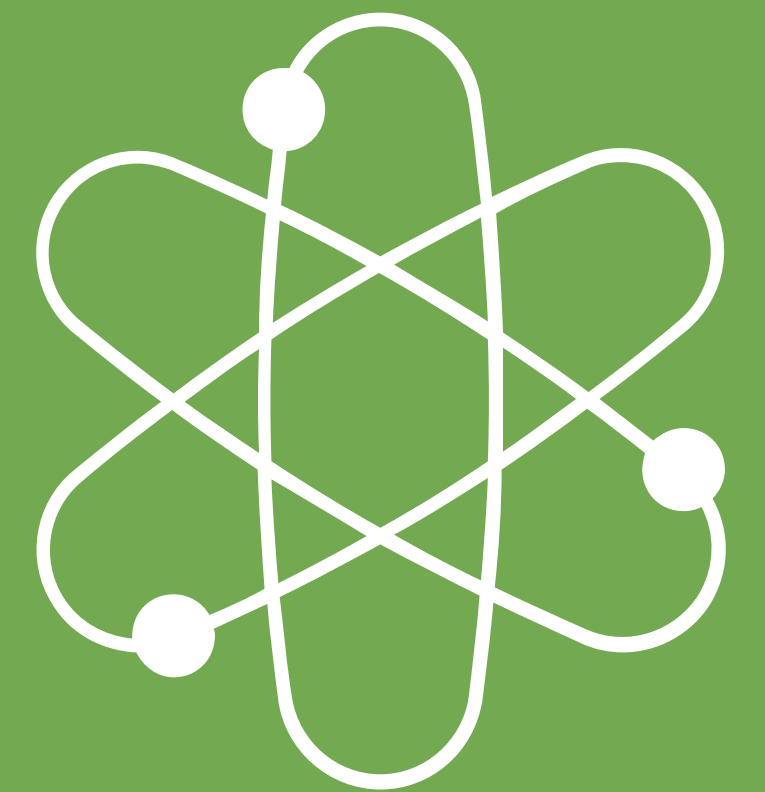


THE  
NOBEL  
PRIZE

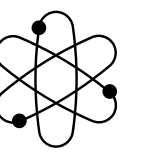
# PHYSICS PRIZE 2023

•

Electrons in pulses of light



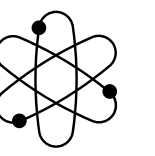
