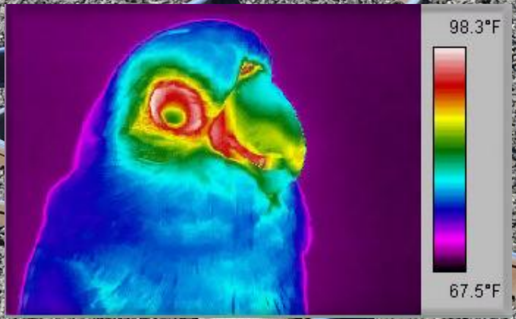
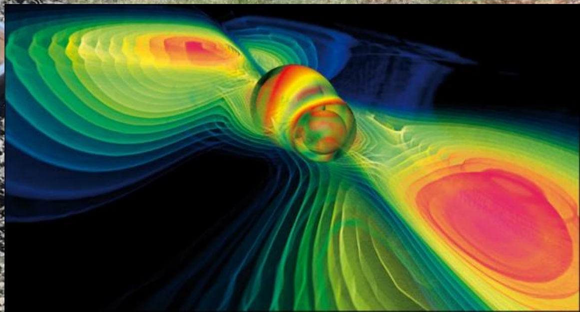
Waves Song

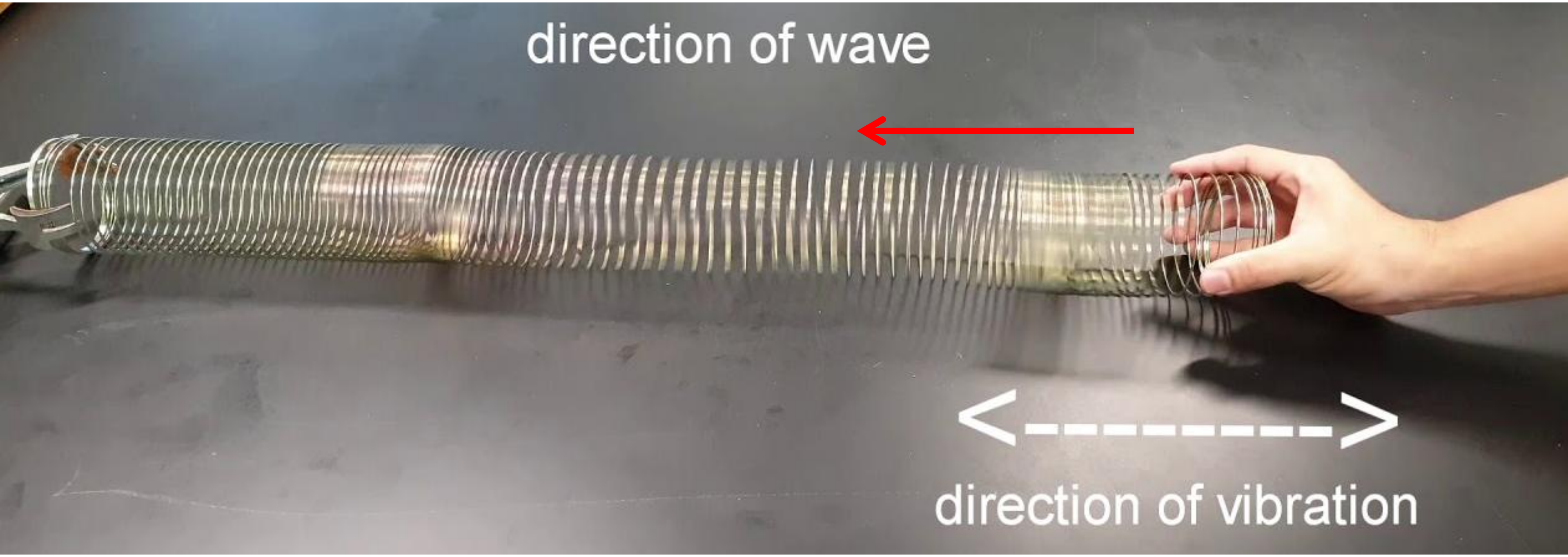


Images CC from Wikipedia
or otherwise credited

Andy “Dijon” French
September 2022



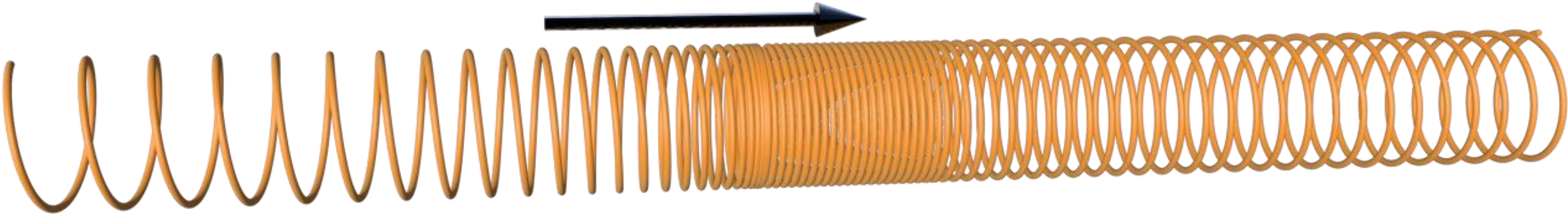
Evan Toh https://www.youtube.com/watch?v=g8GcMn7K0u4



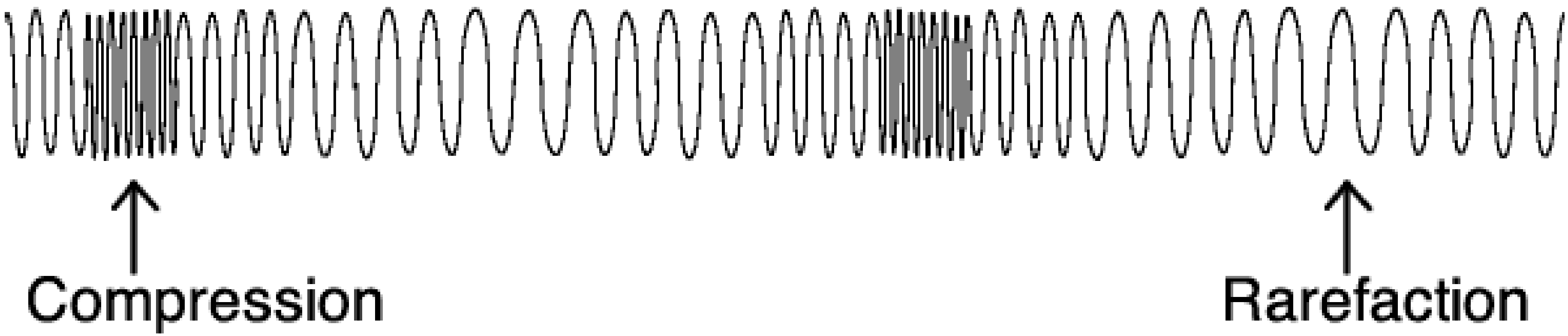
A pulse on a slinky passes by a disturbance called a *wave*

$$\psi(x,t)$$

$$v = f\lambda$$

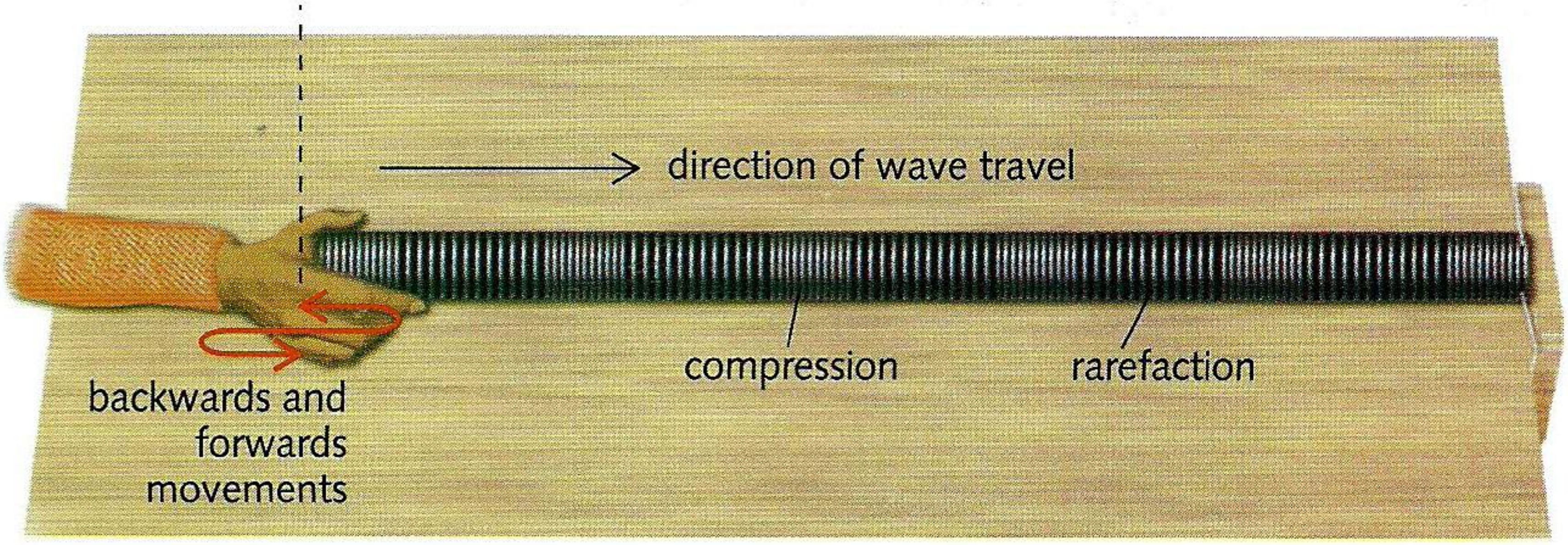


It moves along at a certain speed tells coils how to behave



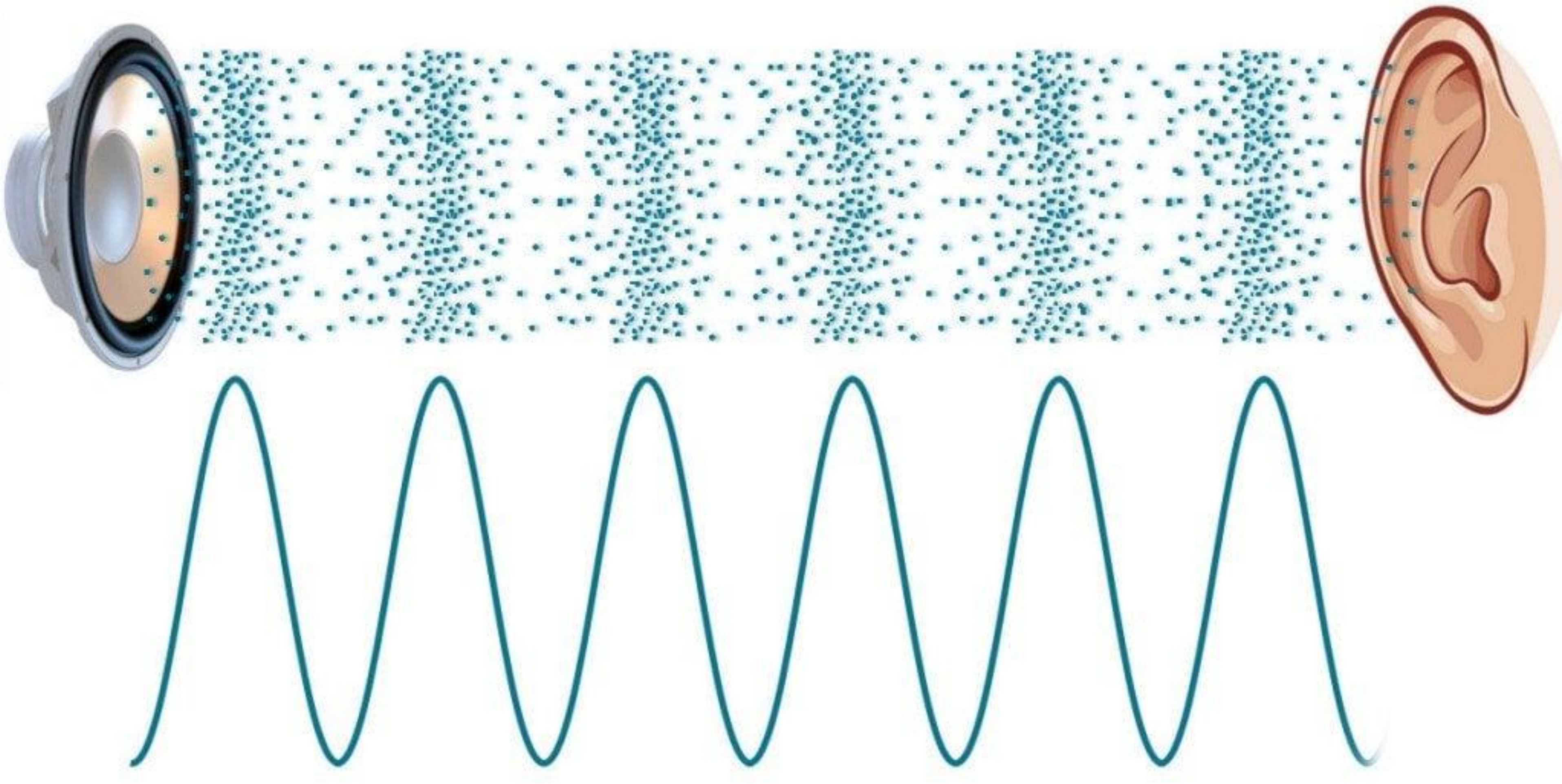
Those springy little loops of wire contract and rarefact

Longitudinal waves

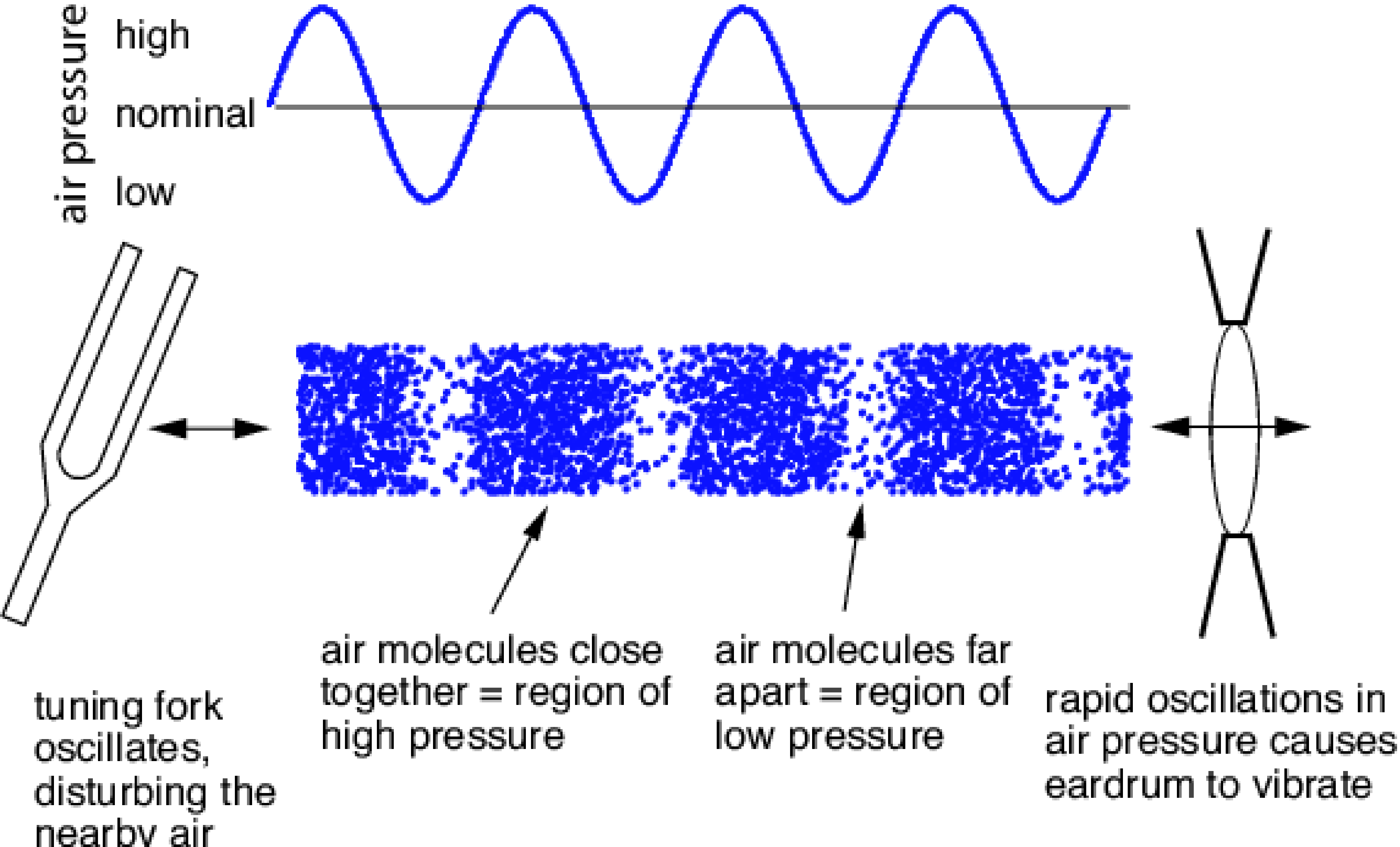


Longitidinal is the direction that it acts

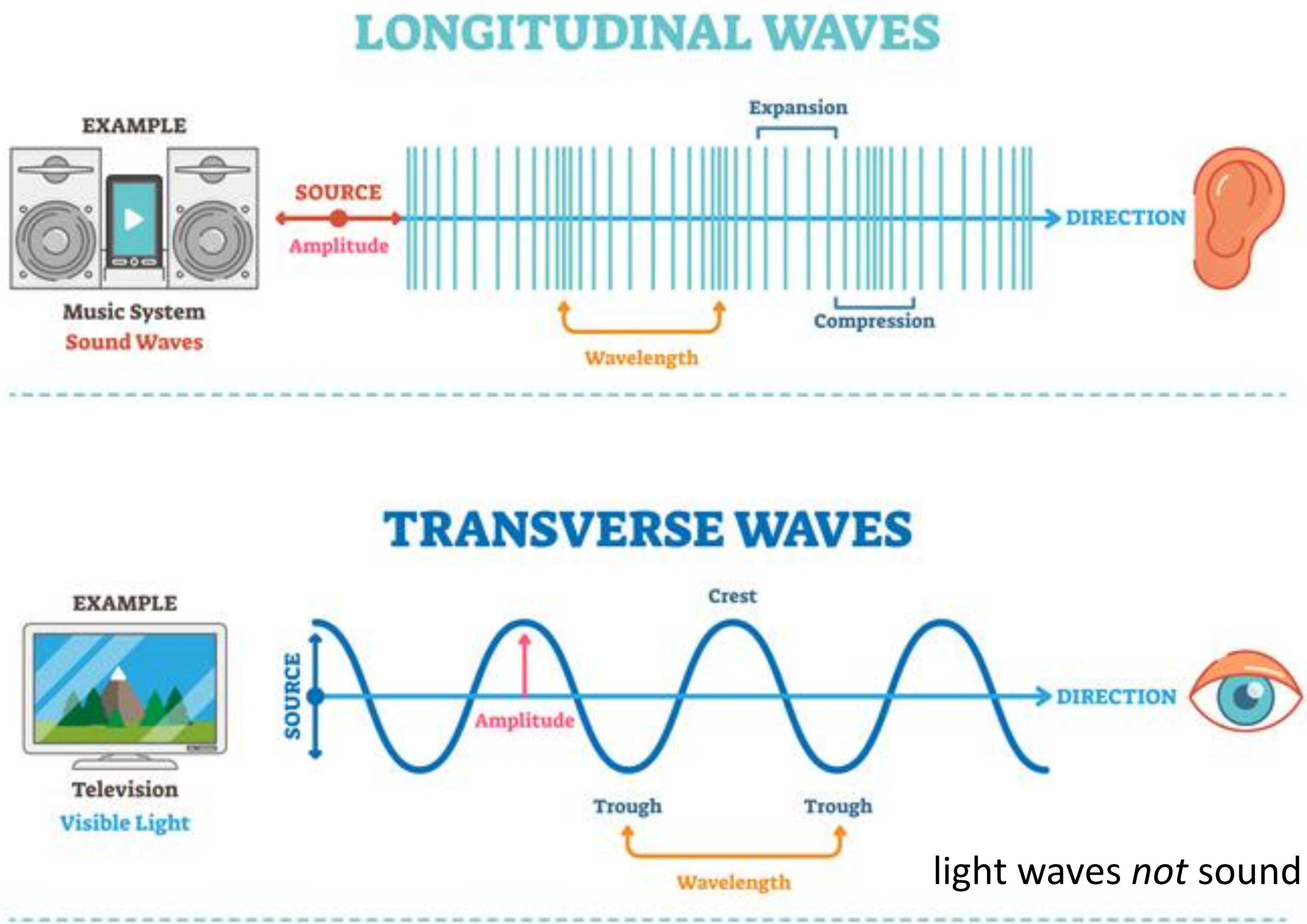
https://www.scienceabc.com/pure-sciences/movement-of-sound-waves-through-different-media.html



They're called P-waves it's how you hear this song



Air pressure rises up and down

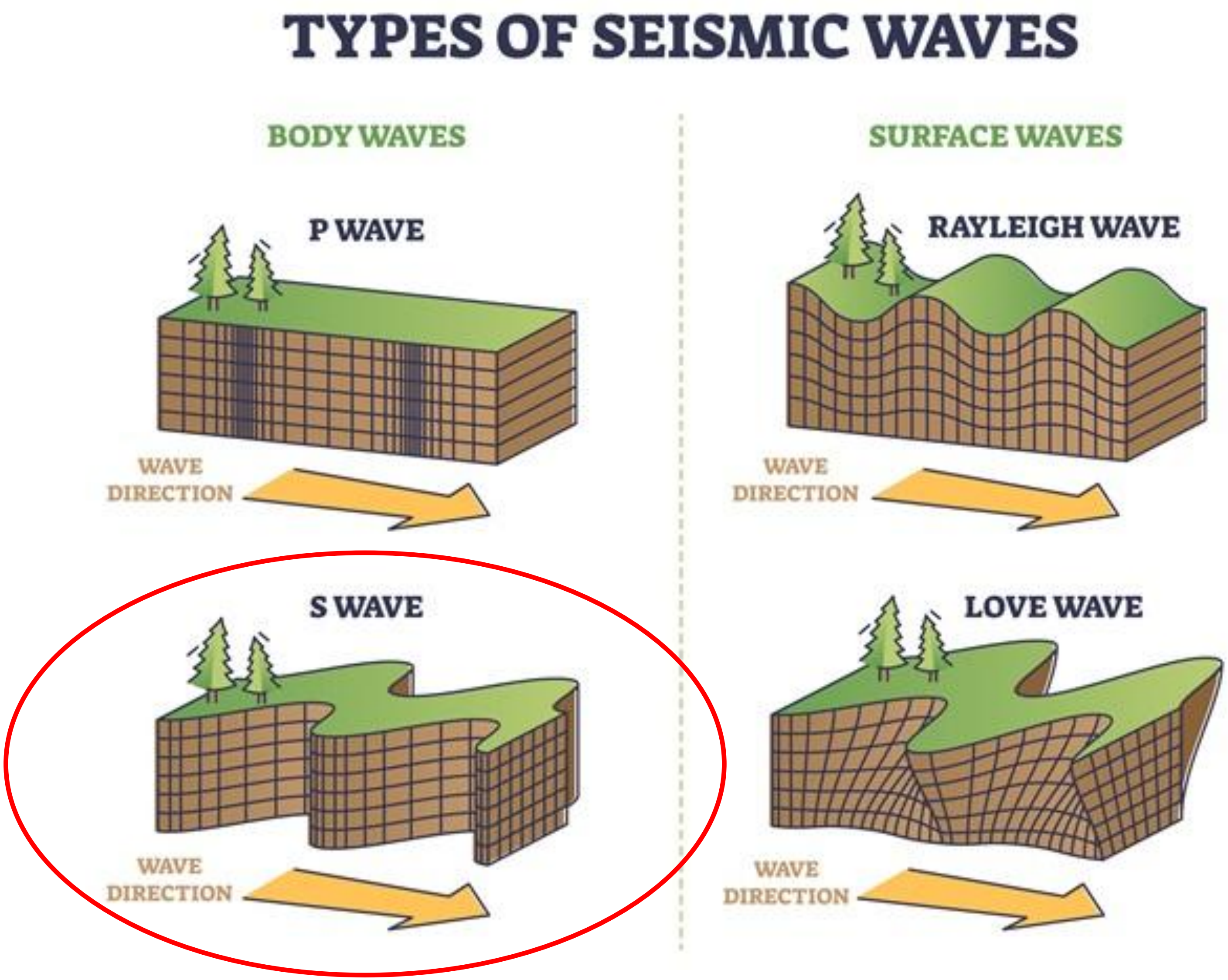


✓

X

light waves *not* sound waves!

Not sideways (that’s just wrong)

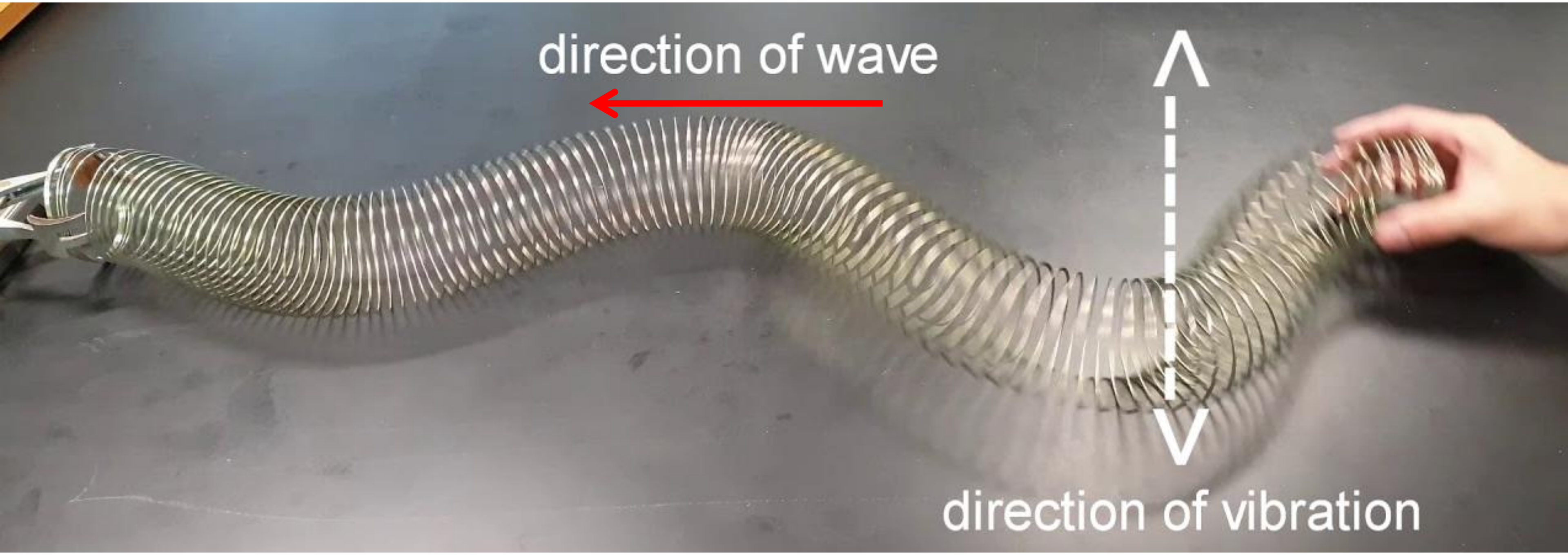


https://astronomy.com/news/2022/06/what-can-earthquakes-and-marsquakes-teach-us-about-planets

But like a seismic shear

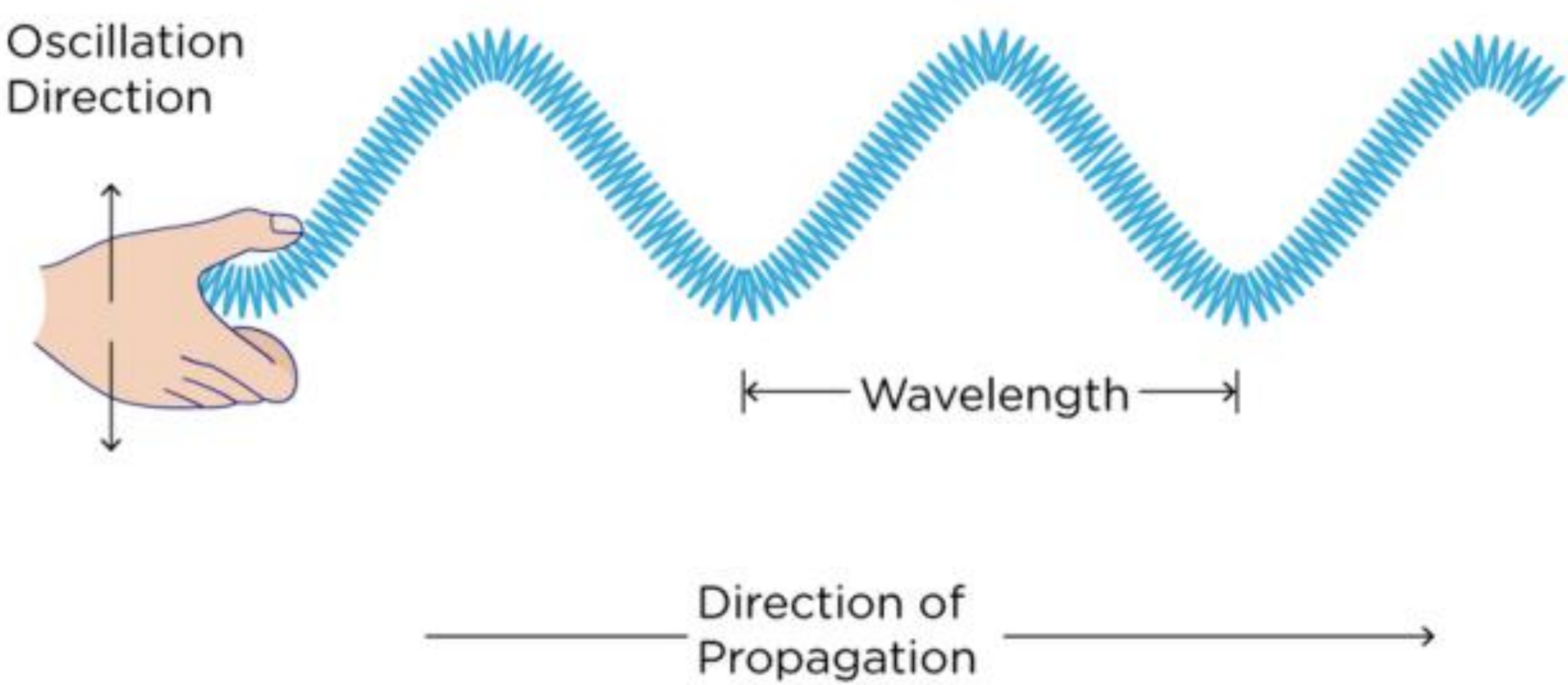
we can wiggle our tensioned spring

Evan Toh https://www.youtube.com/watch?v=g8GcMn7K0u4



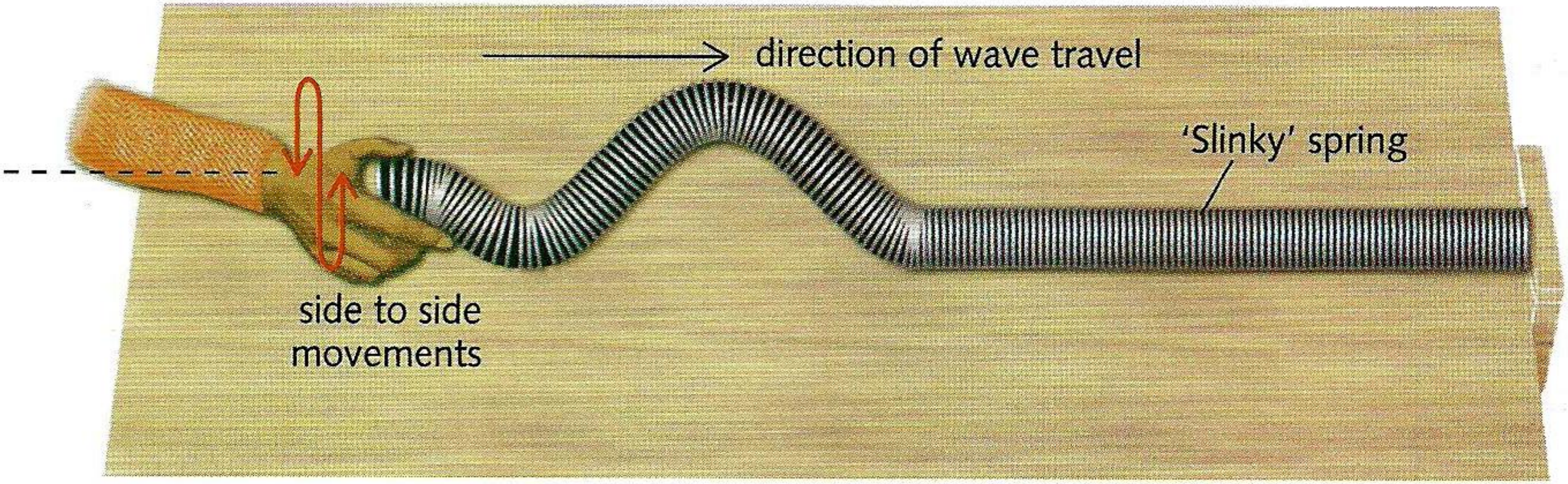
A sinusoidal wave propagates along the thing

https://jackwestin.com/resources/mcat-content/periodic-motion/transverse-and-longitudinal-waves-wavelength-and-propagation-speed

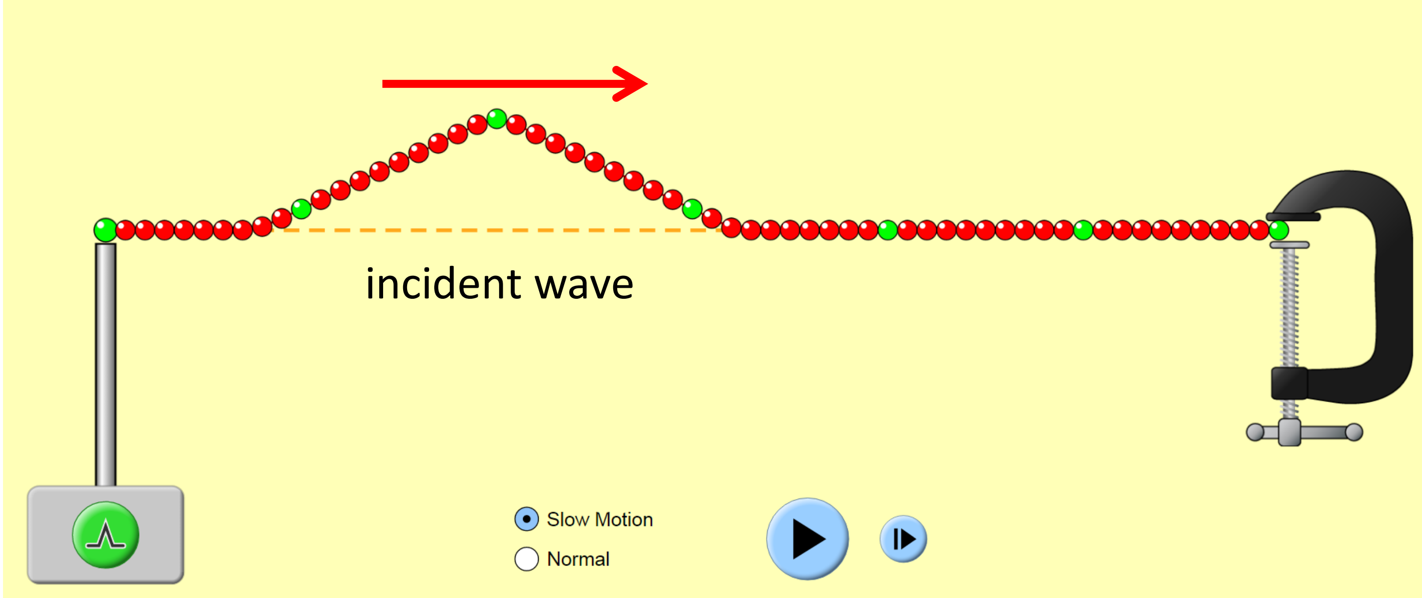


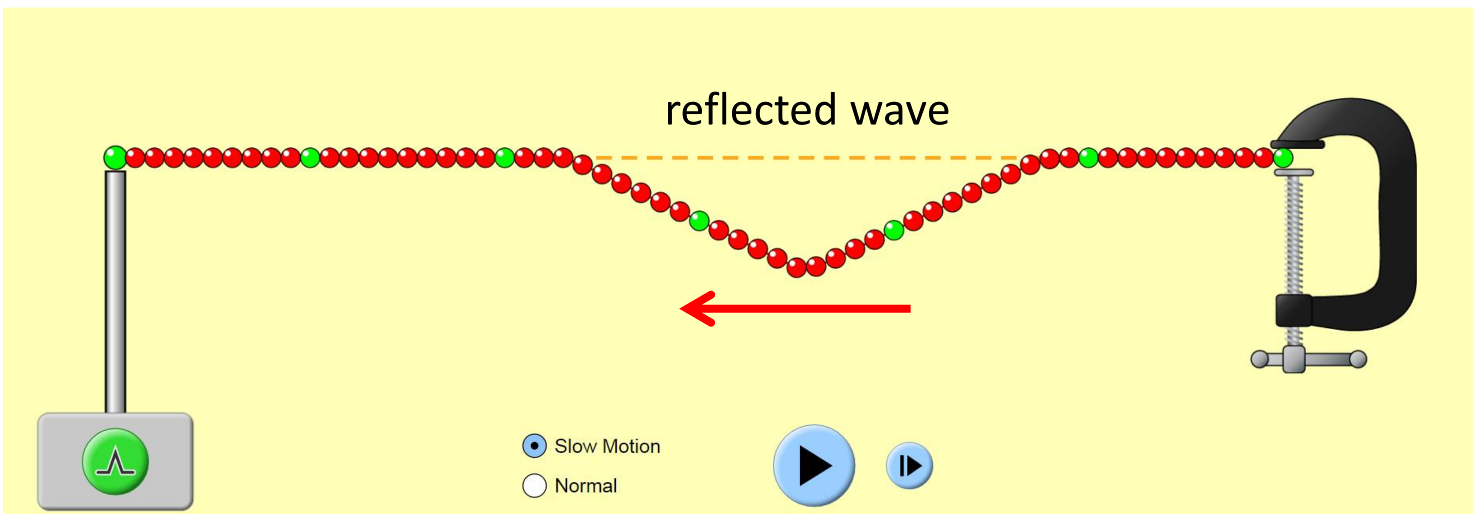
Disturbance *perpendicular* to the direction it came from

