

# Housekeeping

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- Midterm next week
- Thursday may be different

Why the caged bird sings

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# Free waves

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- Can have any primary wavelength (color, pitch)
- Move (always)
- Have a ripple length, and thus range of color
- Have a ripple width (very wide)

# Trapped guitar strings

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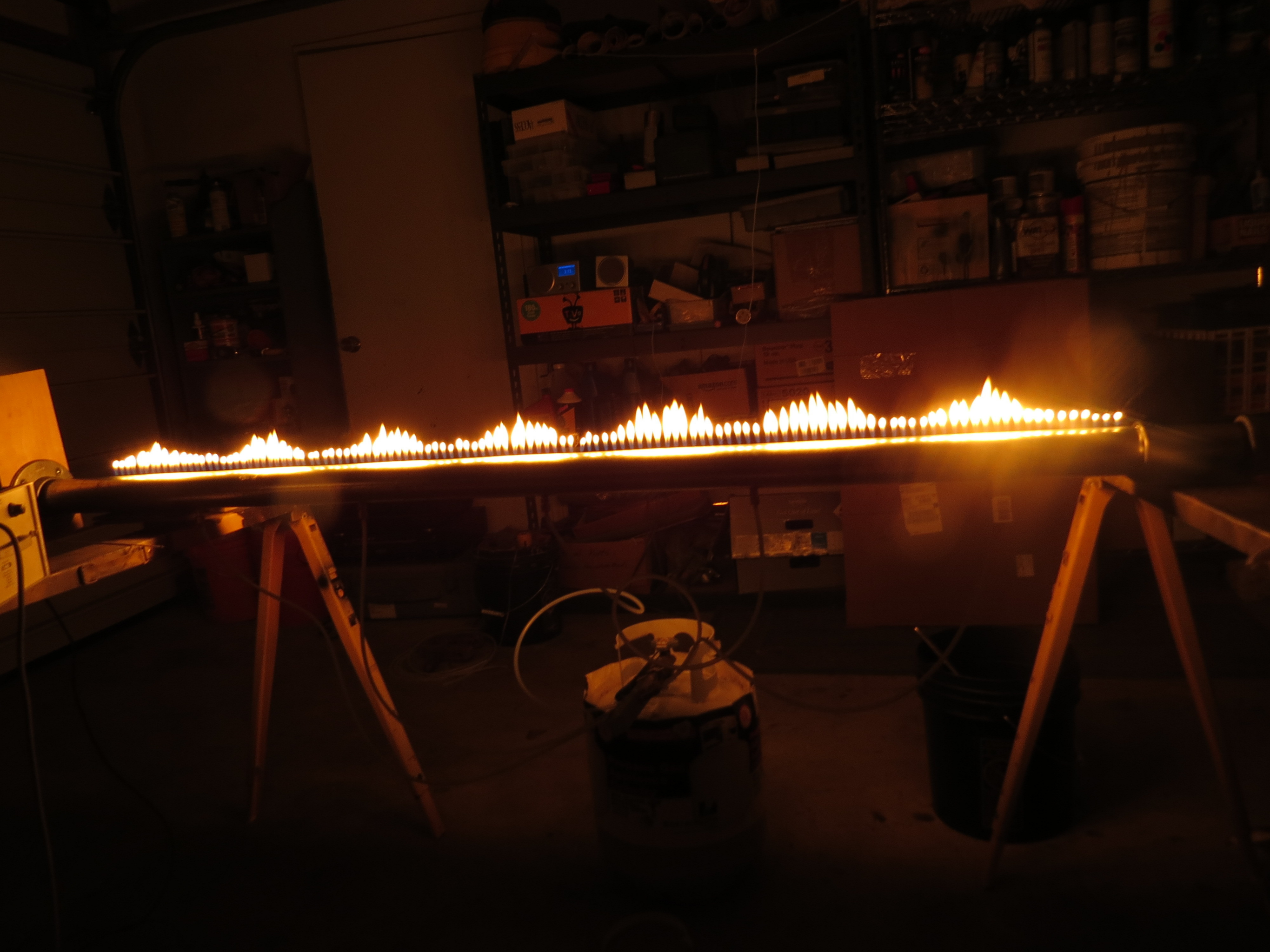




