THE NOBEL PRIZE

# PHYSICS PRIZE 2018

Nobel Prize Lessons

NOBEL PRIZE IN PHYSICS 2018

# The Nobel Prize in Physics

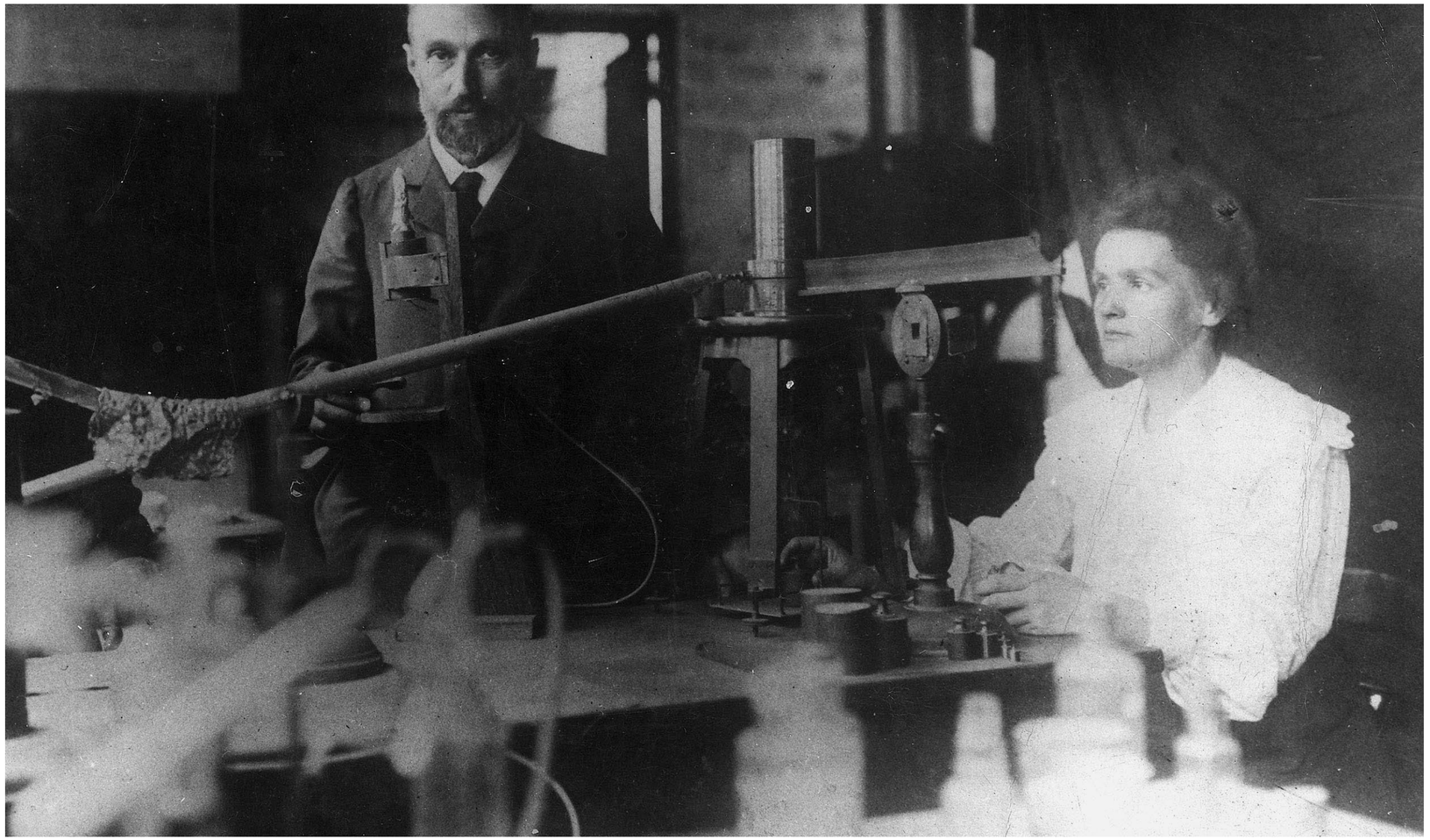
## Since 1901

*"to the person who made the most important discovery or invention in the field of physics"*