Nobel Prize lessons



# The Nobel Prize in Physics

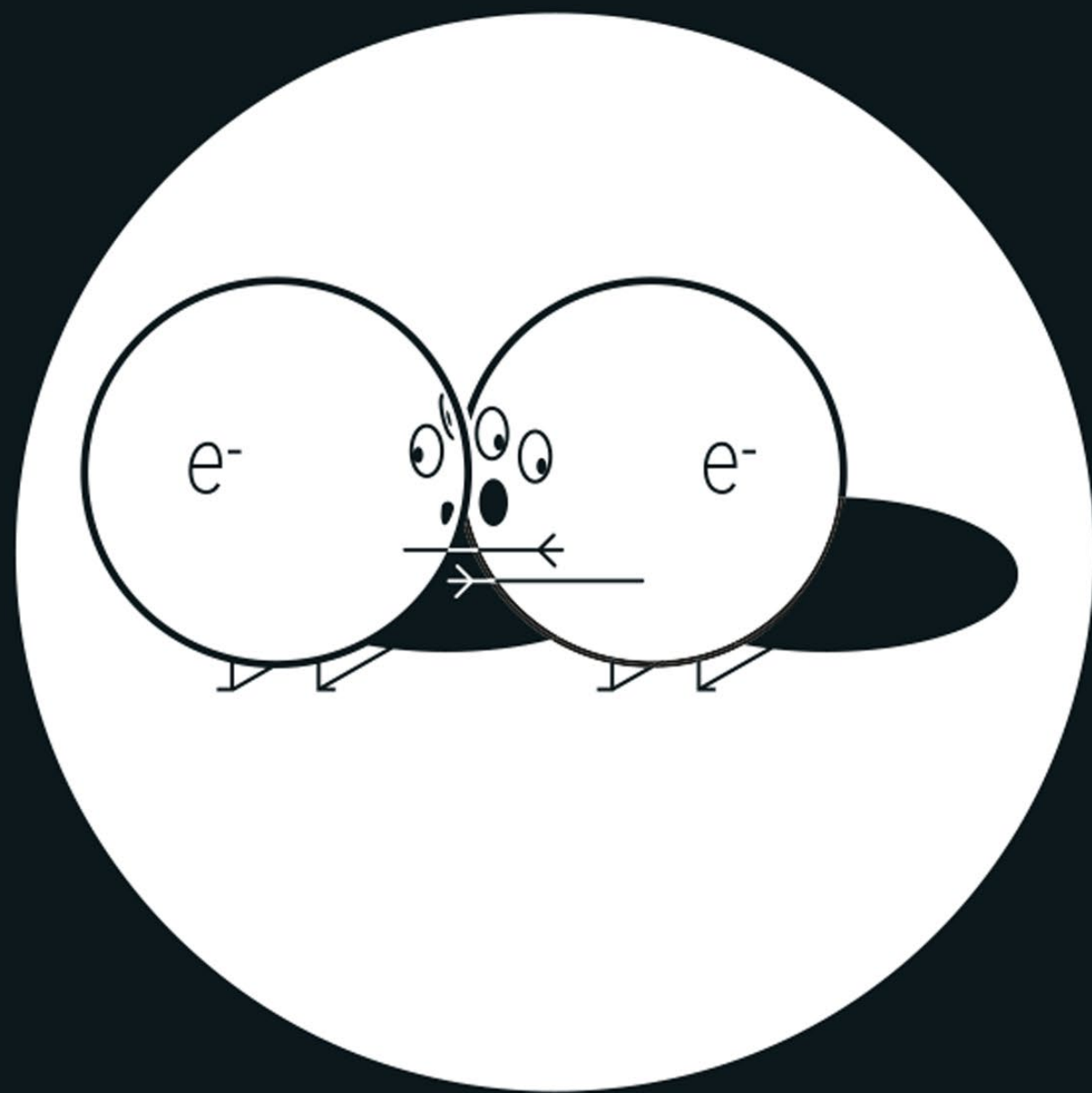
“to the person who made the most important discovery or invention in the field of physics”