Result of color coating









# Sound in a pipe

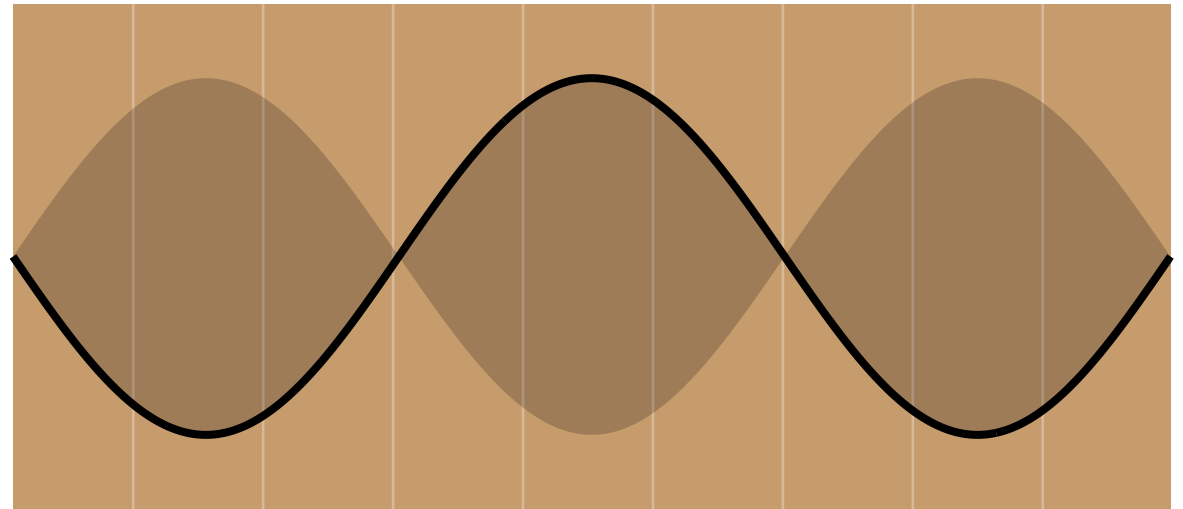
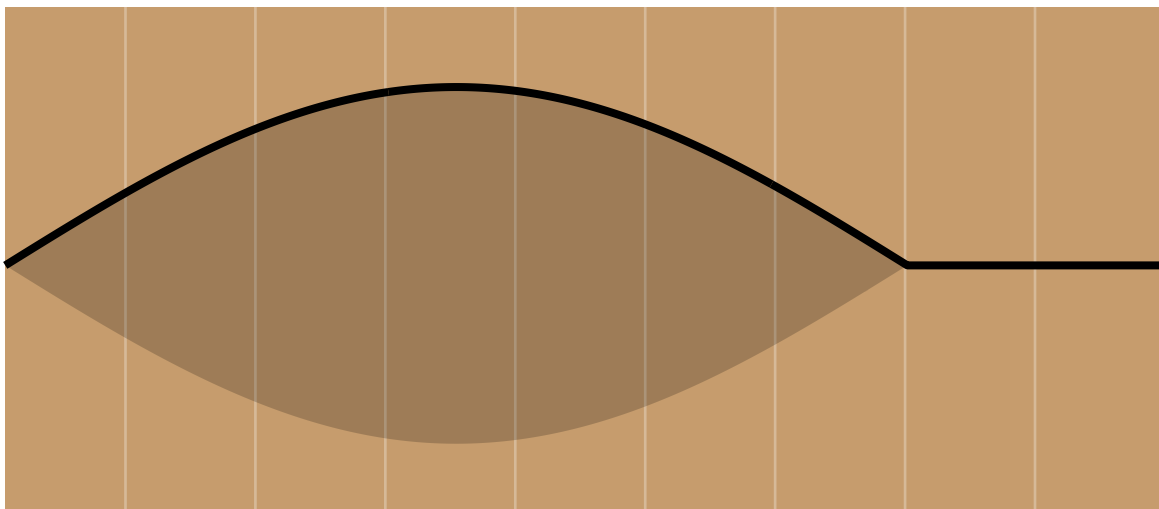
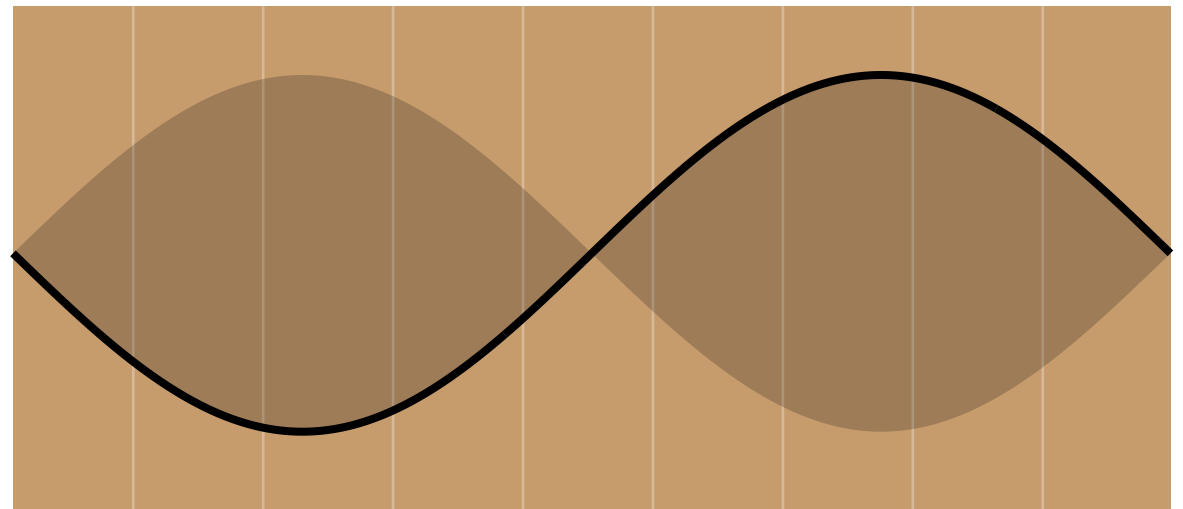
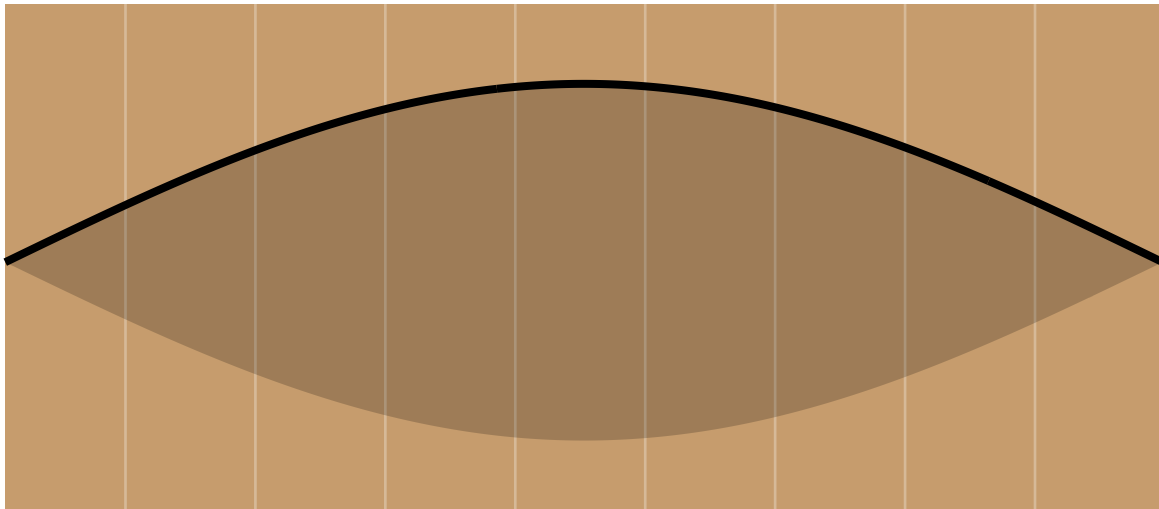
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# Trapped Waves

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- Change length
- Nodes & anti-nodes

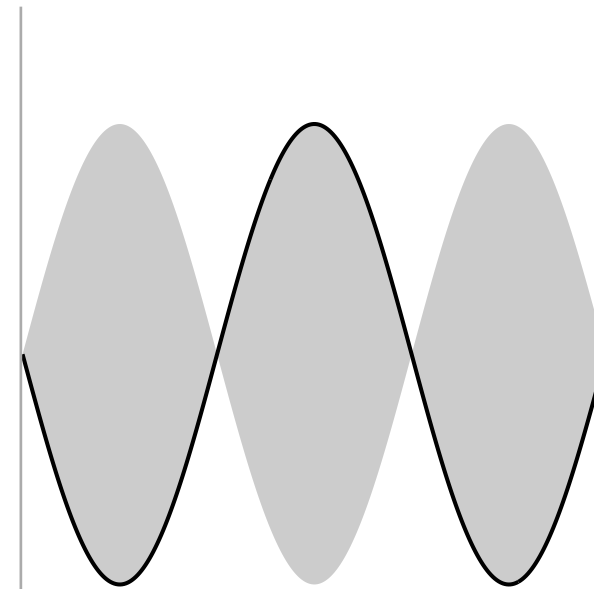


# Guitar waves

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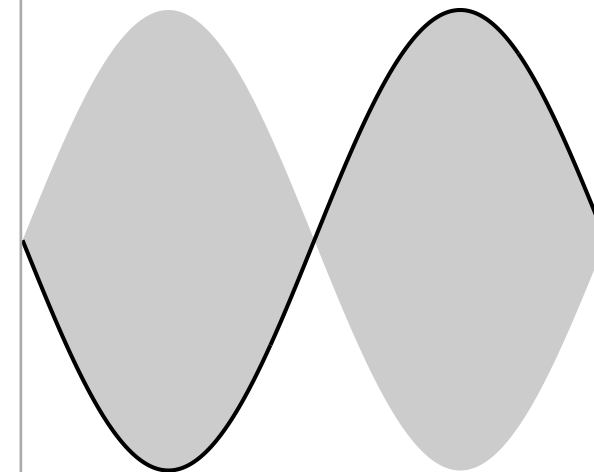
- Really any uniform trap of a line-like wave

