenger hunt
- What if we could make a trap? An 'artificial atom'?

Quantum corral





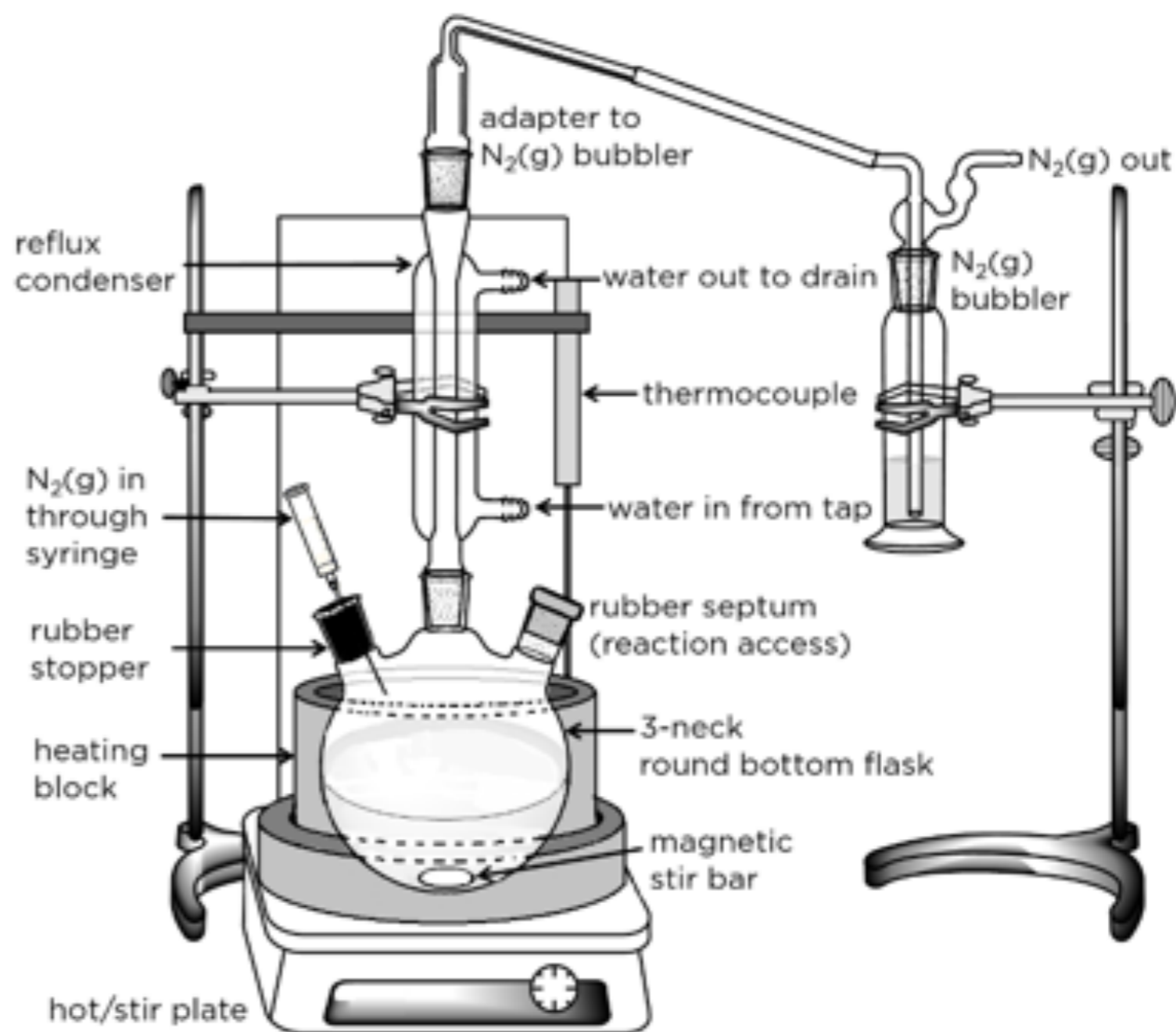
QUANTUM DOTS



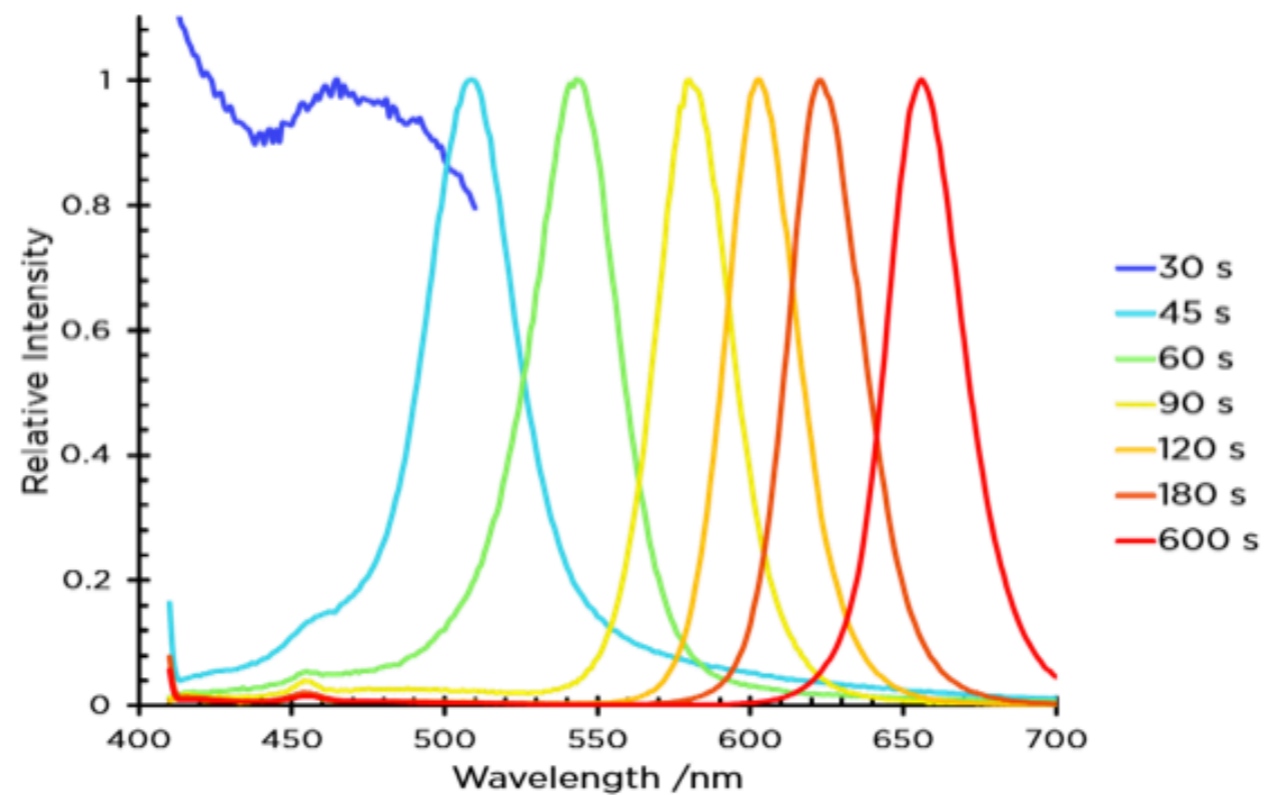