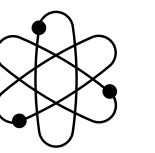




# Physics prize 2023

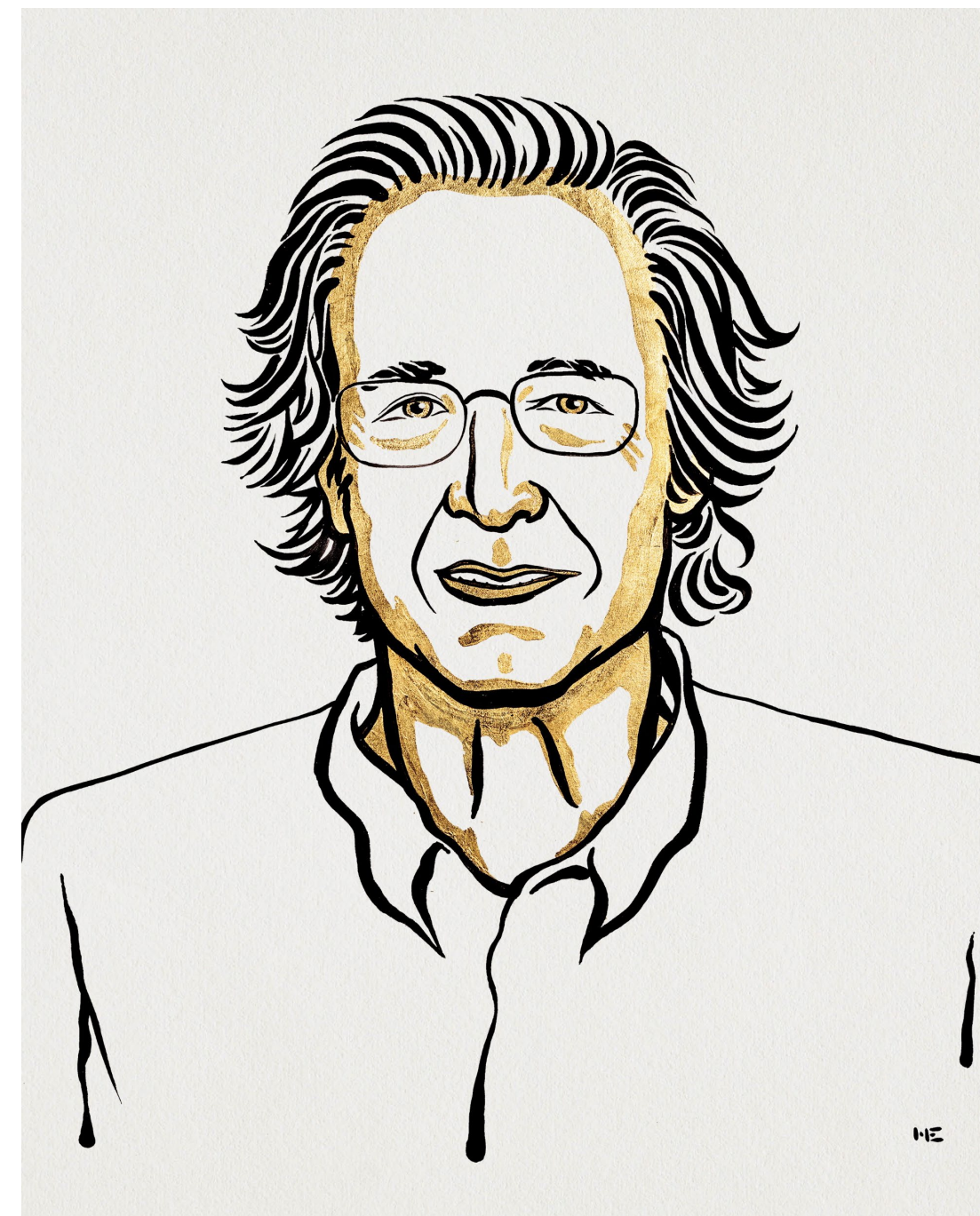
The 2023 physics prize recognises experiments with short pulses of light that can capture momentary images of the movements of electrons.





## 2023 physics laureates

"for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter"



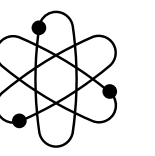
Pierre Agostini



Ferenc Krausz  
Born: 1962, Hungary

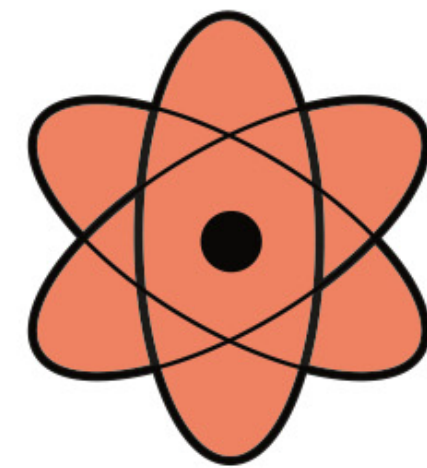


Anne L'Huillier  
Född: 1958, Frankrike



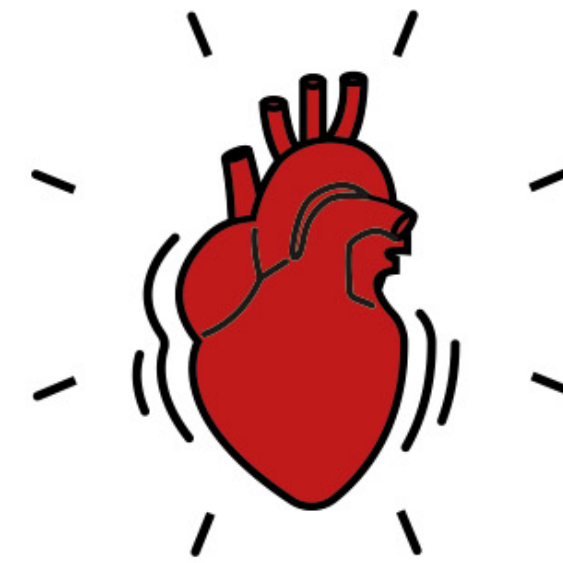
# Time scales

How fast do the electrons in an atom move?