Photo: Alexander Mahmoud

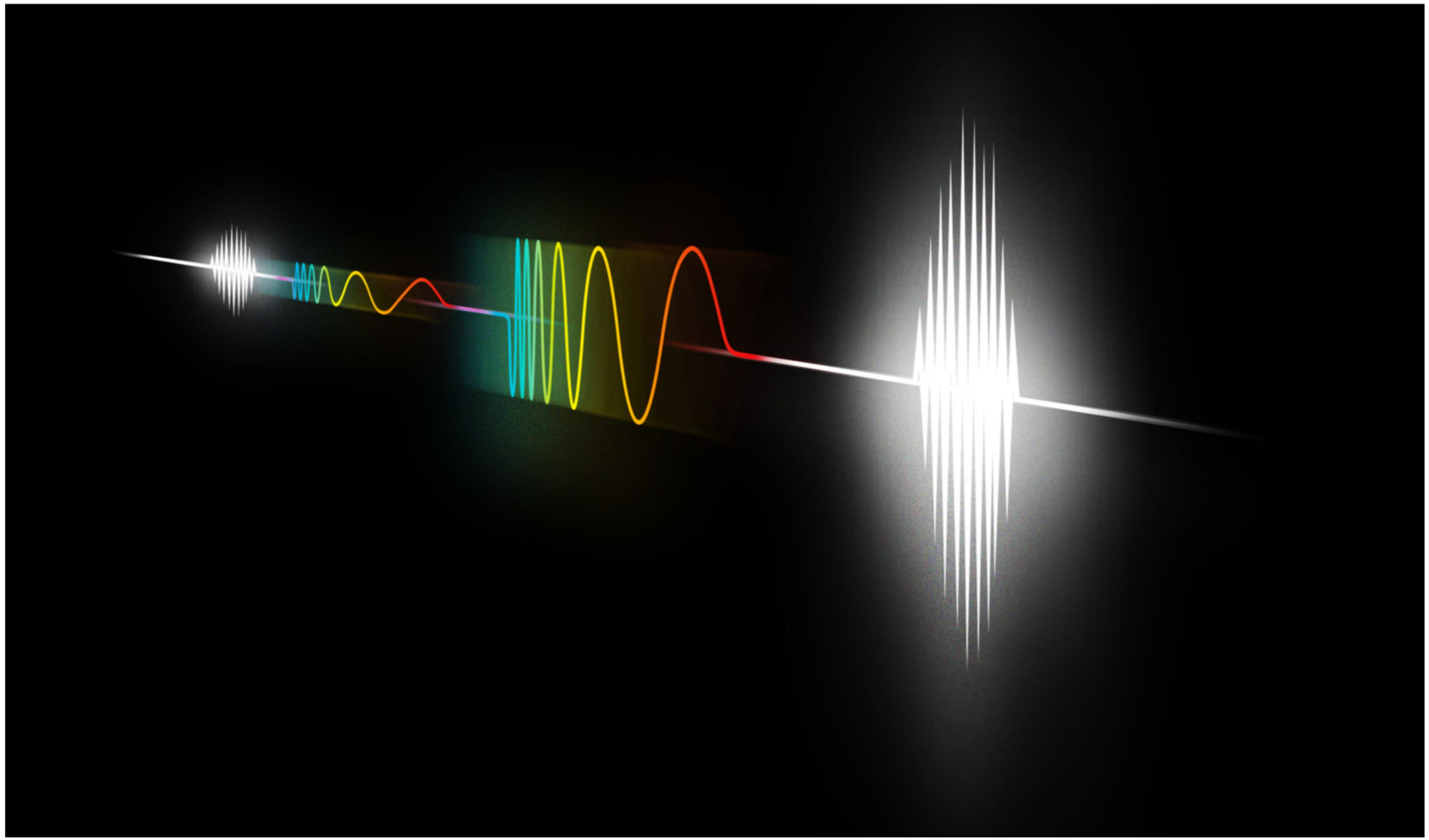
# Who is rewarded with the Physics Prize?