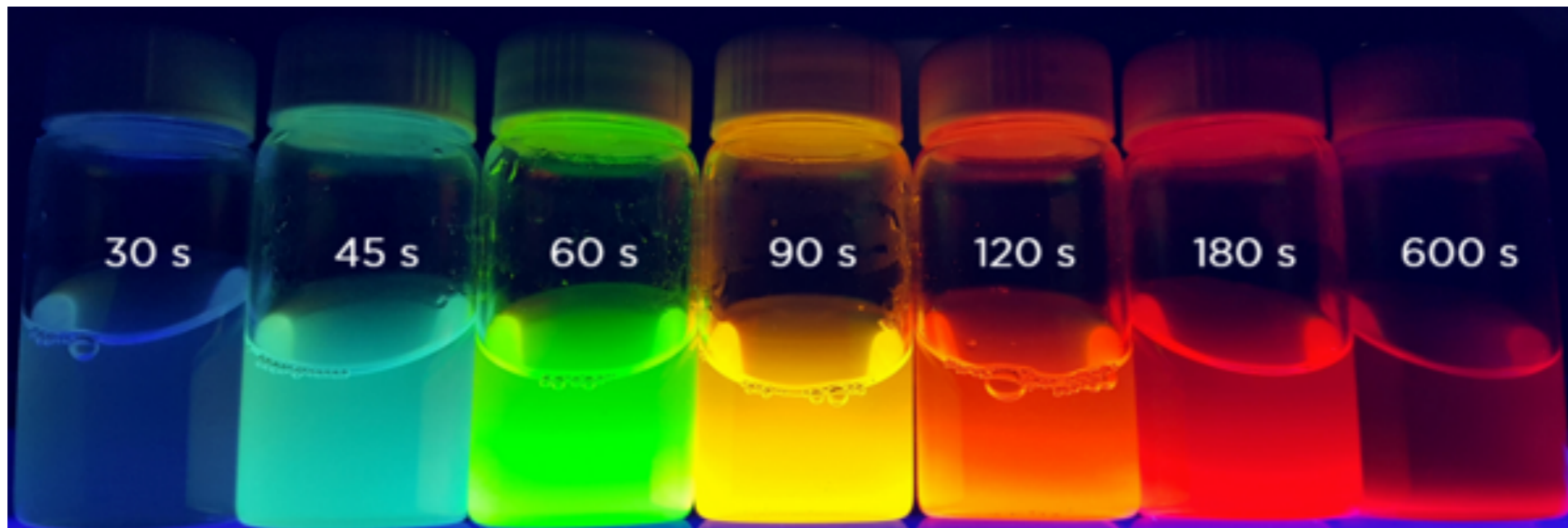
TARAN PREET SINGH (MS12044)