3<sup>rd</sup> harmonic



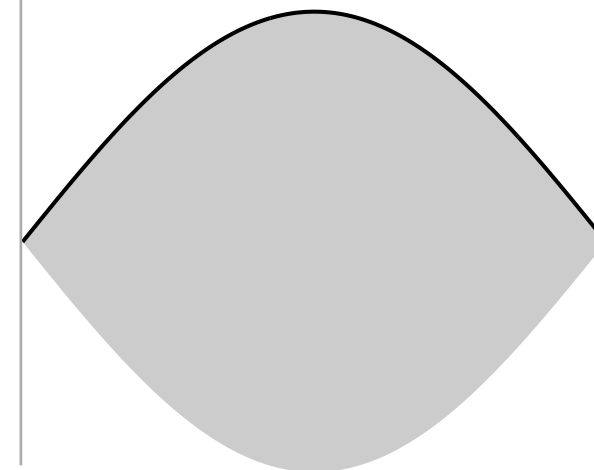
Next-next  
lowest energy

2<sup>nd</sup> harmonic



Next lowest  
energy

Fundamental



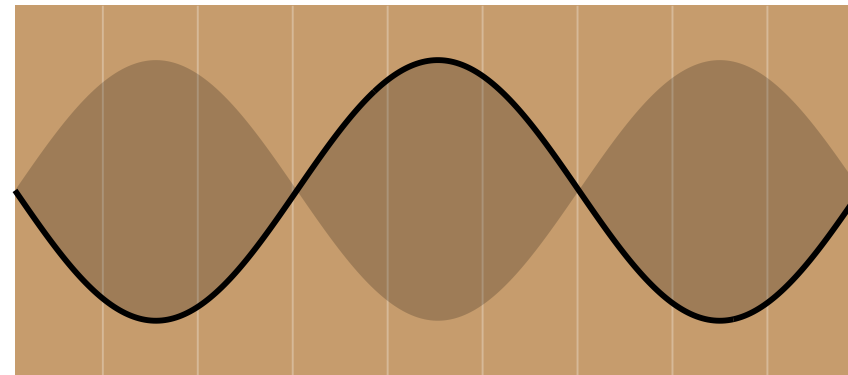
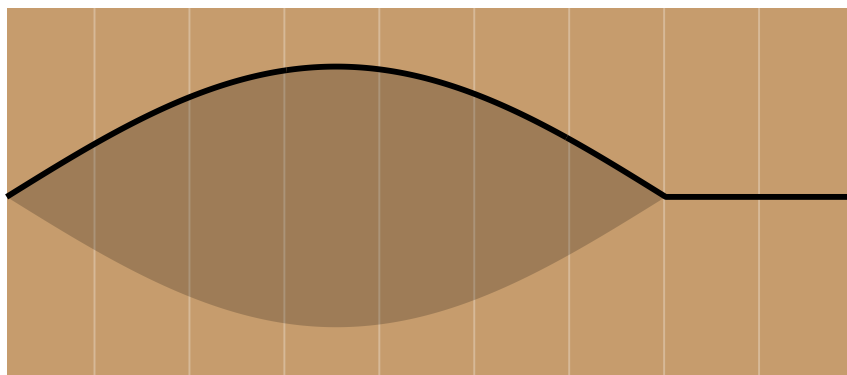
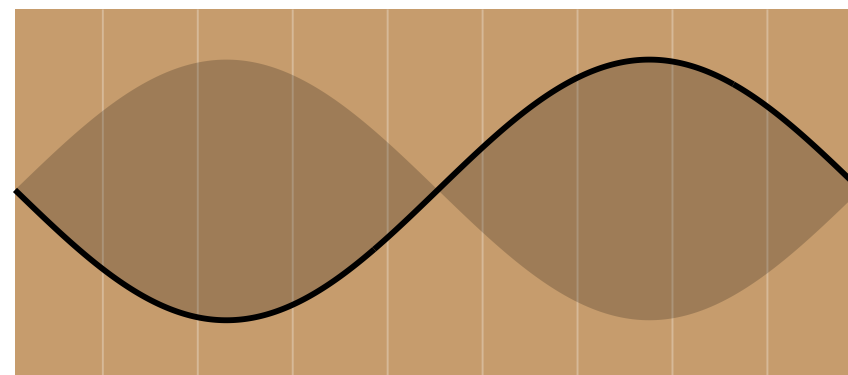
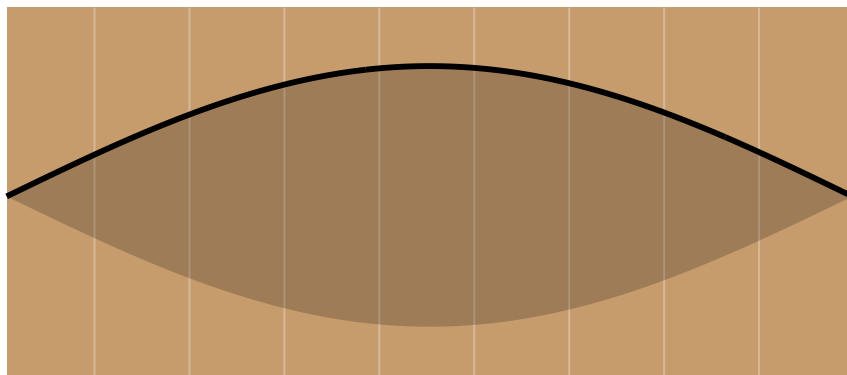
Lowest  
energy



# Trapped waves

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- Can only have wavelengths (colors, pitches) that fit in the trap. Colors are ***discrete***.
- Stay within the strap (~stationary)
- Have very narrow color ranges