Persons who have made important discoveries or inventions in the field of physics.



# Physics Prize 2018

A tool for using laser light to capture and manipulate particles, and a method for creating very strong, rapid laser pulses.



# The 2018 Nobel Laureates in Physics

Arthur Ashkin, *"for the optical tweezers and their application to biological systems"*.

Donna Strickland and Gérard Mourou, *"for their method of generating high-intensity, ultra-short optical pulses"*.

Arthur Ashkin

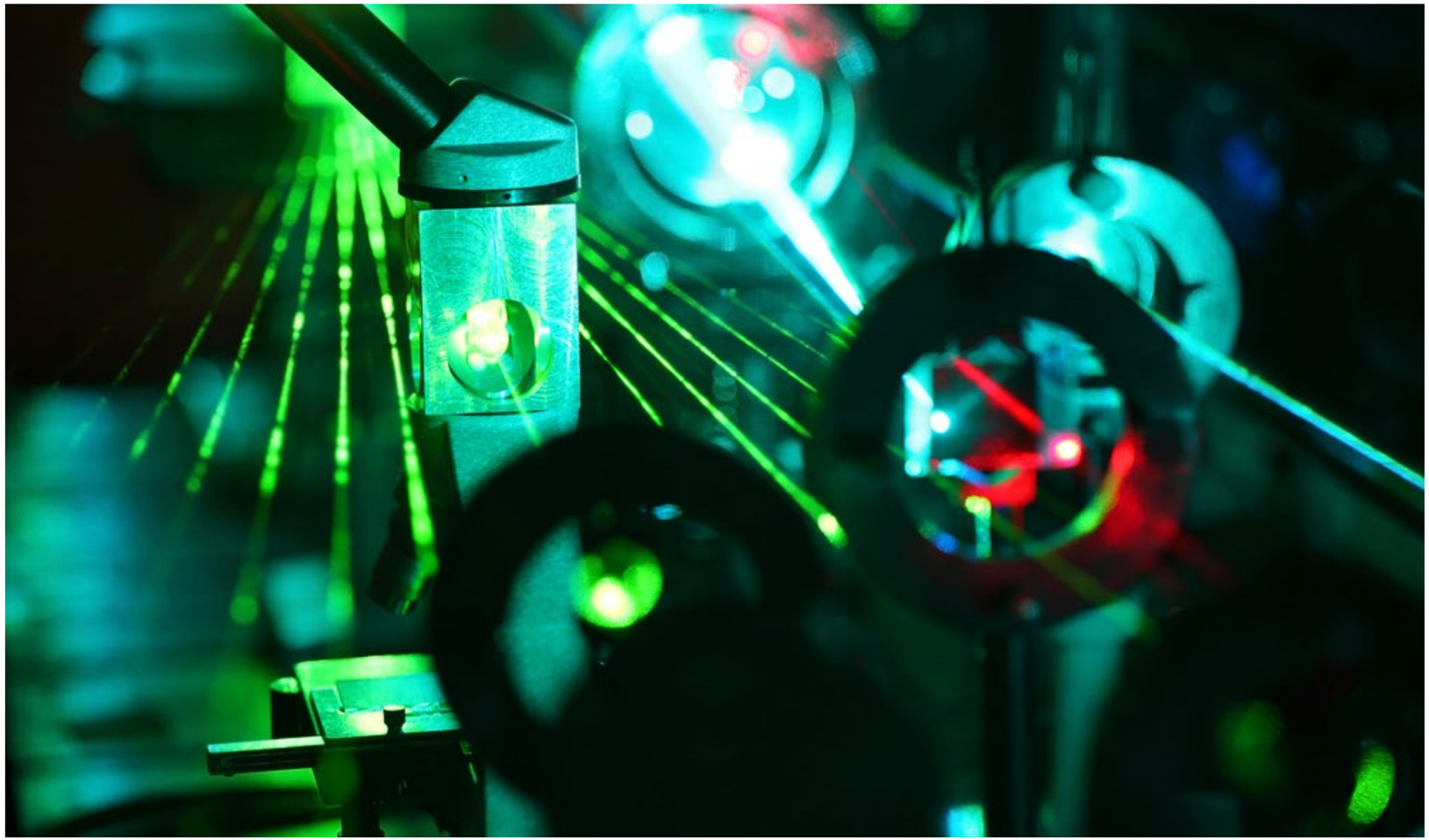
Gérard Mourou

Donna Strickland

Illustration: Niklas Elmehed

# Lasers

A laser generates light with a single wavelength, intensity and direction.

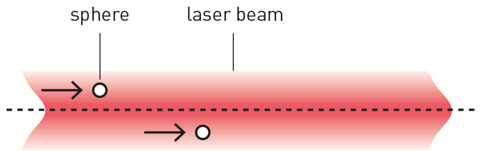


# Optical tweezers

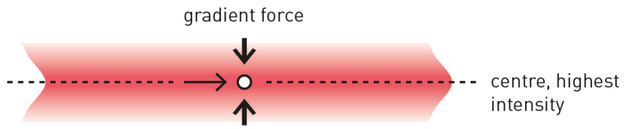
## Using a laser beam to move and capture objects.

### Ashkin creates his light trap

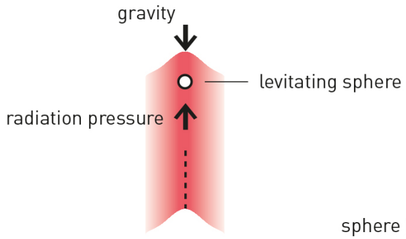
1 Small transparent spheres are set in motion when they are illuminated with laser light. Their speed corresponds to Ashkin's theoretical estimation, demonstrating that it really is radiation pressure pushing them.



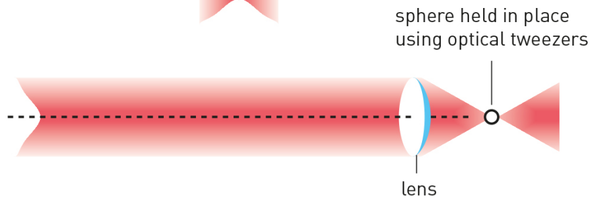

2 One unexpected effect was the gradient force that pushes the spheres towards the centre of the beam, where the light is most intense. This is because the intensity of the beam decreases outwards and the sum of all the forces pushing the spheres sends them towards its centre.




3 Ashkin makes the spheres levitate by pointing the laser beam upwards. The radiation pressure counteracts gravity.




4 The laser beam is focused with a lens. The light captures particles and even live bacteria and cells in these optical tweezers.



# Benefits of optical tweezers

By using a laser that generated infrared light, Ashkin was able to capture viruses, bacteria and living cells.