Transverse waves



Transverse is the name of this wave phenomenon

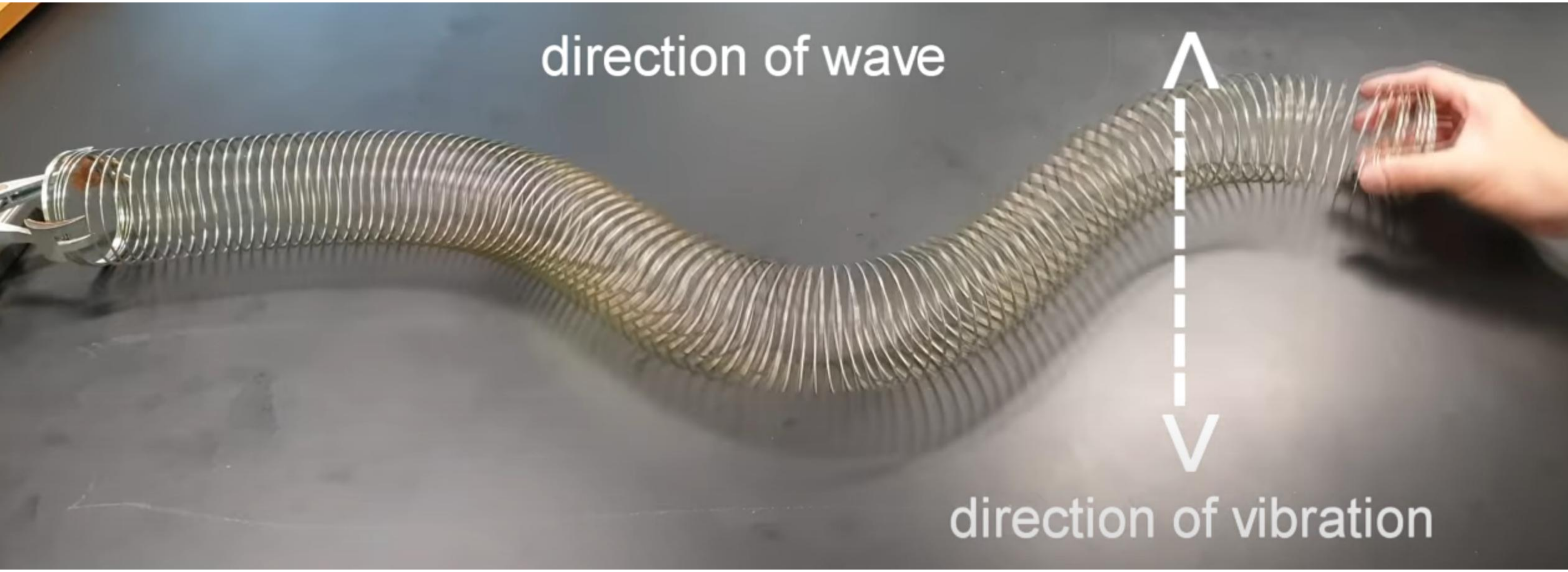




If you hold the slinky's end the wave it will invert

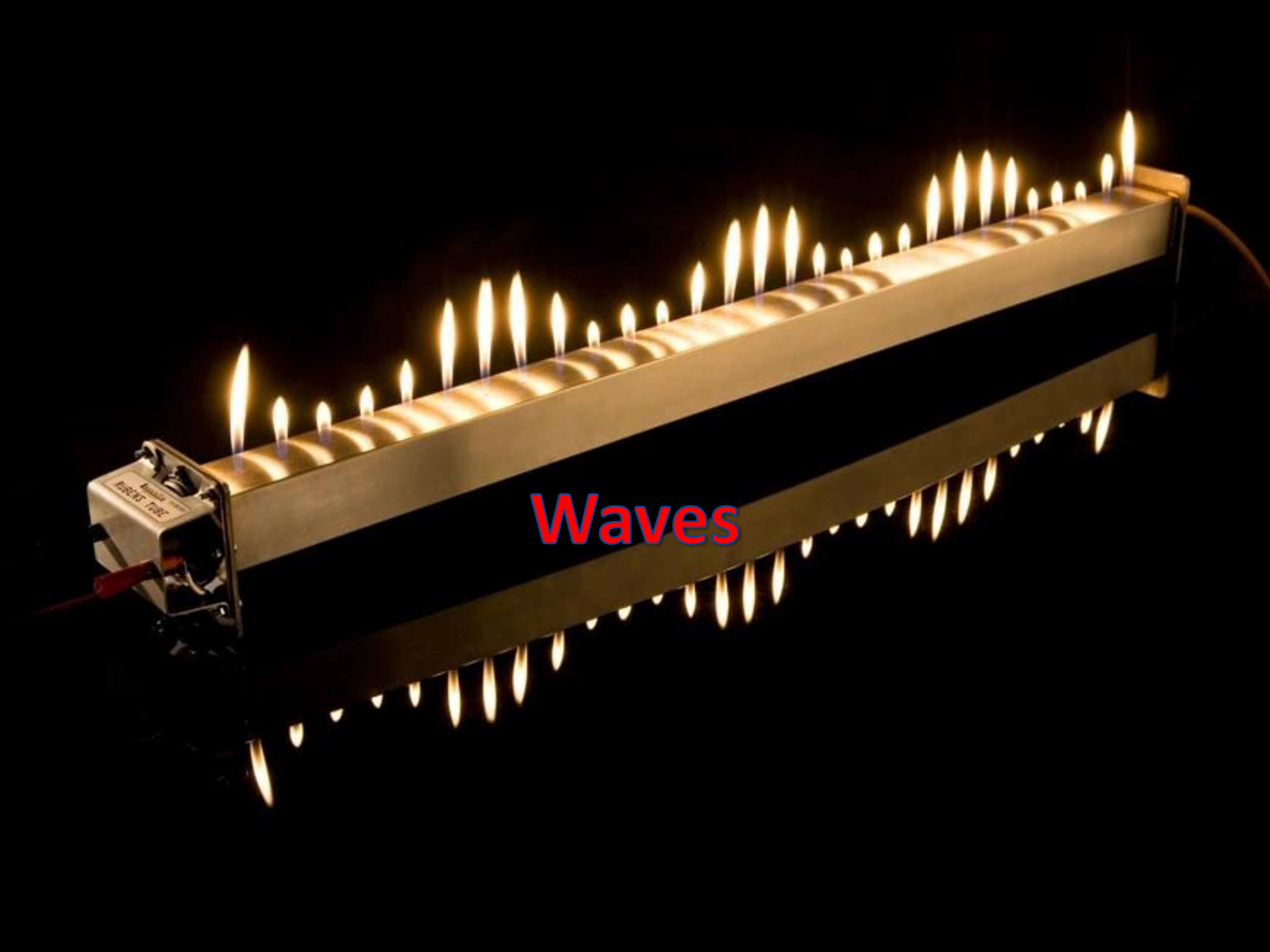
https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html