Making Cadmium Selenide QD

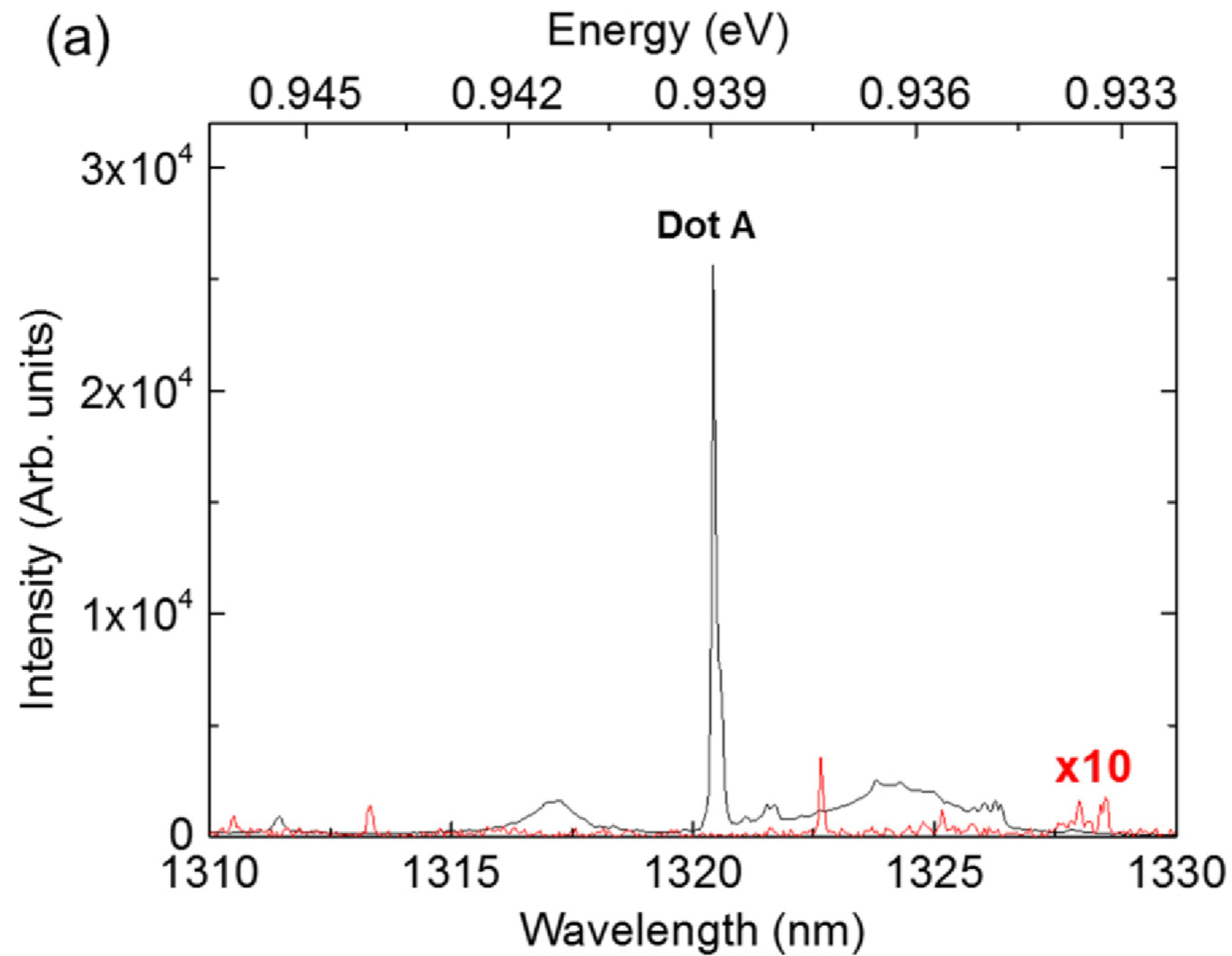
- Make a solution of Cadmium oxide
- At 250° C, add Selenium solution
- Small beads of Cadmium Selenide immediately start to grow
- Pull out samples with a syringe every few seconds