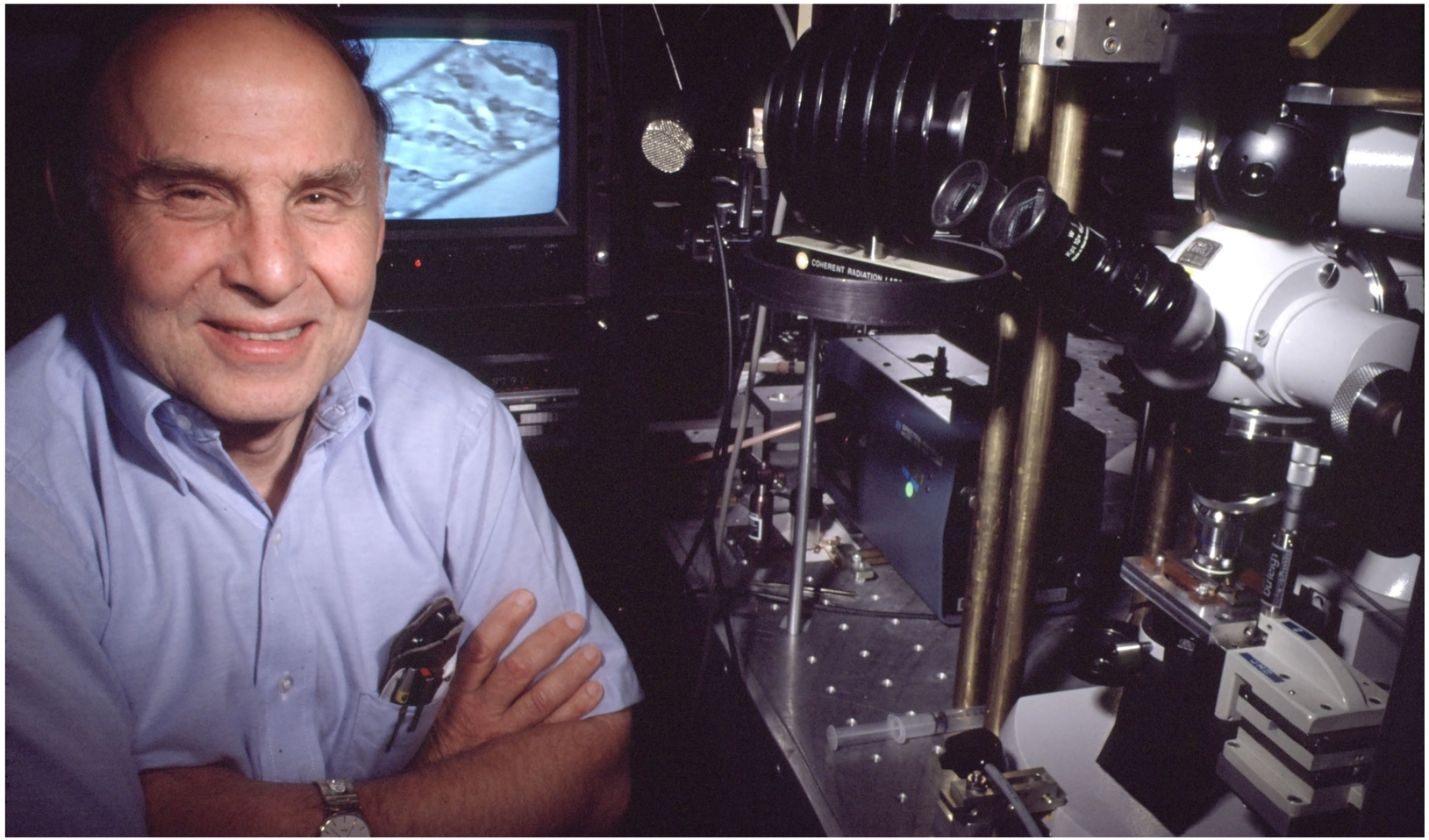