Evan Toh https://www.youtube.com/watch?v=g8GcMn7K0u4

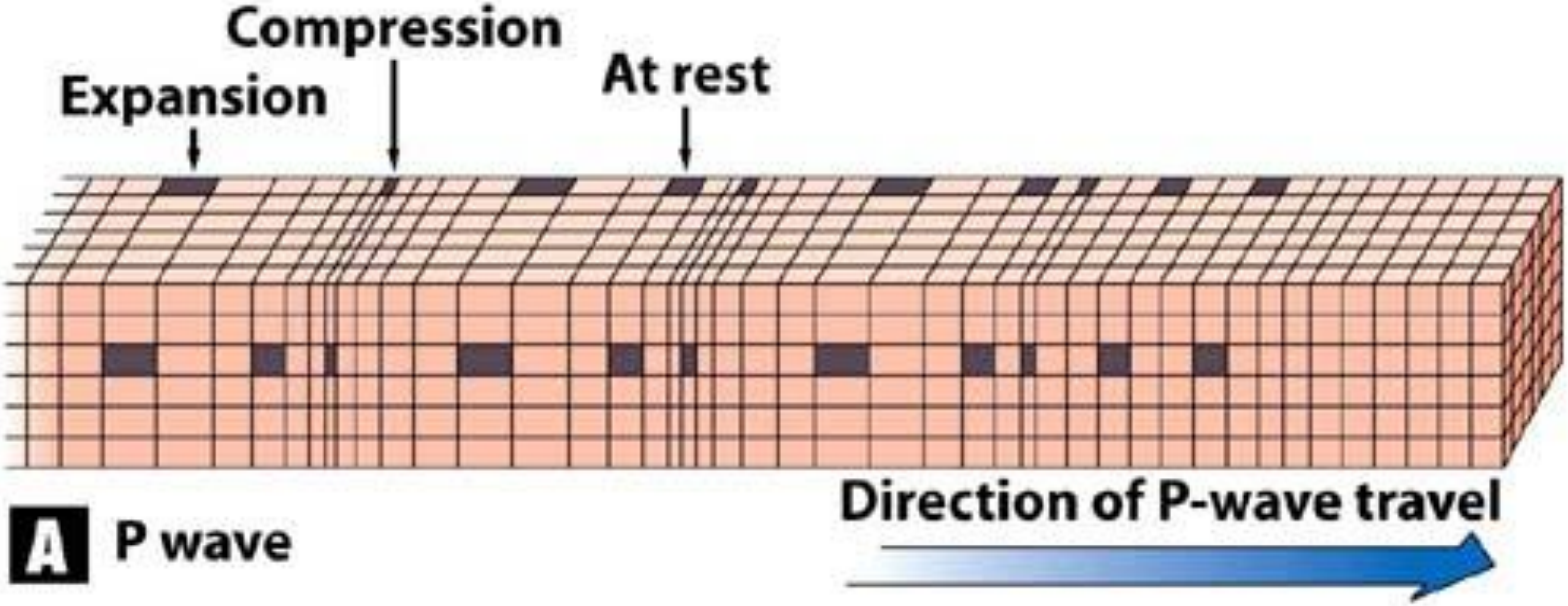


Then travel back towards the source where force your wrist exerts

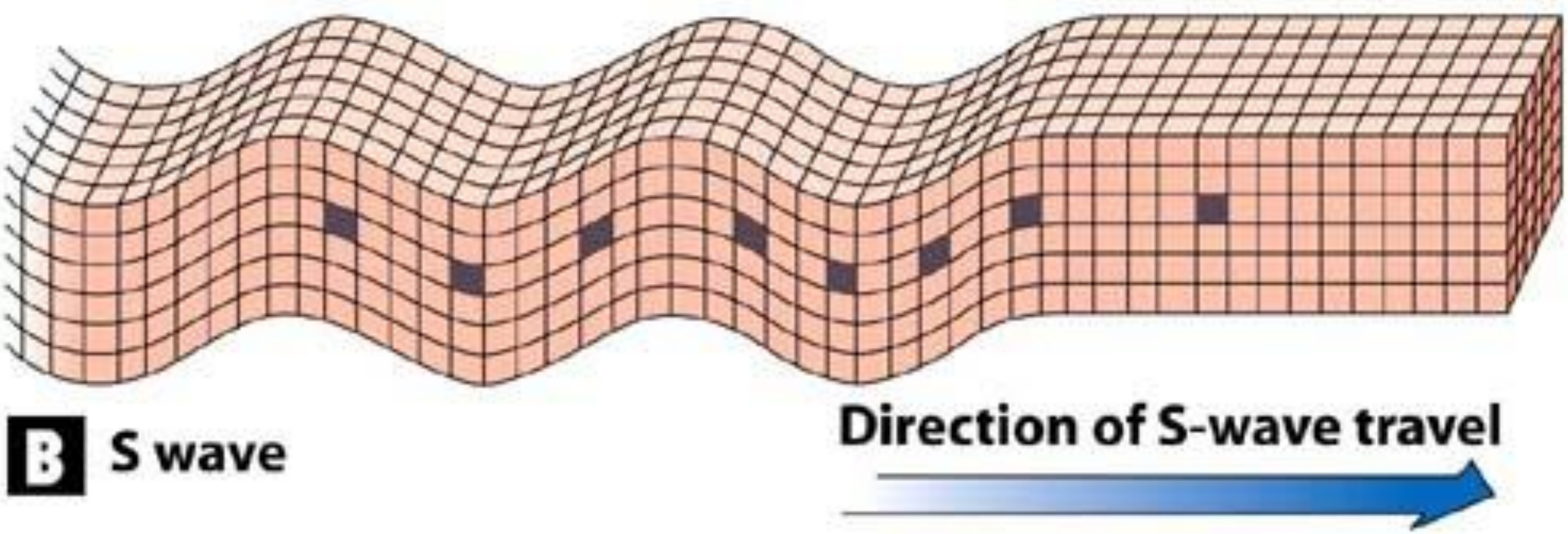
Waves

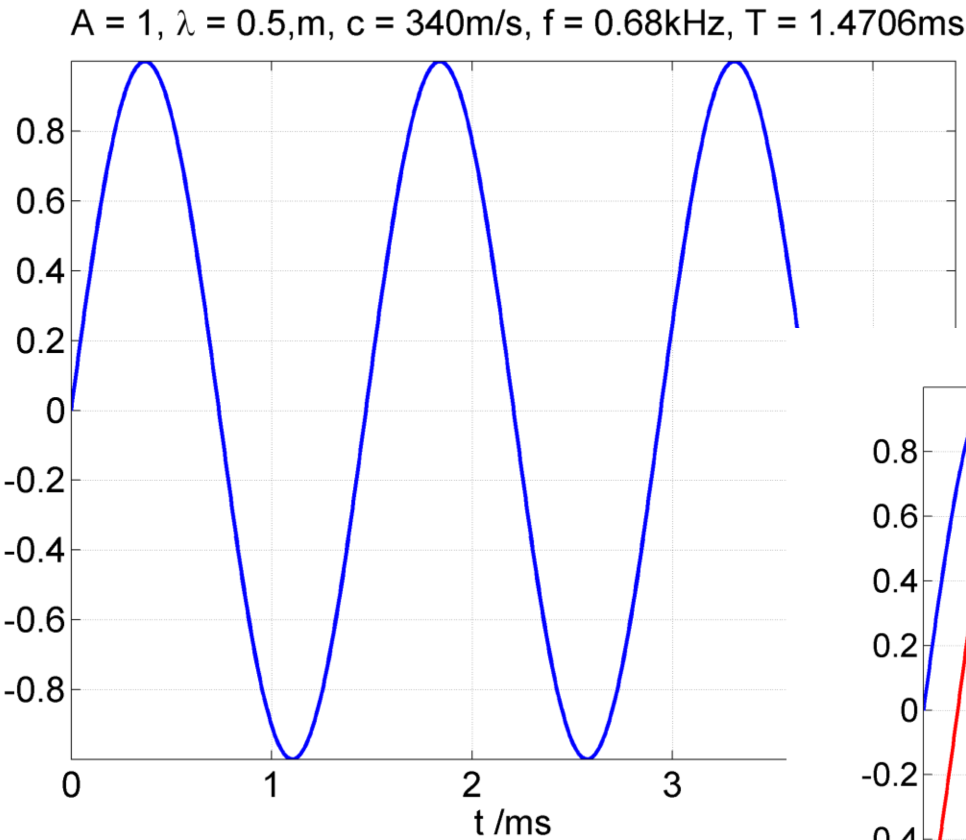


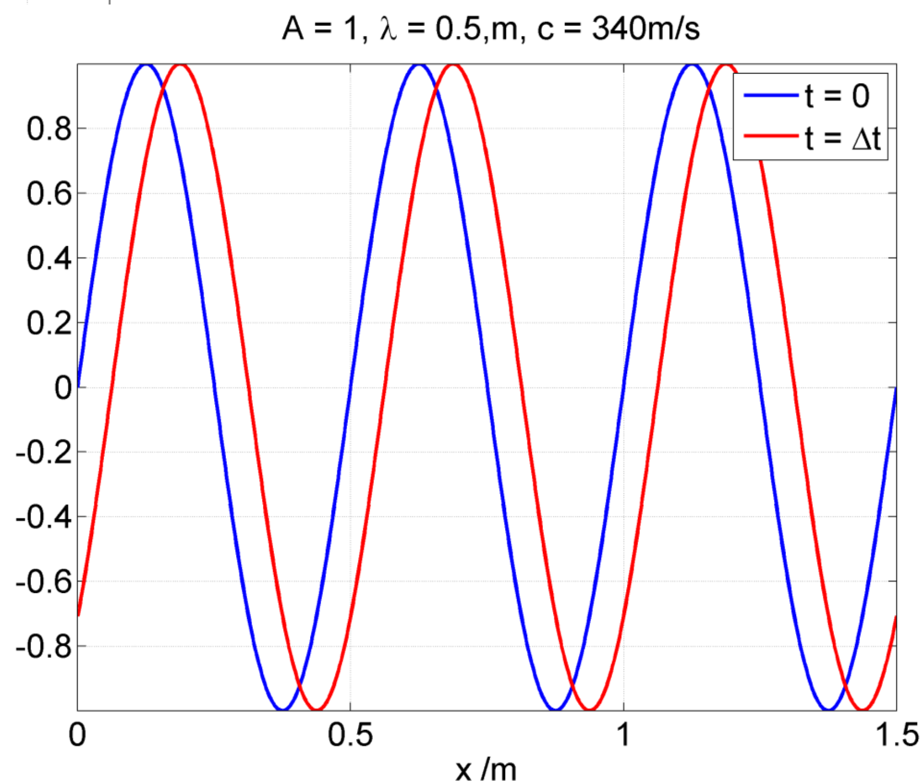

Waves


Compression
Expansion
At rest
Direction of P-wave travel
A
P wave

Waves

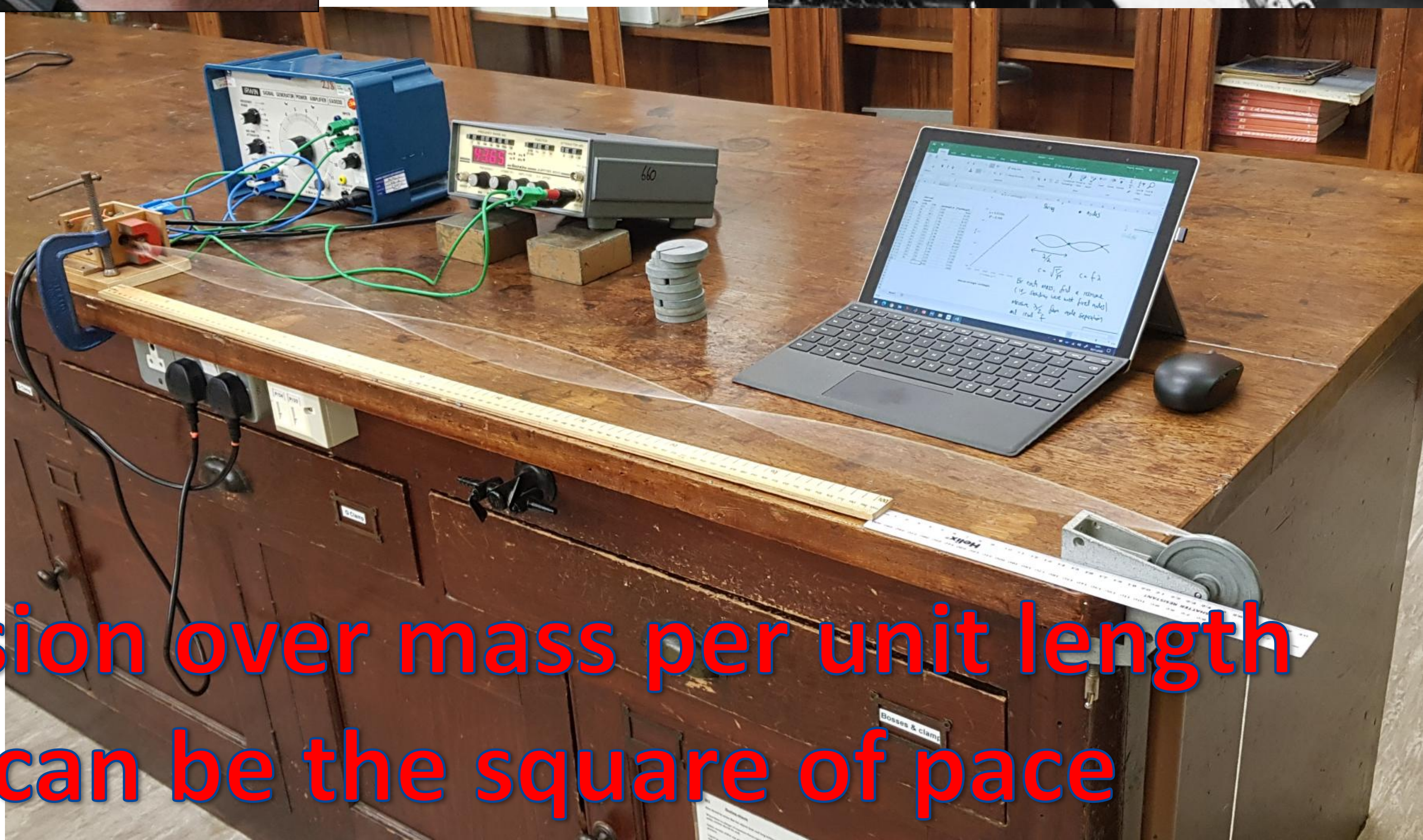

Direction of S-wave travel
B
S wave





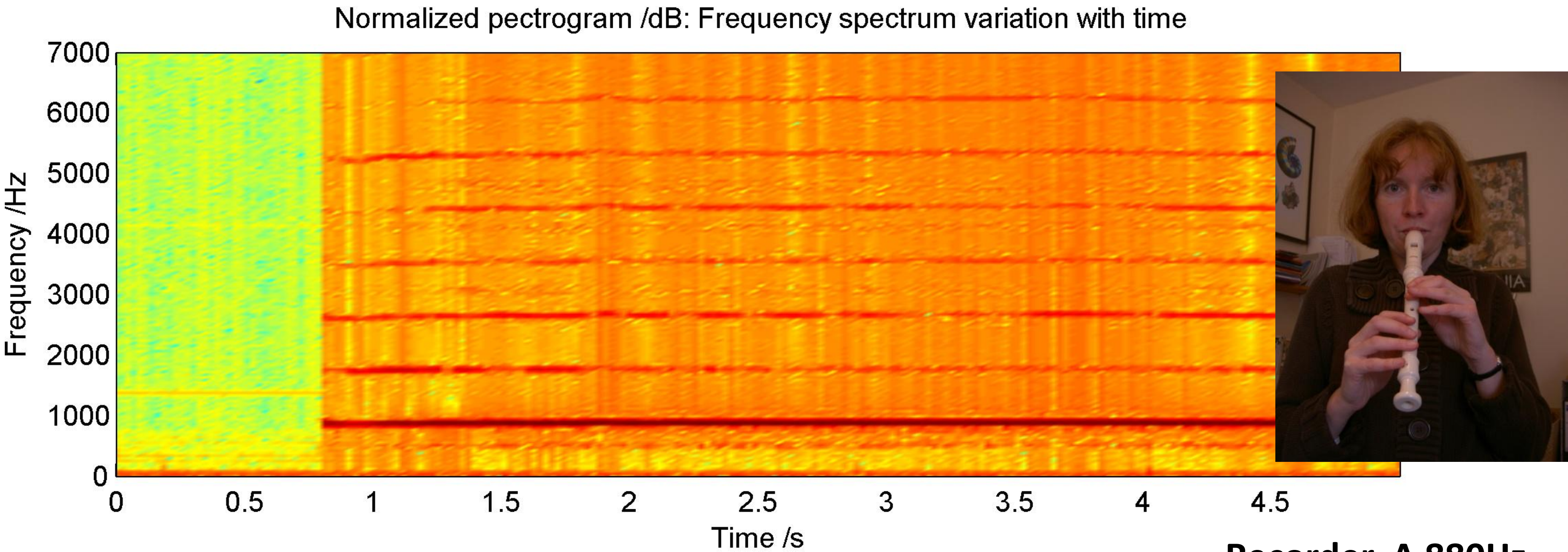
Translate through time and space

$$v^2 = \frac{T}{\mu}$$

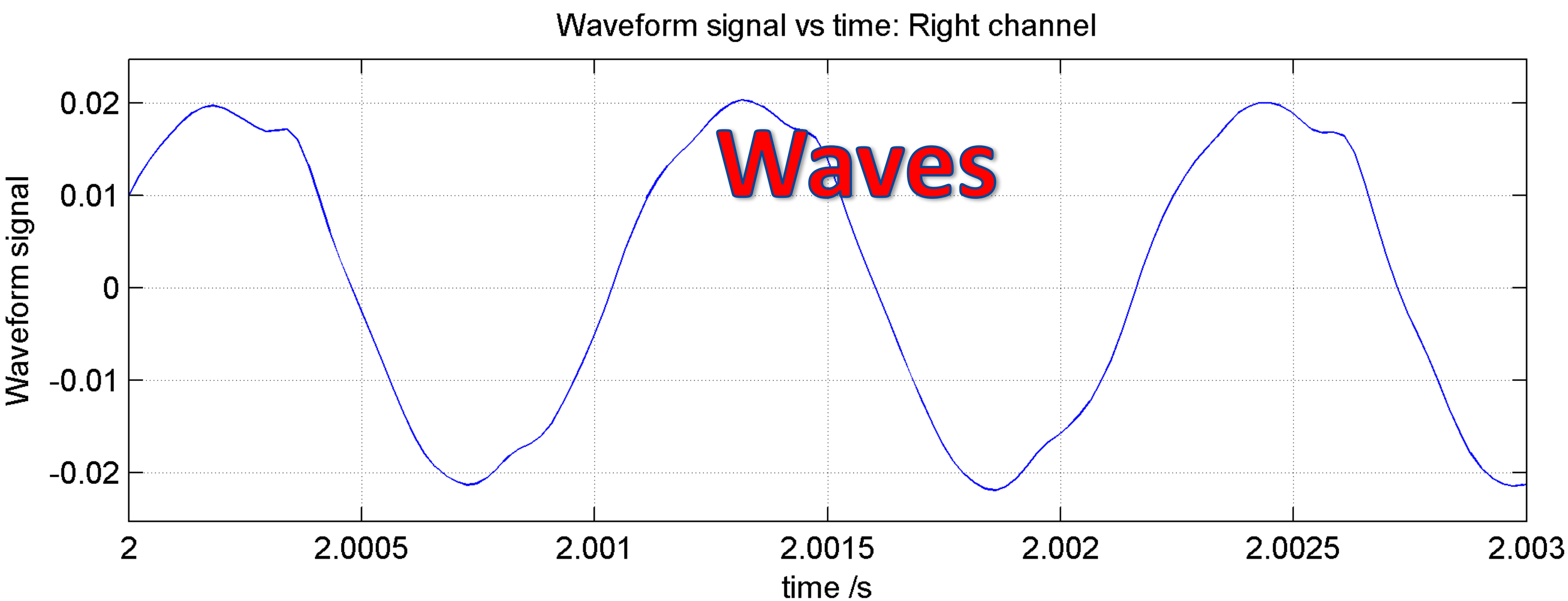


Tension over mass per unit length can be the square of pace

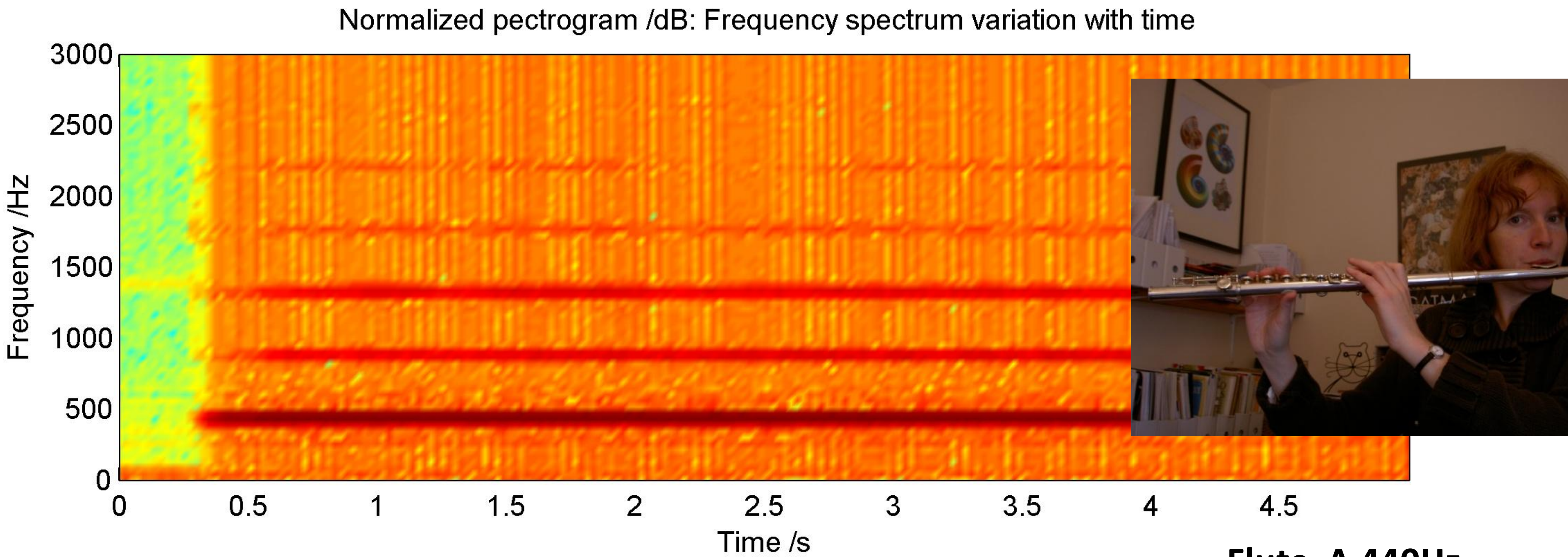
Waves



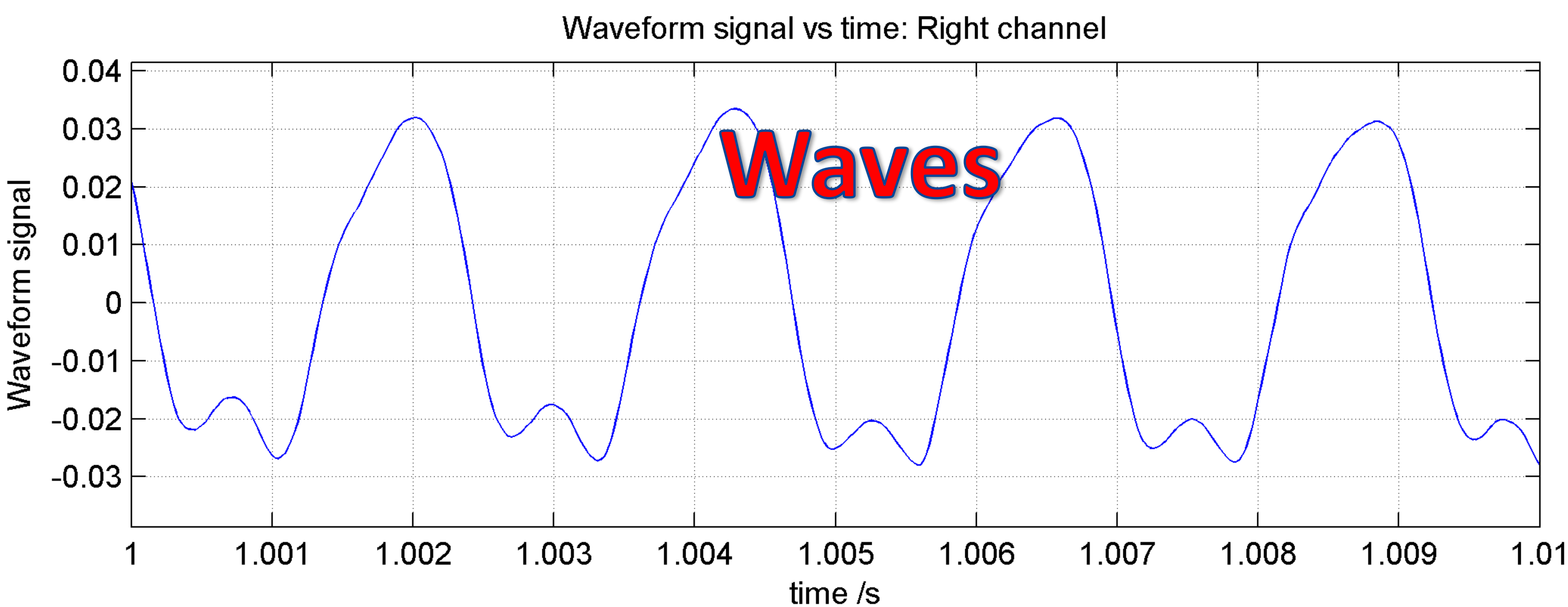
Recorder A 880Hz

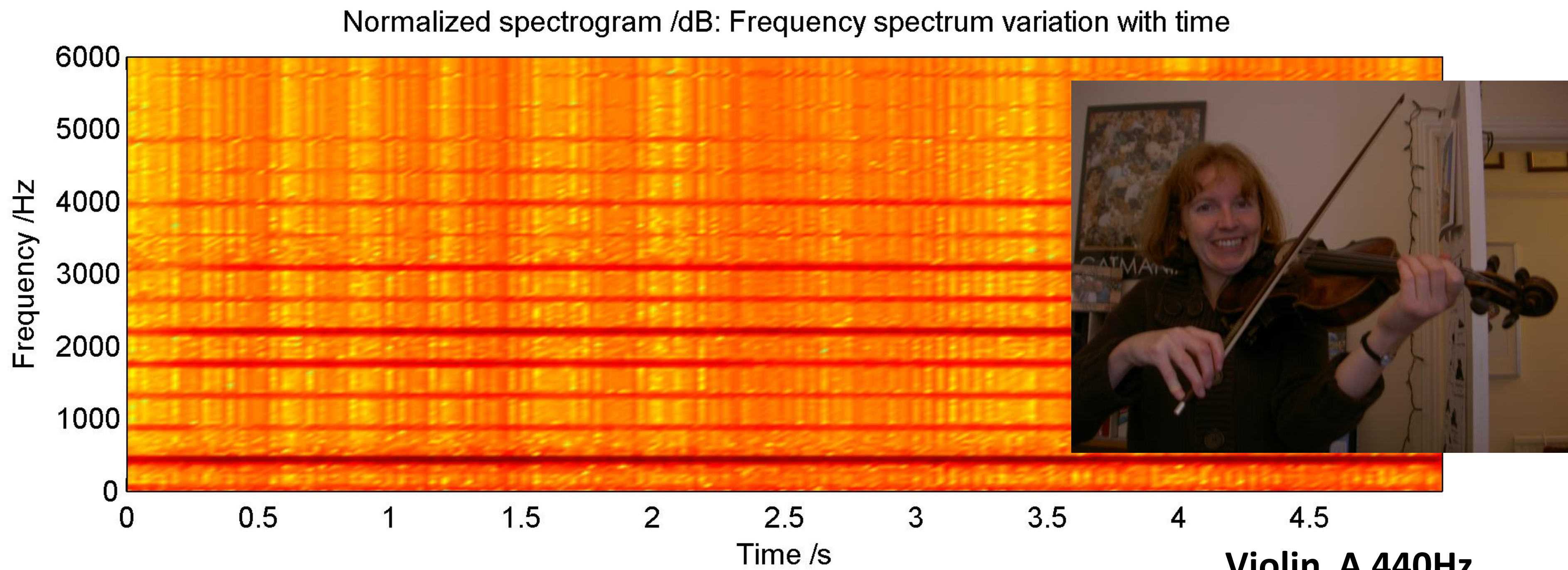


Waves

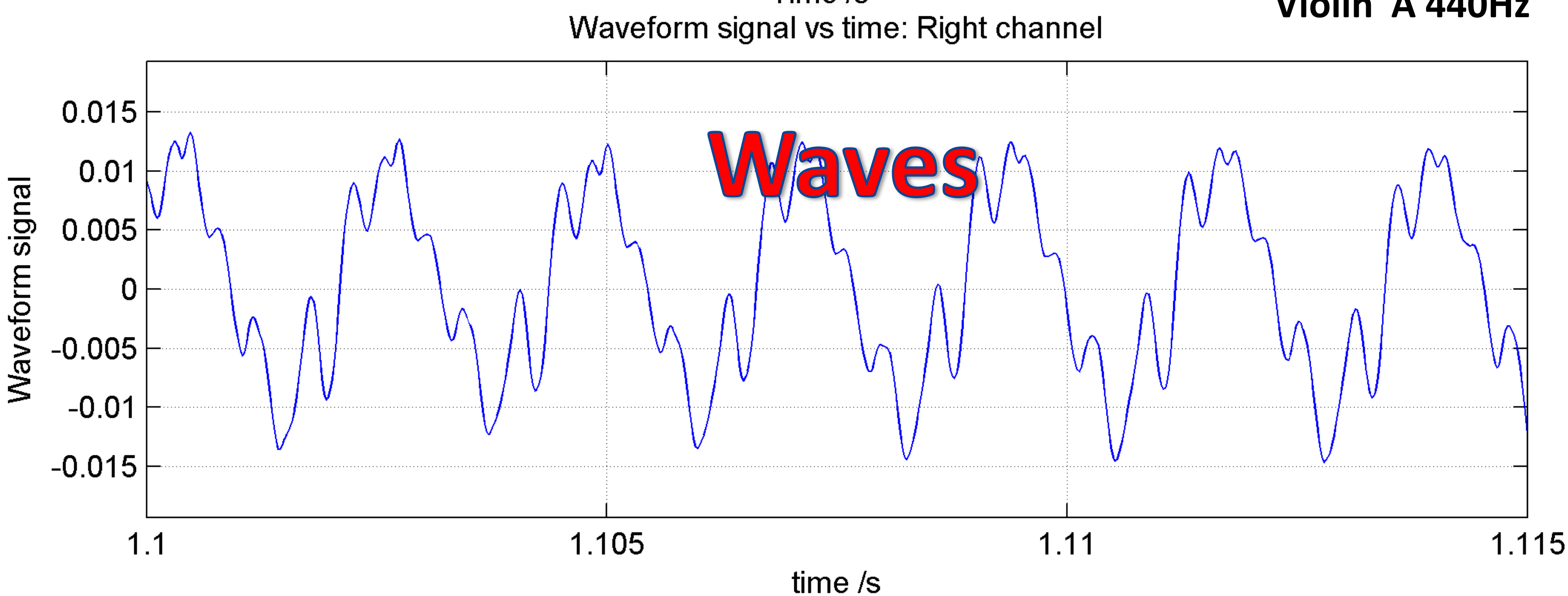


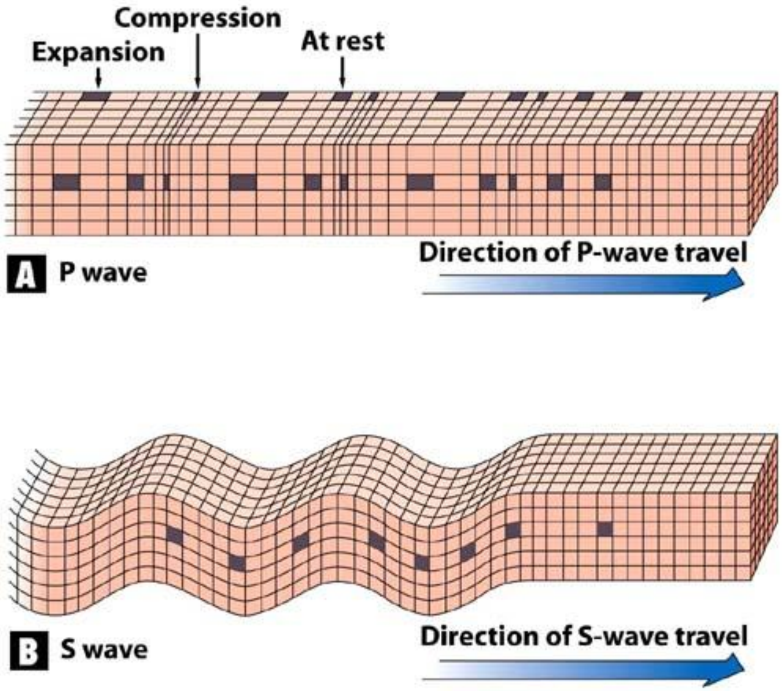
Flute A 440Hz



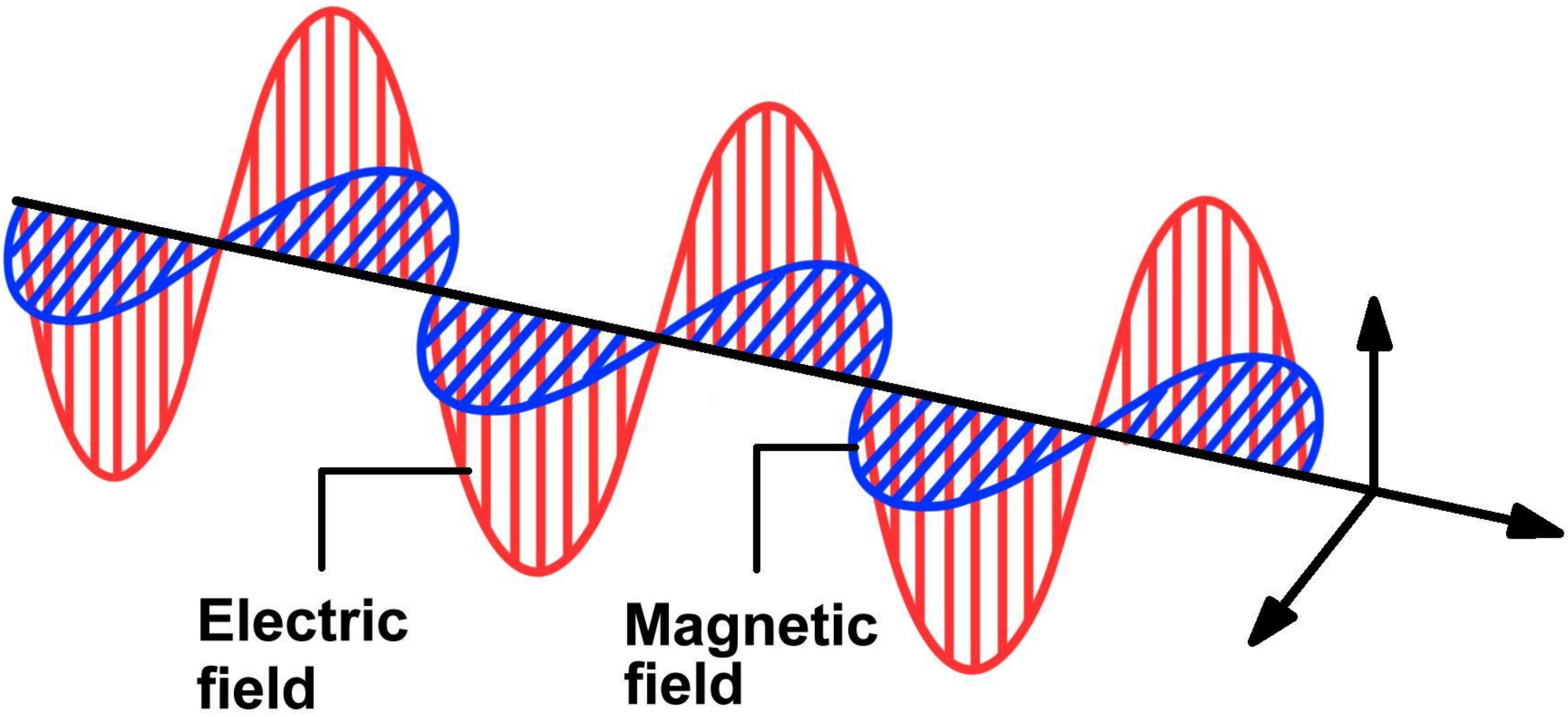


Violin A 440Hz



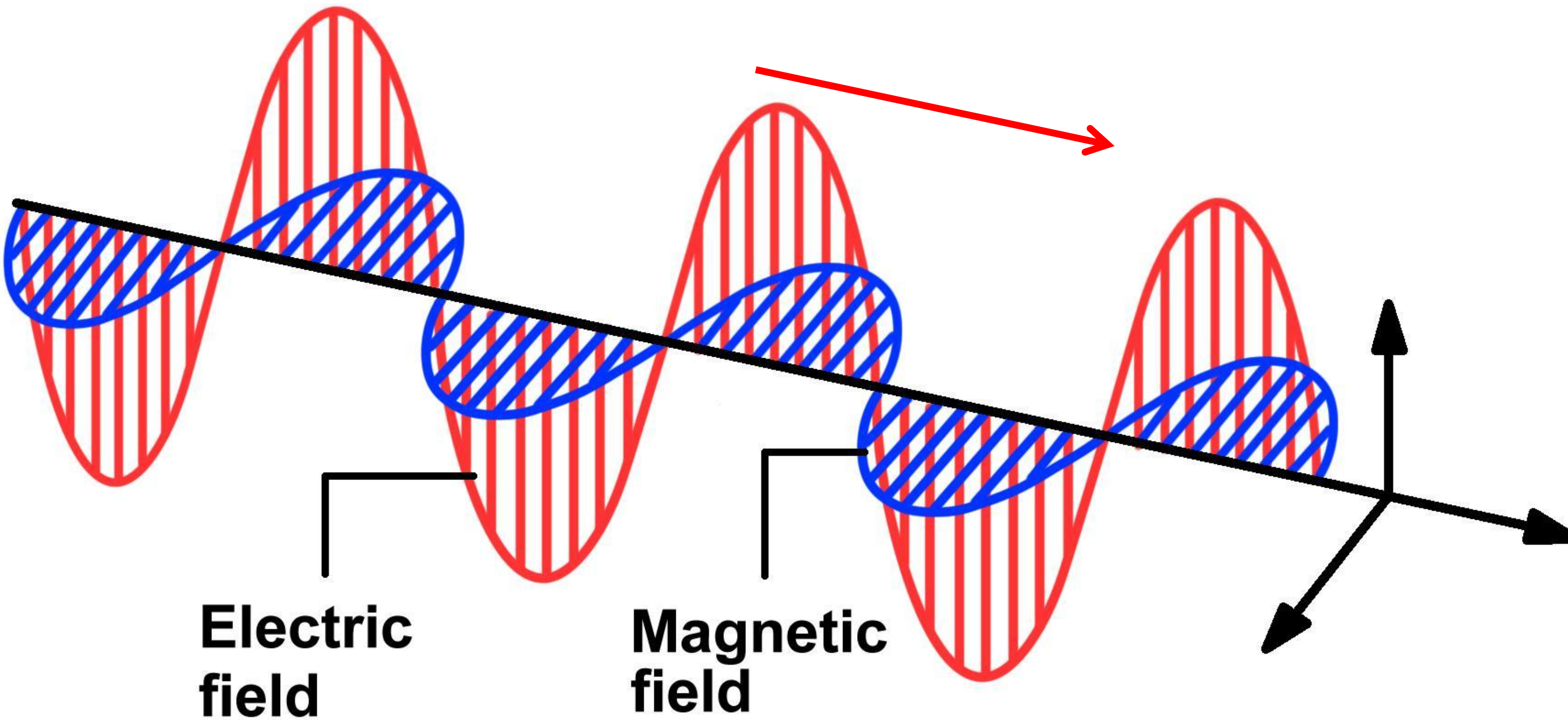


In solids, liquids, gas

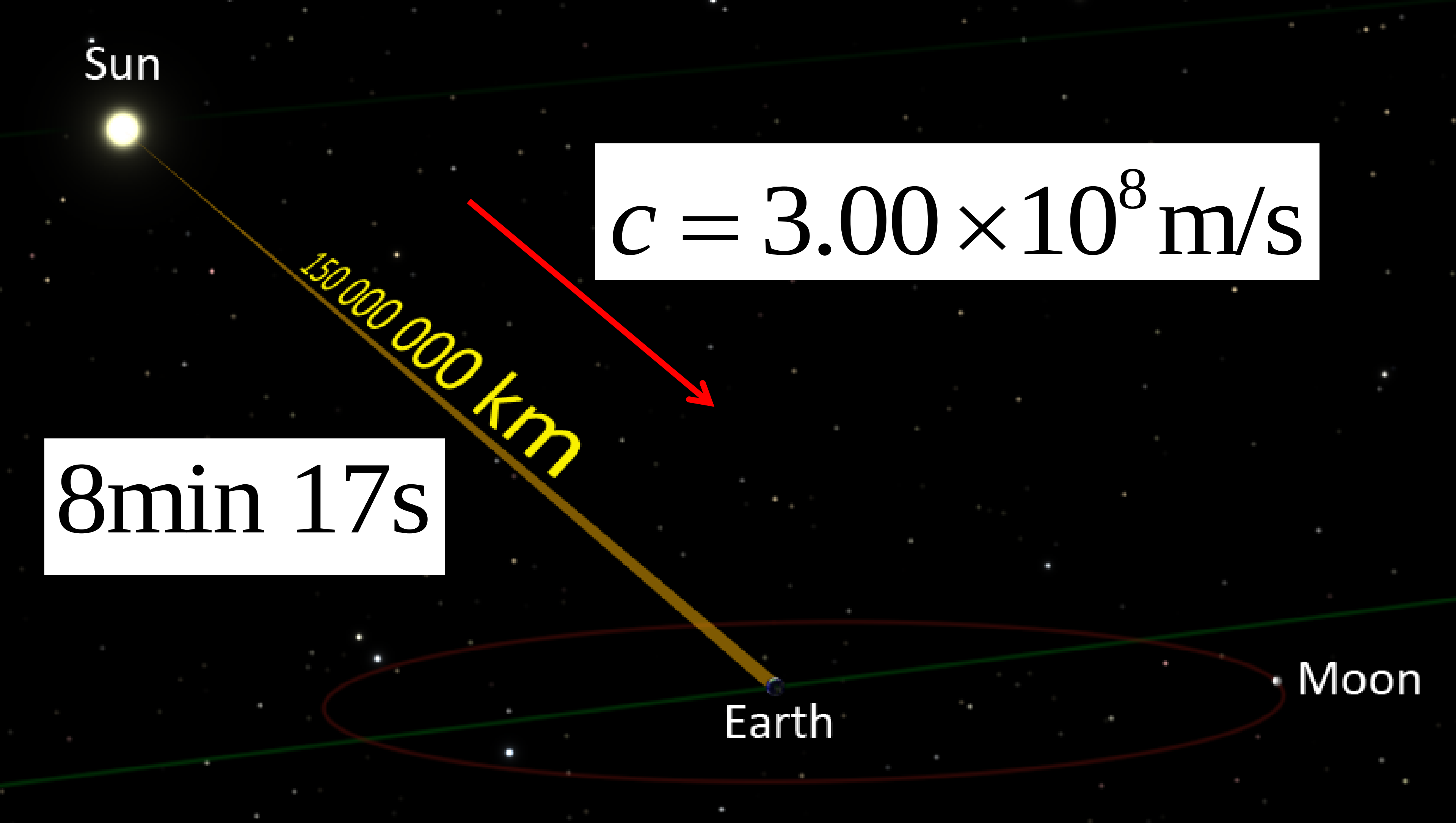


And in electric fields in space which don't have any mass

$$c = 3.00 \times 10^8 \text{ m/s}$$



Electromagnetic waves are really fast



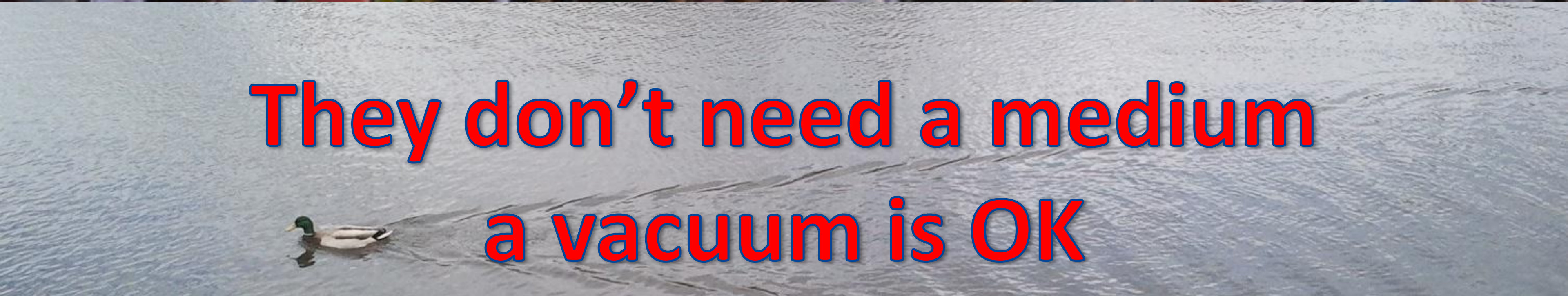
300 million metres every second that is passed

There is no aether. Light can propagate in vacuum.

It itself moves

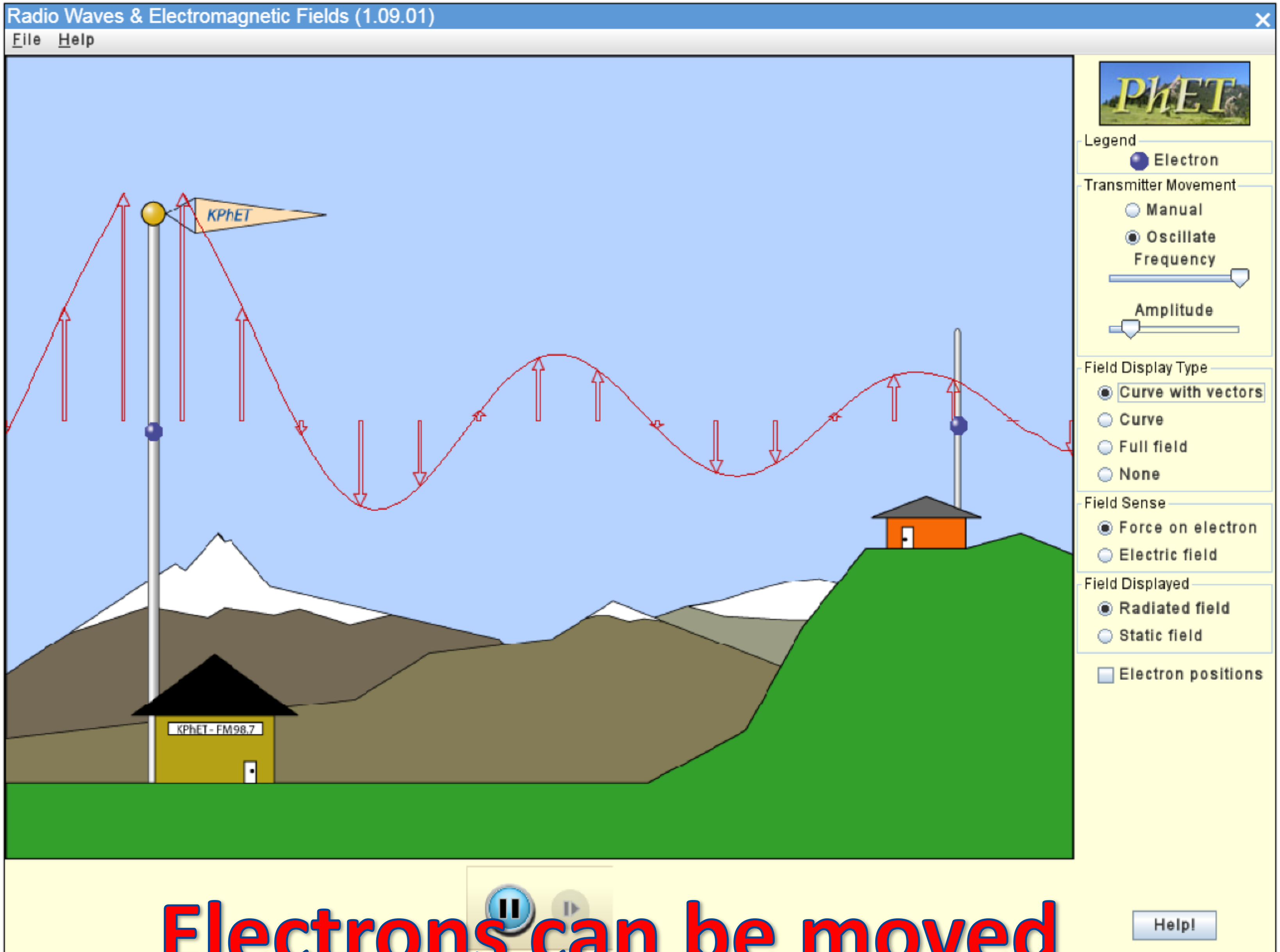
No

No

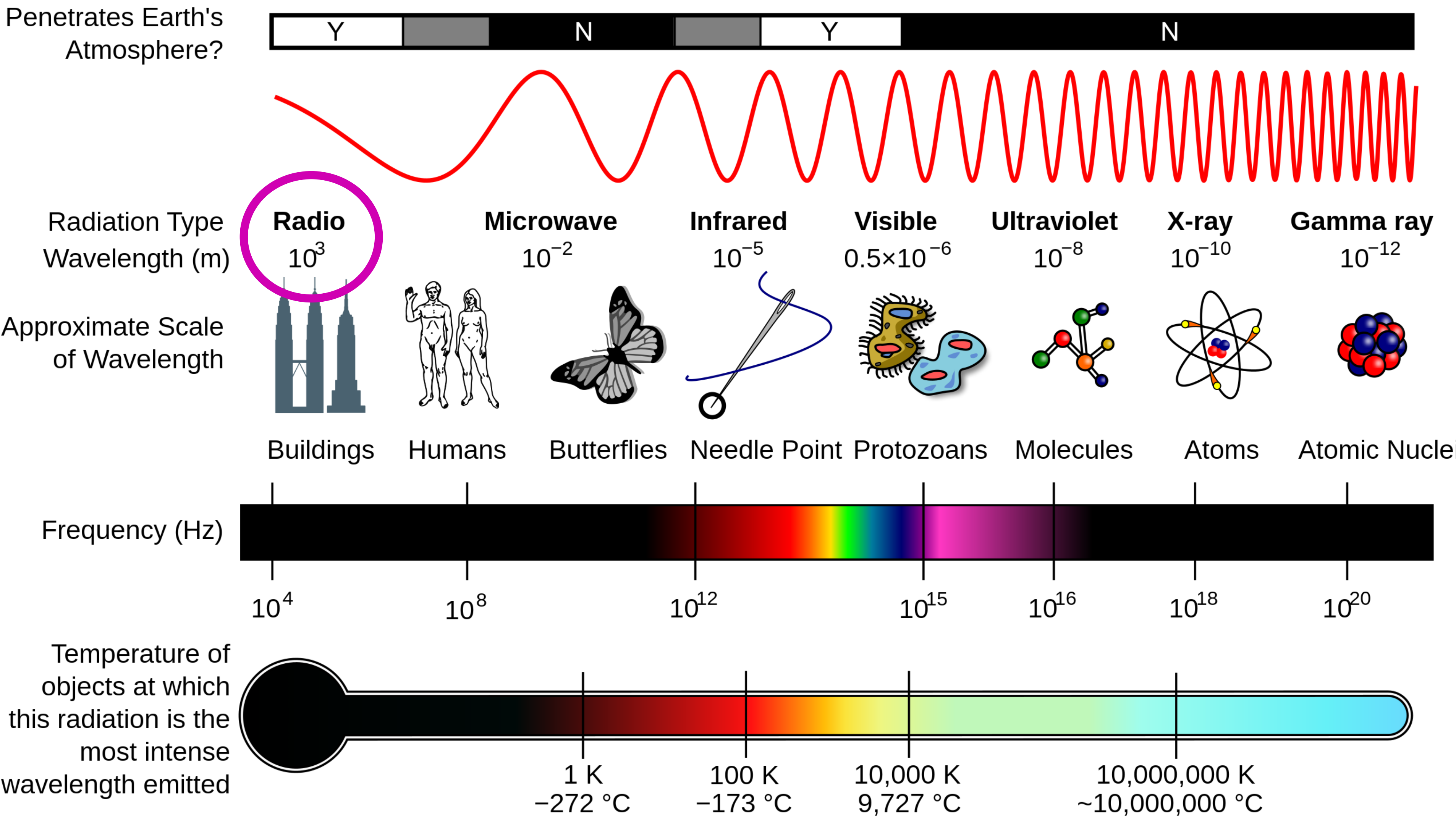


They don’t need a medium

a vacuum is OK



Electrons can be moved in a perpendicular way



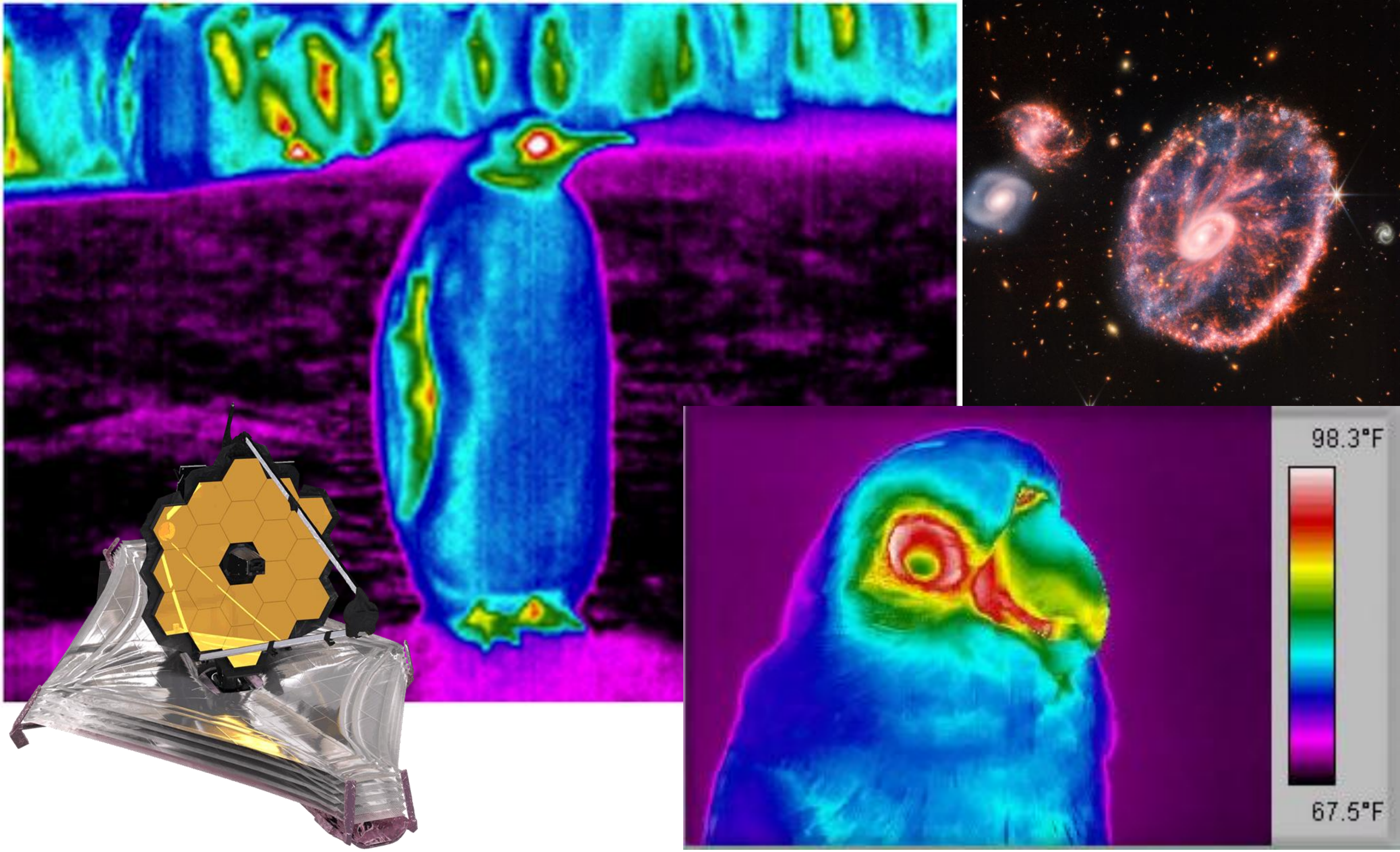
Radio's the longest wavelength and the smallest frequency

You need a mast that’s pretty big to use efficiently

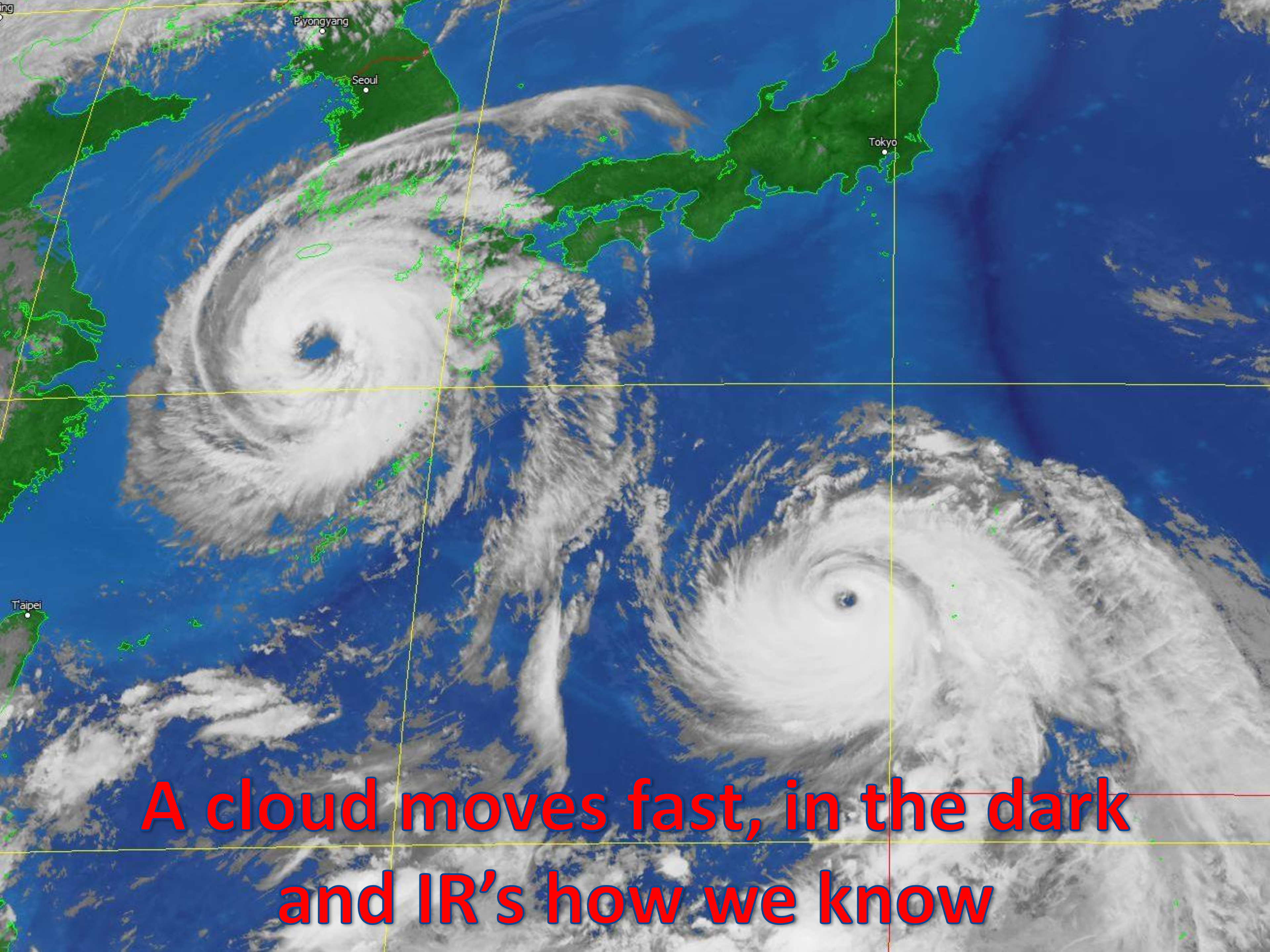
Wi Fi ALLIANCE™

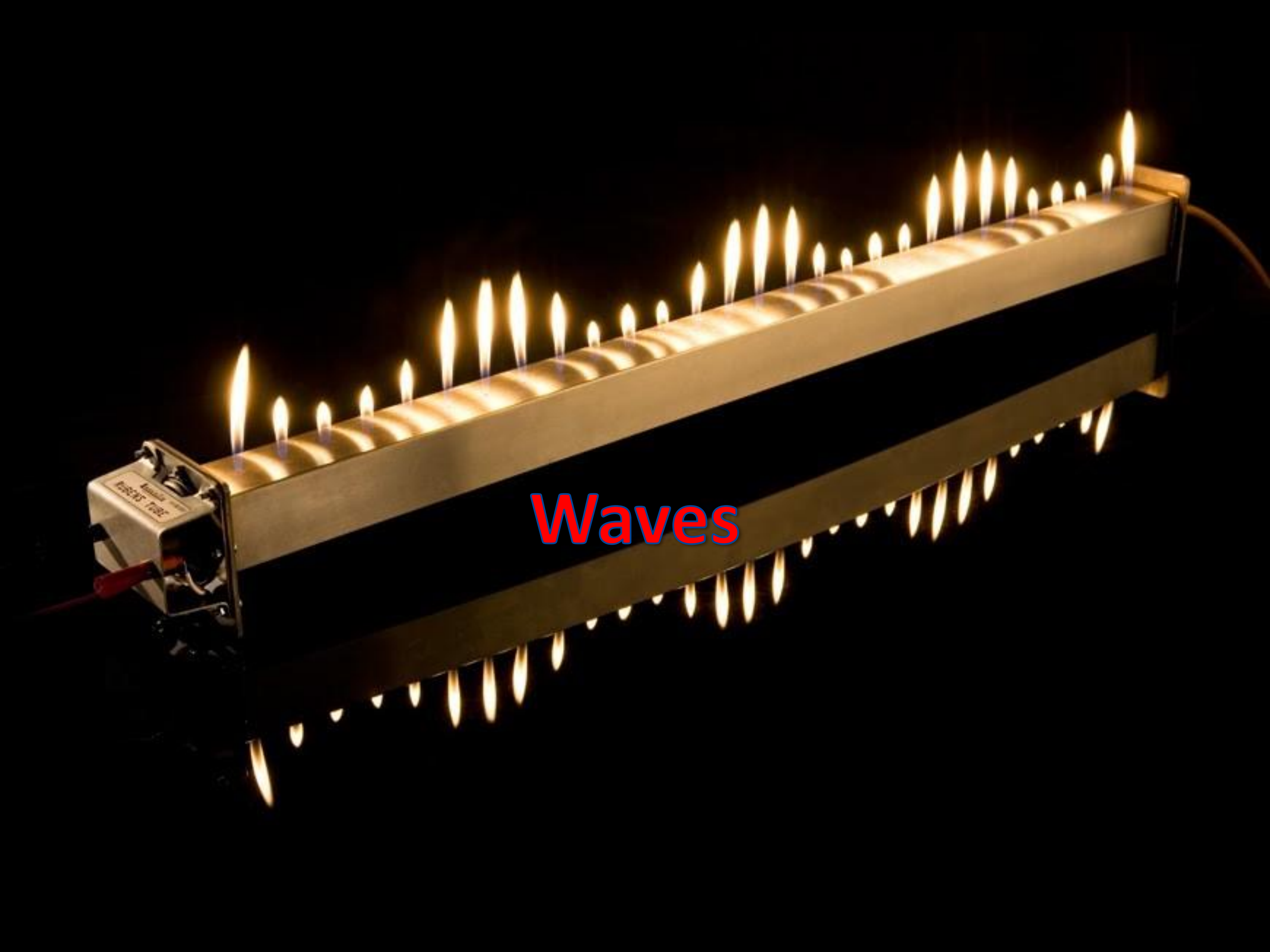
Microwaves come next with Radar and Wi-Fi

They’re why your mobile phone works and how you heat a pie

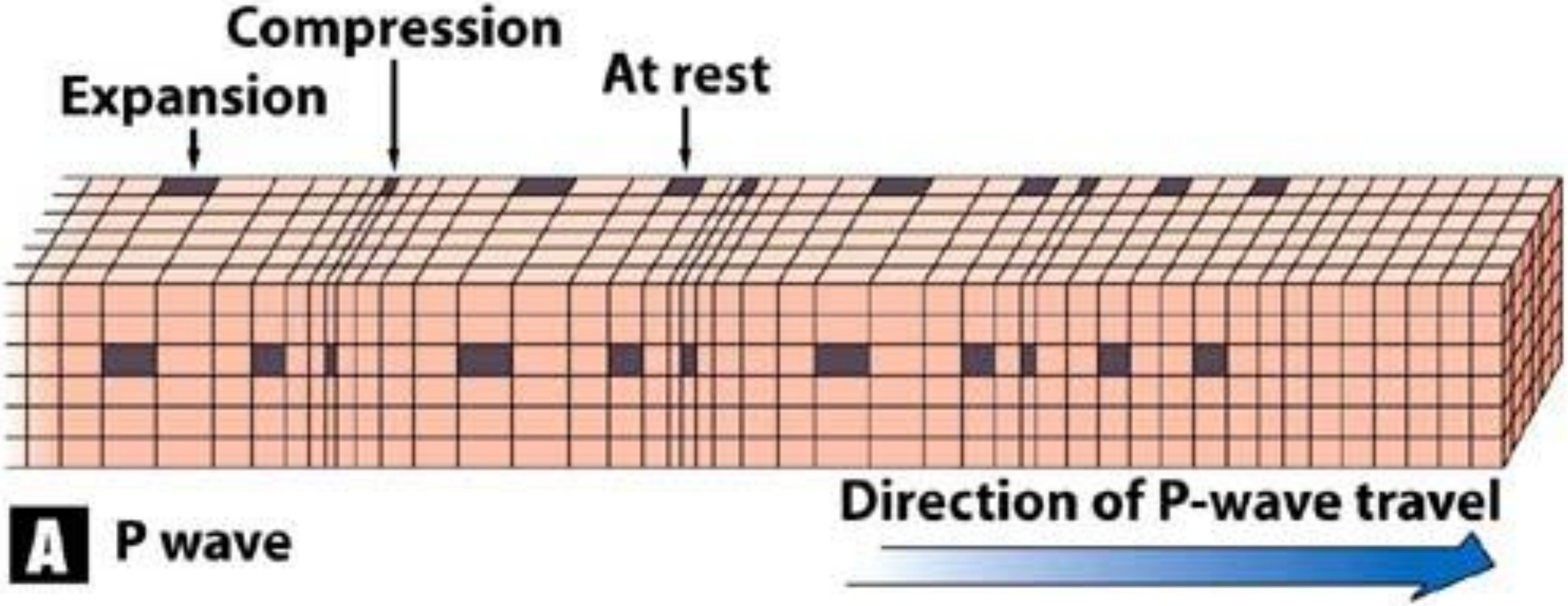


Infra-Red’s produced when things are hot but don’t yet glow

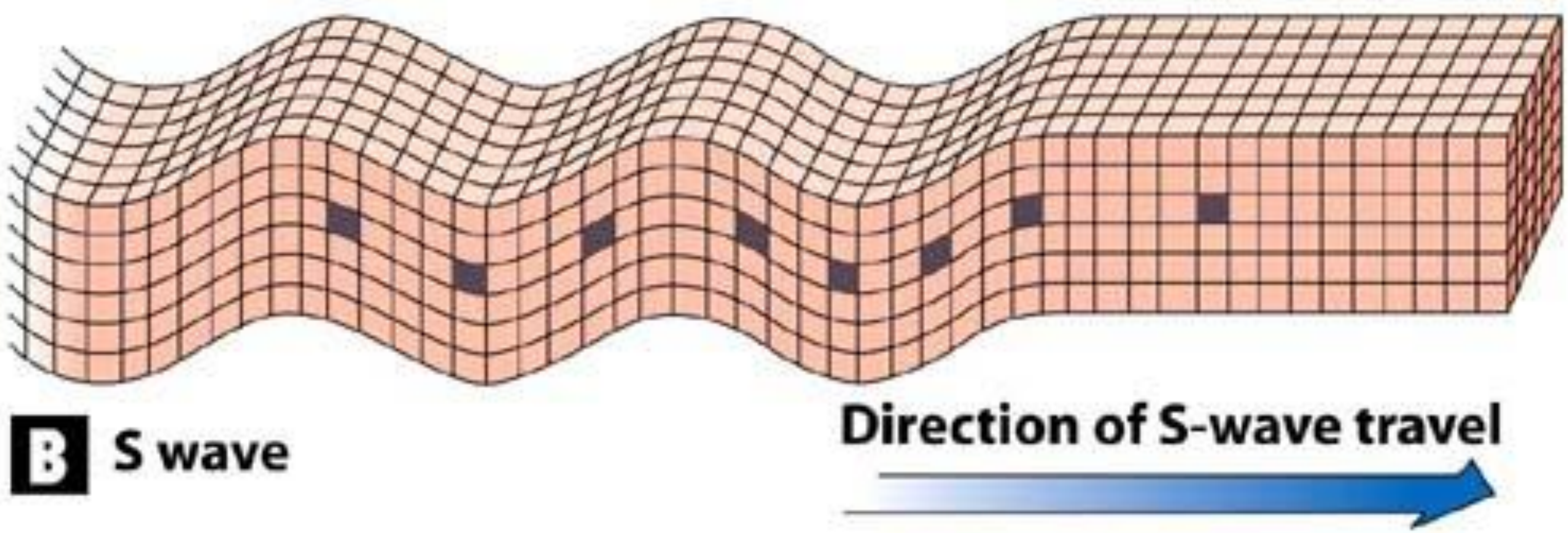

P'yongyang
Seoul
Tokyo
T'aipei
A cloud moves fast, in the dark
and IR's how we know