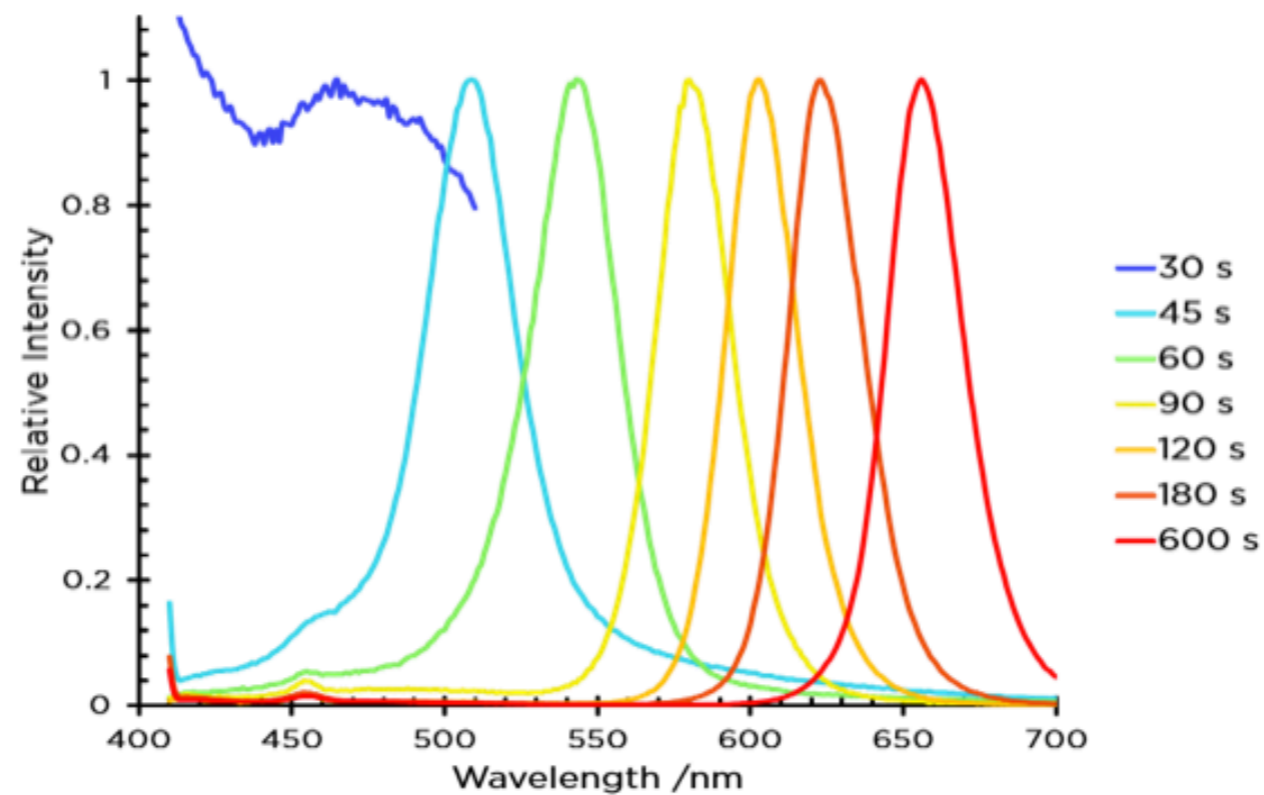
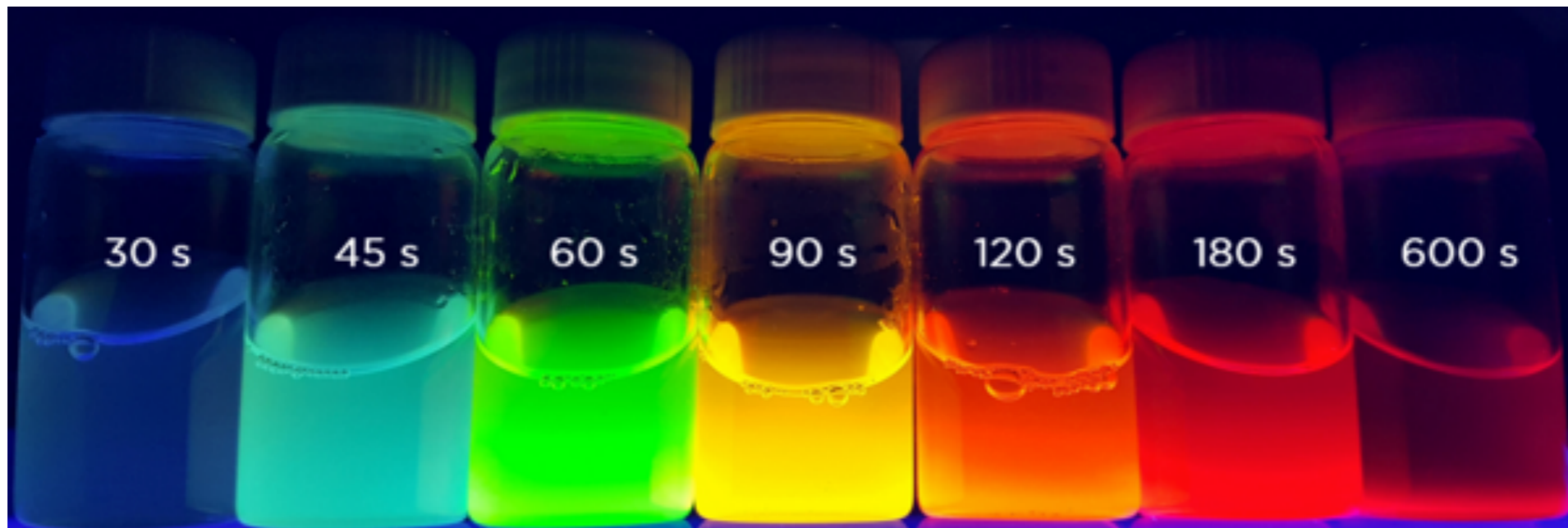
Making Cadmium Selenide QD