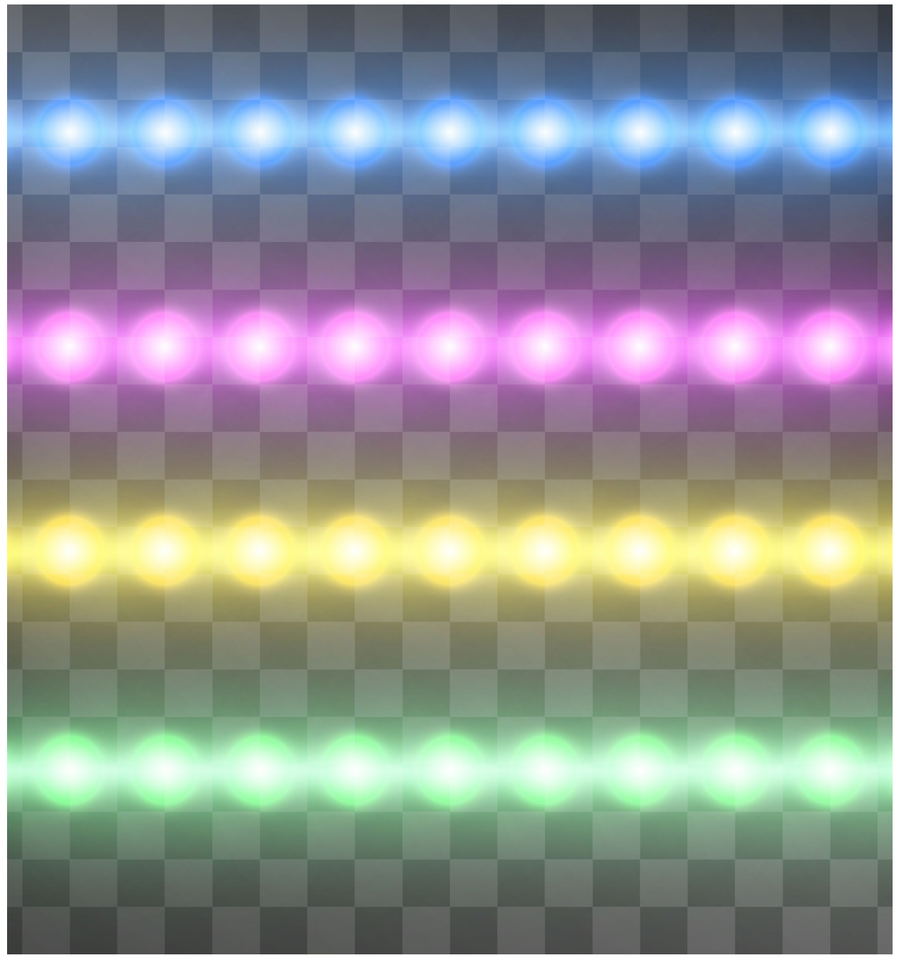