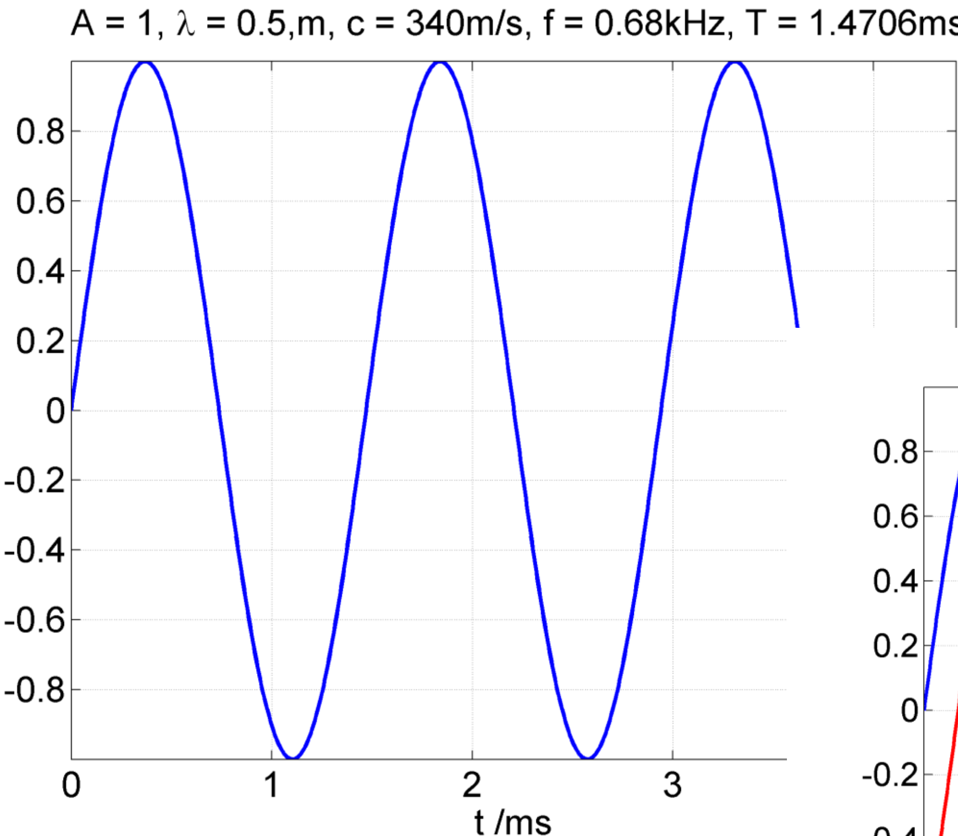

Waves

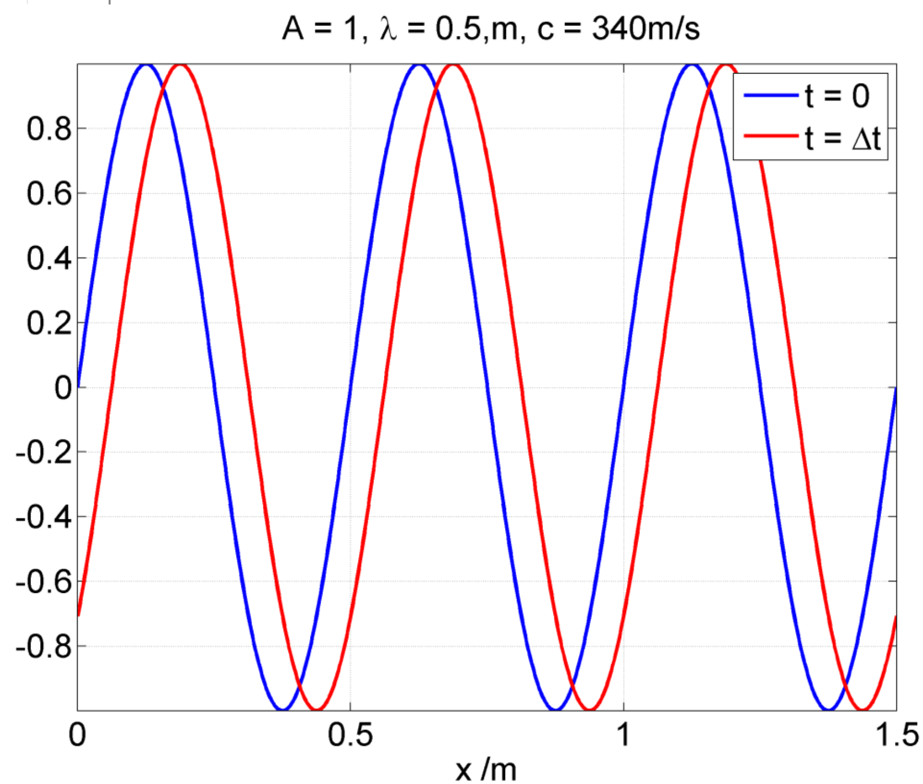
Waves


Compression
Expansion
At rest
A
P wave
Direction of P-wave travel

Waves


B
S wave
Direction of S-wave travel





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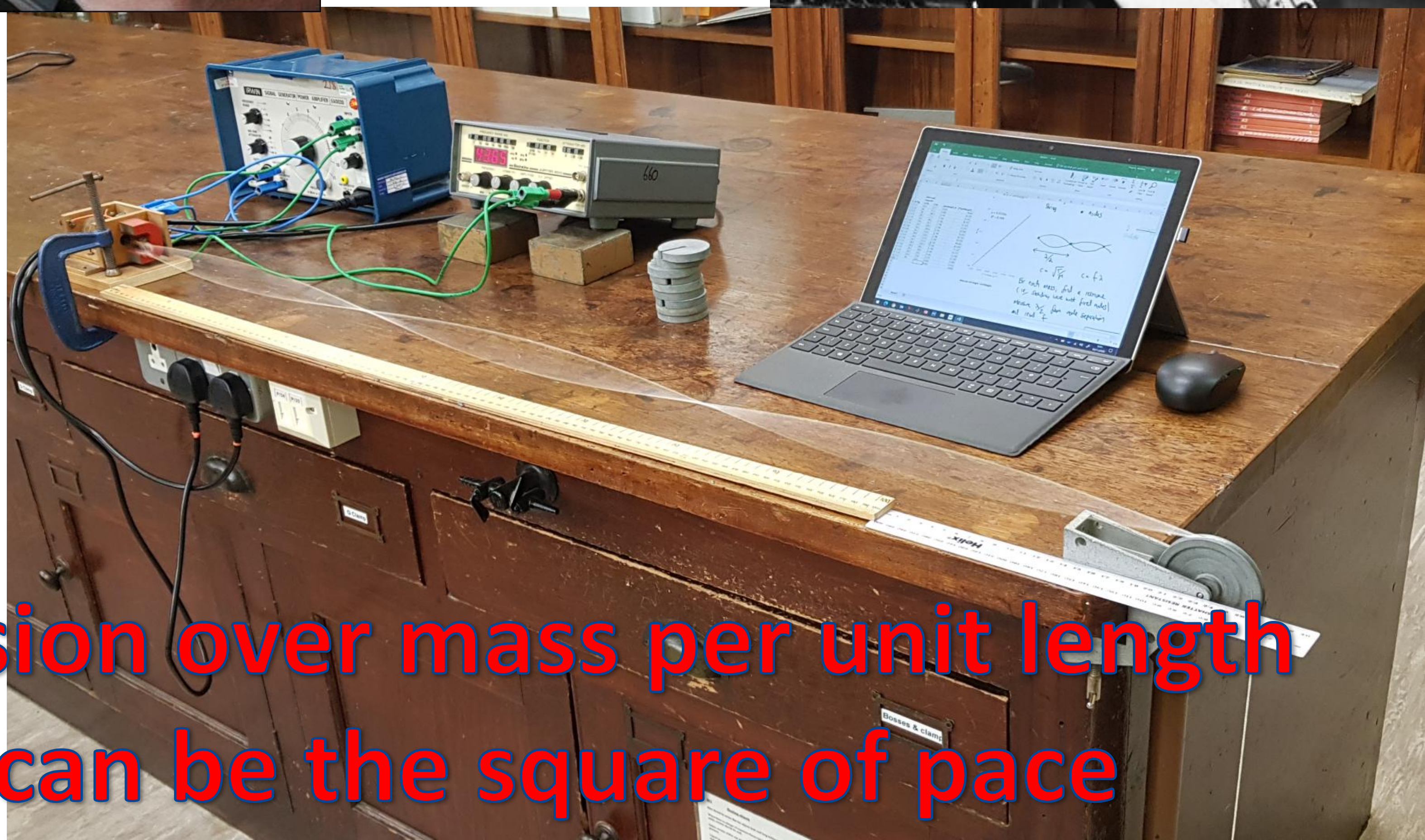

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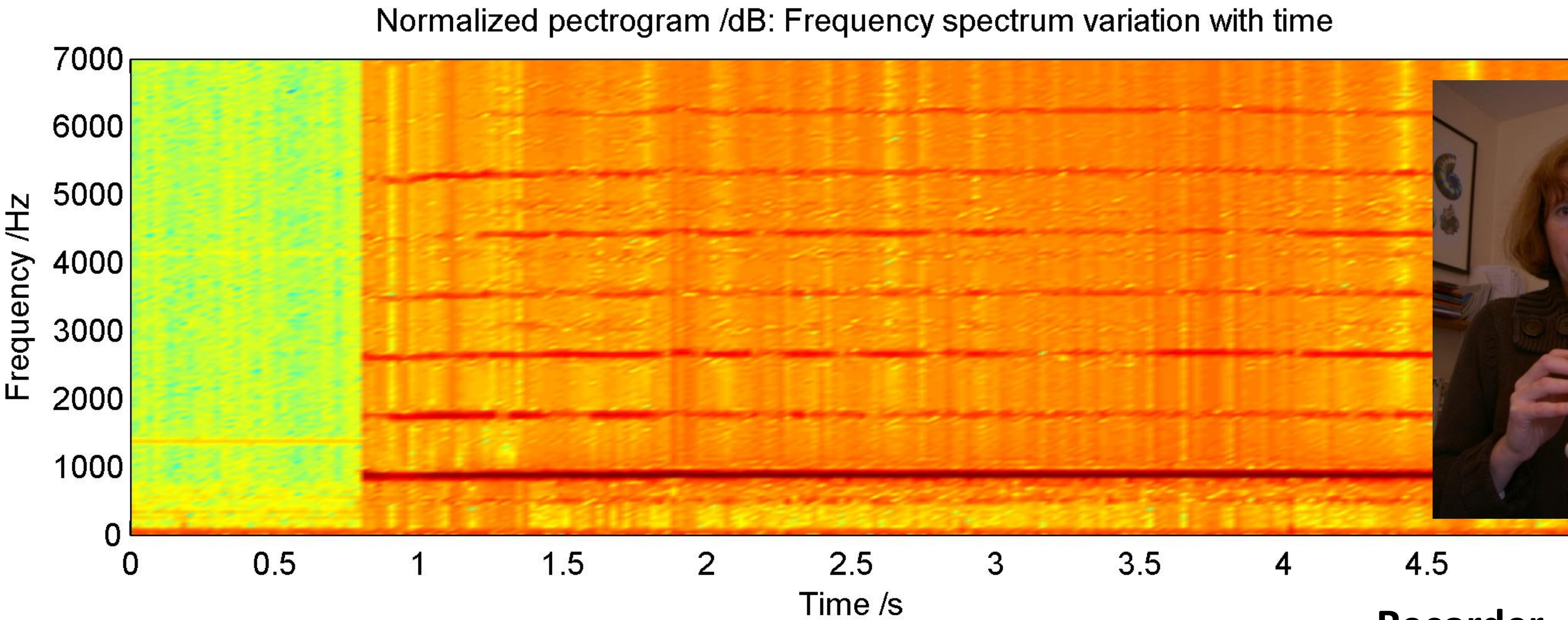

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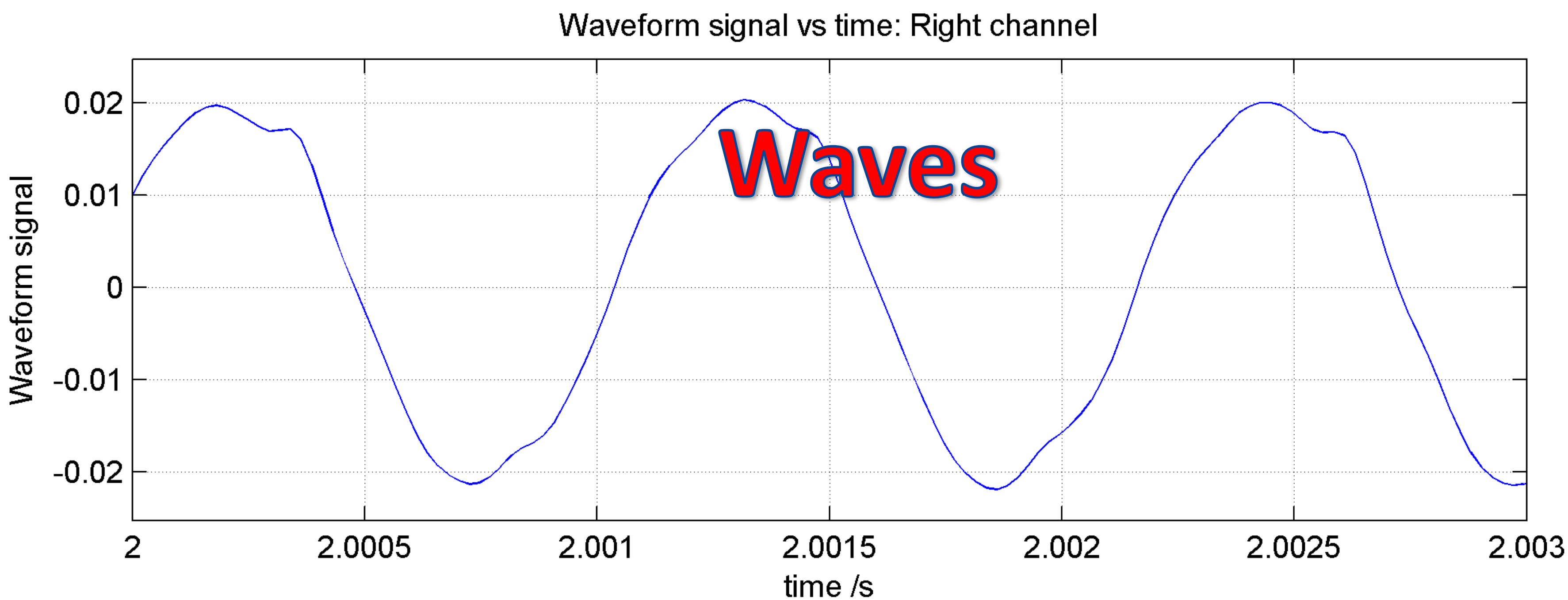

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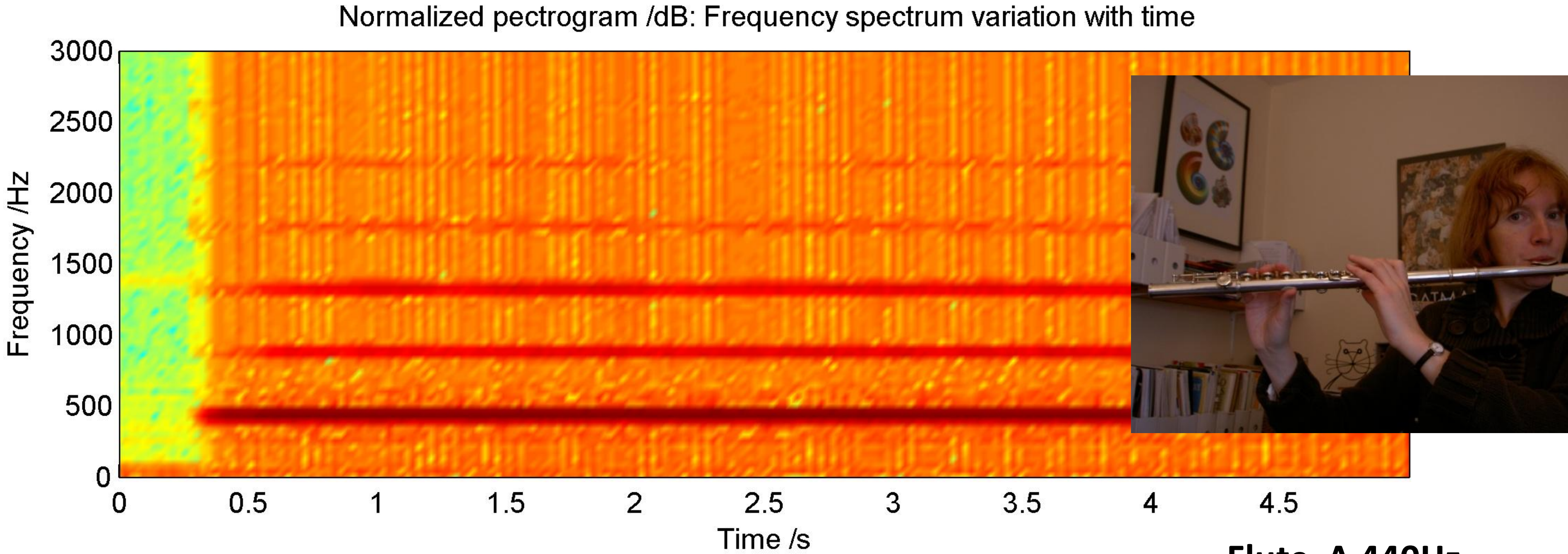
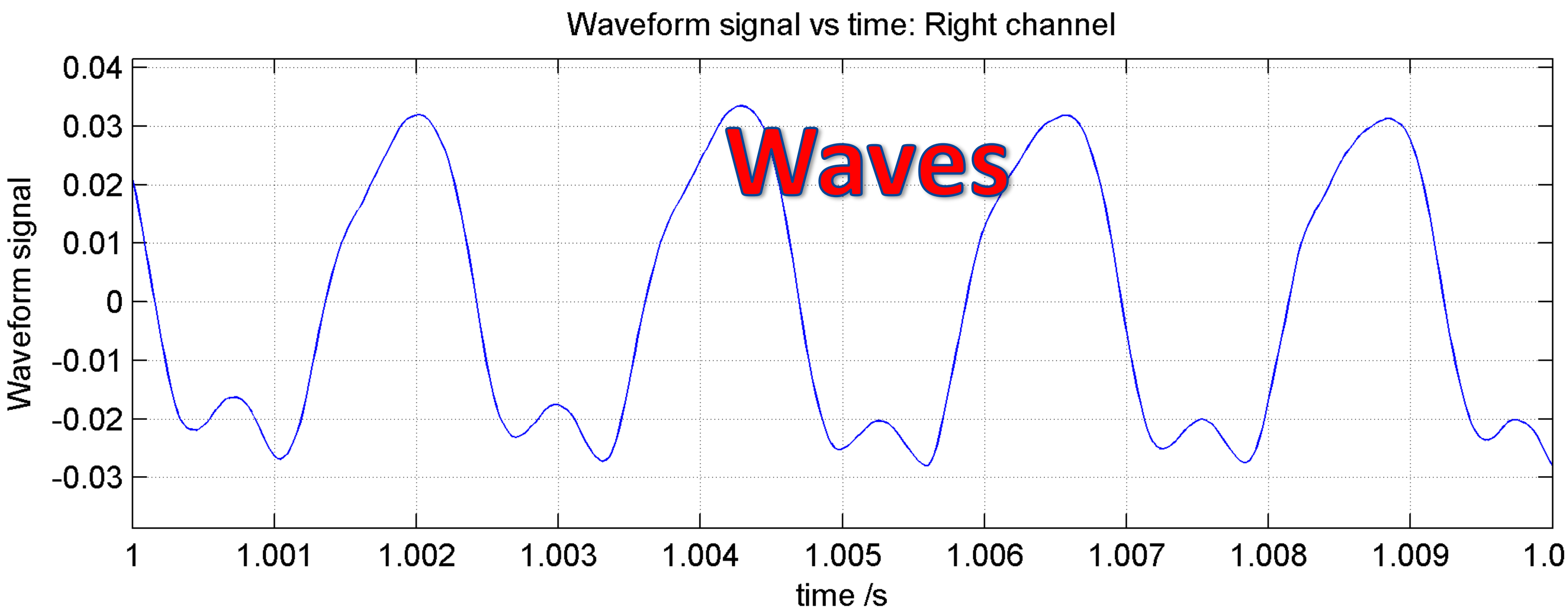
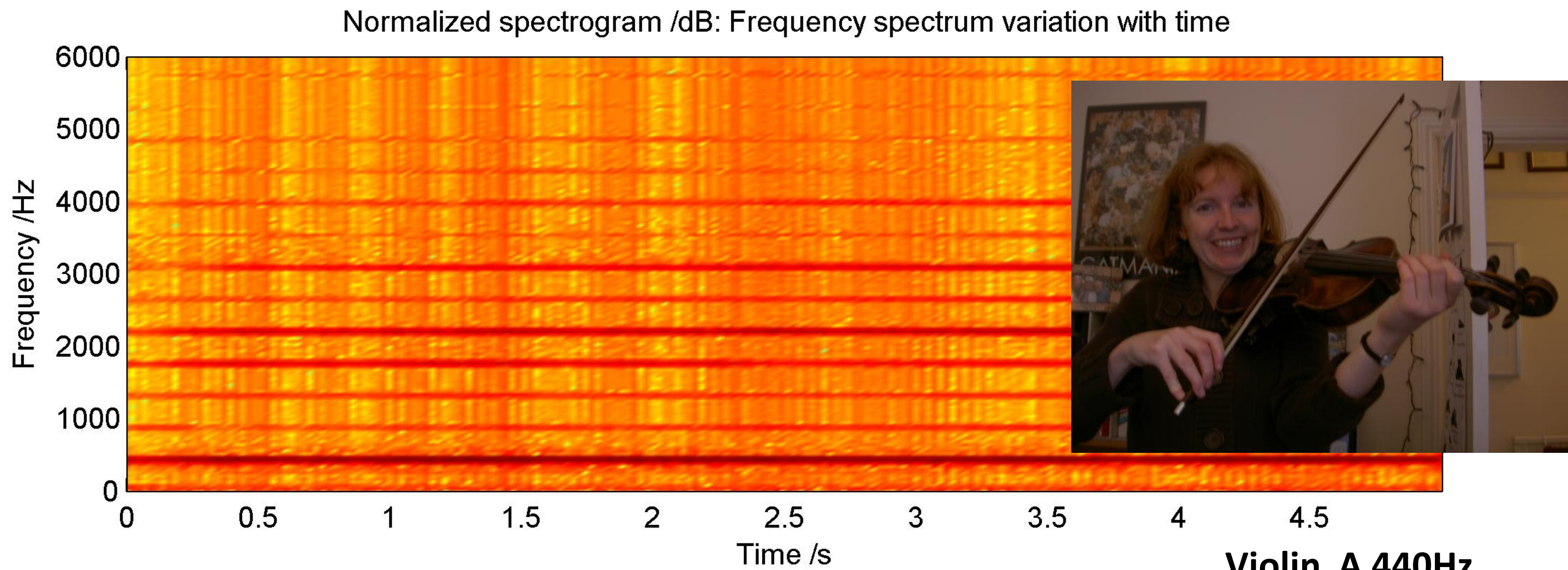


Flute A 440Hz



Waves



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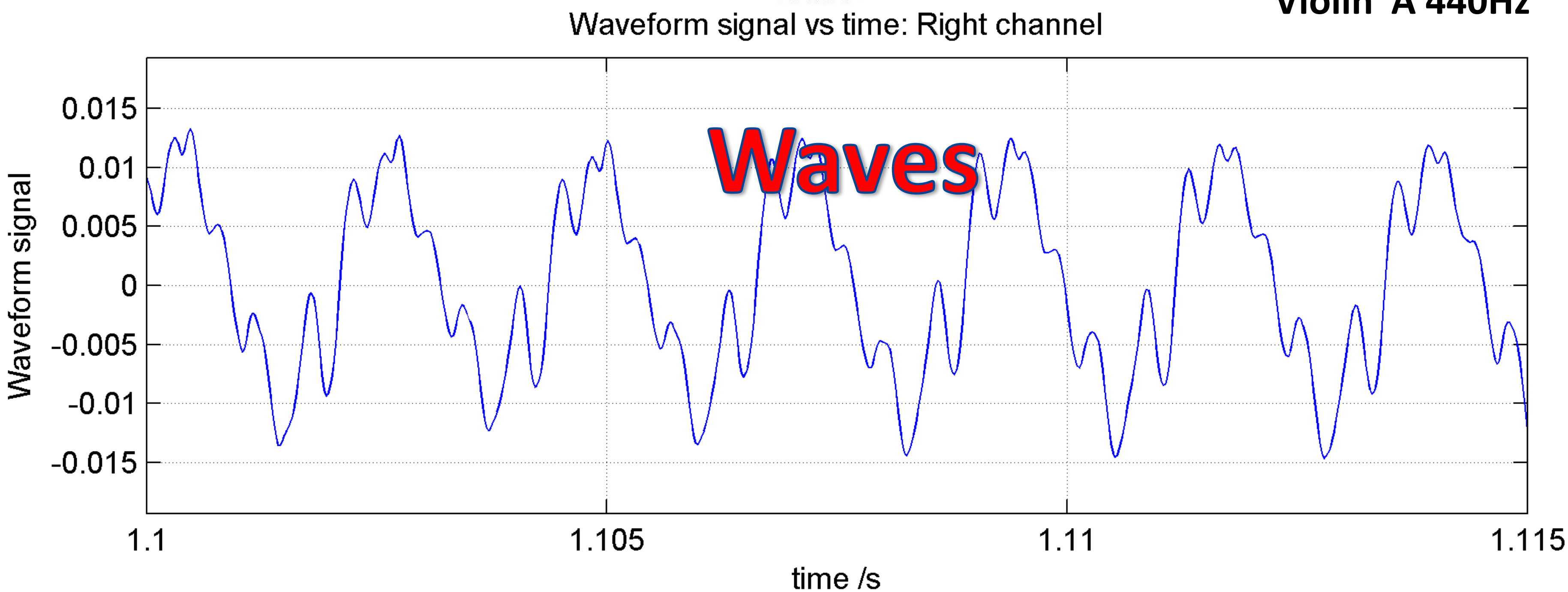
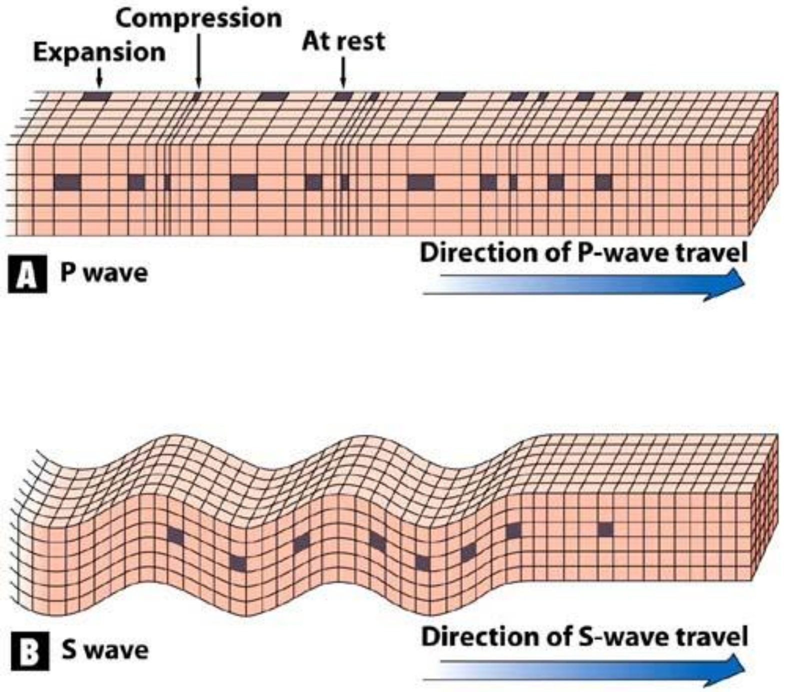
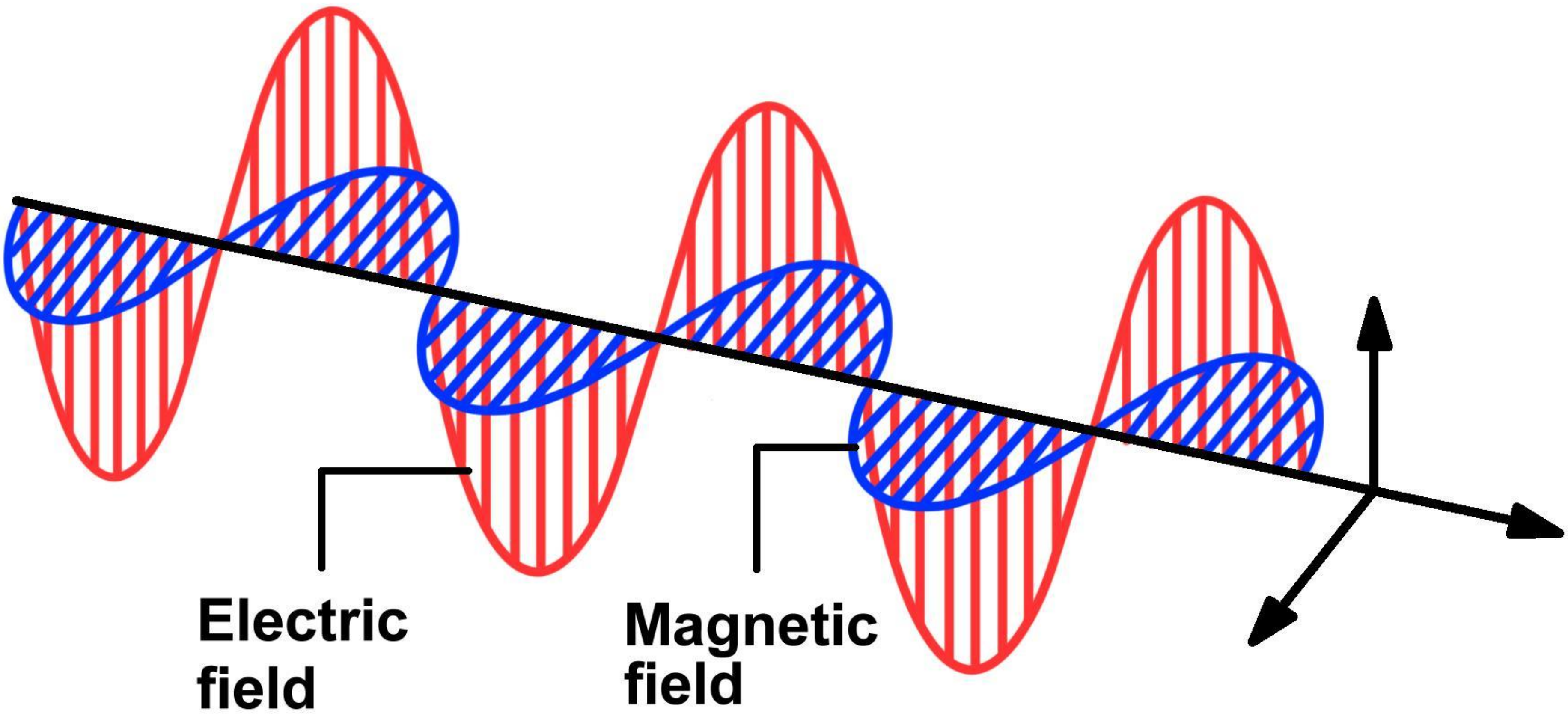




In solids, liquids, gas



And in electric fields in space which don't have any mass

Red

Orange

Yellow

Green

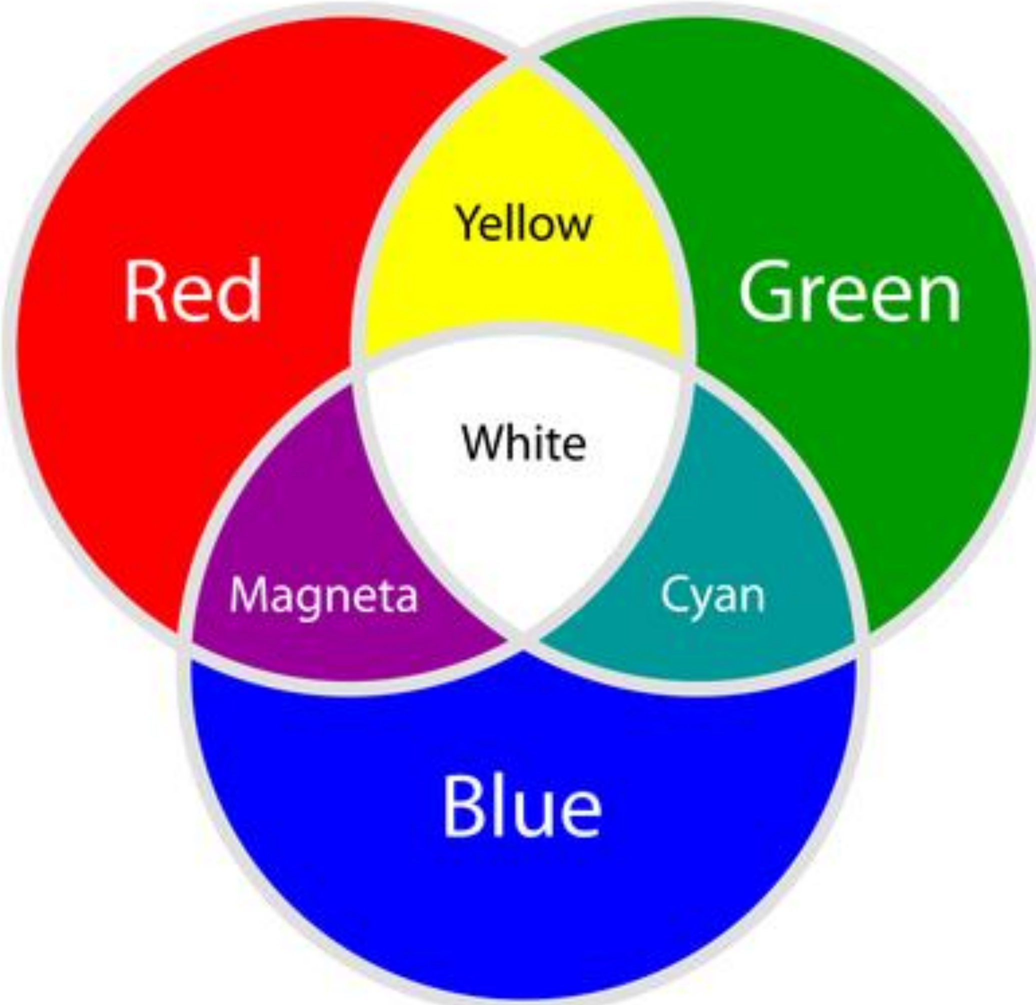
Blue

Violet


The colours of a bathroom

And together make a toilet (!)

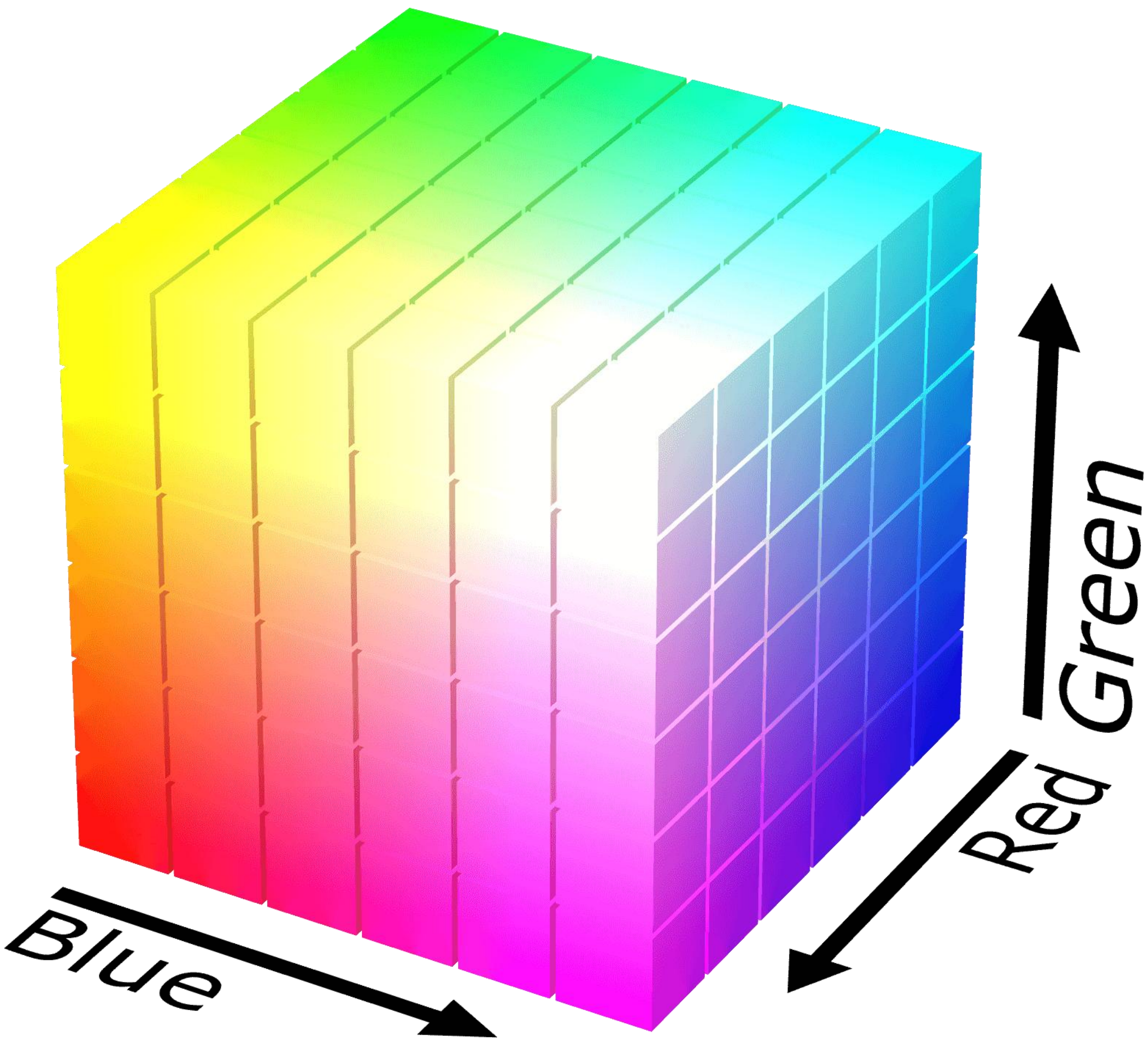
RGB



See white is red and green and blue

And black is none at all

Many other combinations can be daubed upon a wall

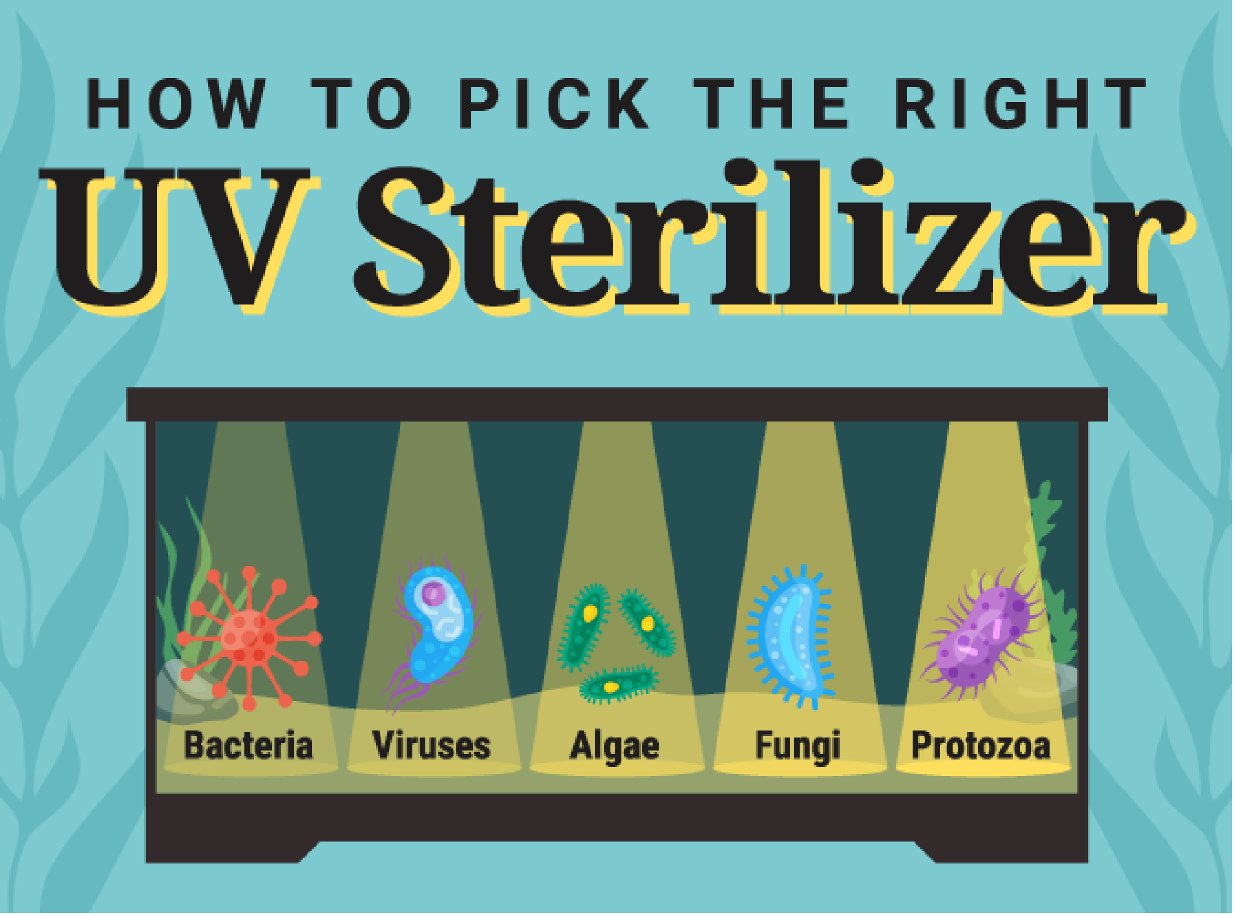


Avoid [255,105,180]

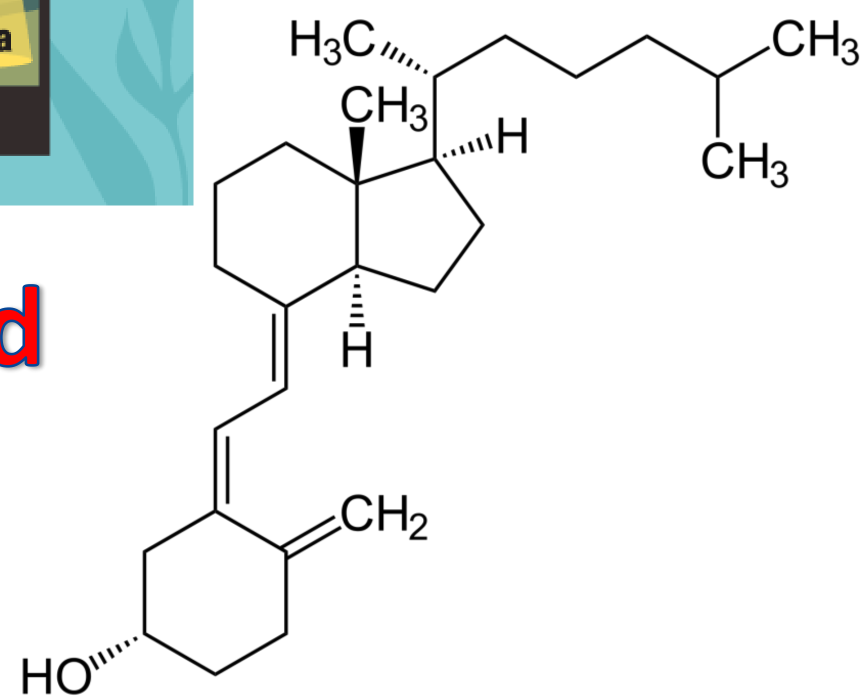
do please stop and think

This will give a hue most foul…
Your room will be hot pink!