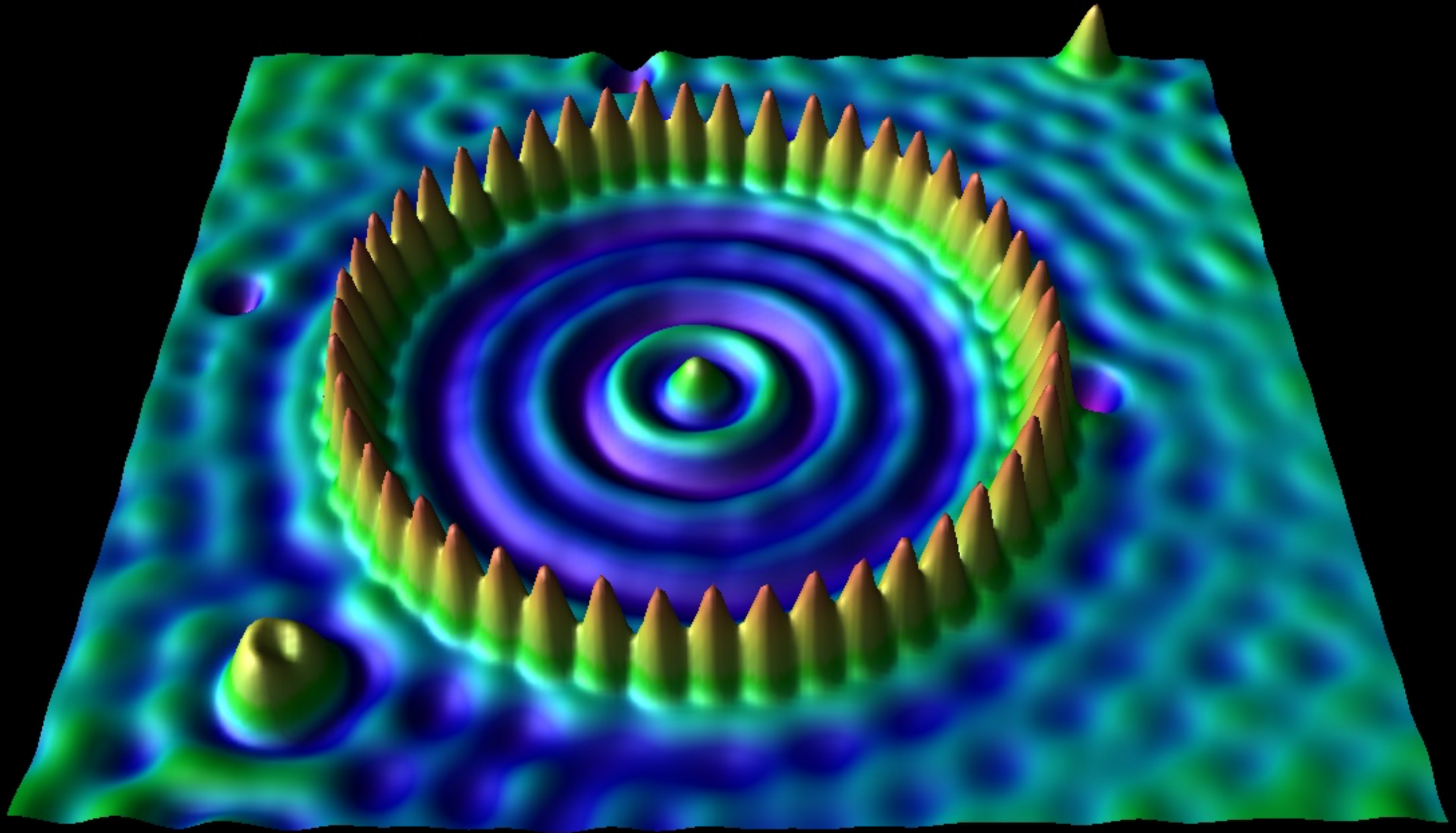
# Drums

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# Quantum corral

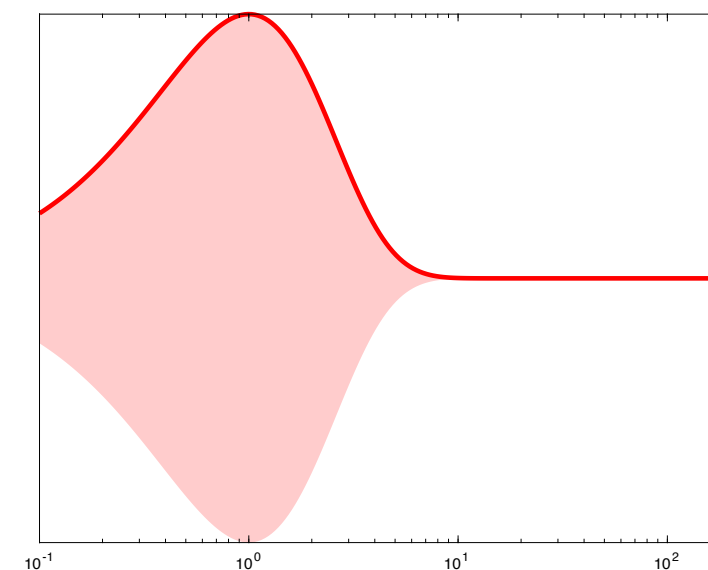
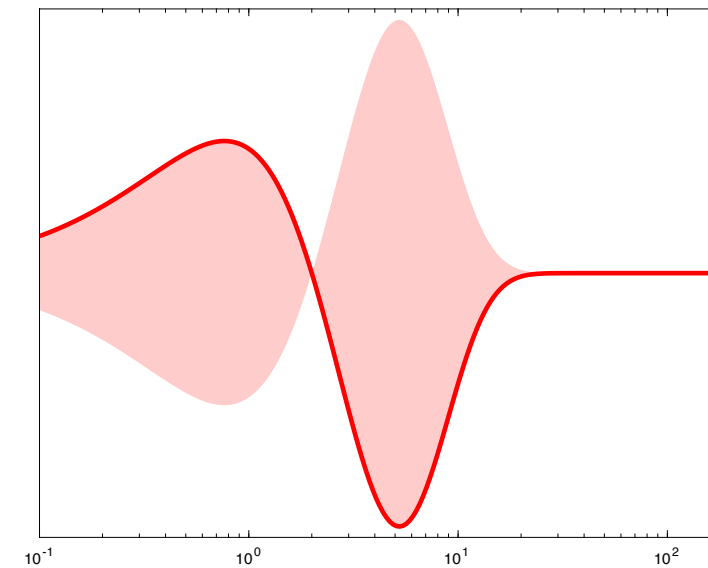
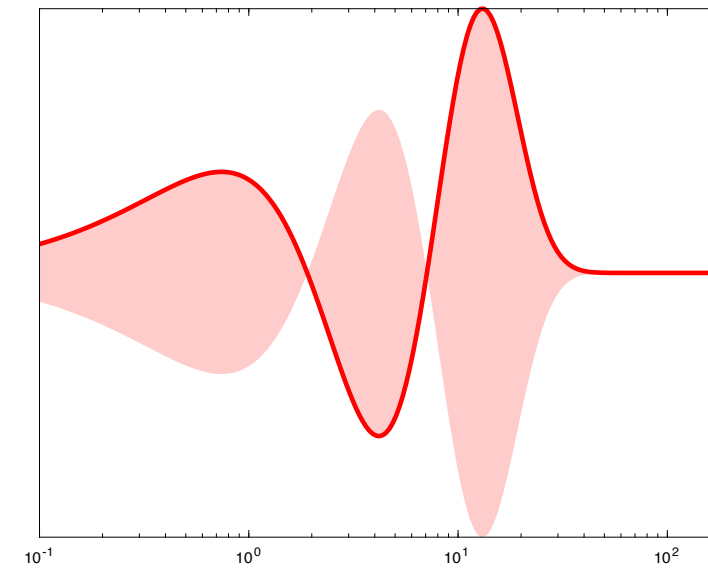
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# Atomic traps