Photo: Nokia Bell Labs

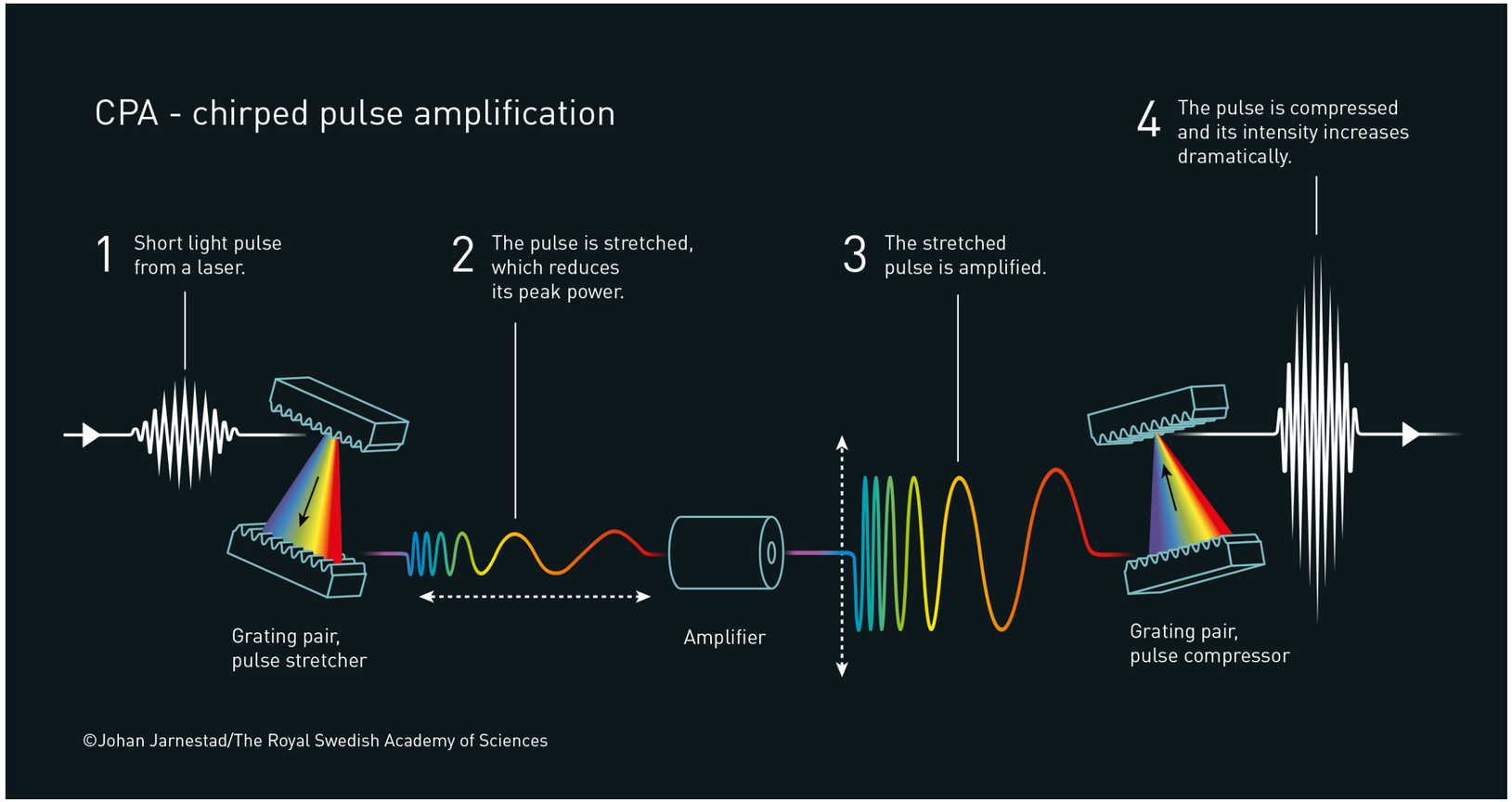
# Pulsing lights

A method for regulating laser intensity and pulses.



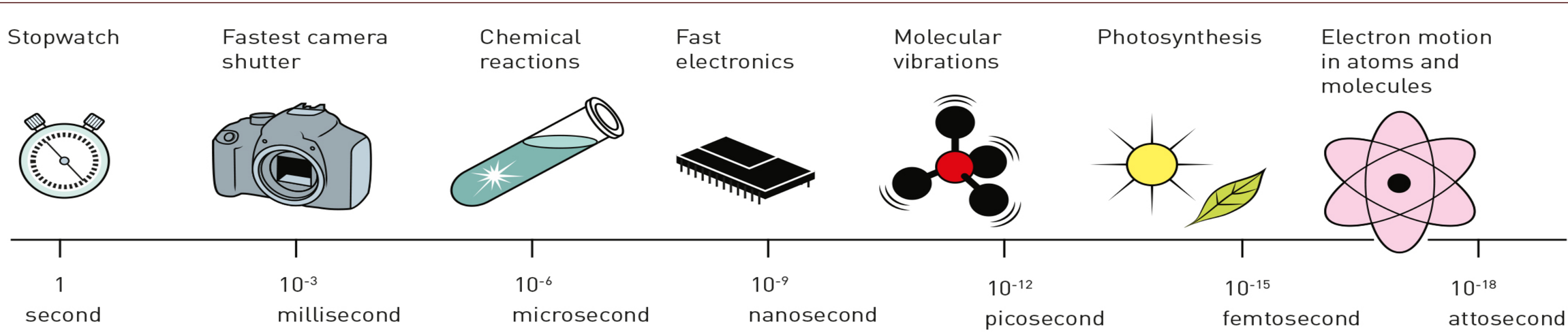
# CPA improves the laser

A short, intensive pulse is stretched, amplified and then compressed, forming a short and much more intensive pulse.



# The benefits

## CPA makes it possible to use a laser as a knife or to record images of rapid events.



THE NOBEL PRIZE

# FOR THE GREATEST BENEFIT TO HUMANKIND

Nobel Prize Lessons