Ten to four hundred nanometres is the wavelength of UV



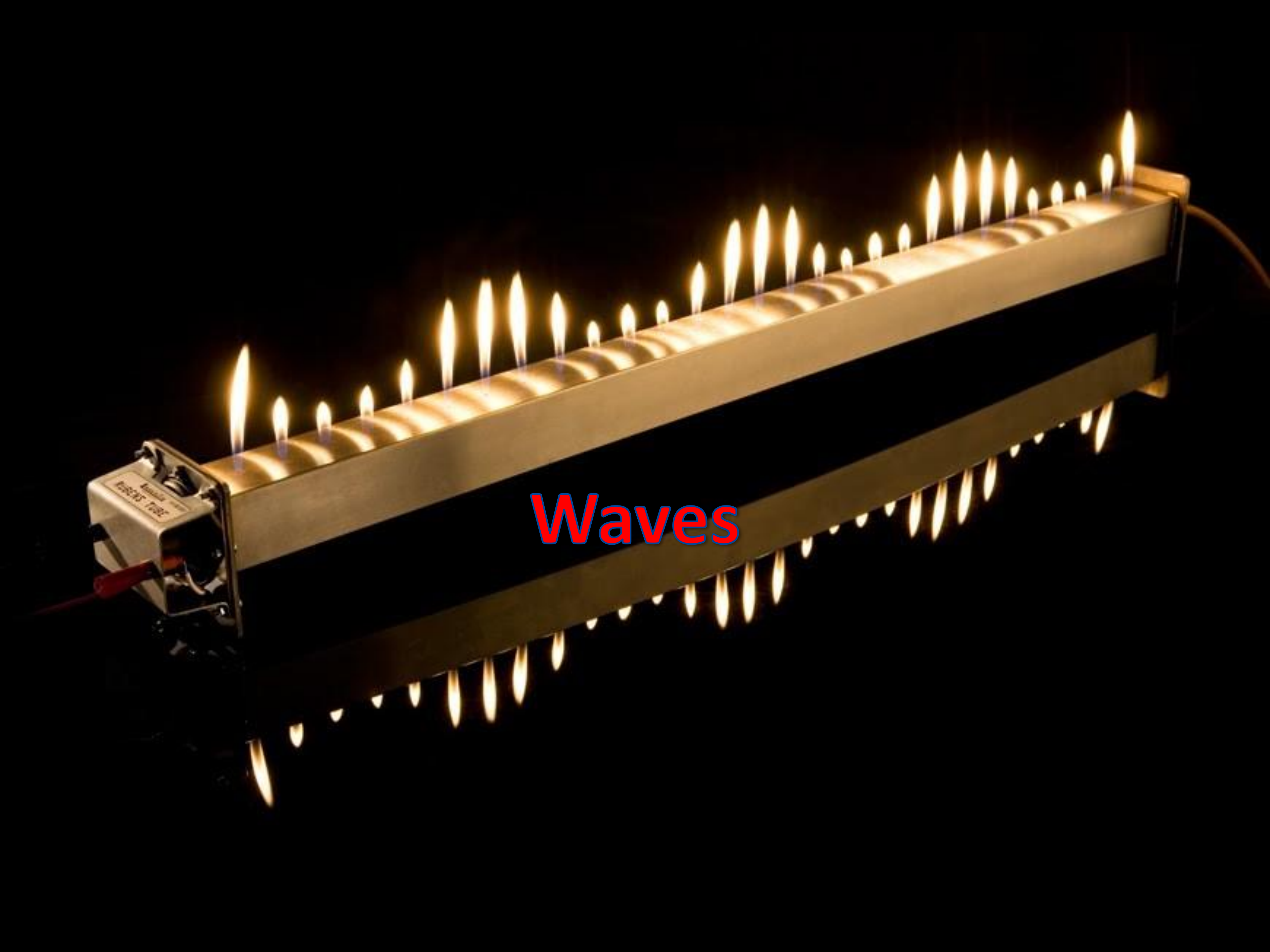
It sterilizes bugs and helps make Vitamin D



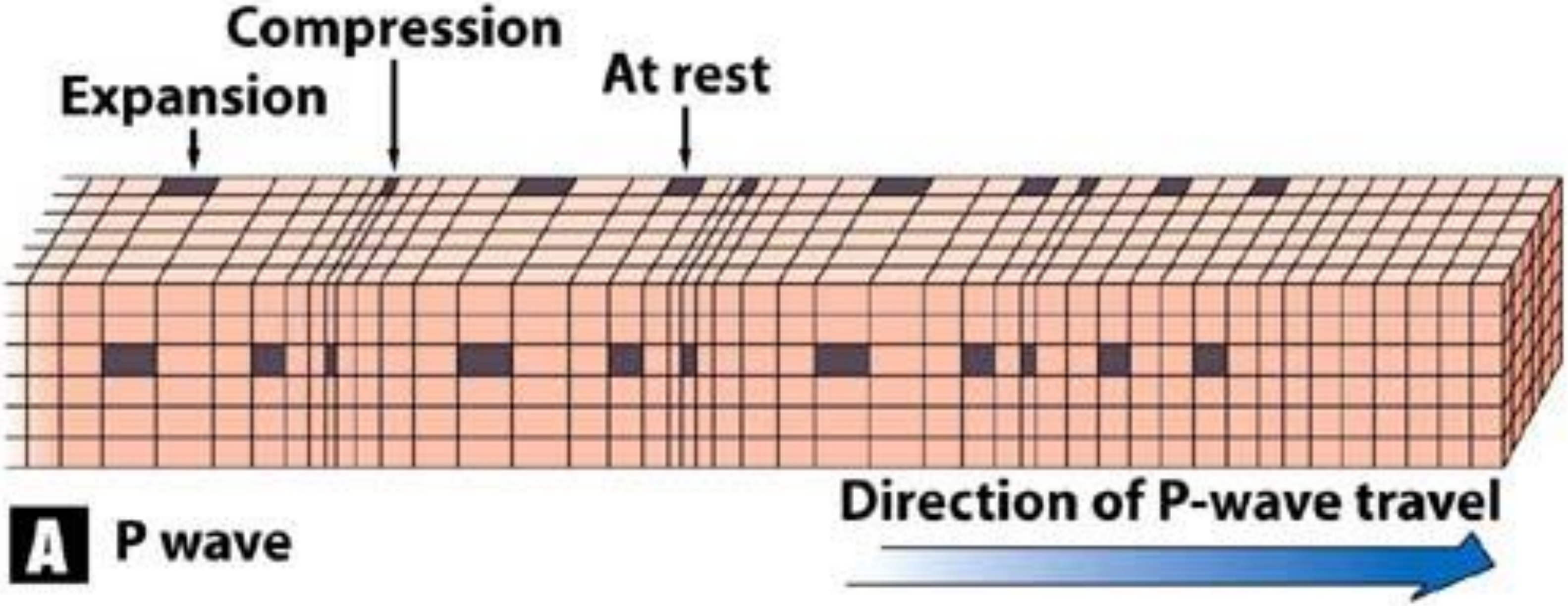
Insects see, with these waves makes flowers look quite odd

And things fluoresce under UV like spiders, rocks and frogs

Waves




Waves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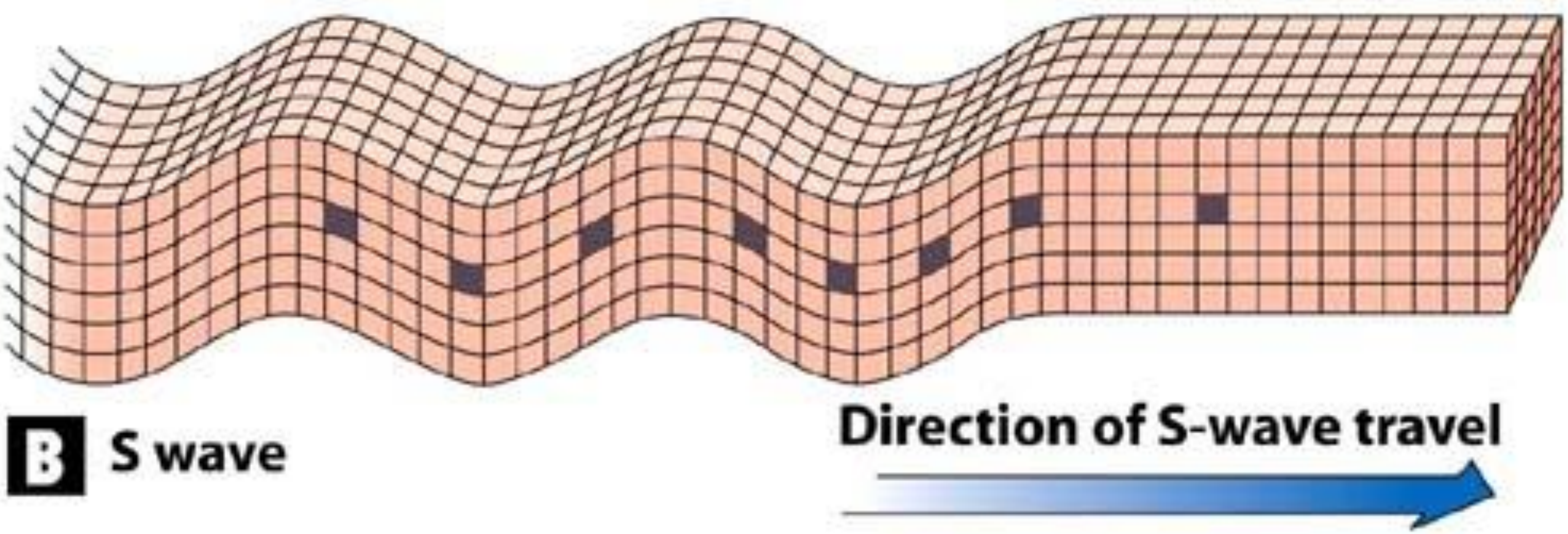
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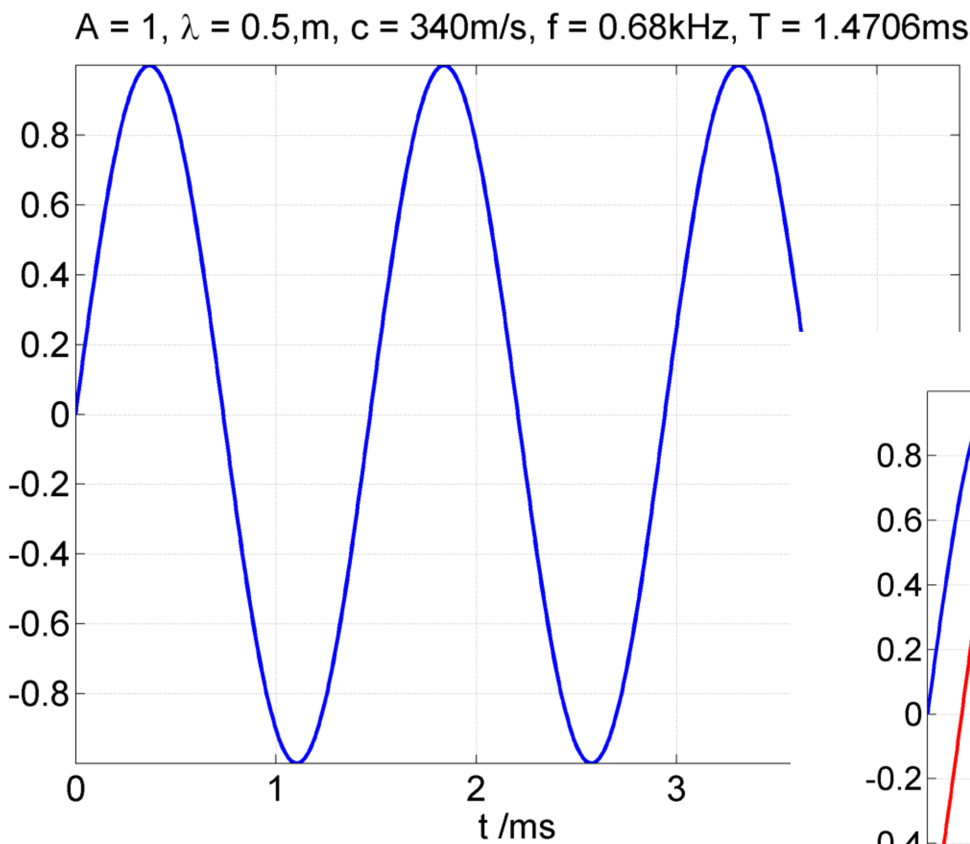

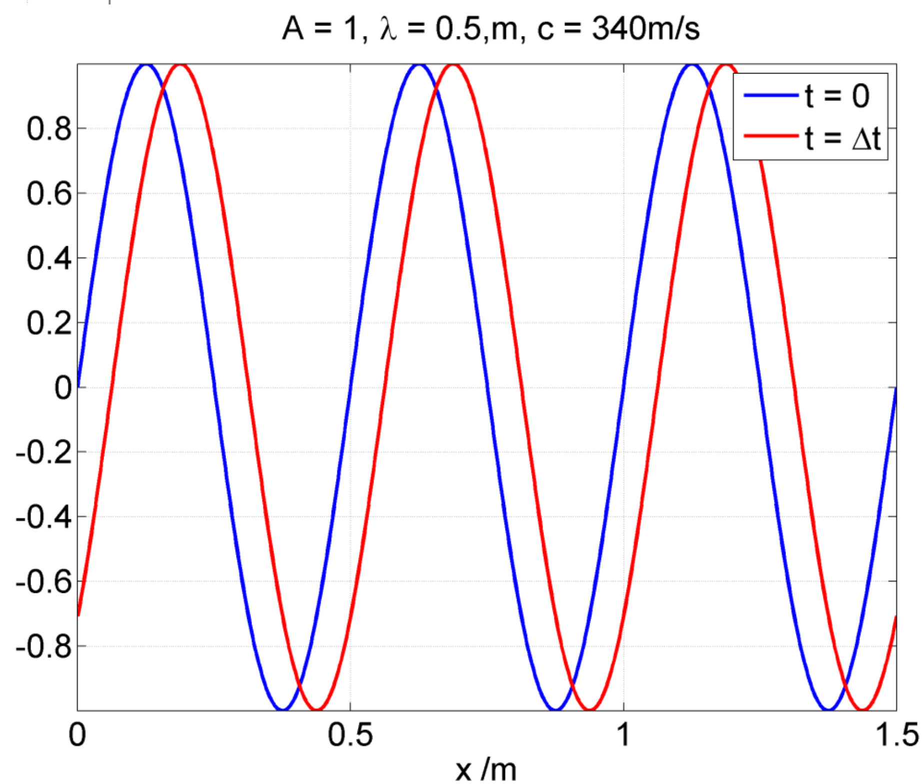

Translate through time and space

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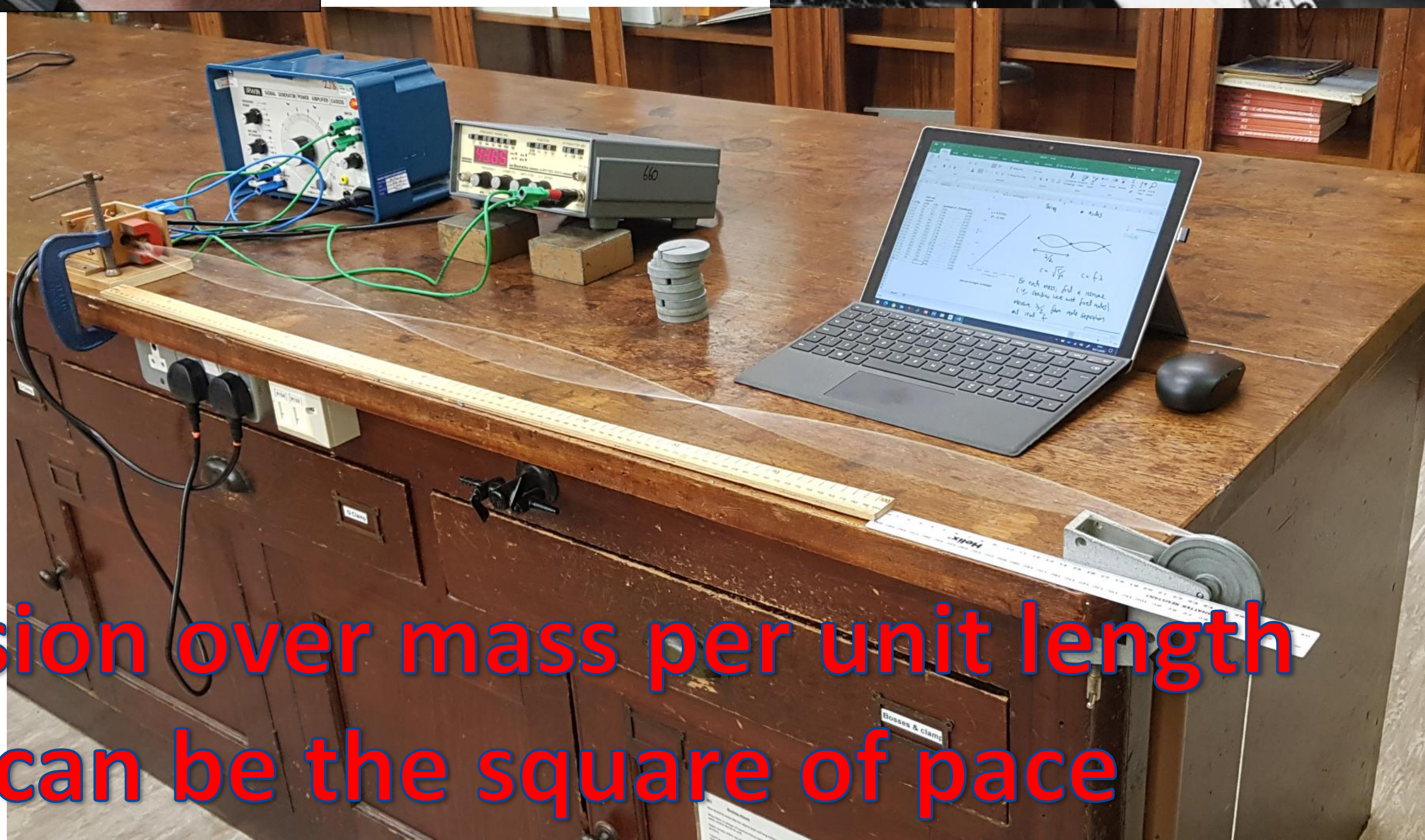
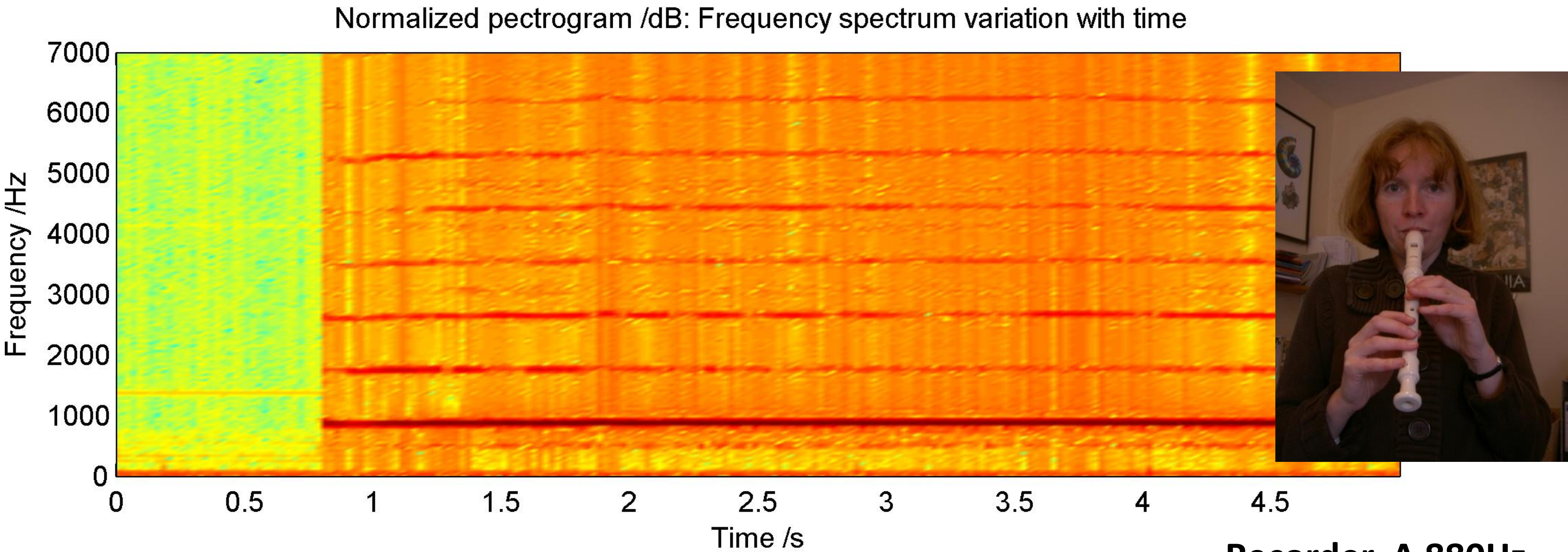


Tension over mass per unit length can be the square of pace



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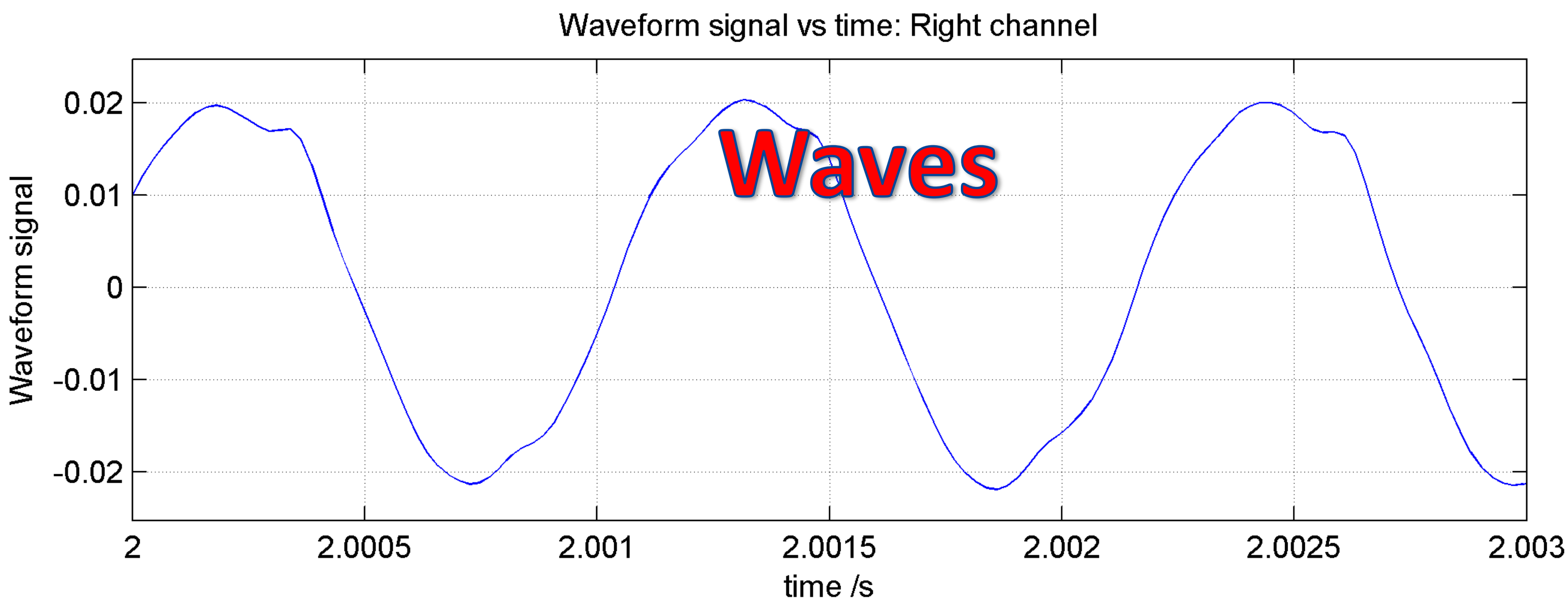

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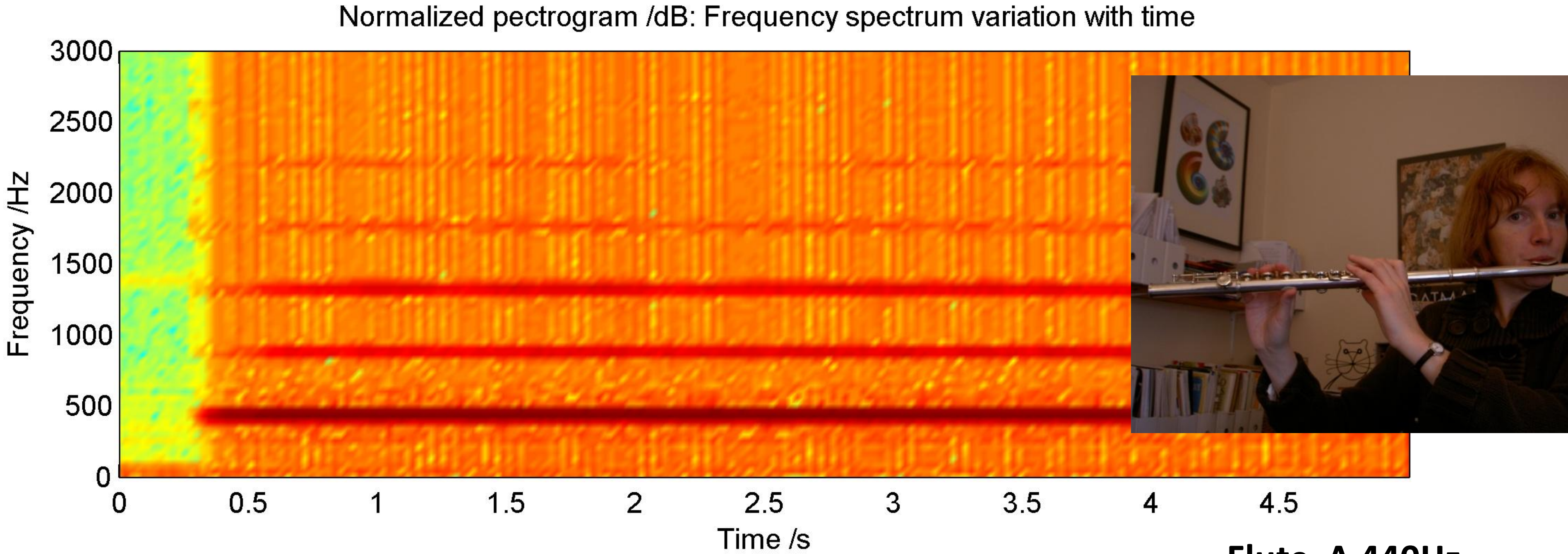

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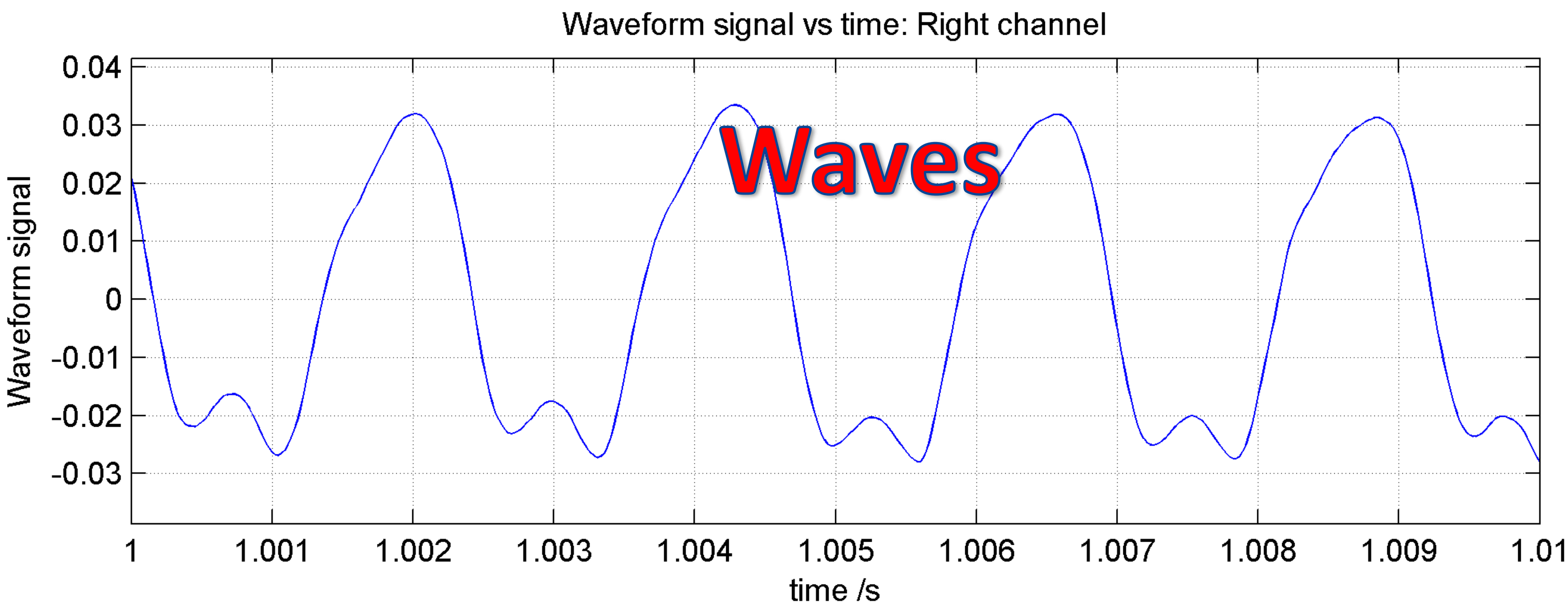
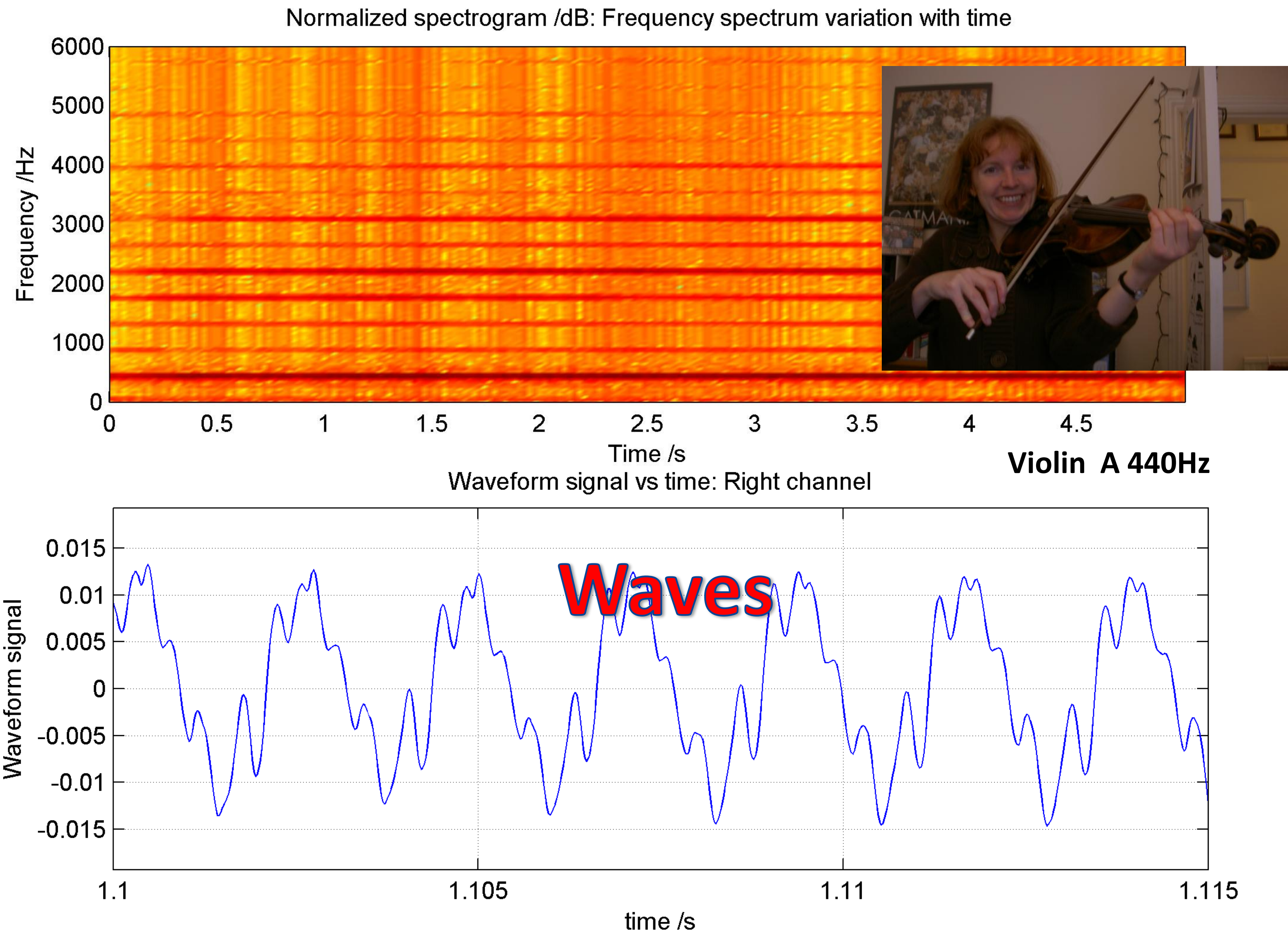
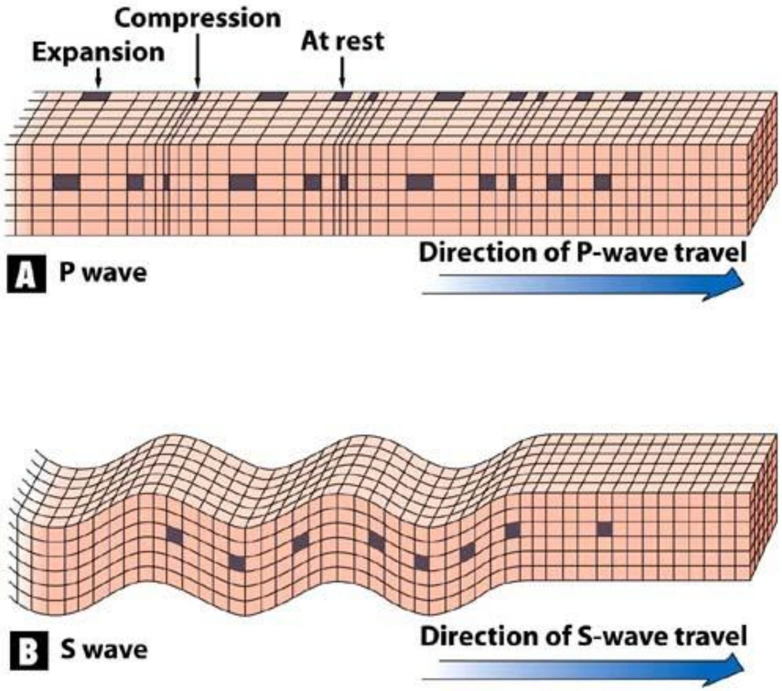
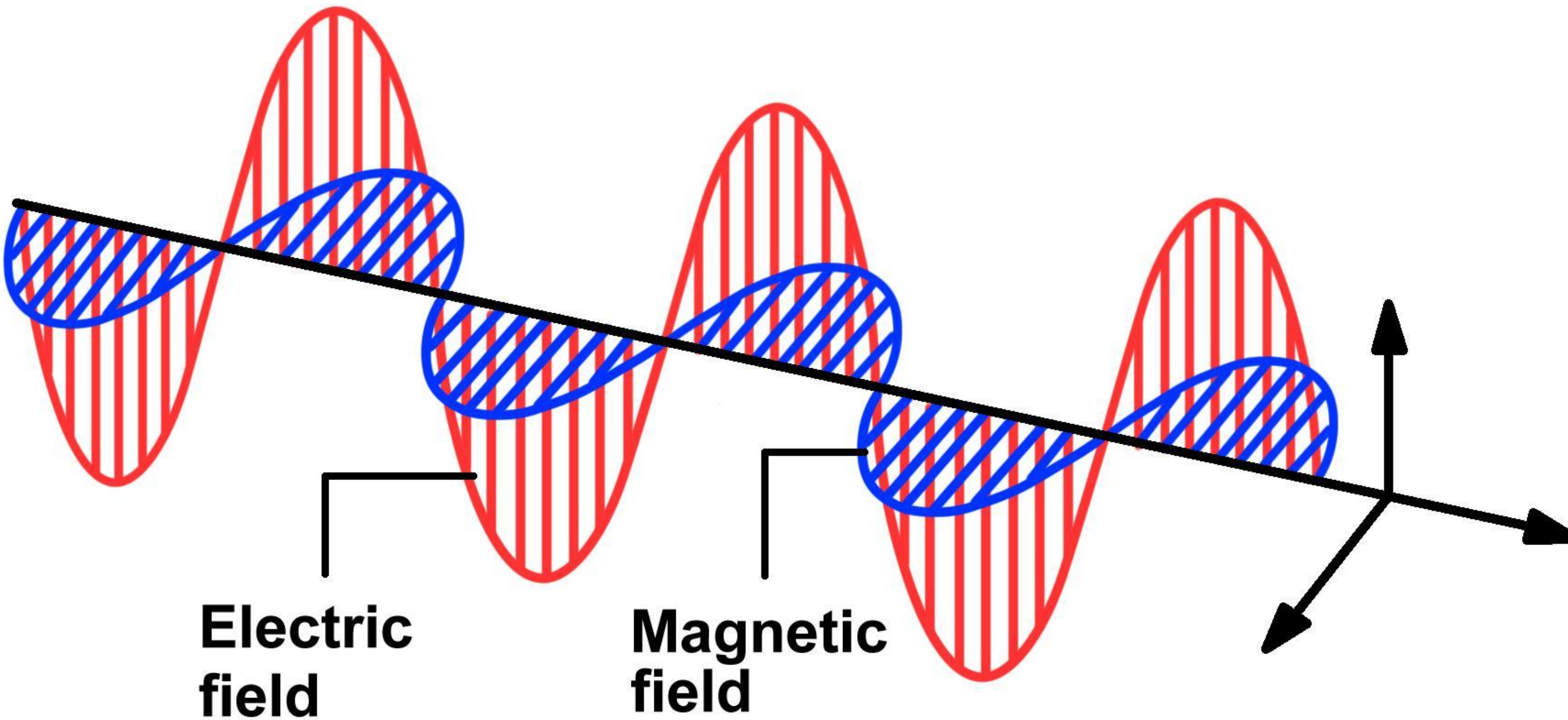