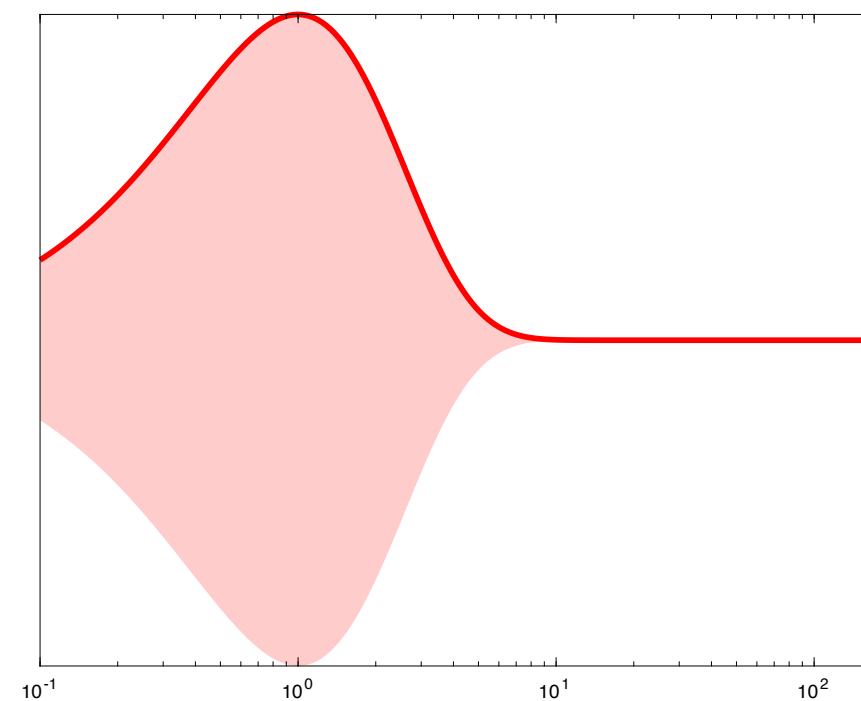
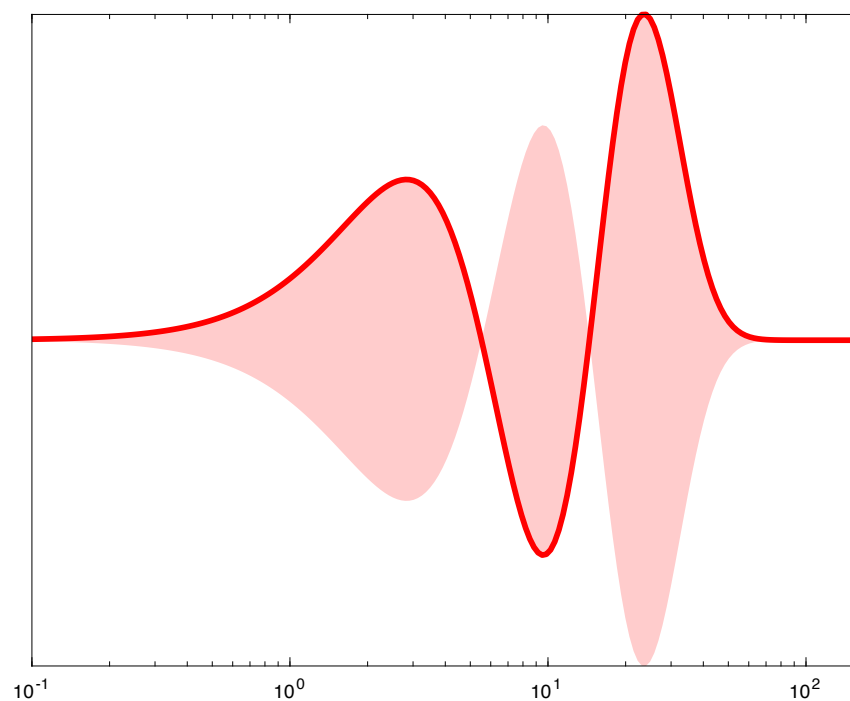
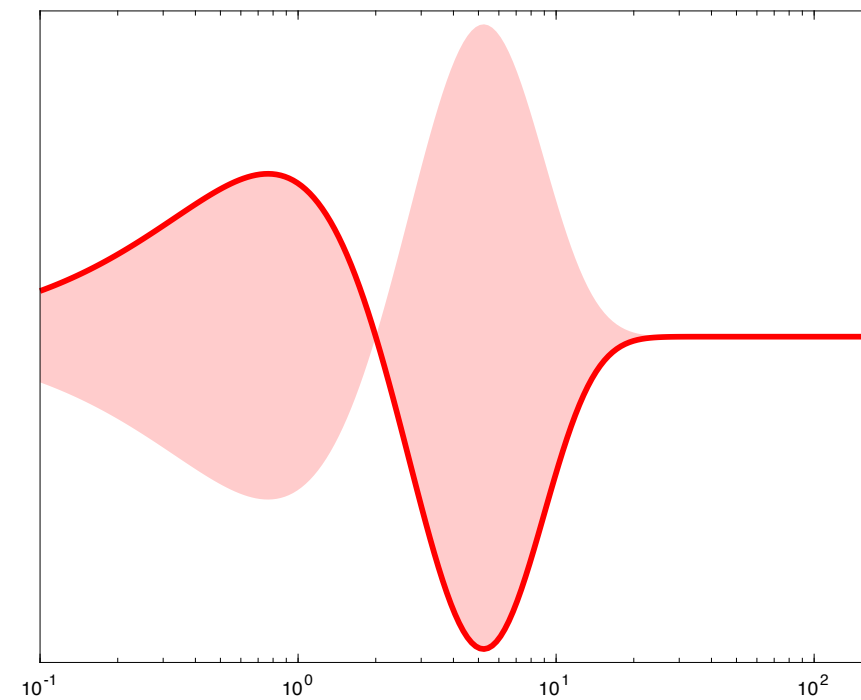
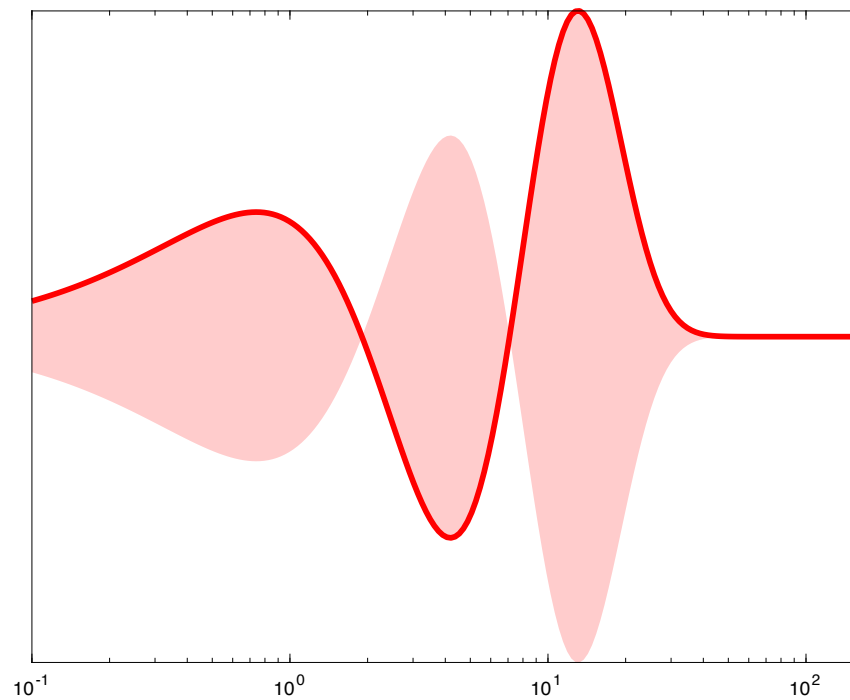
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- Electron moves like a wave
- Is trapped by the nucleus
- Funny trap 'shape': strong near nucleus weaker farther away
- Really 3D, only showing radial shape here