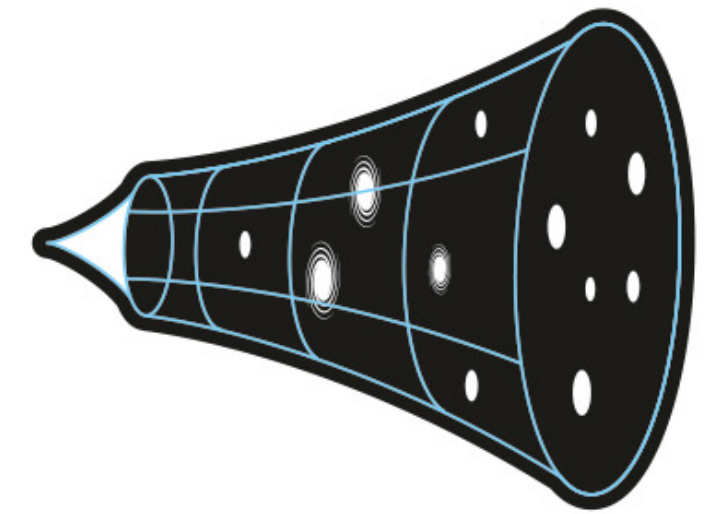
**ATTOSECOND**

1/1,000,000,000,000,000,000  
SECOND



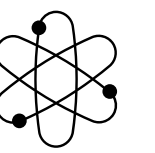
**HEARTBEAT**

1 SECOND

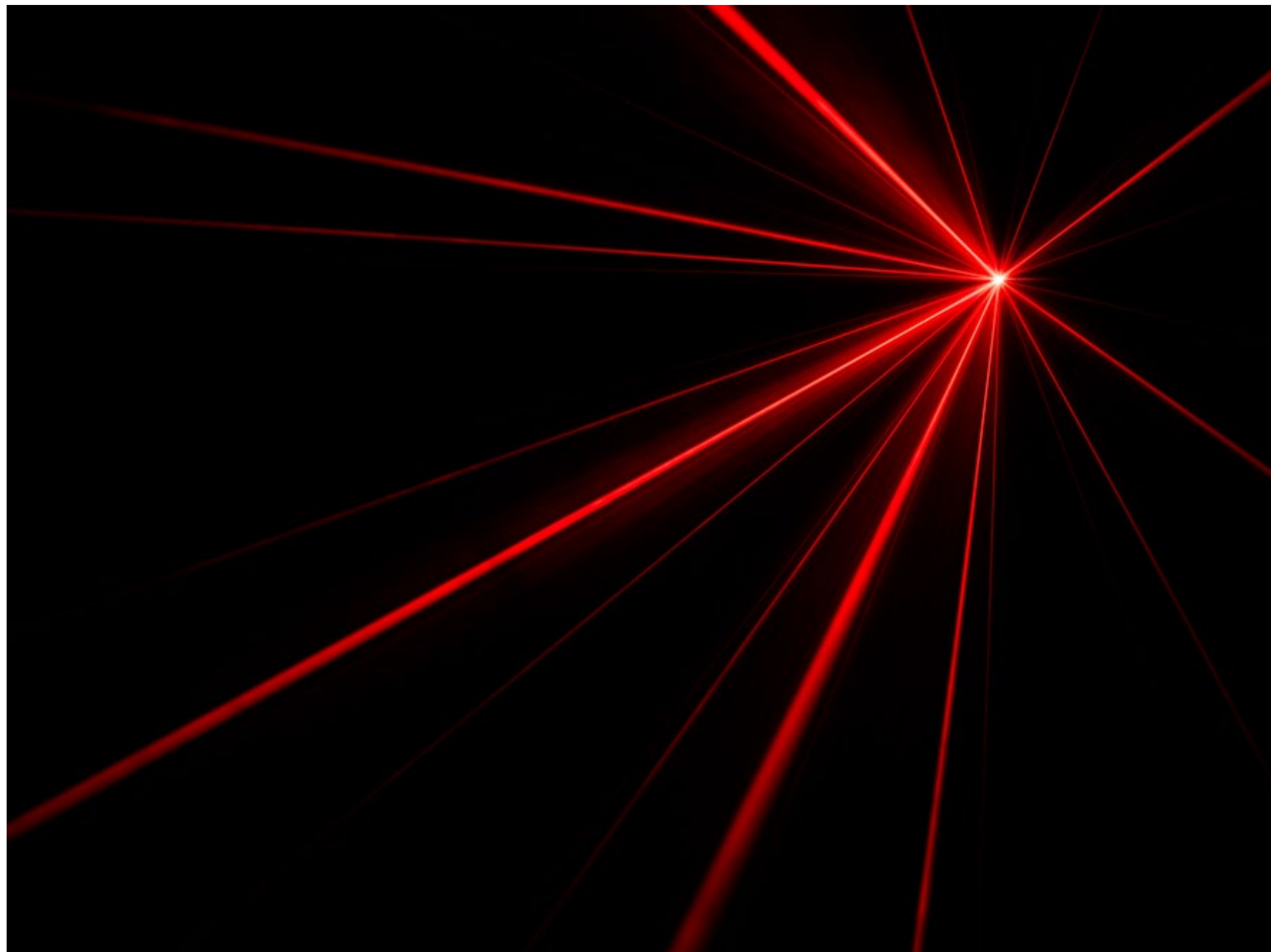


**AGE OF THE UNIVERSE**

1,000,000,000,000,000,000  
SECONDS

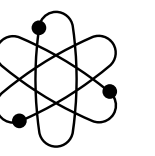


# Laser pulses



Pulses of laser light can help us capture rapid events.