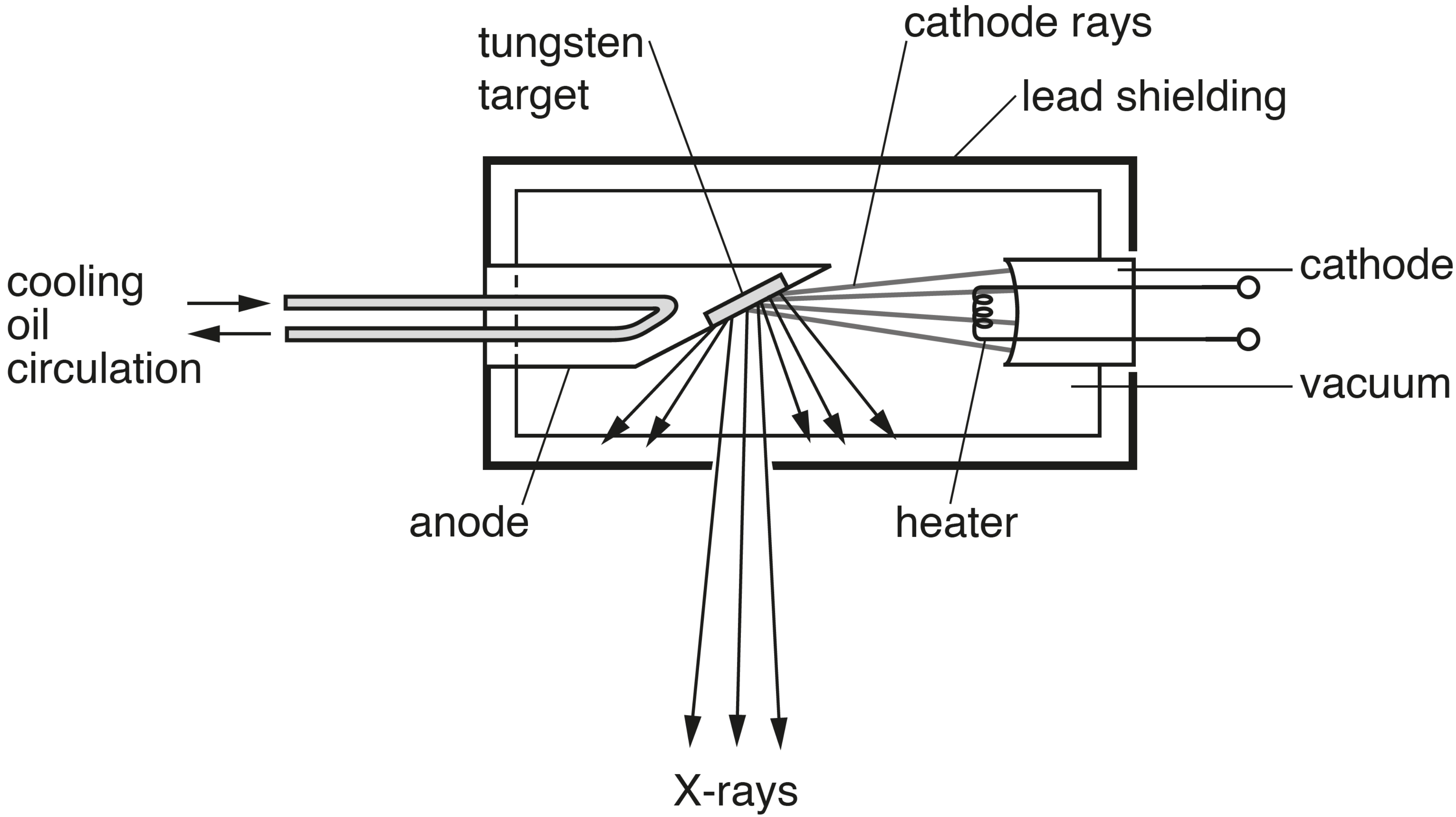
Normalized spectrogram /dB: Frequency spectrum variation with time
Frequency /Hz
6000
5000
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Time /s
Violin A 440Hz
Waveform signal vs time: Right channel
Waves
Waveform signal
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
1.1
1.105
1.11
1.115
time /s



In solids, liquids, gas

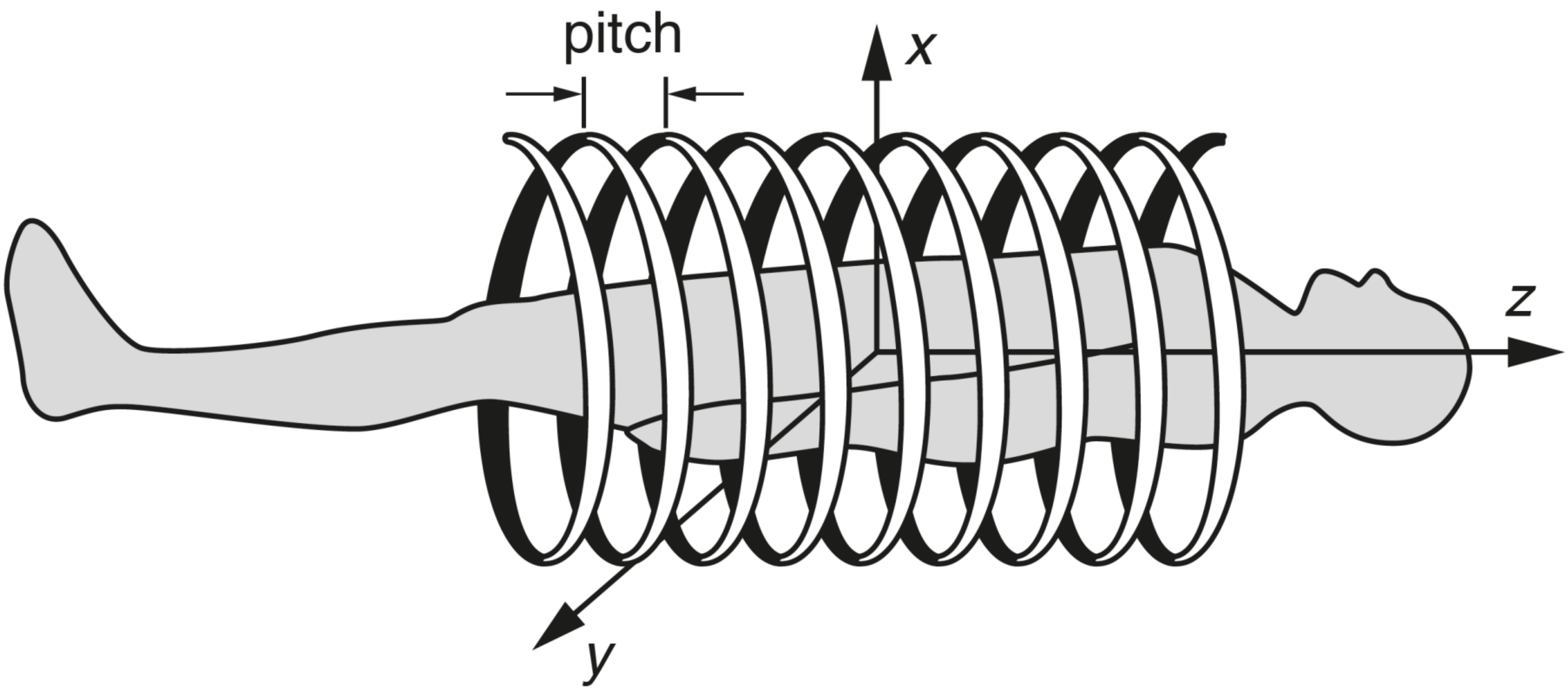


And in electric fields in space which don't have any mass

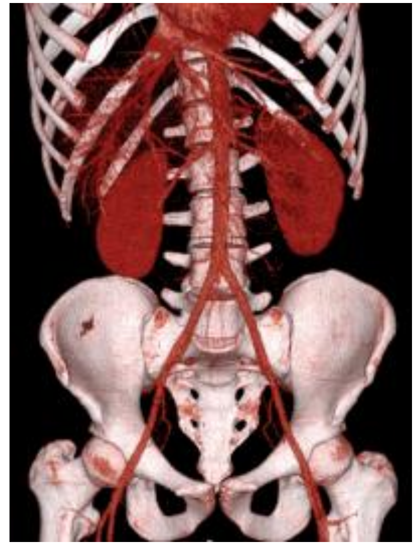


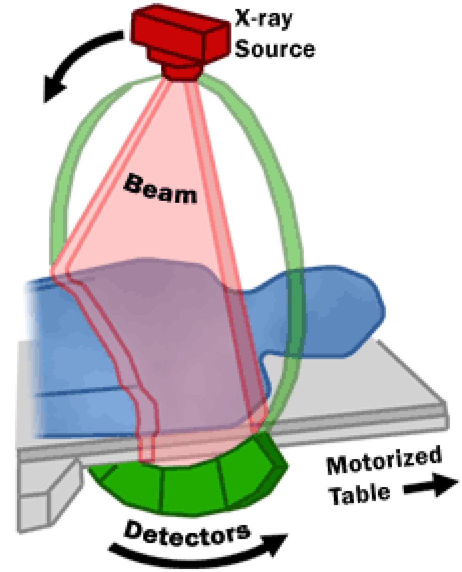
Accelerate an electron and it will give off X-rays

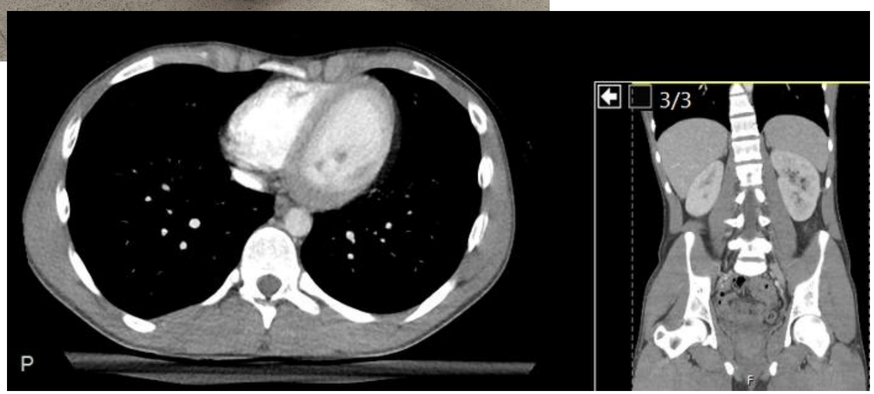
Pass these through, bone and flesh
so damage can be appraised



Scan a man in slices and you'll build up a 3D model

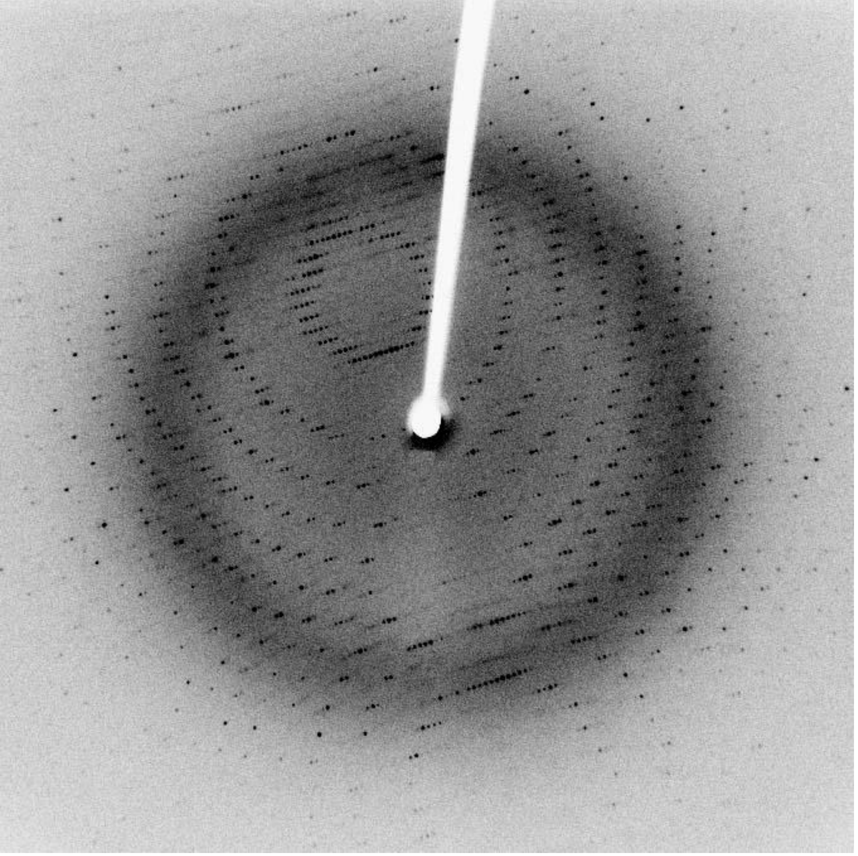




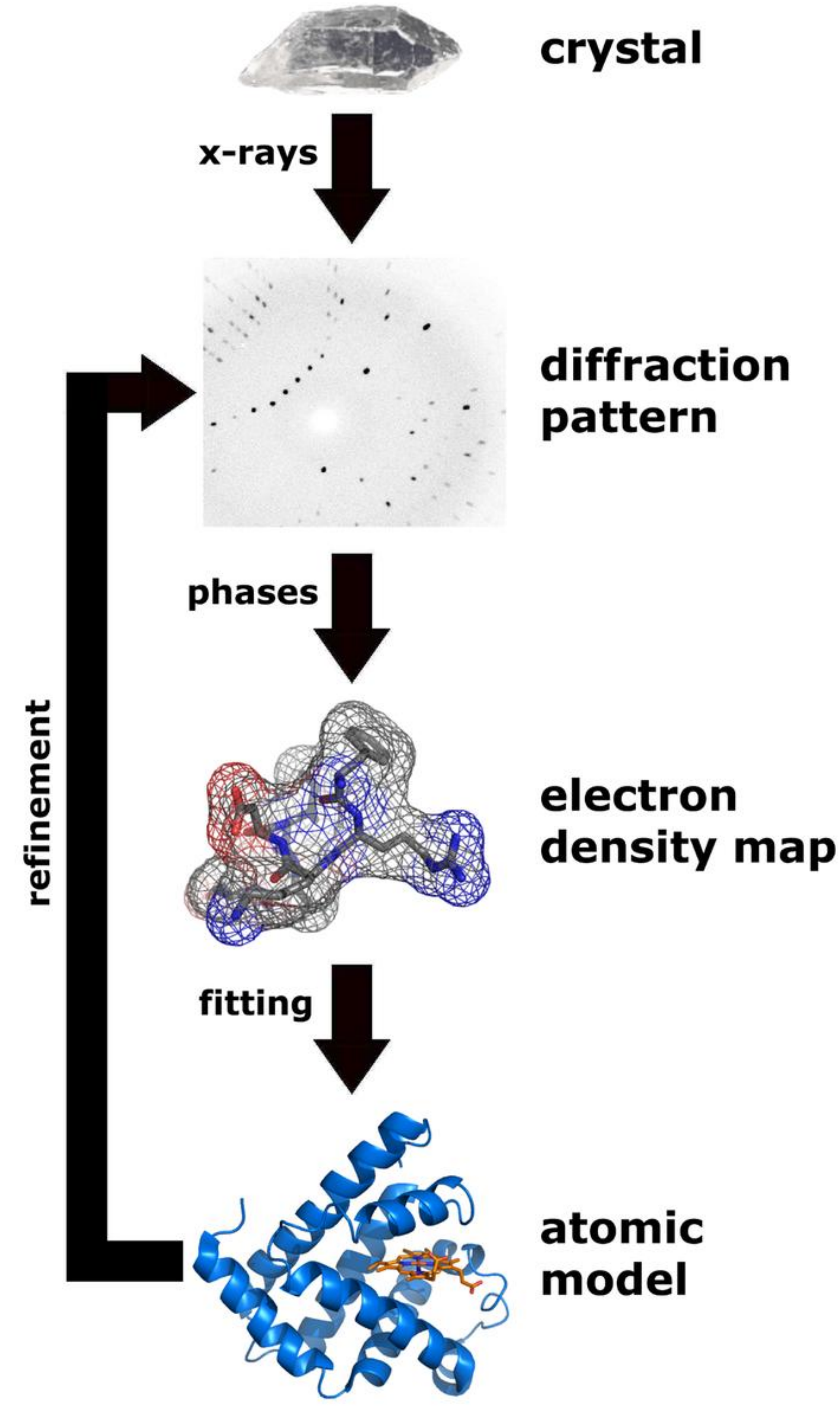


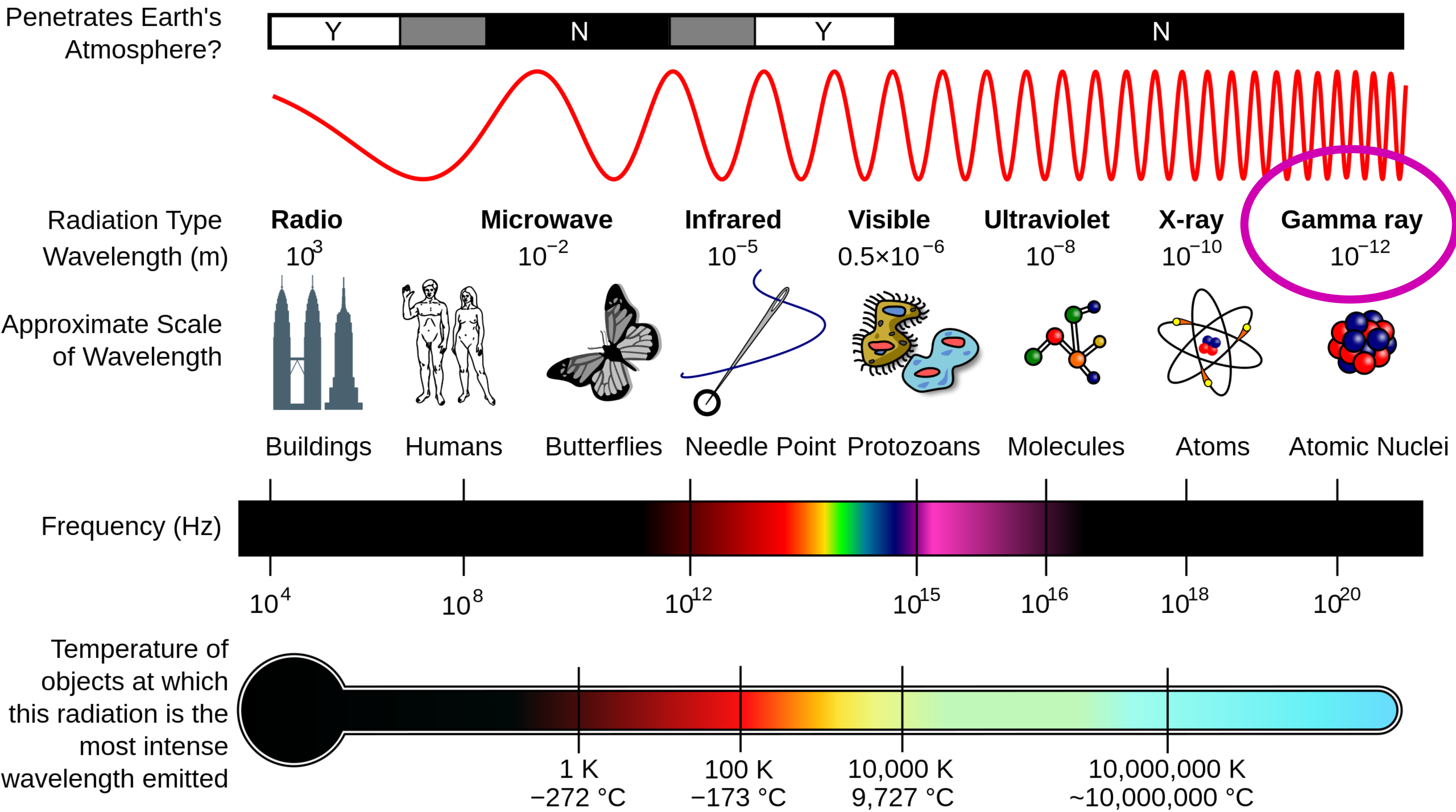
Virtually dissect him...
It's really quite a doddle

X-ray your baggage and reveal your drugs and guns



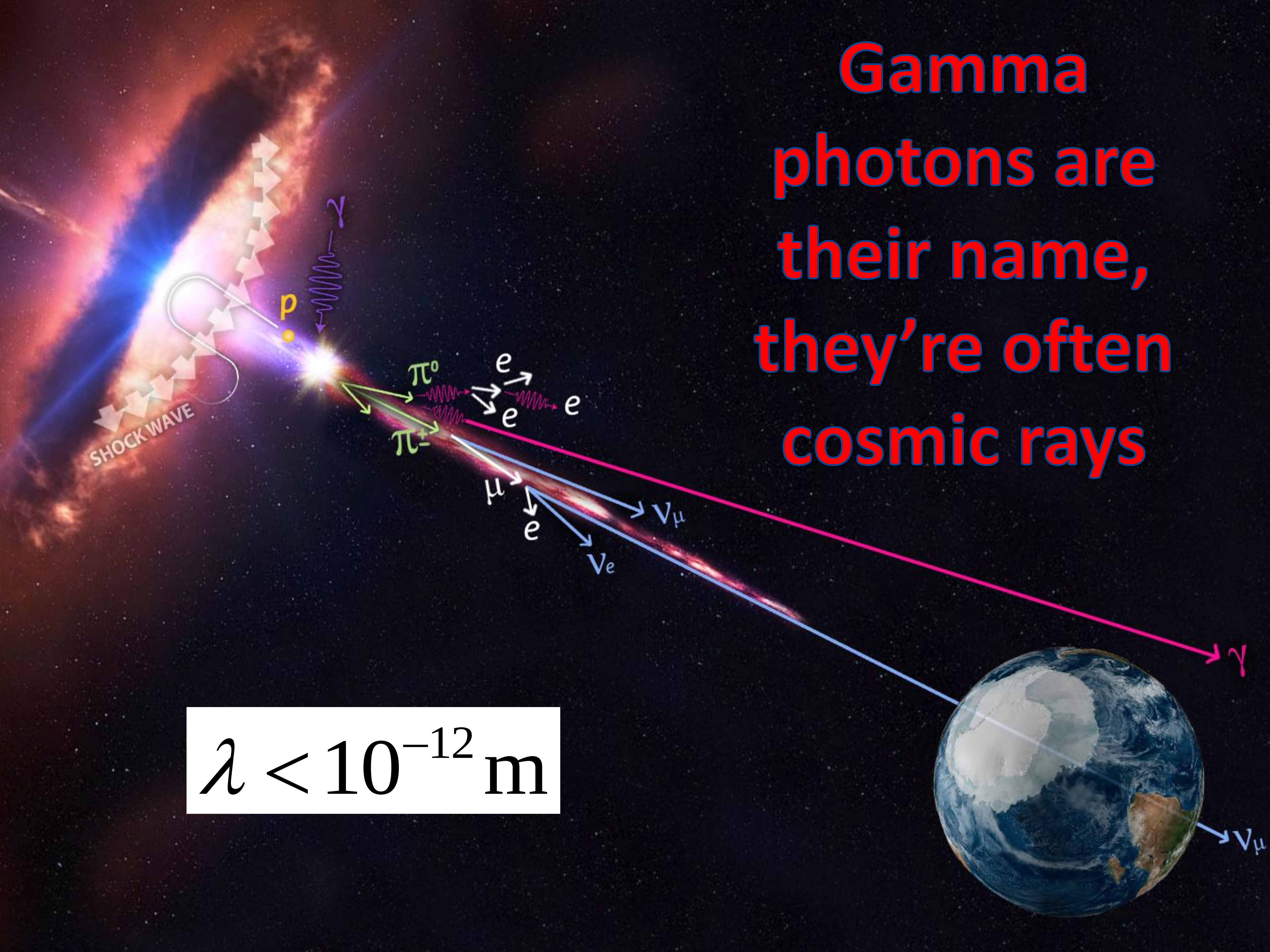
Diffract 'em off molecules, work out their construction



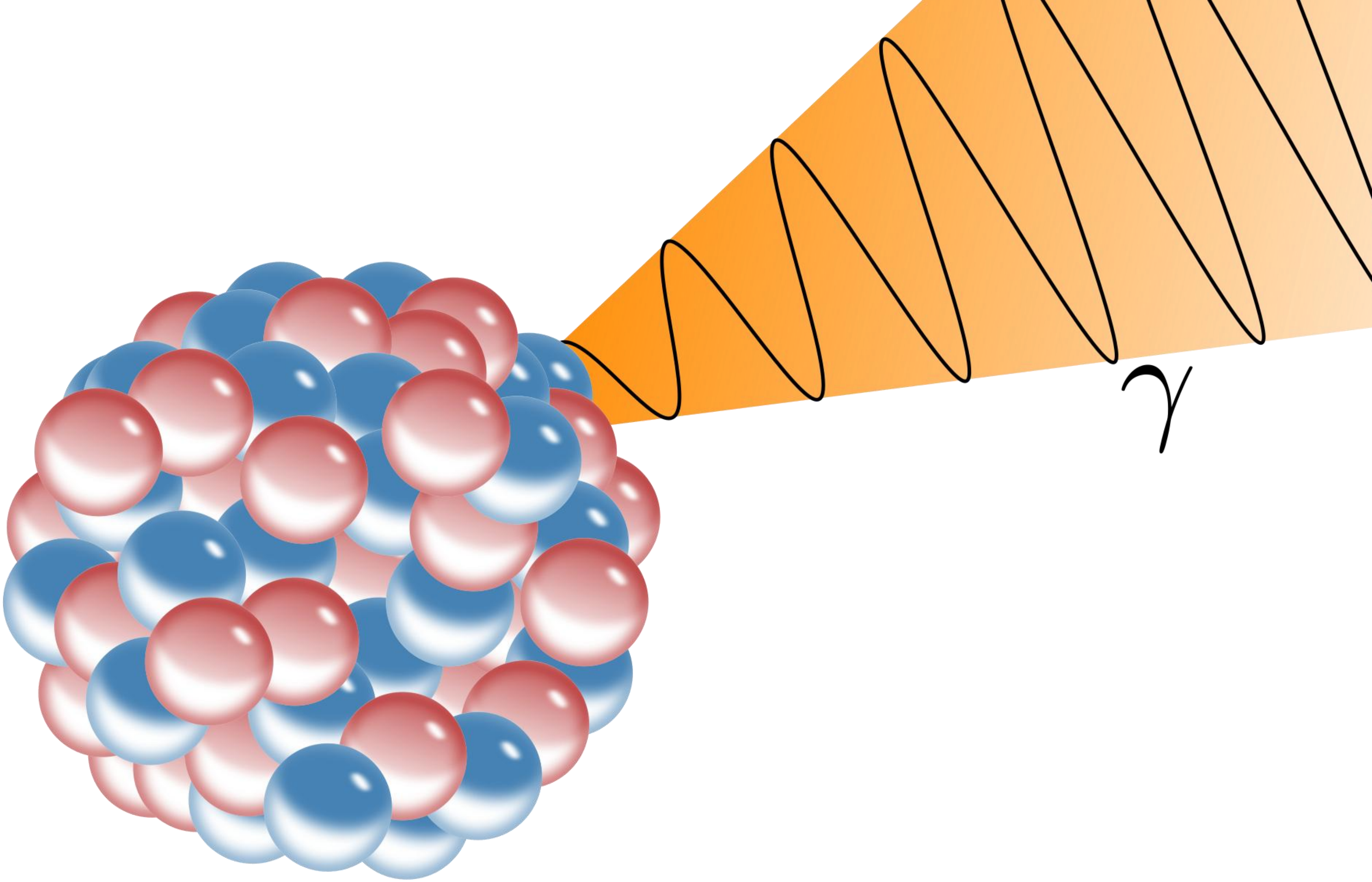


Finally we reach the shortest EM waves

Gamma photons are their name, they're often cosmic rays

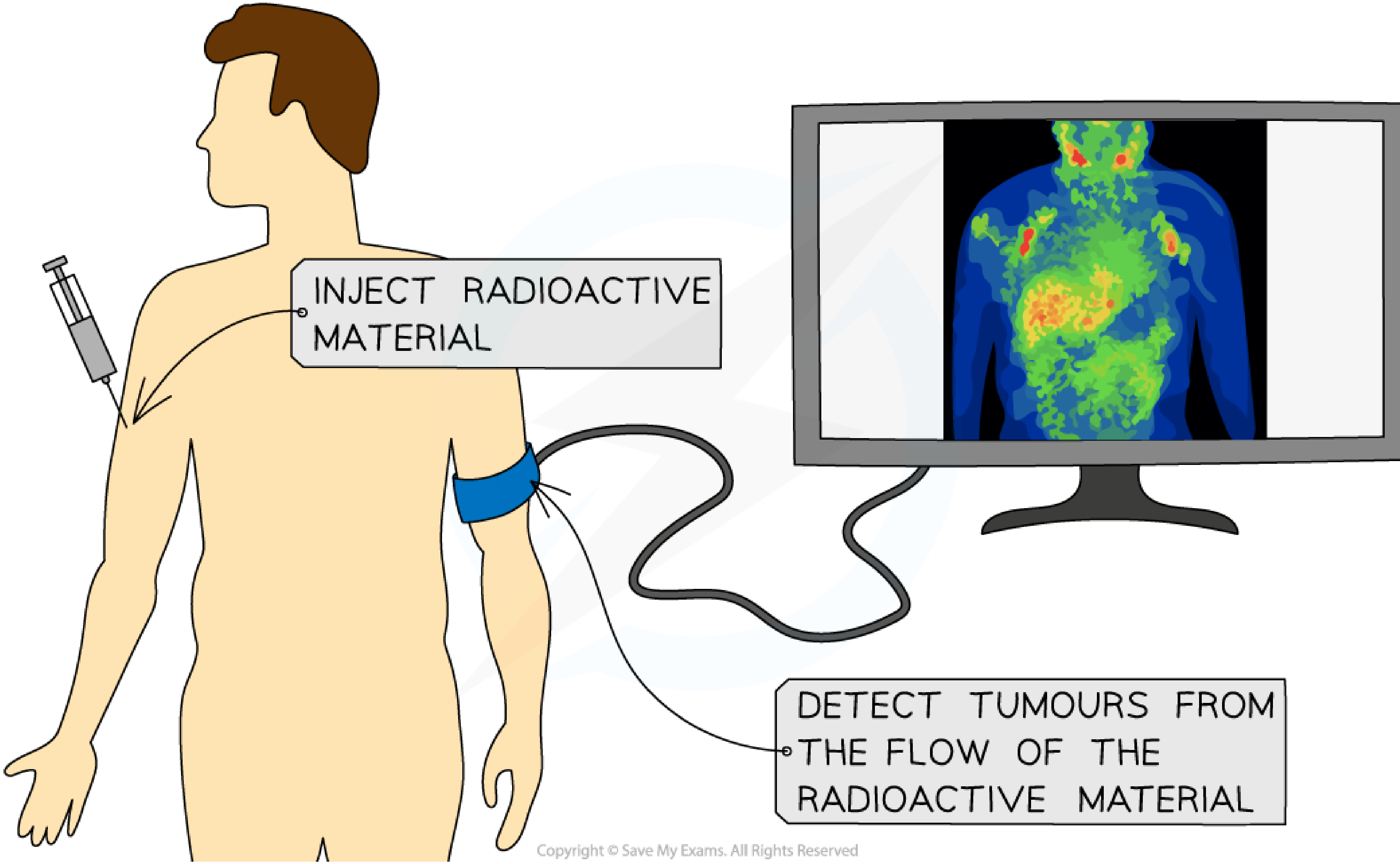


$$\lambda < 10^{-12}\,\mathrm{m}$$

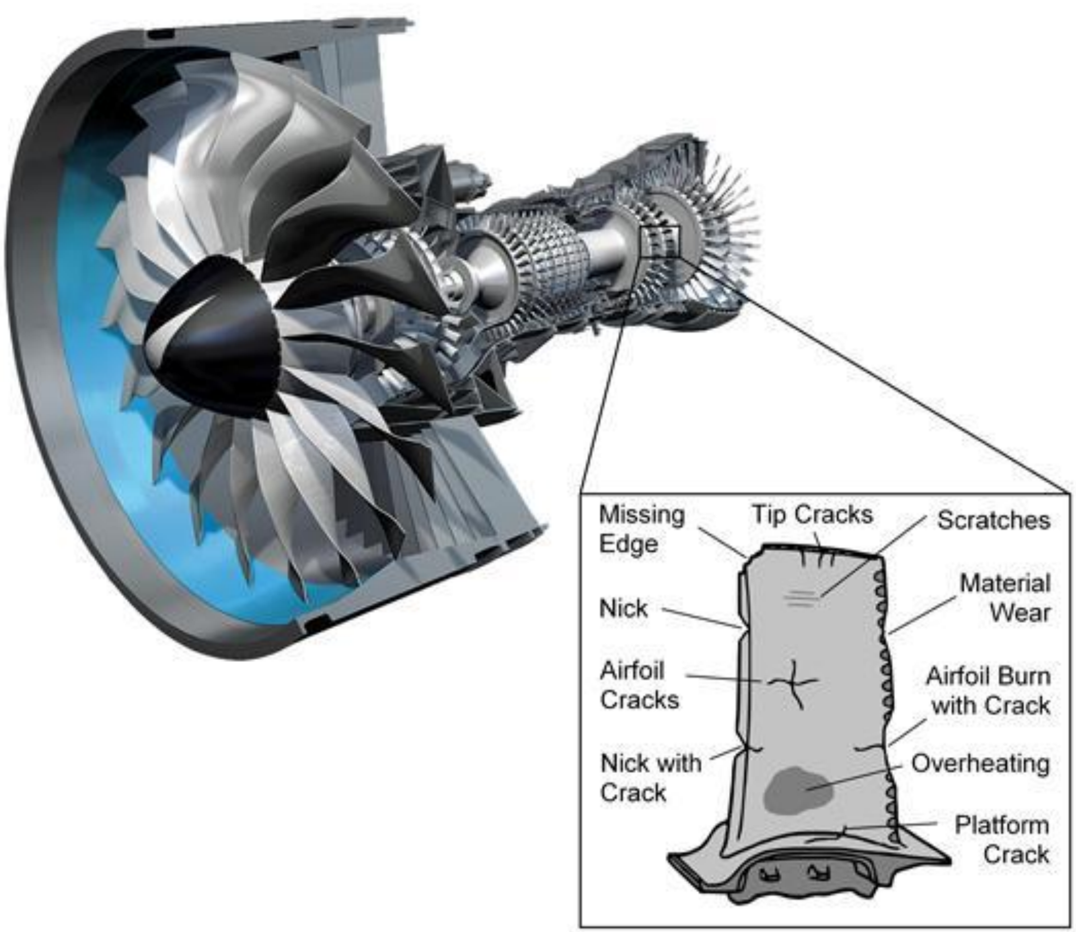


Excited nuclei will give off this radiation

Penetrates through, all but lead (careful with your dose or you'll end up dead)