# 4 waves

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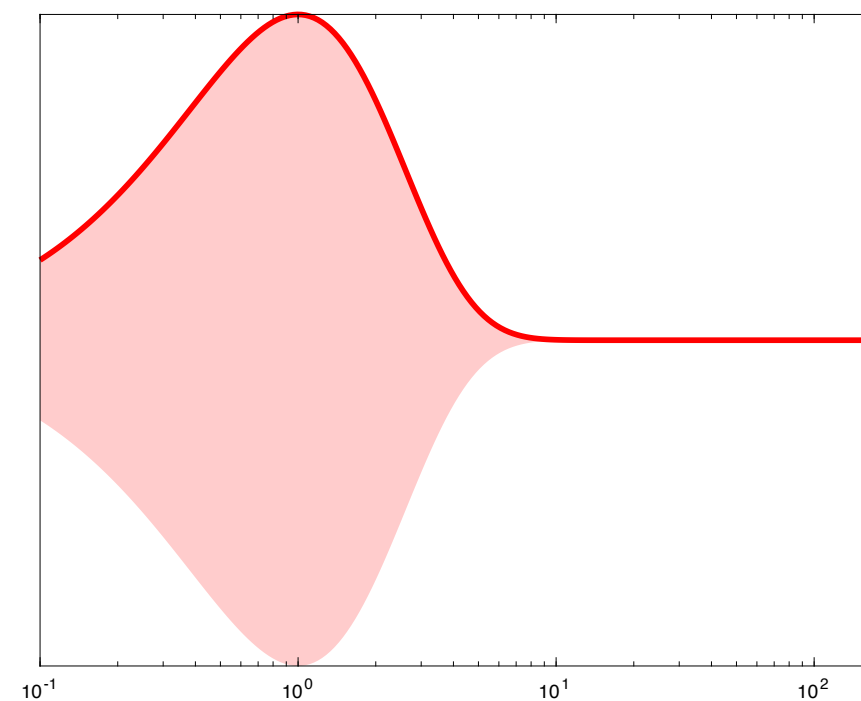
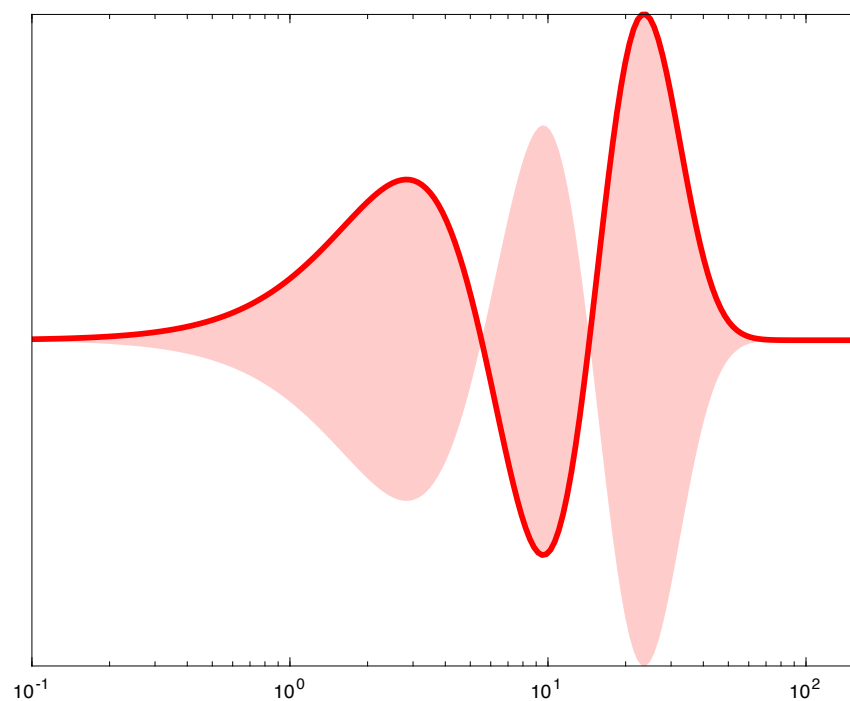
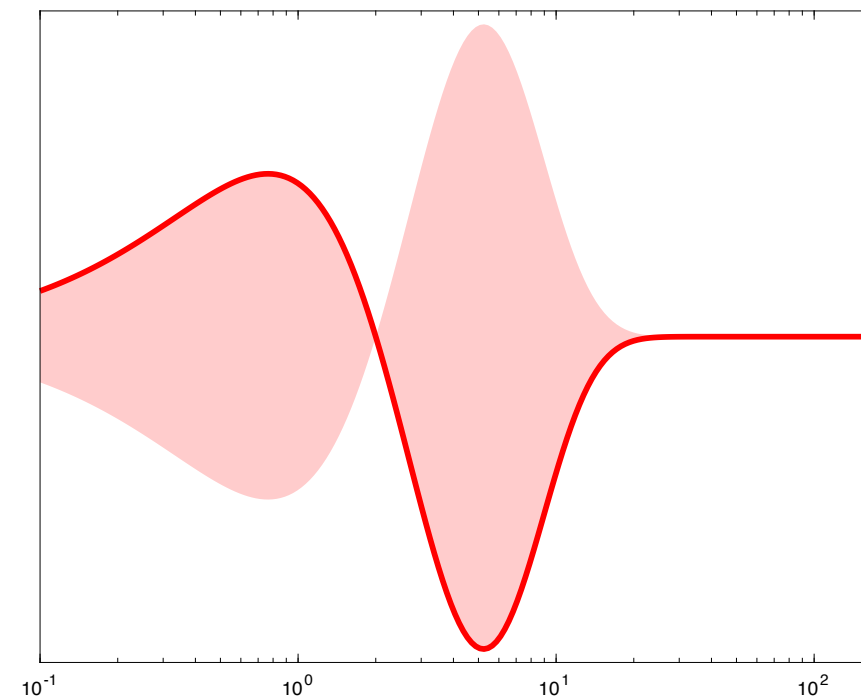
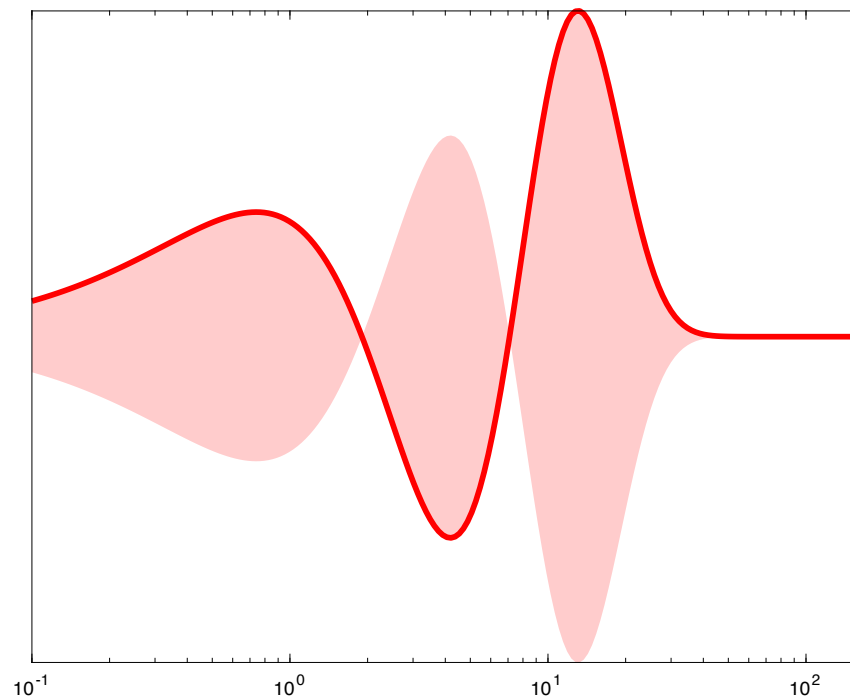
# Energy of an electron wave depends on:

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- How sharp the wave curvature is
- How far from the nucleus (how far right)

# 4 waves

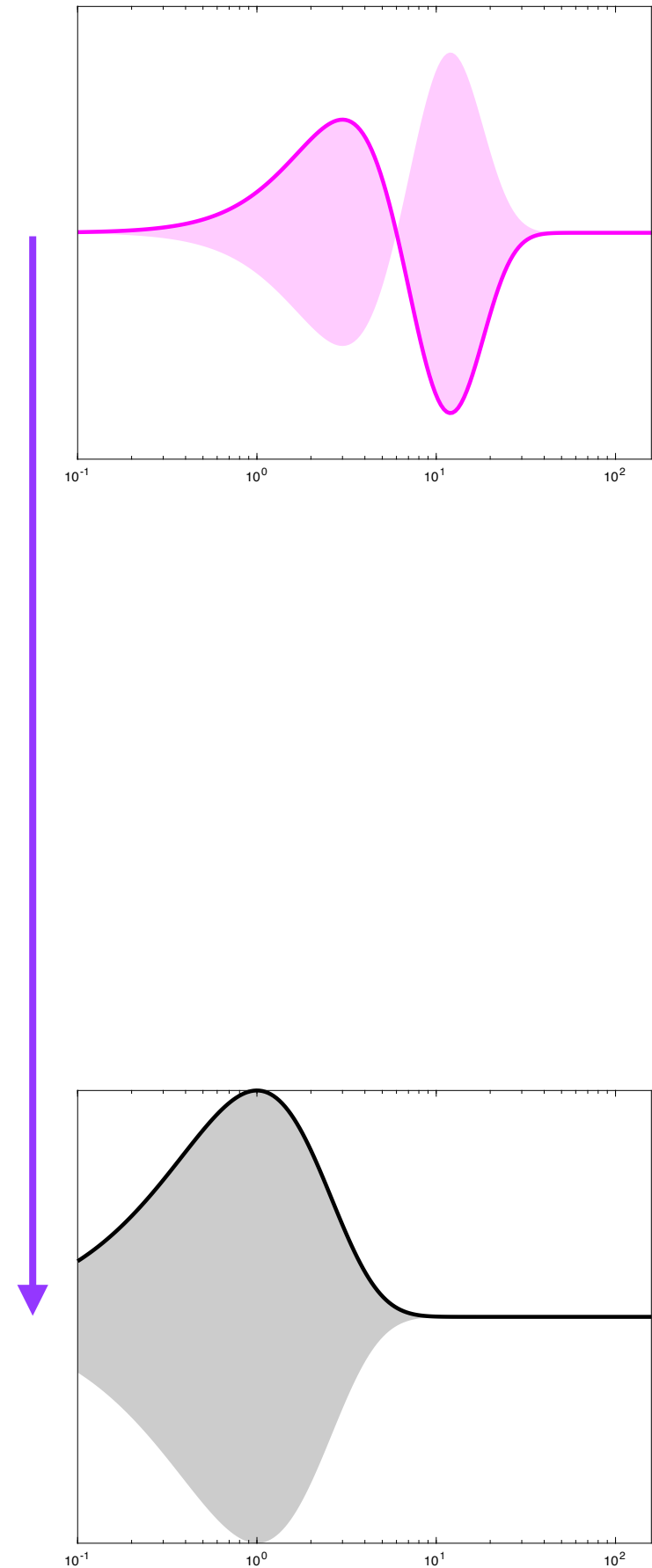
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# Making light