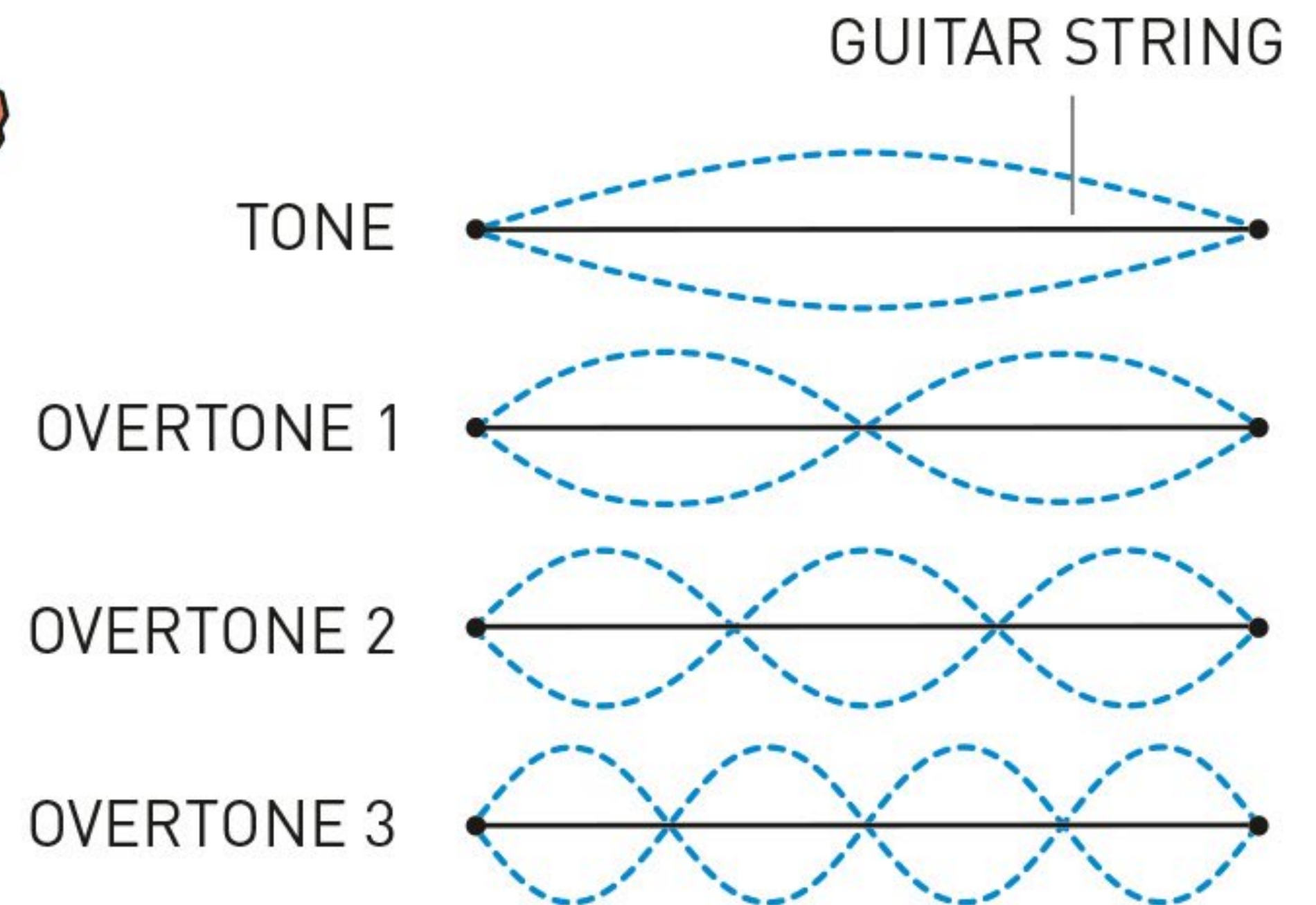
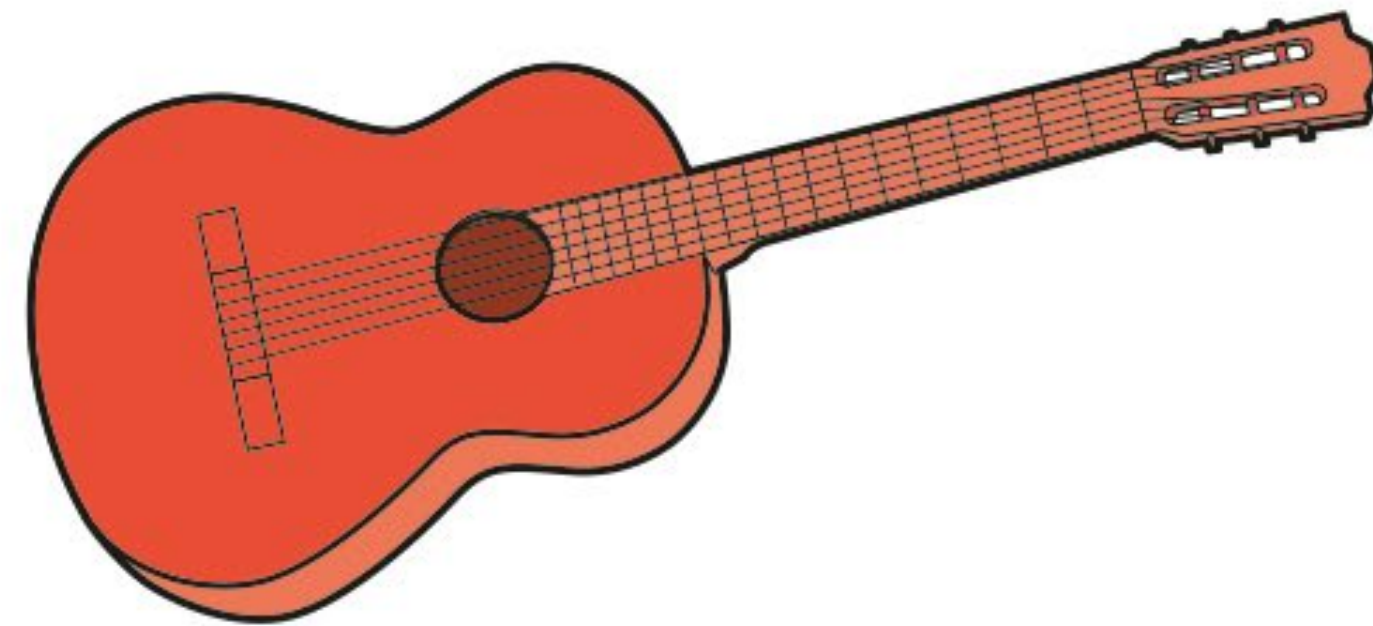
Capturing the movements of the electrons in an atom demands extremely rapid pulses.