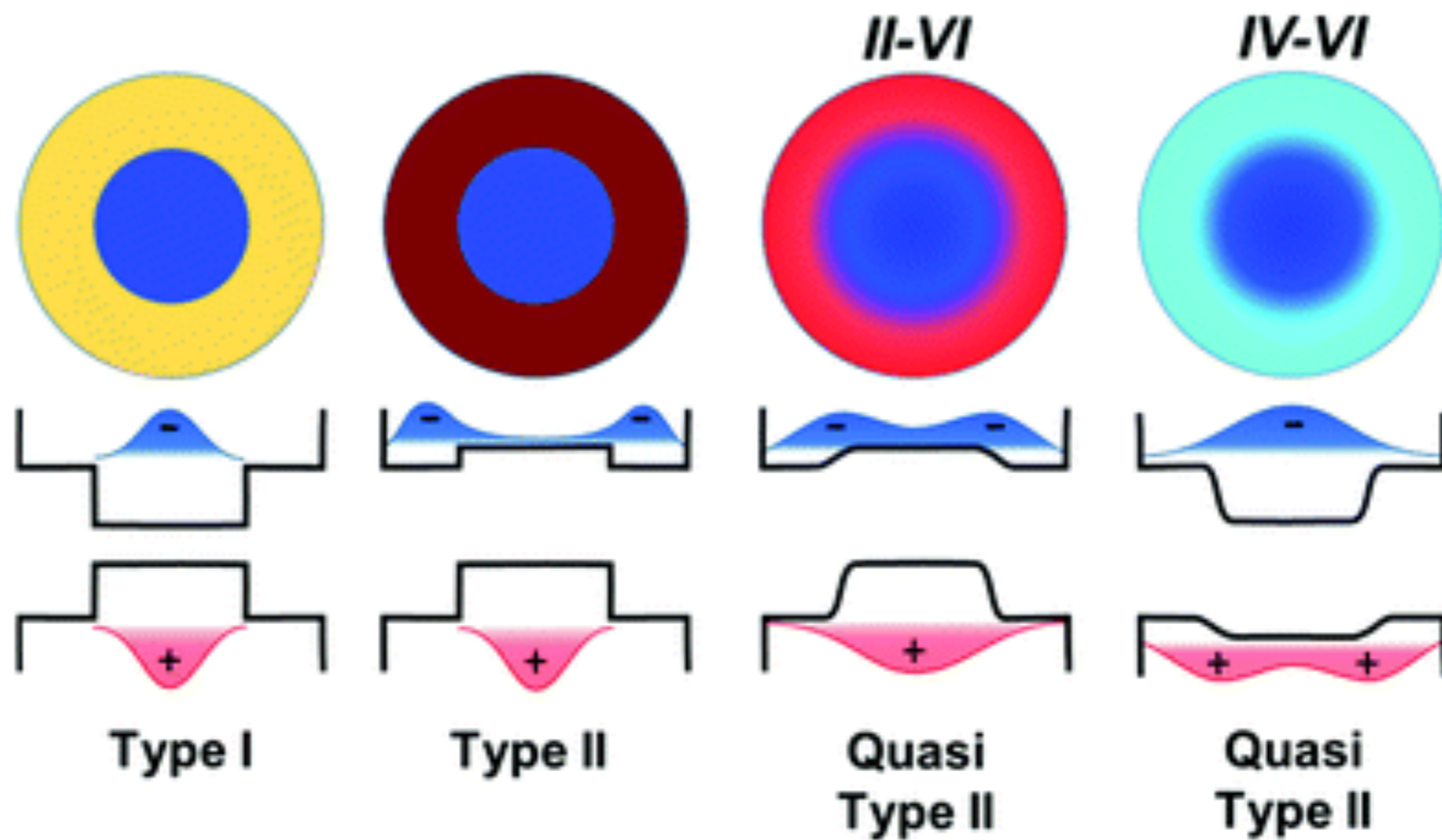
Single QD



Making Cadmium Selenide QD



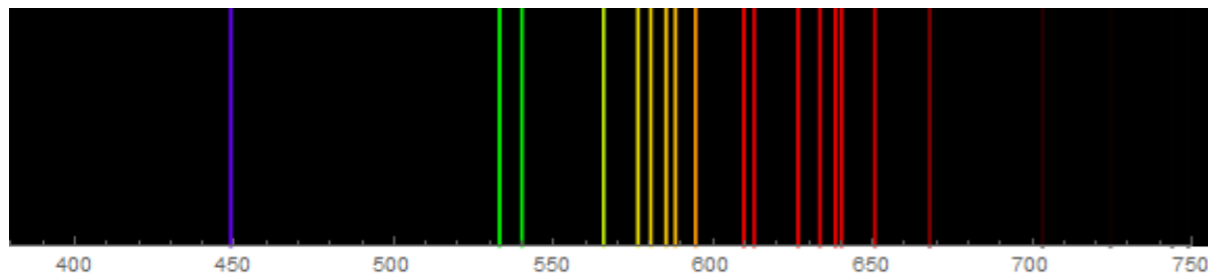
Two-layer beads



Natural vs. artificial traps

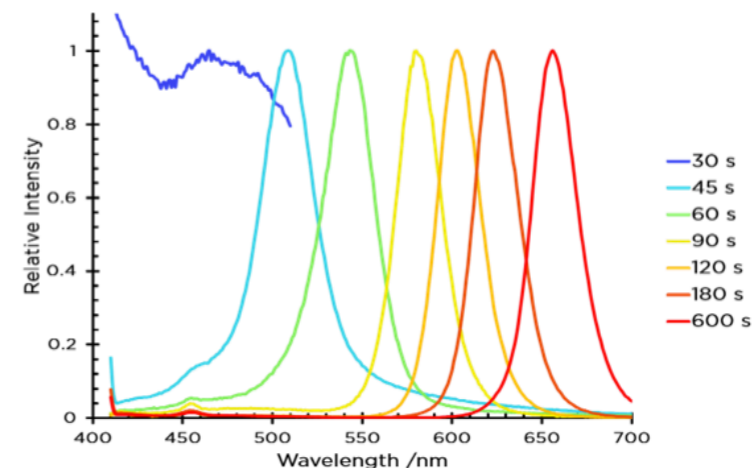
Natural

- Colors are what they are
- All traps of a type are identical (all neon atoms are identical)



Artificial (QD)