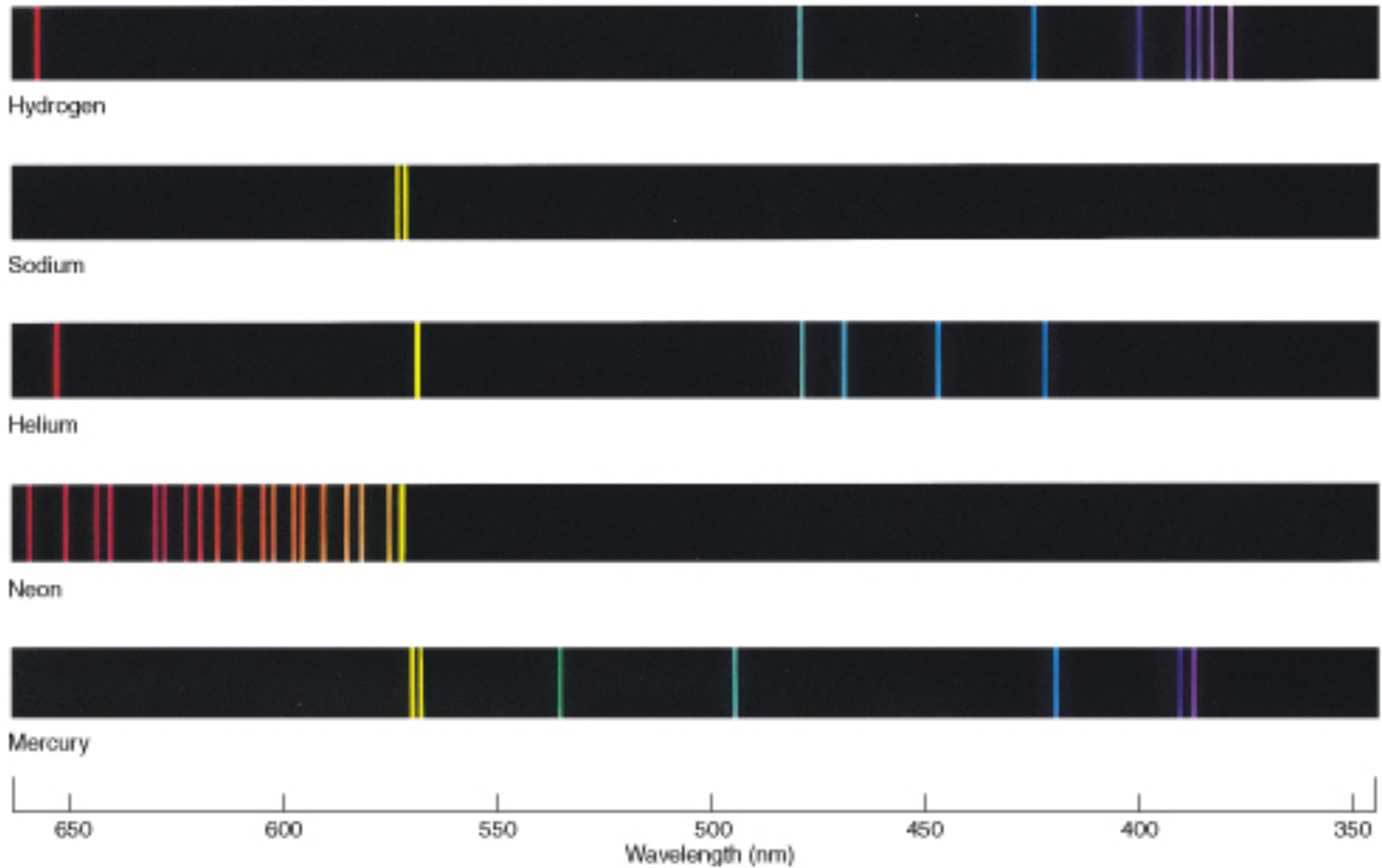
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- We don't see the electron waves, or what energy they have
- When an electron jumps down from one wave to another, it creates a photon with the energy ***difference***.



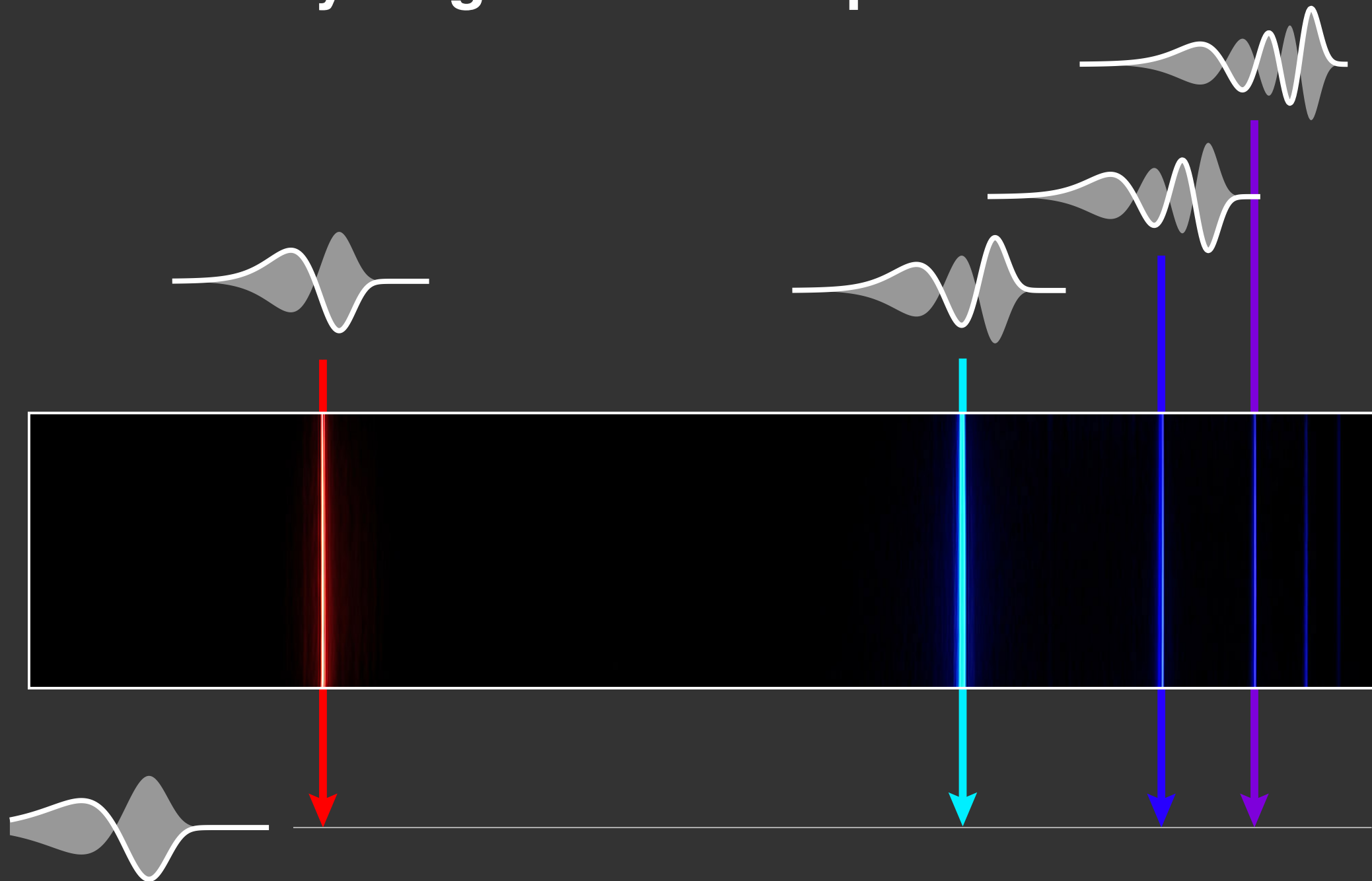
# Spectra of elements

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# Hydrogen Spectrum

## Hydrogen Balmer Spectrum





# Spectra of elements

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Hydrogen



Sodium



Helium



Neon



Mercury