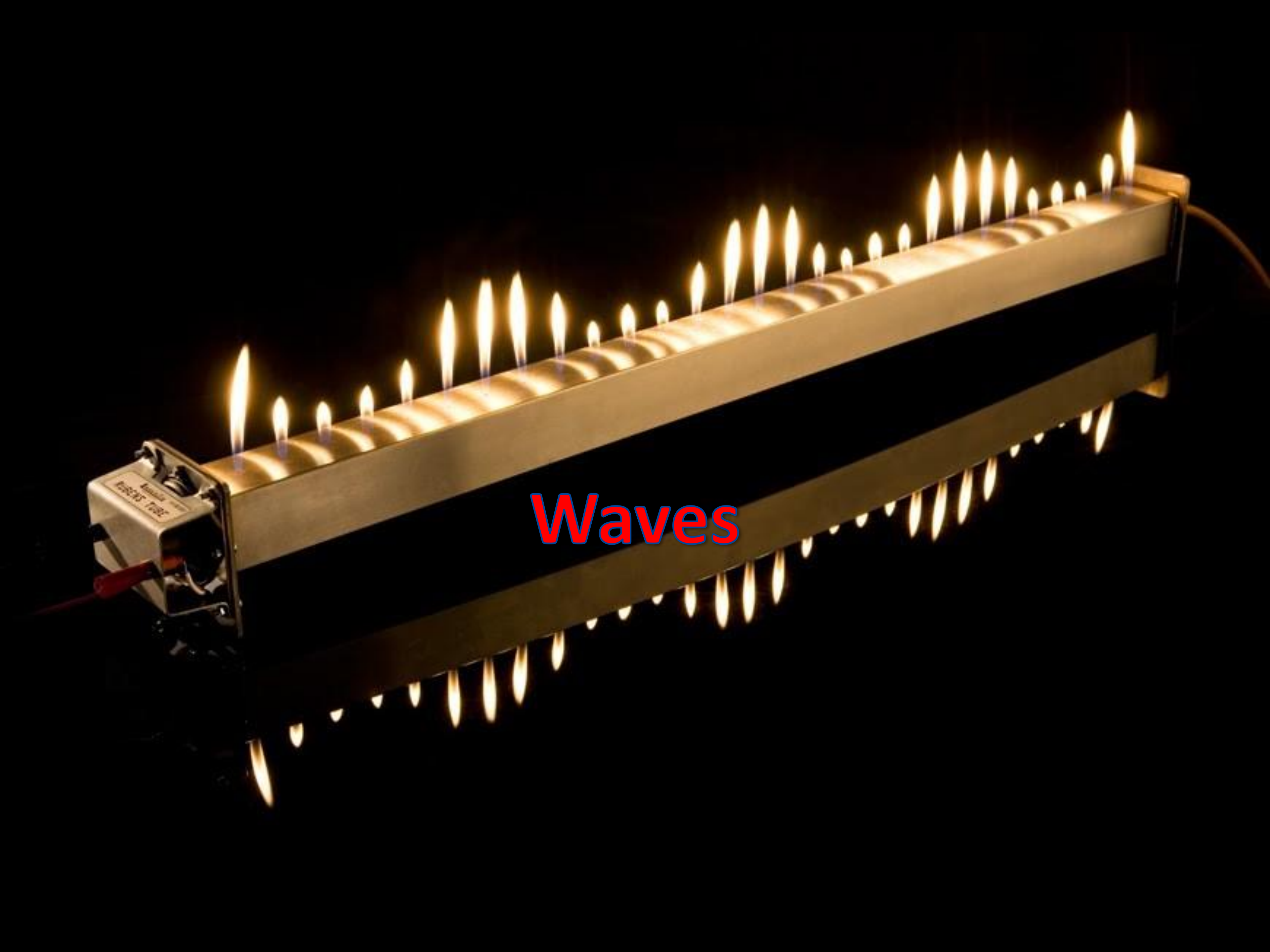


Gamma can be a tracer checks your flow of blood

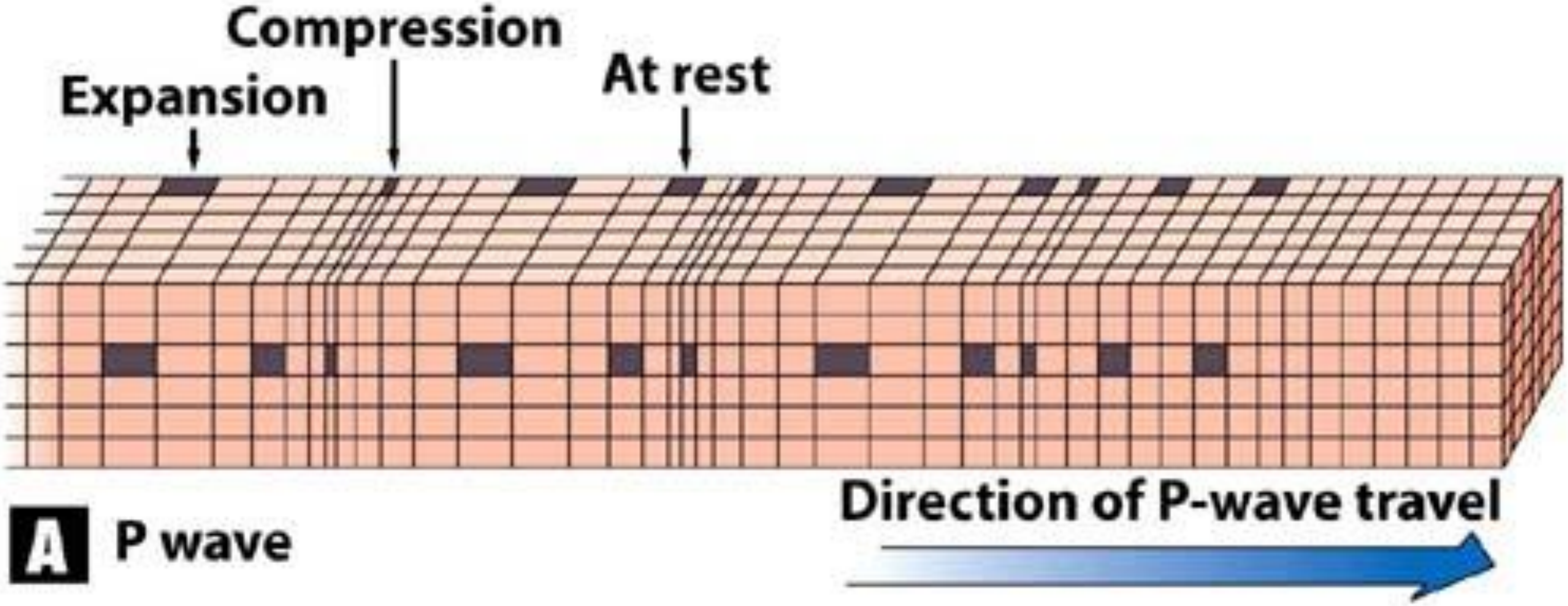


Or photograph turbine blades checks which ones are dud

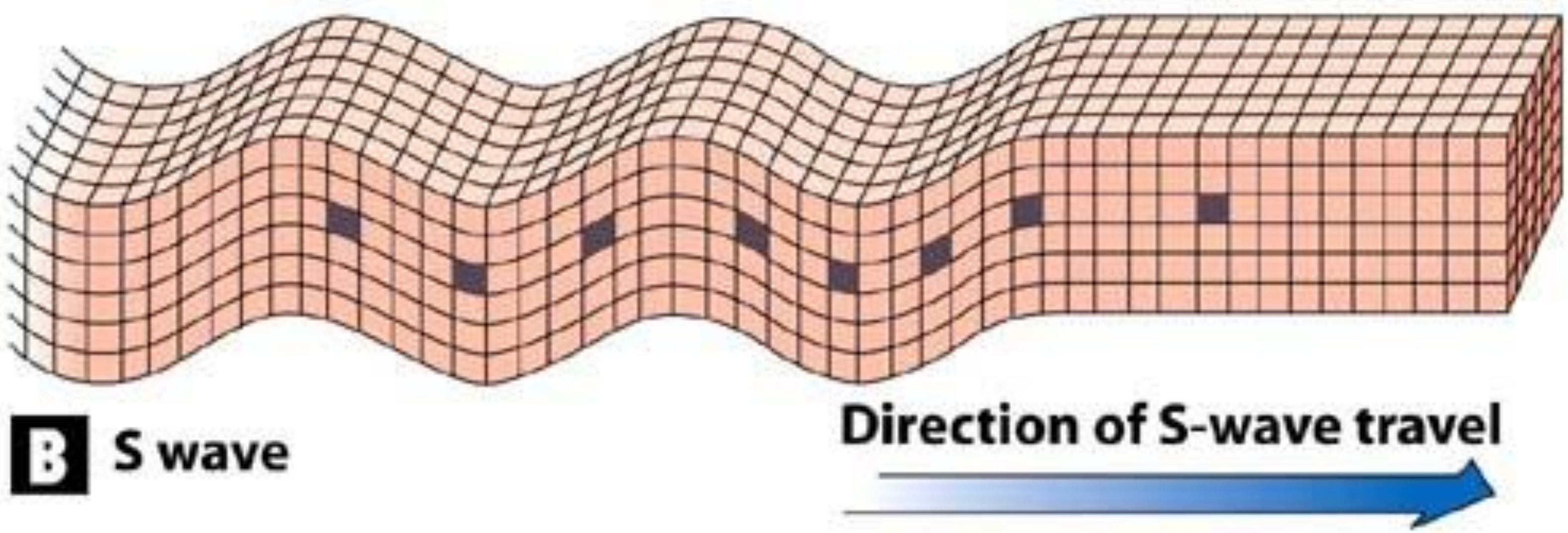
Waves

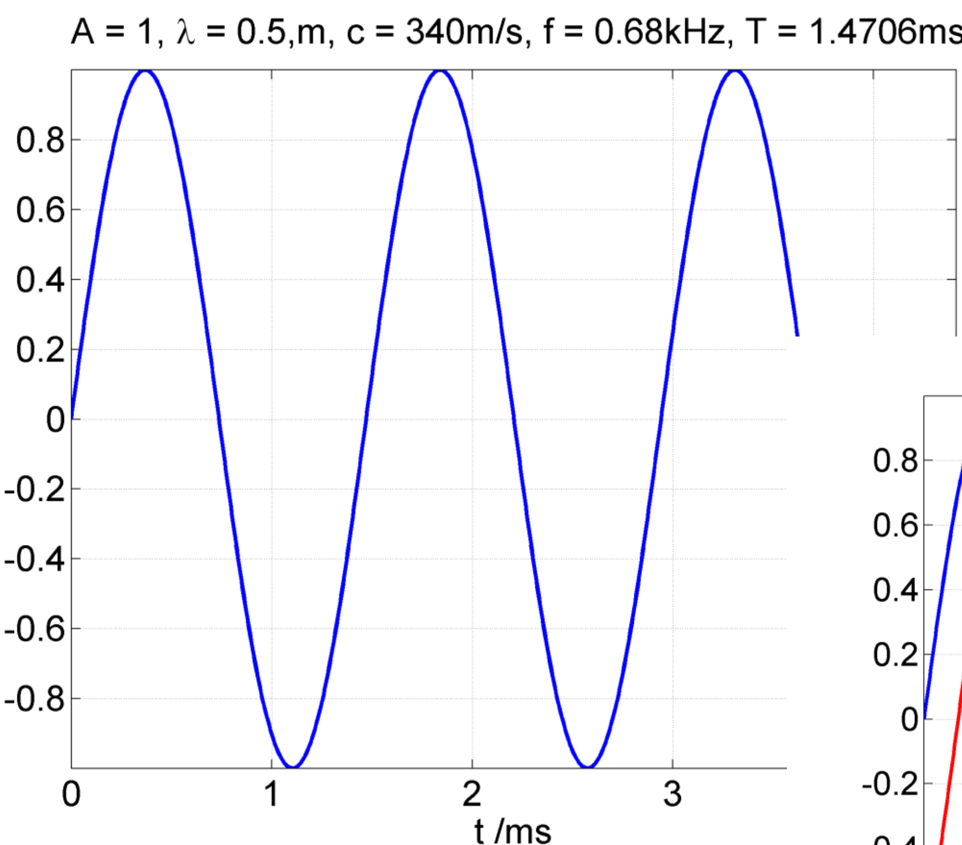


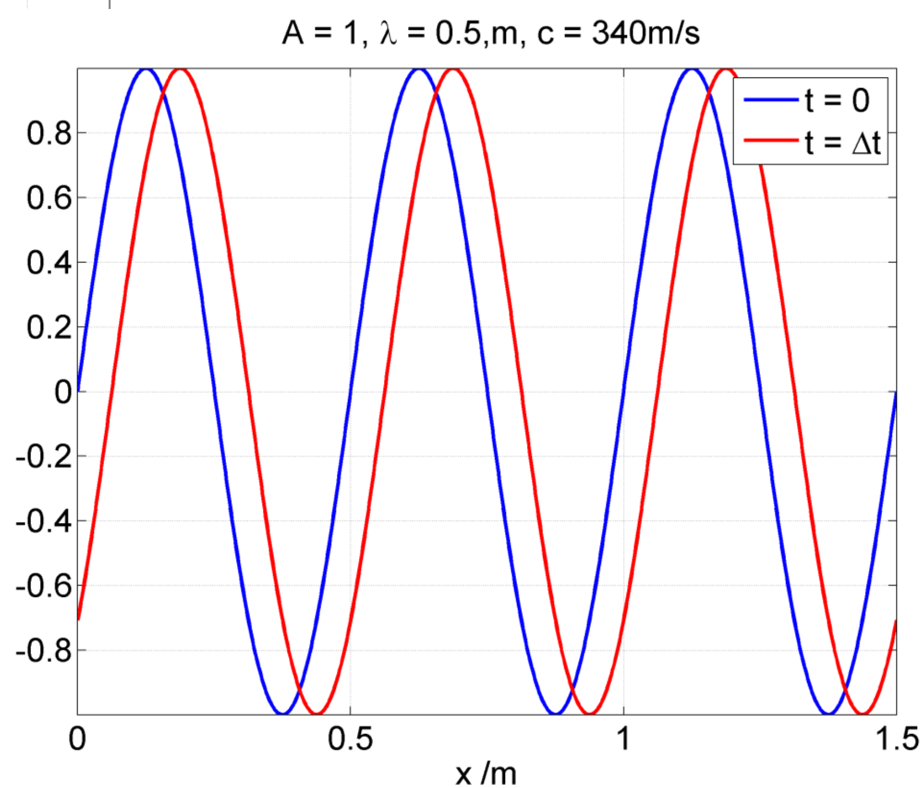
Waves


Compression
Expansion
At rest
Direction of P-wave travel
A
P wave

Waves

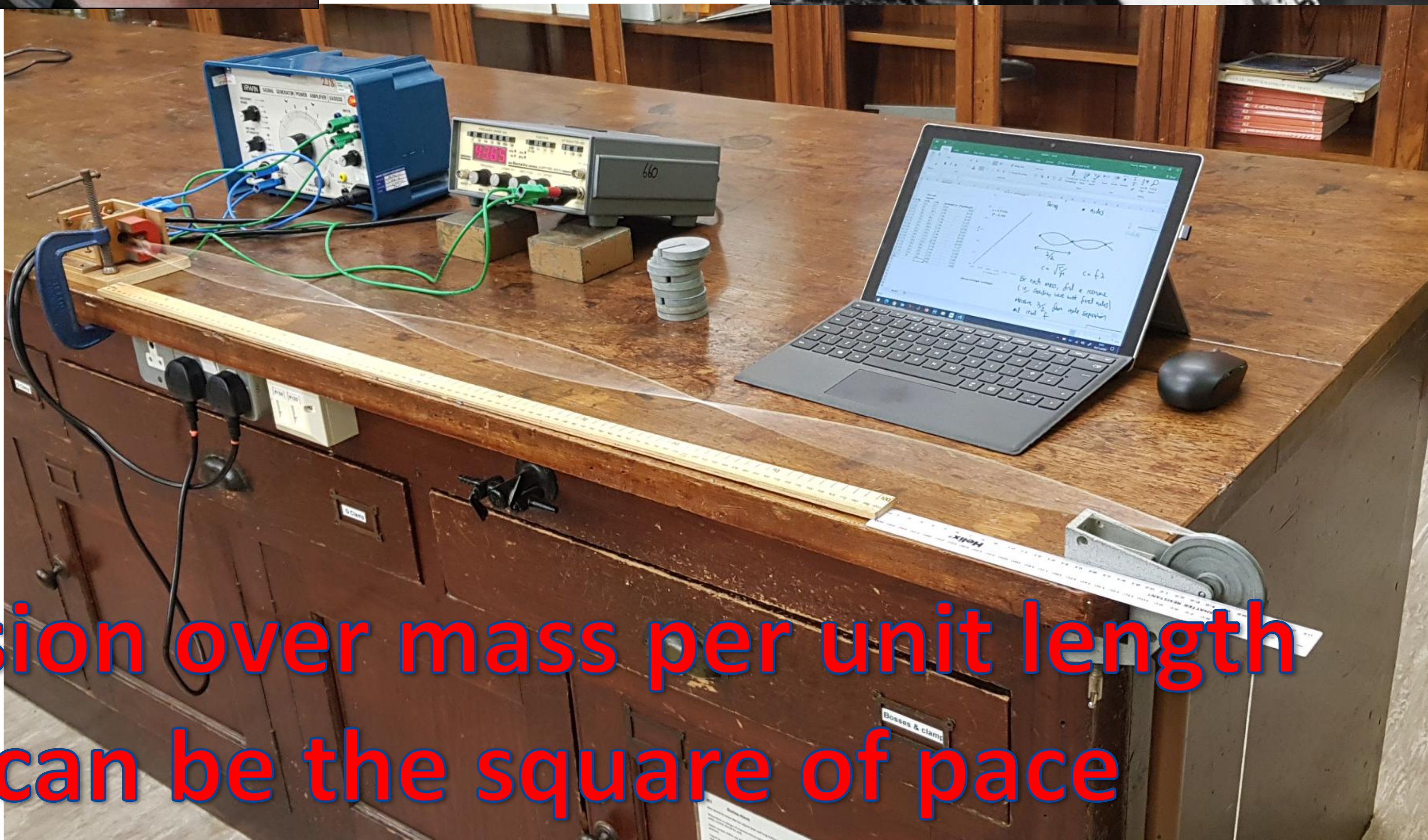

Direction of S-wave travel
B
S wave





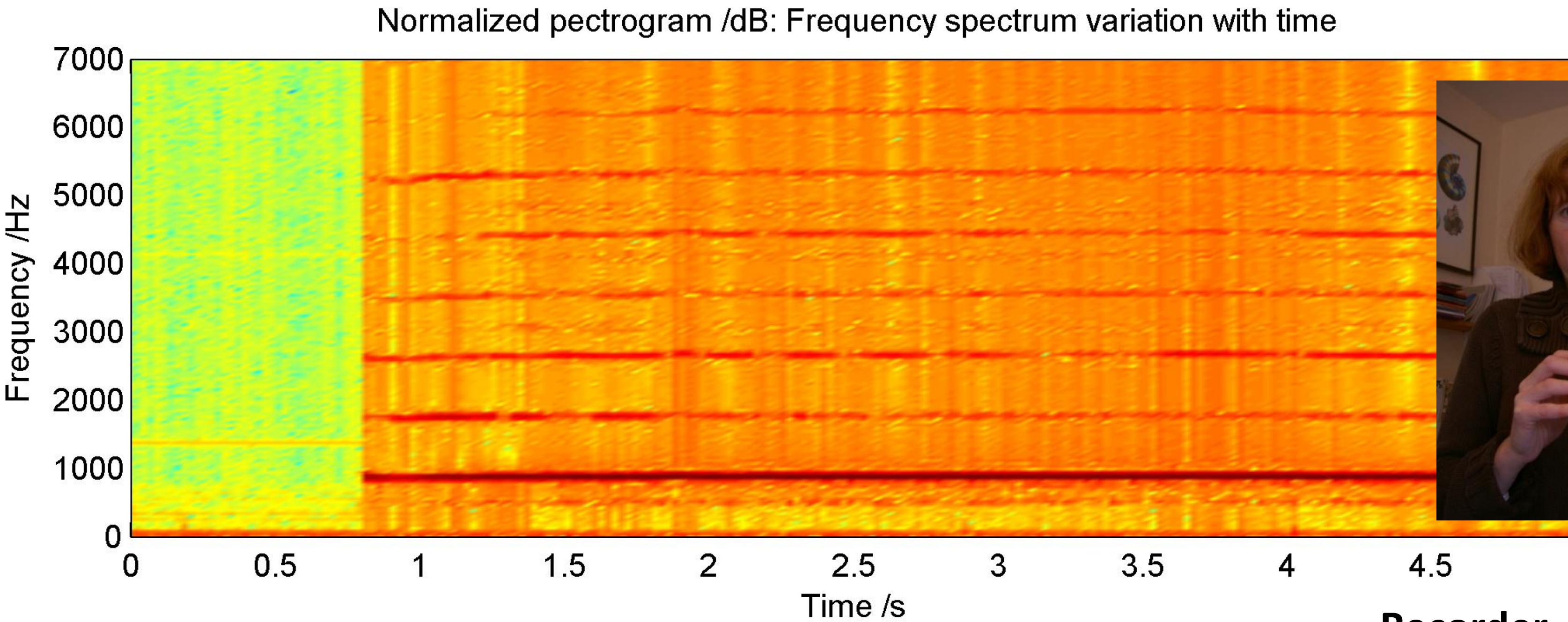
Translate through time and space

$$v^2 = \frac{T}{\mu}$$

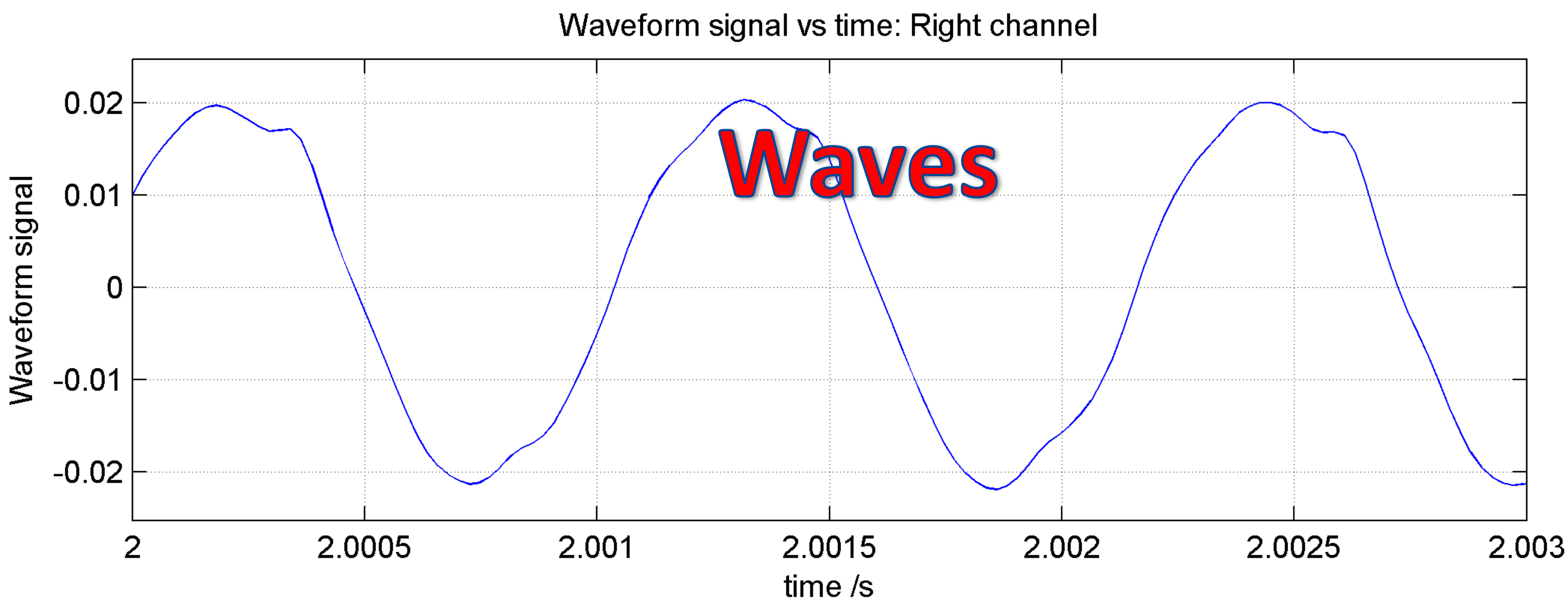


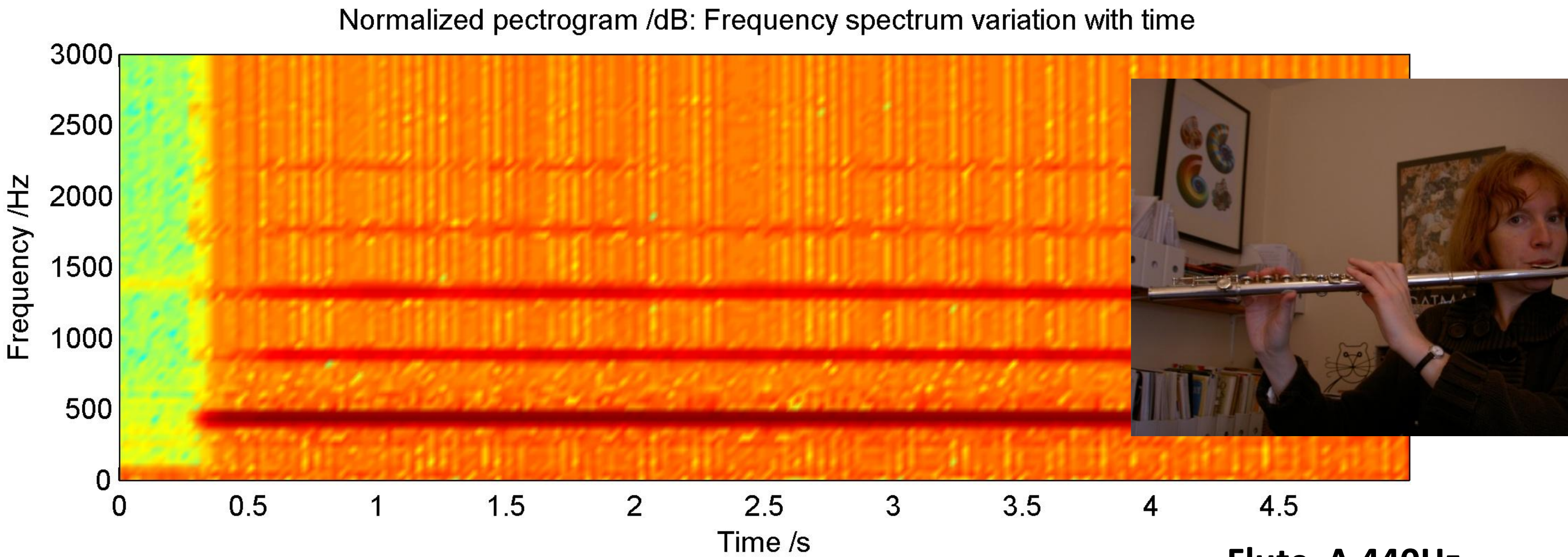
Tension over mass per unit length can be the square of pace

Waves



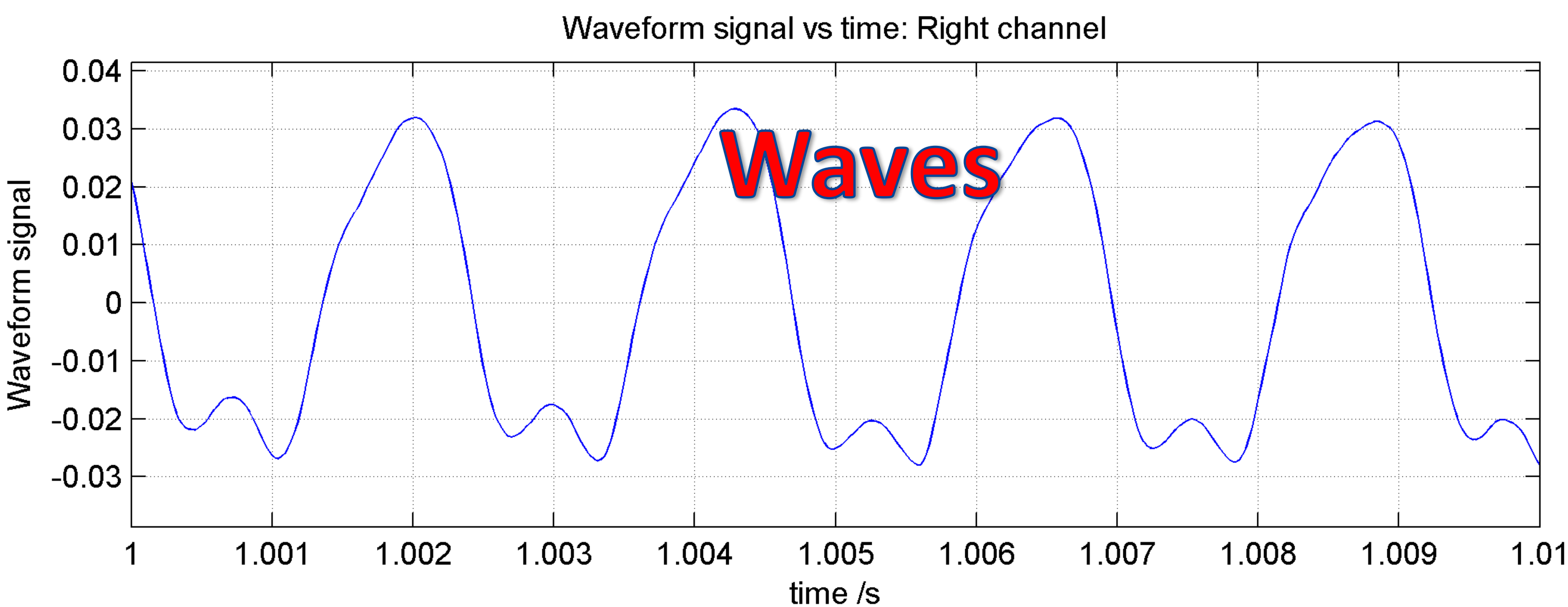
Recorder A 880Hz

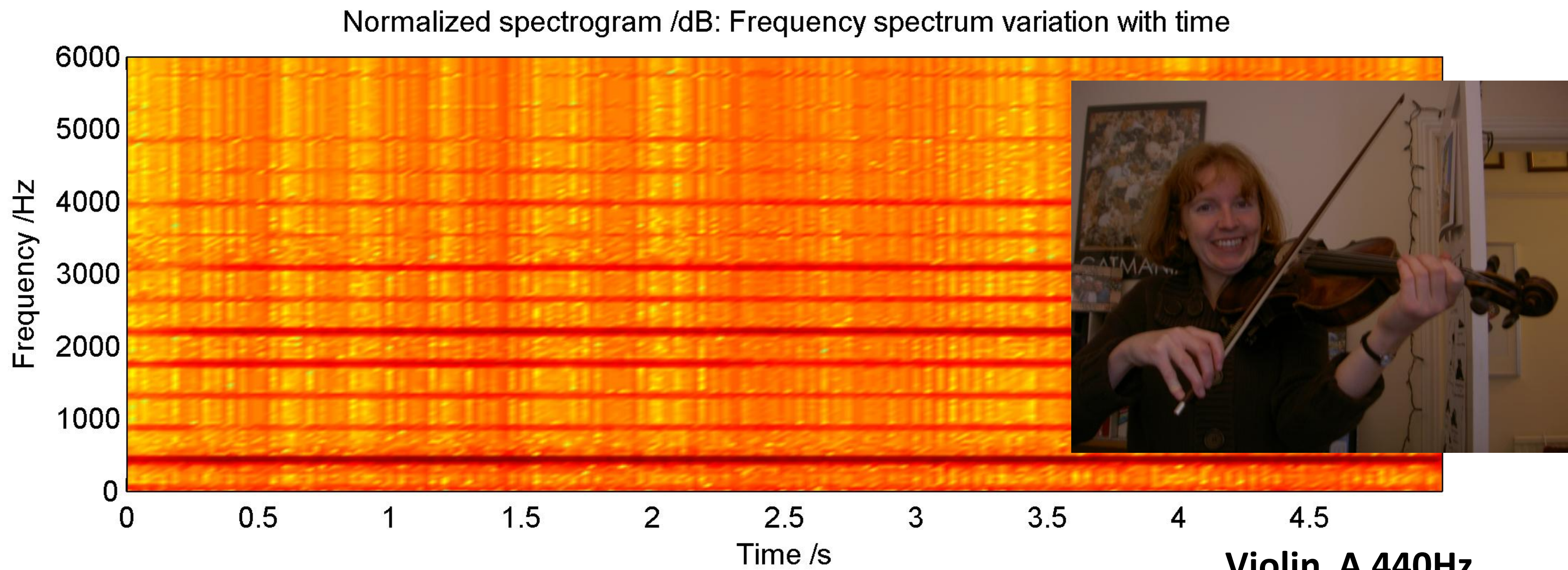




Flute A 440Hz

Waves





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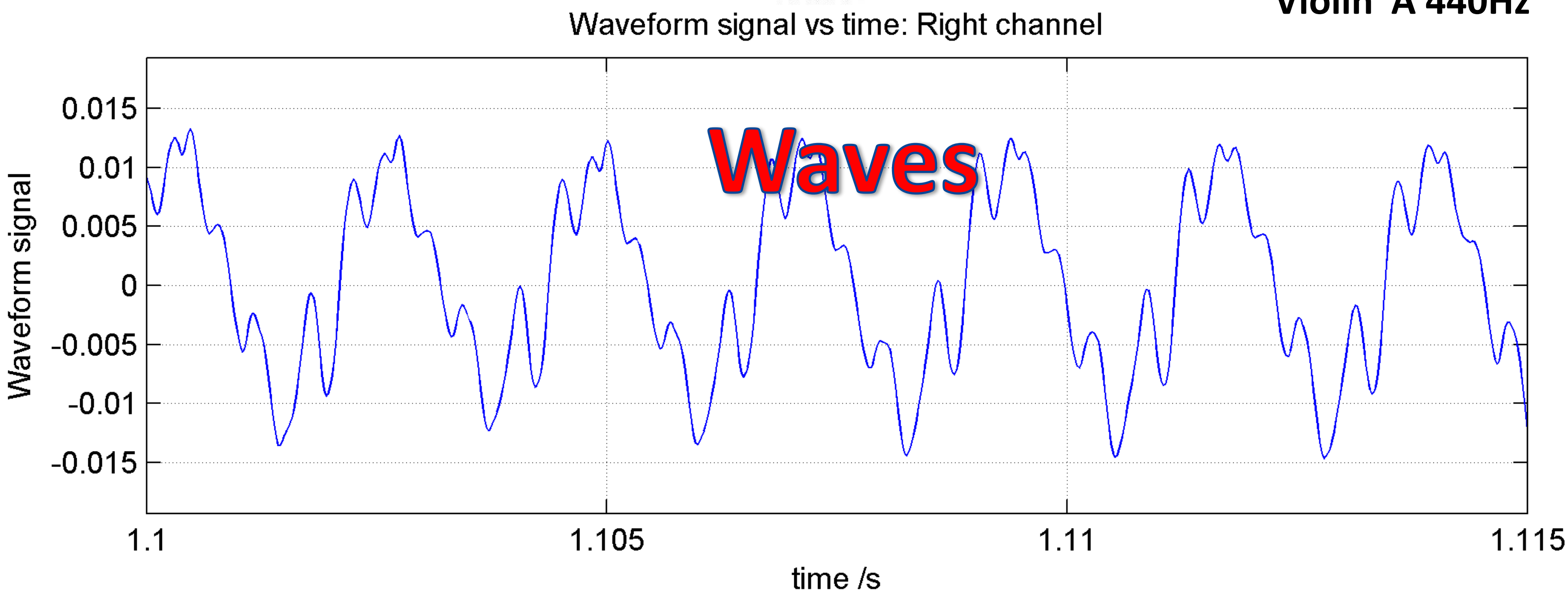
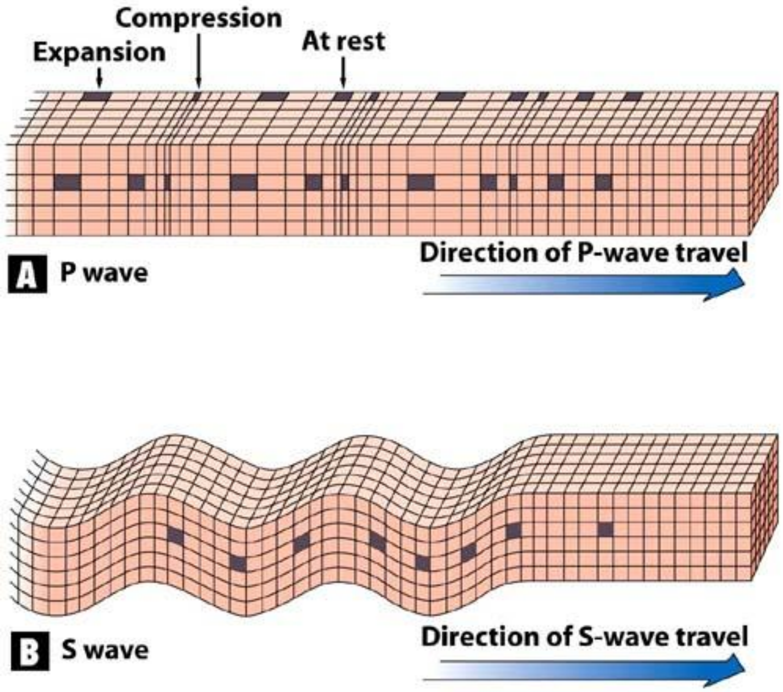
Waves





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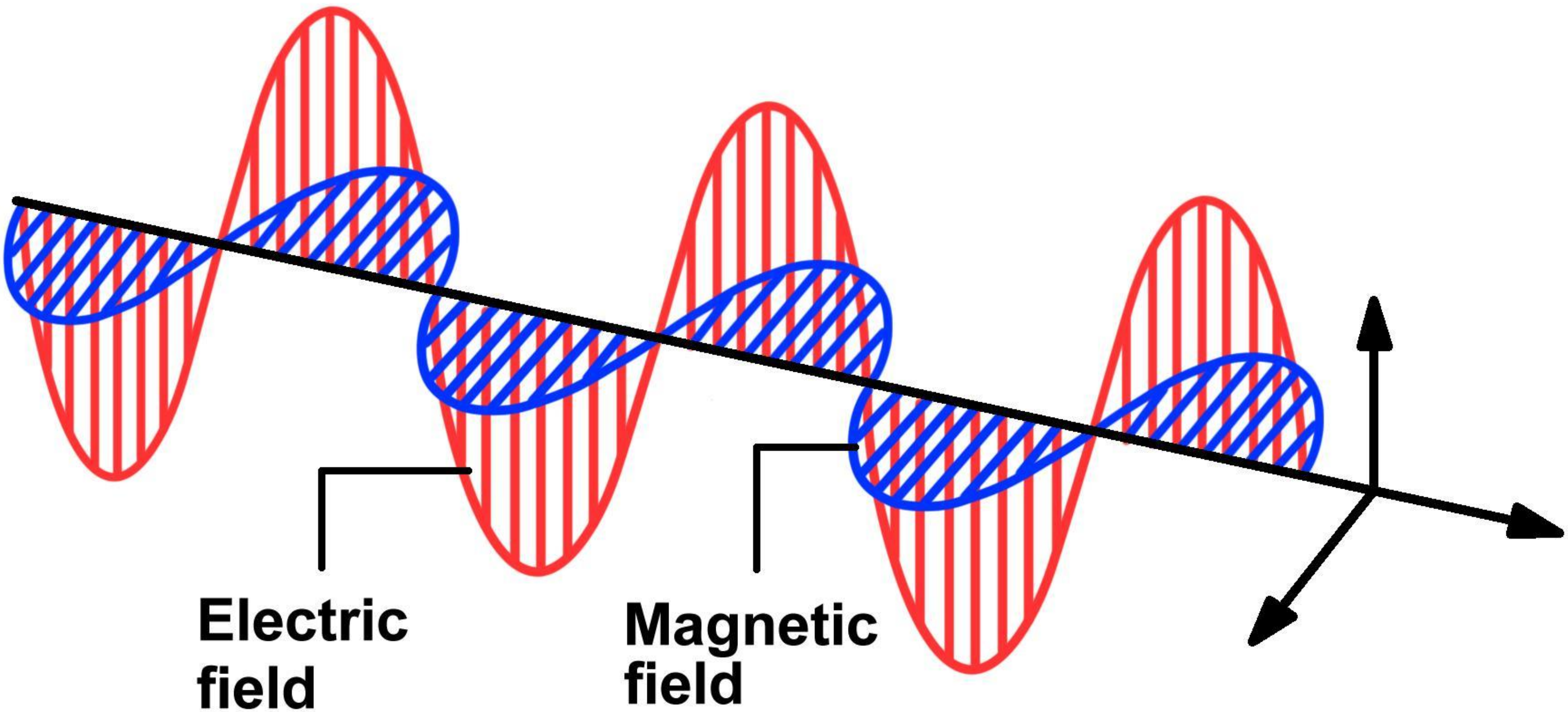
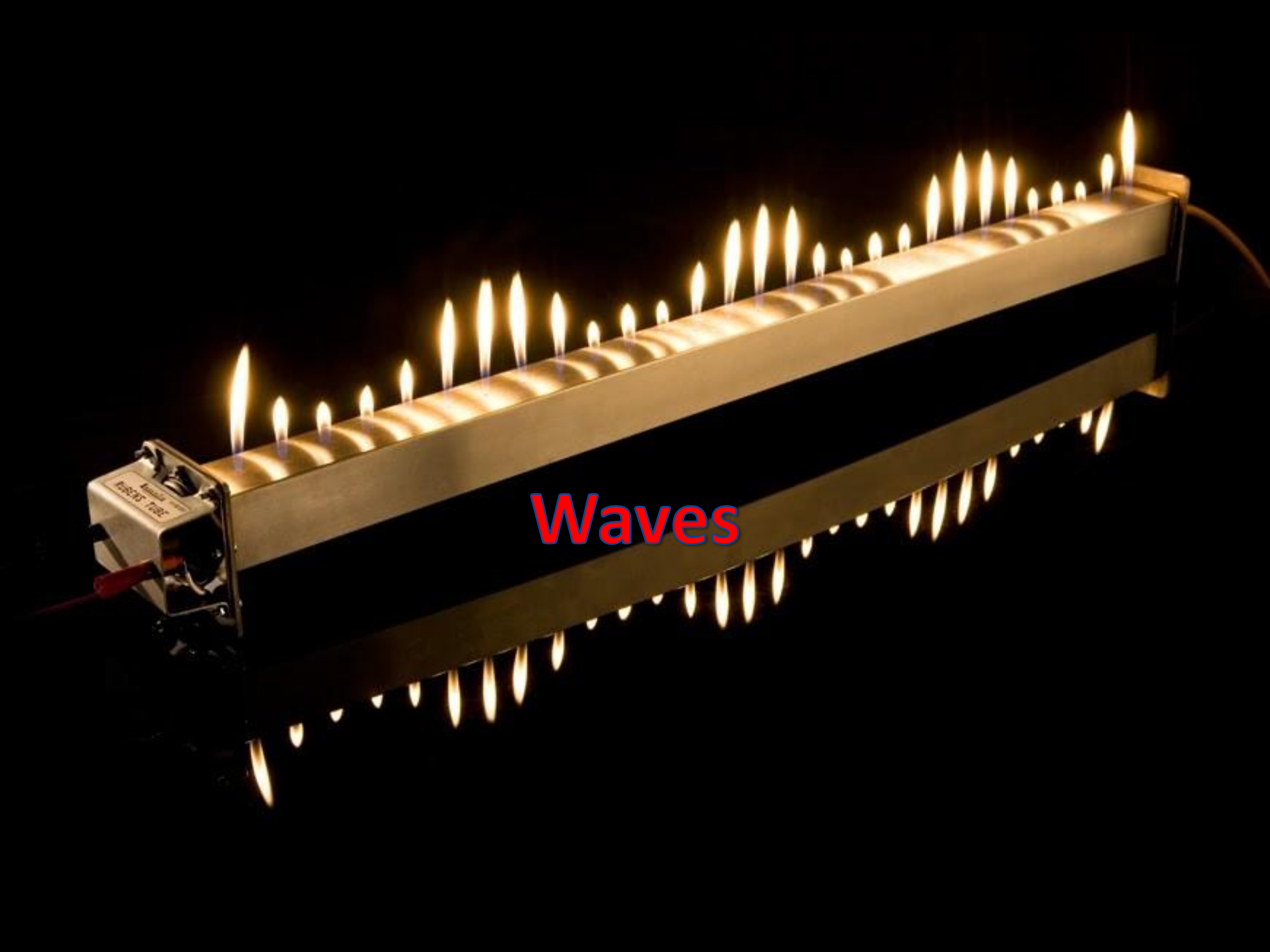
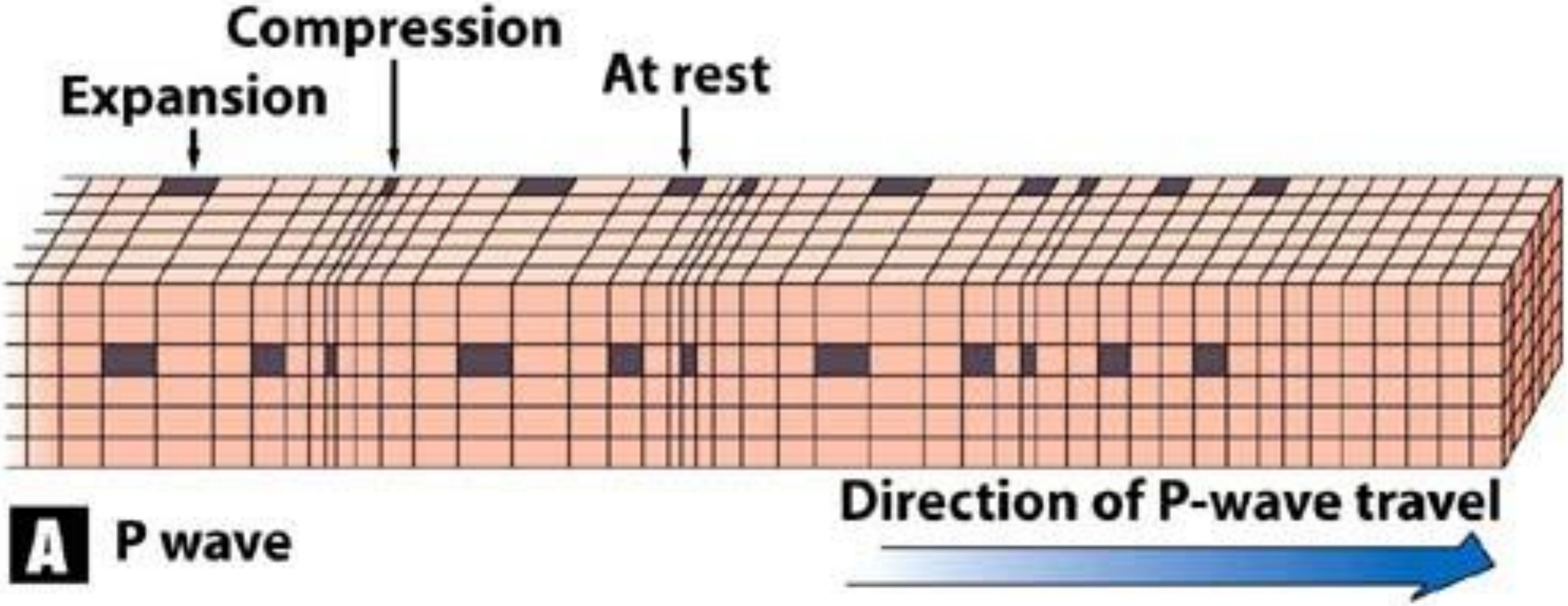