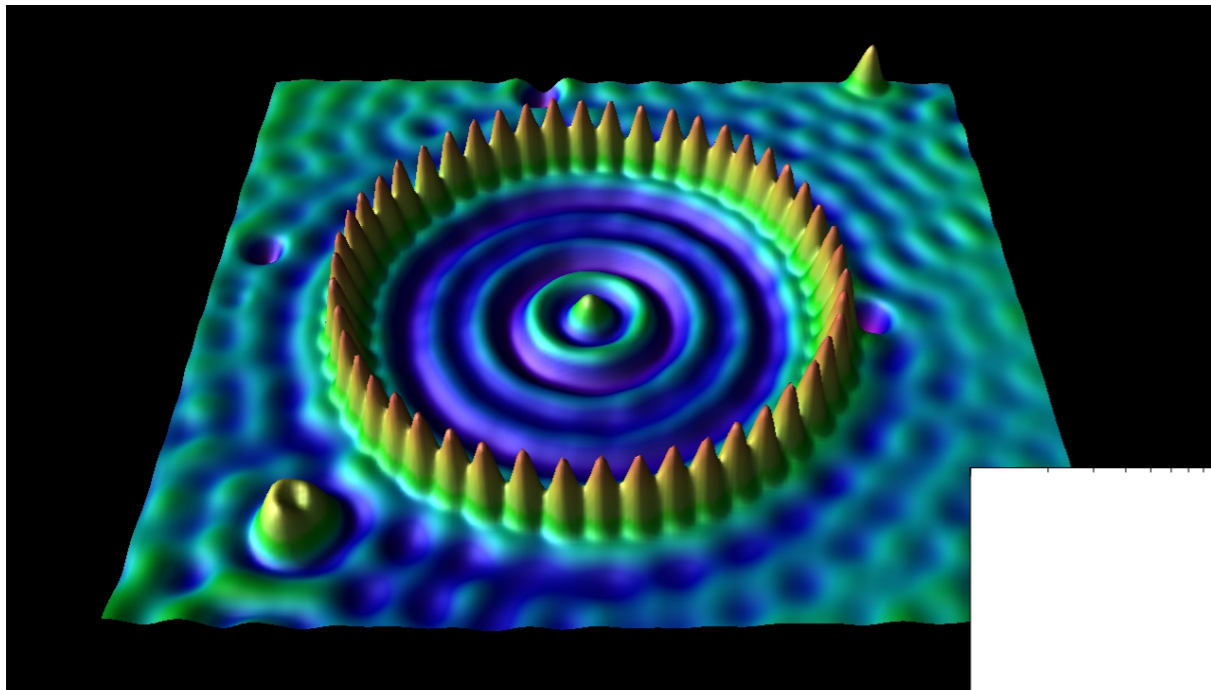
- Color can be tuned
- A variety of related traps is often unavoidable



Screens

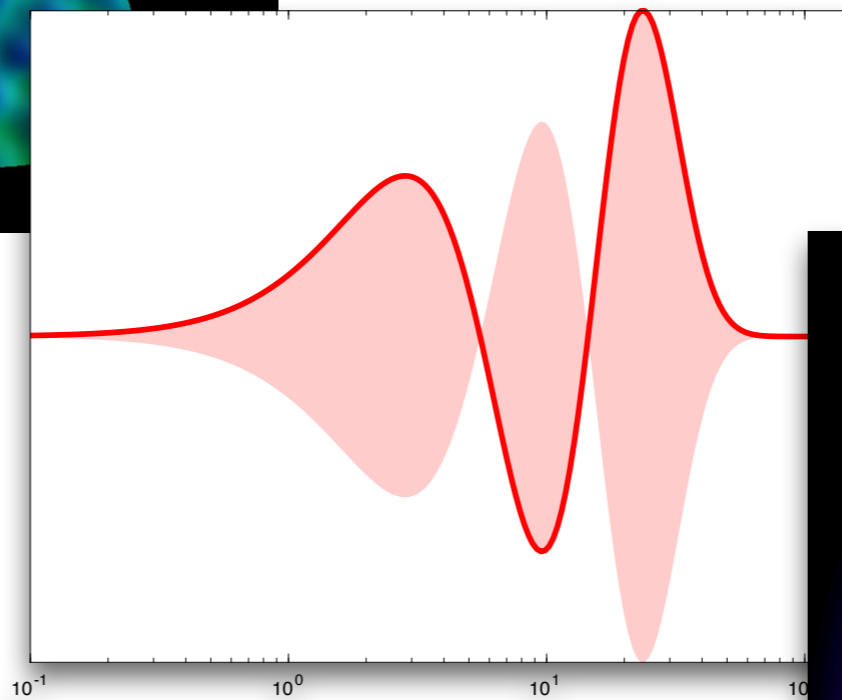


Electrons move as waves



Quantum
corral

Atom



Quantum dot