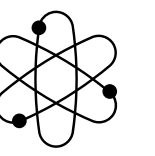


# Overtone

Light waves, like sound waves, can have overtones.

Anne L'Huillier created overtones of laser light by causing it to pass through a gas.



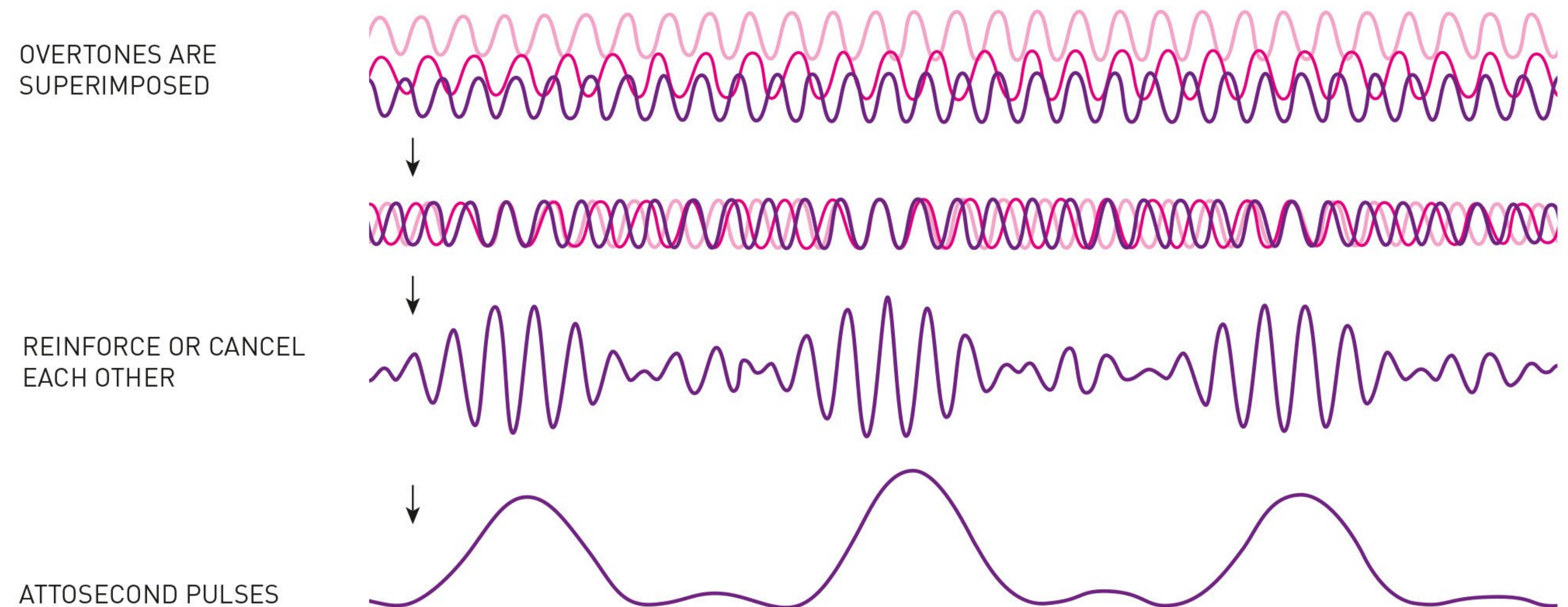


# The combination of light waves

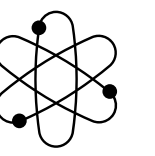
The combination of light waves of varying wavelengths can generate pulses of light.

Pierre Agostini created a train of attosecond pulses of light.

Ferenc Krausz isolated a single pulse.







# Applications

The potential to study processes inside of atoms and molecules.

Possible practical applications in a variety of fields from electronics to medicine.



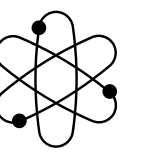


PHOTO: JOHANN MAURITSSON

“Even now, 30 years afterwards, we are still learning new things.”

Anne L'Huillier, 2023 Nobel Prize laureate in physics

THE  
NOBEL  
PRIZE

FOR THE GREATEST  
BENEFIT TO  
HUMANKIND

Nobel Prize lessons