And in electric fields in space which don’t have any mass



Waves

Waves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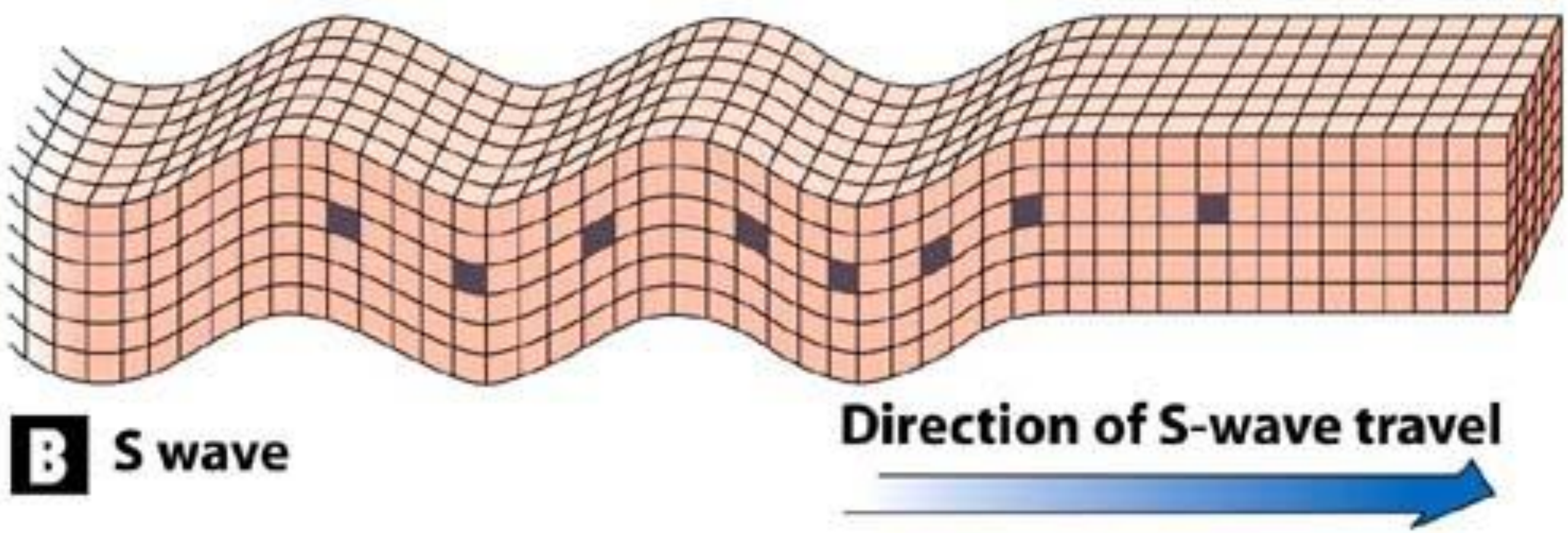
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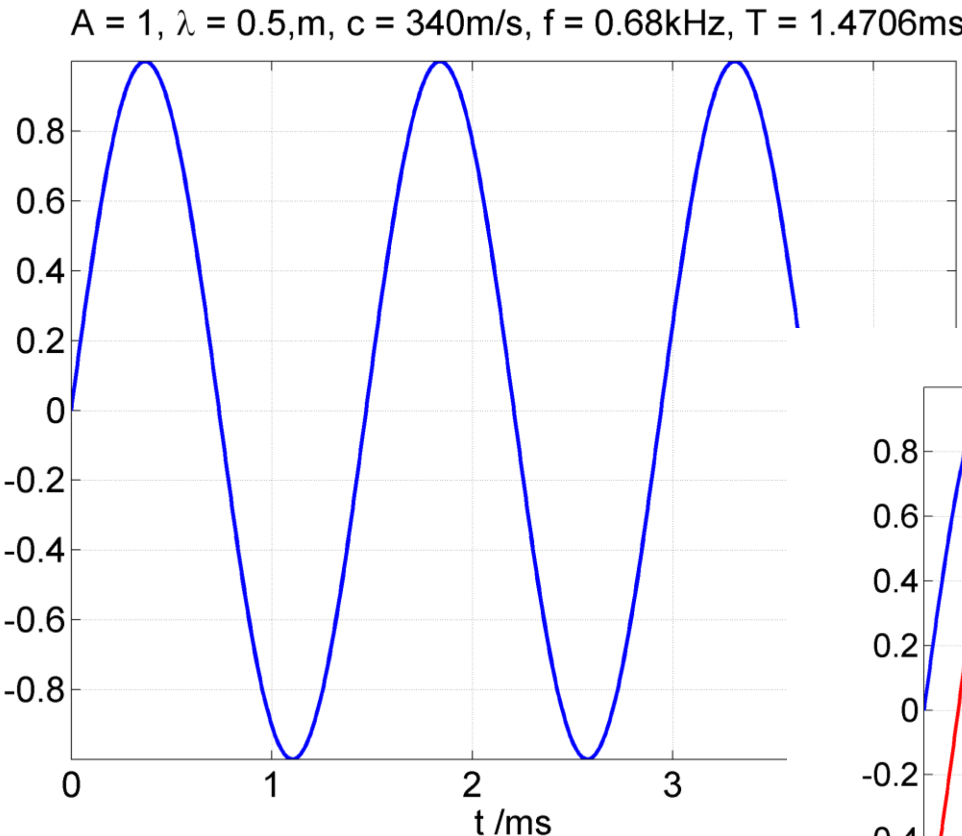

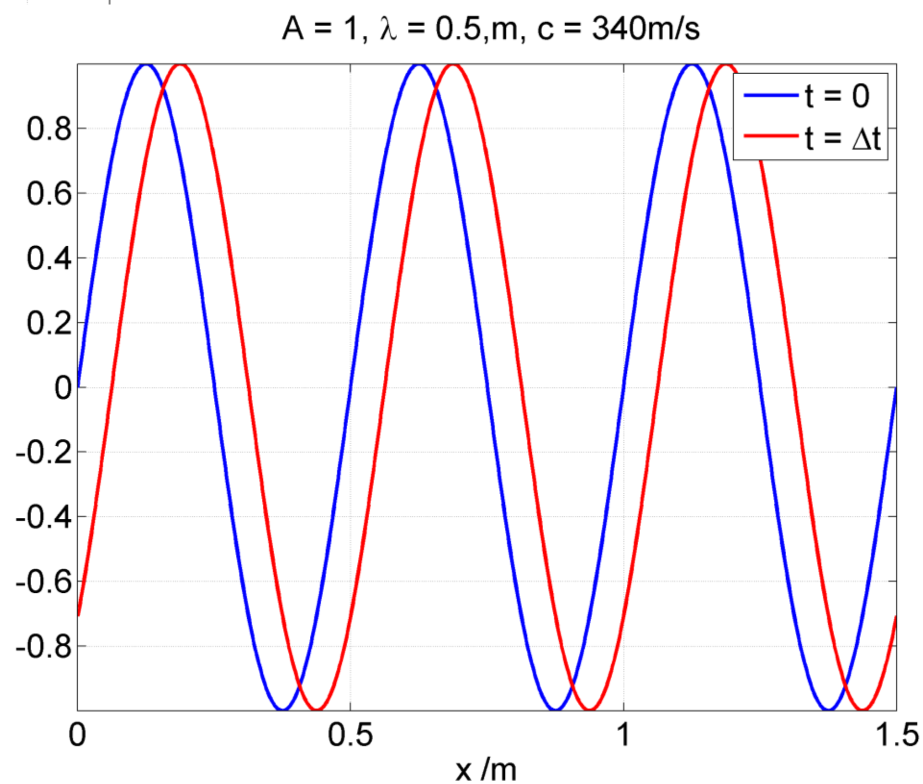

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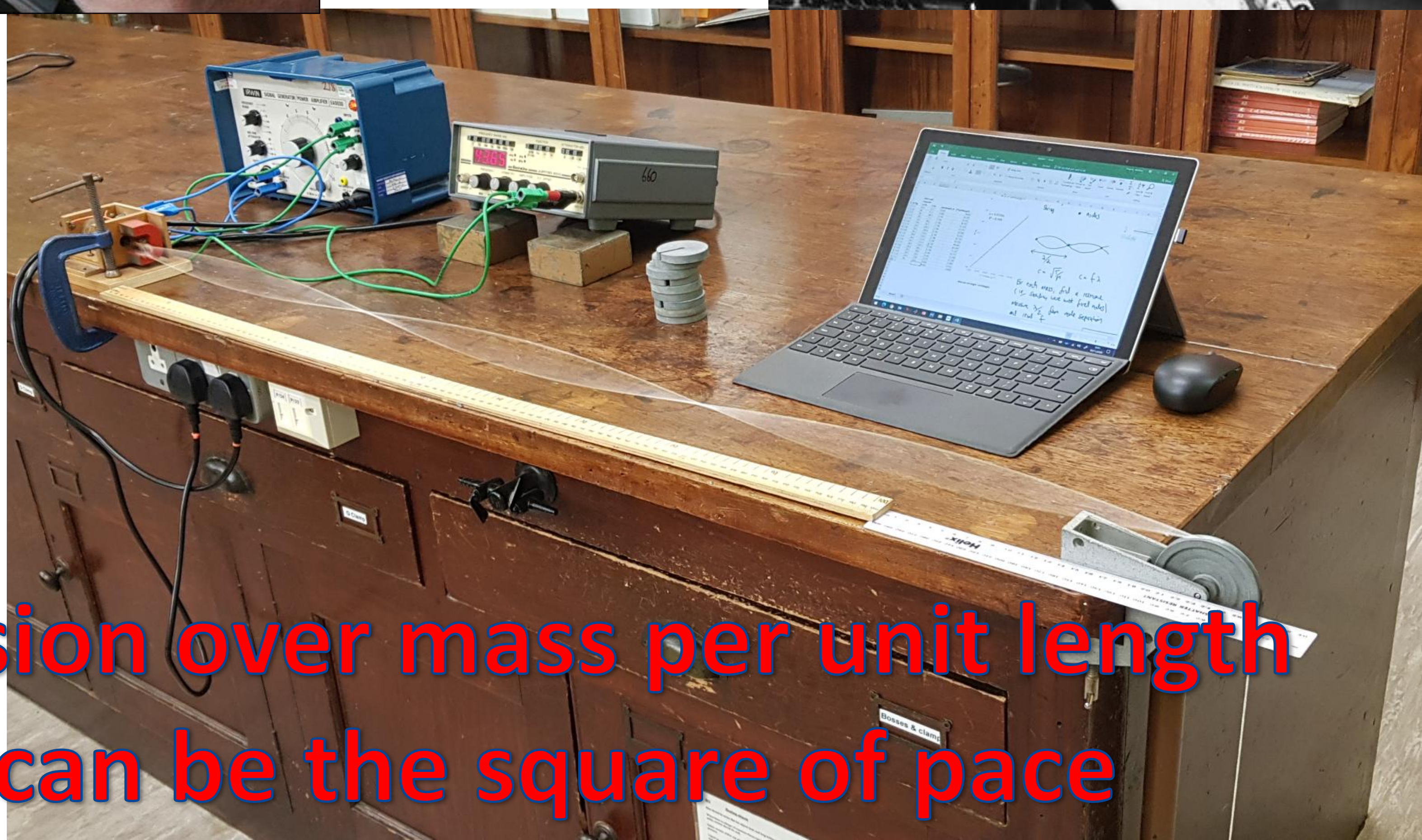

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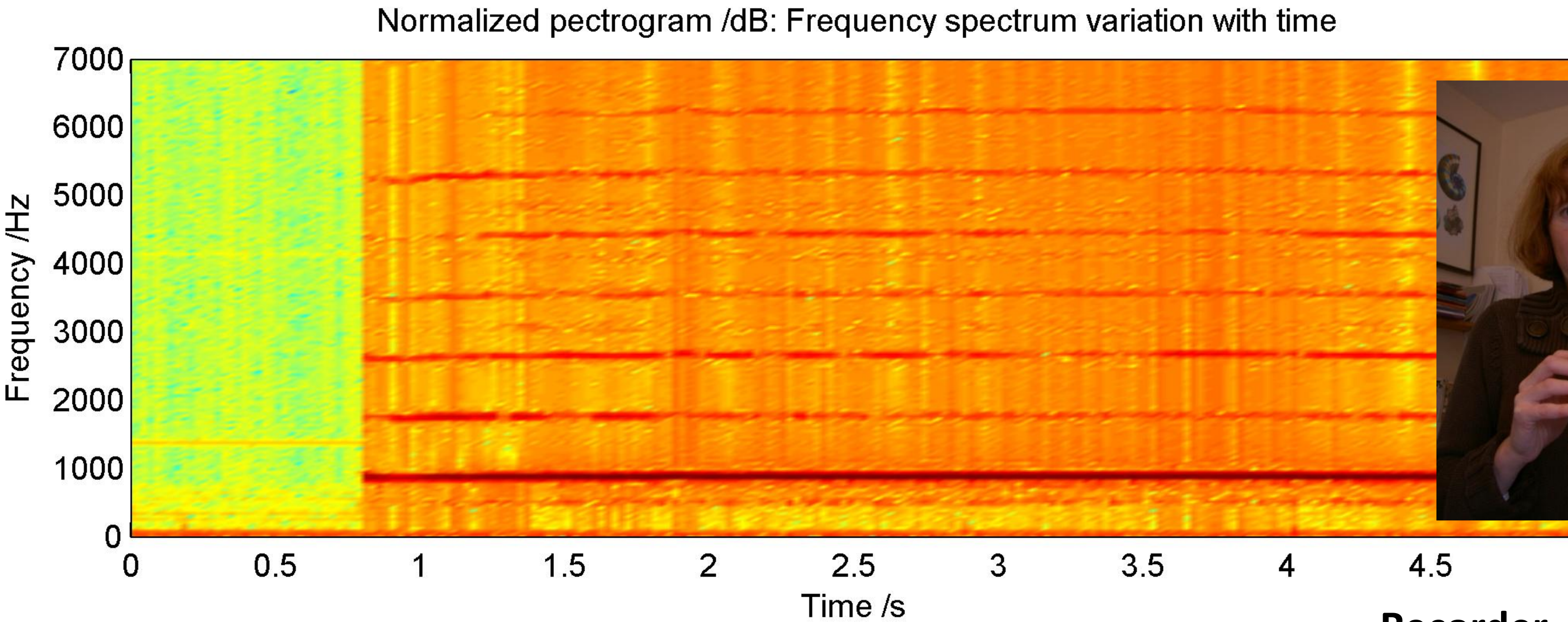

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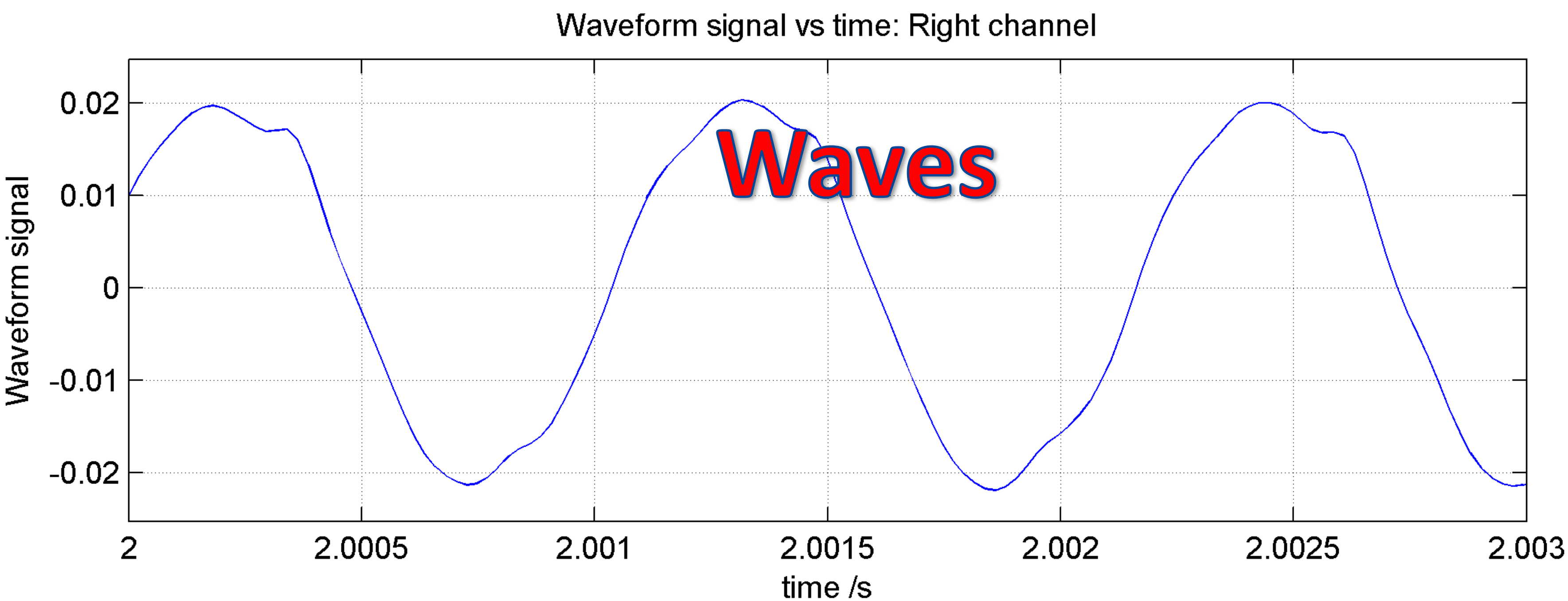

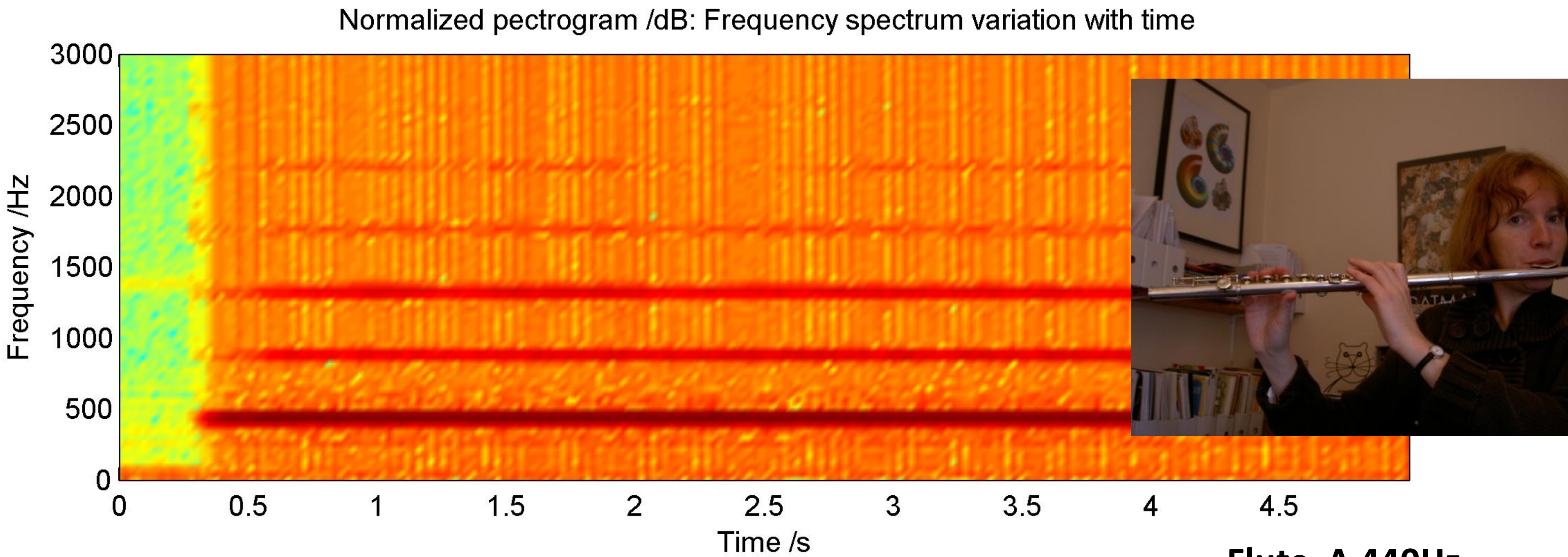

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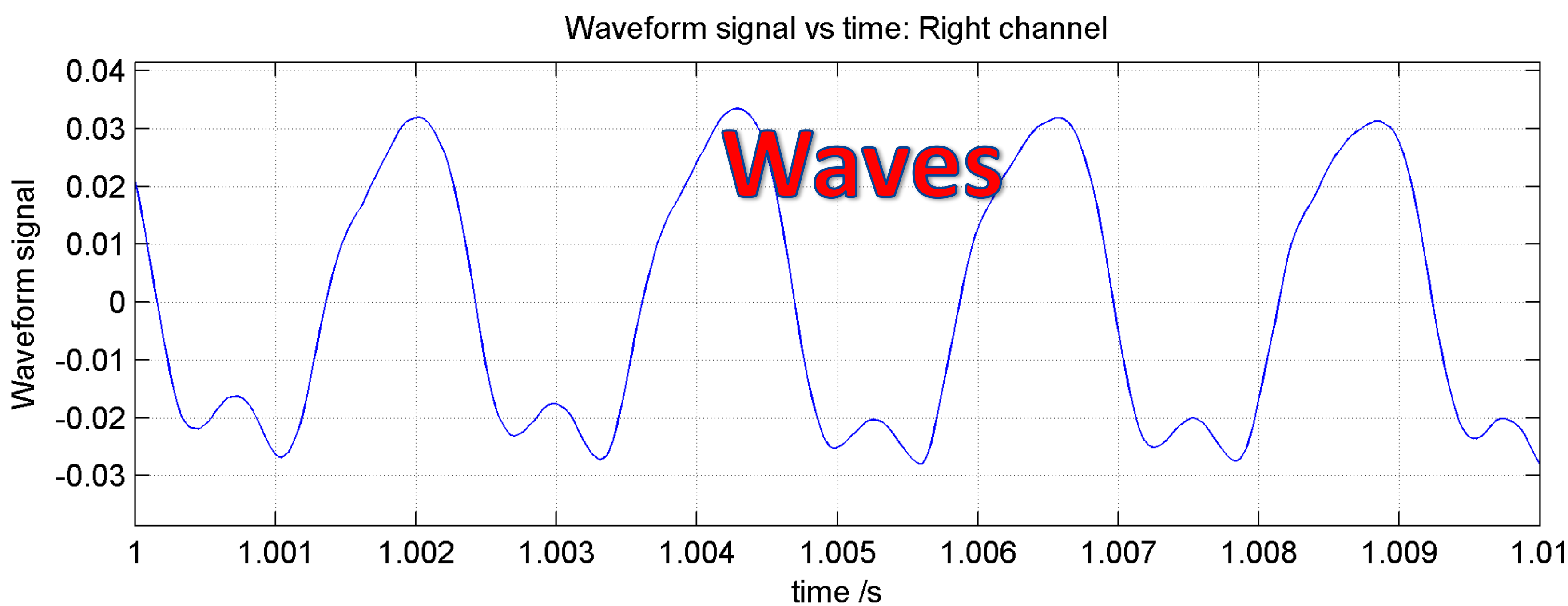
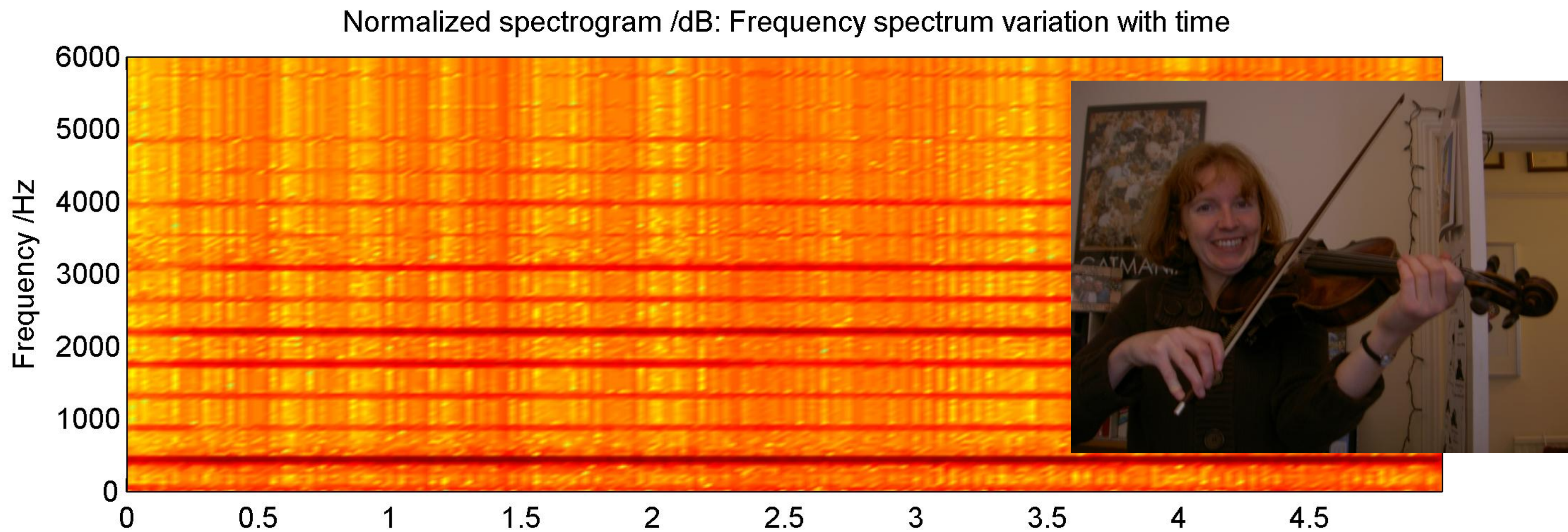
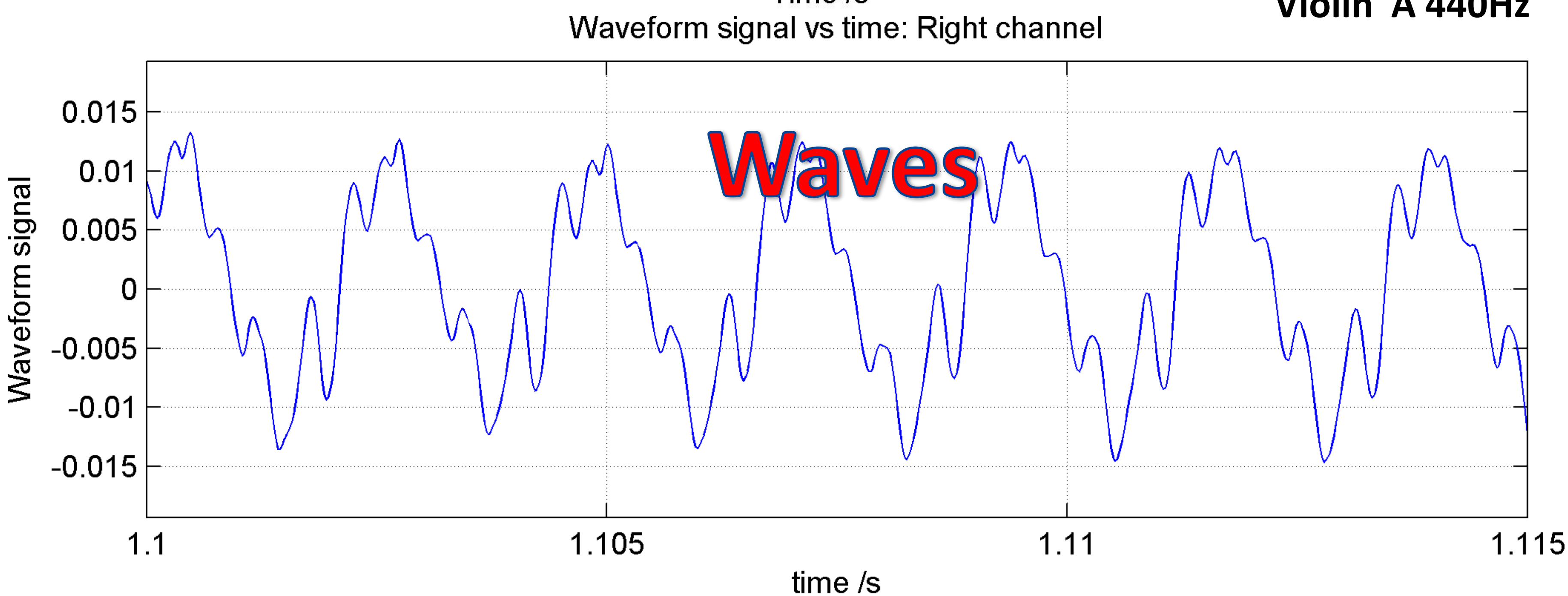
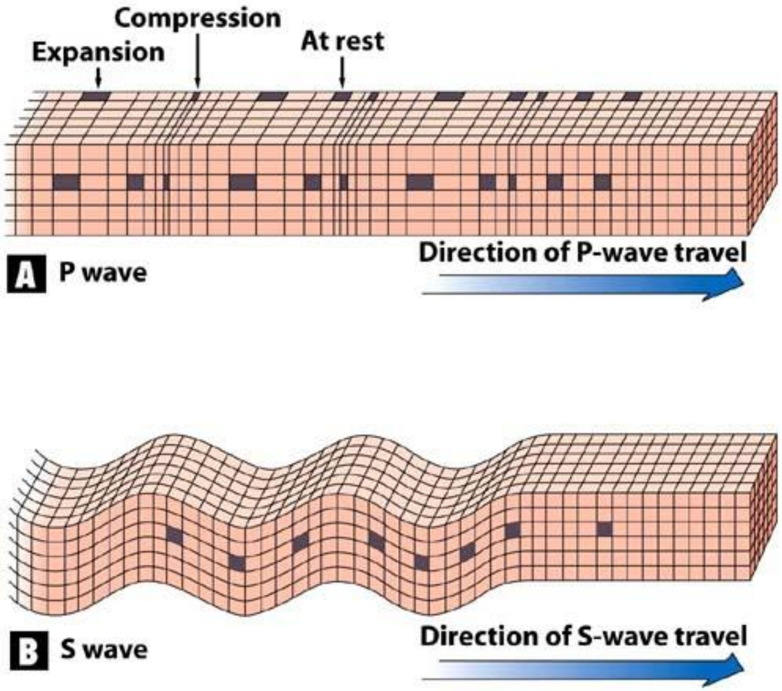




Violin A 440Hz





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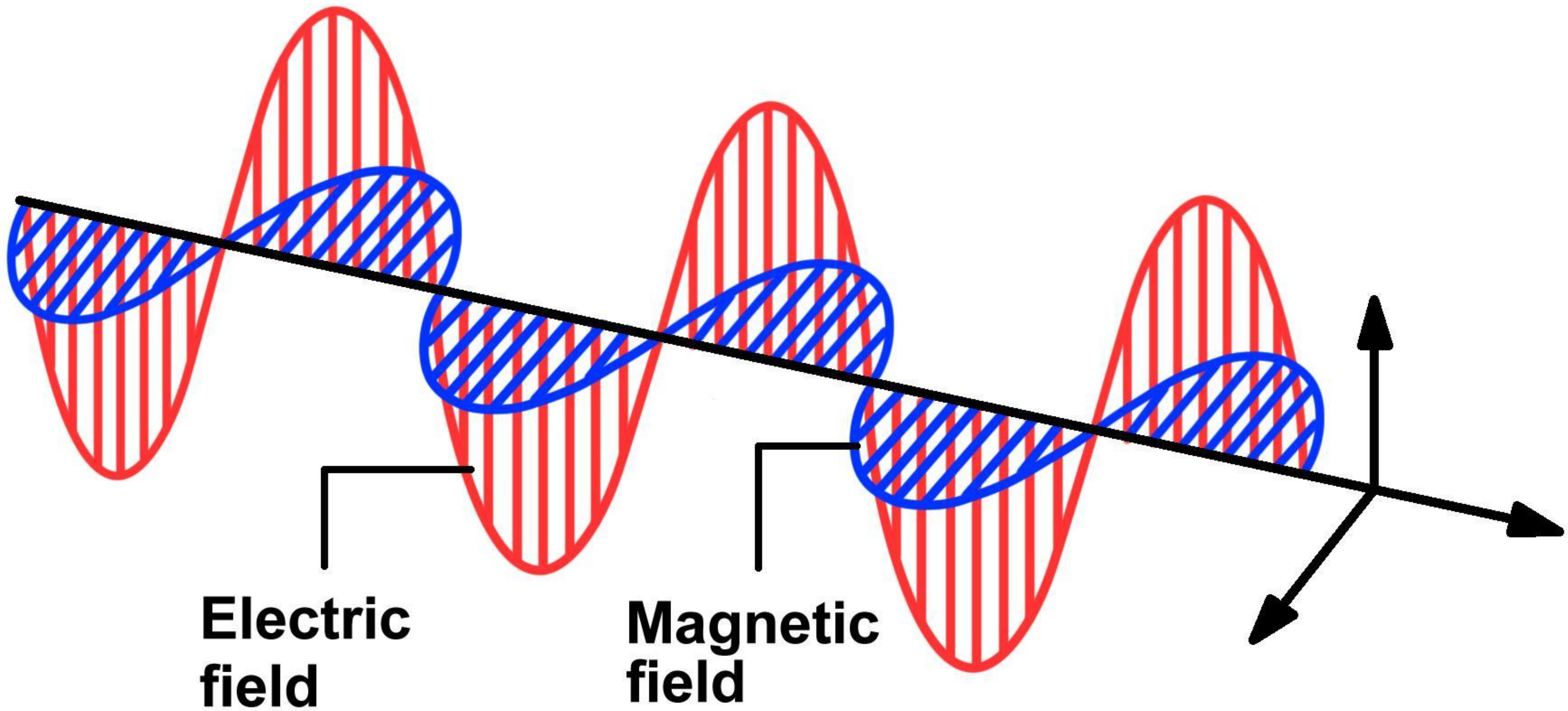
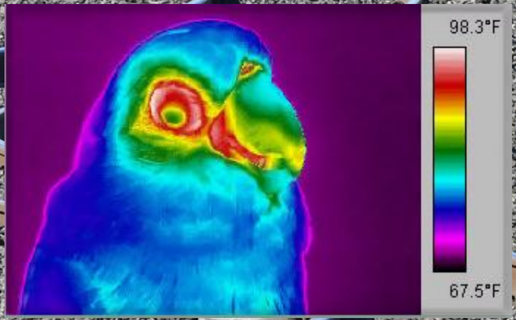
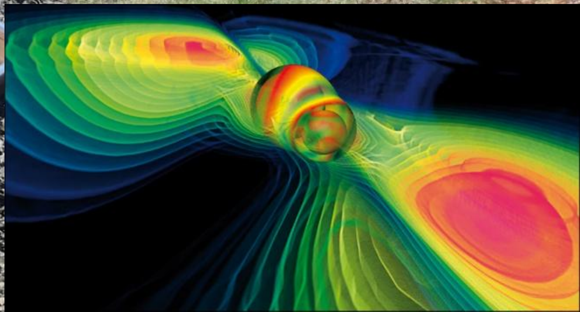


And in electric fields in space which don’t have any mass

Waves Song





Andy "Dijon" French
September 2022