

# VAI GAISMA IR DAĻIŅA?

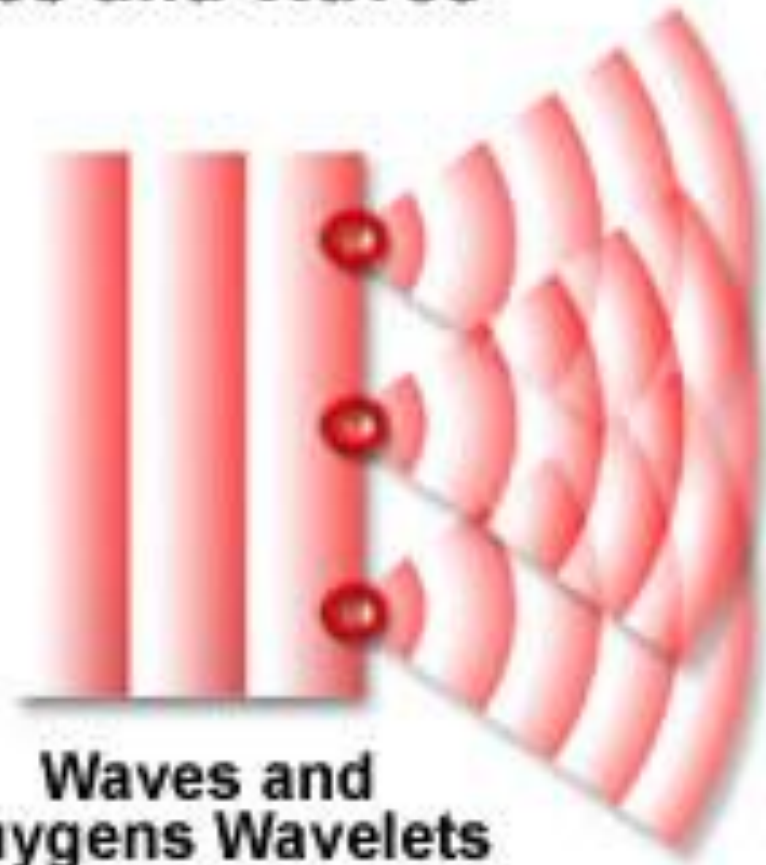
Virgīnija Liepiņa

# Daļiņa vai vilnis?

## Light as Particles and Waves



**Particles**



**Waves and  
Huygens Wavelets**

# Newton vs Huygens

**Pioneers in Visible Light Physics**

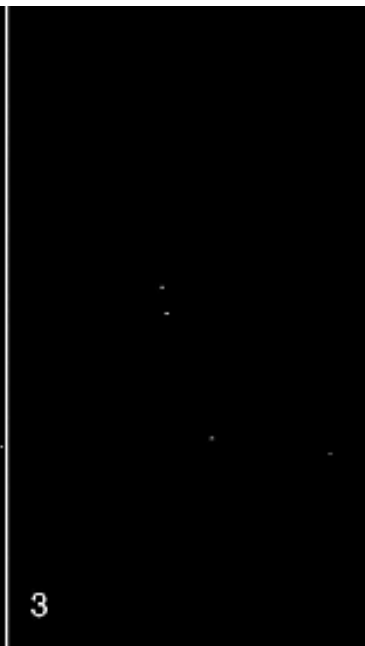
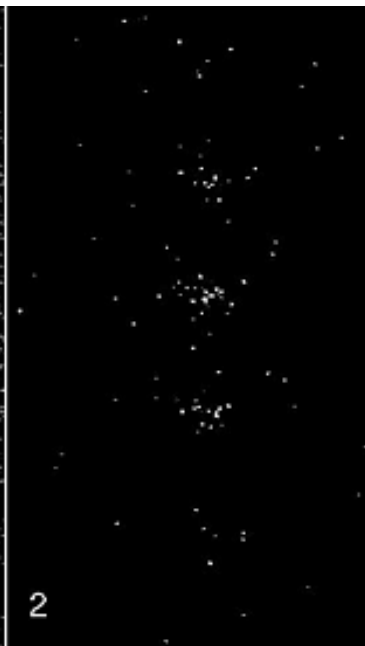
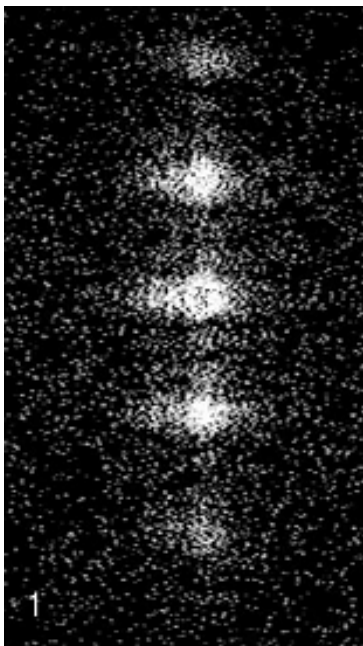
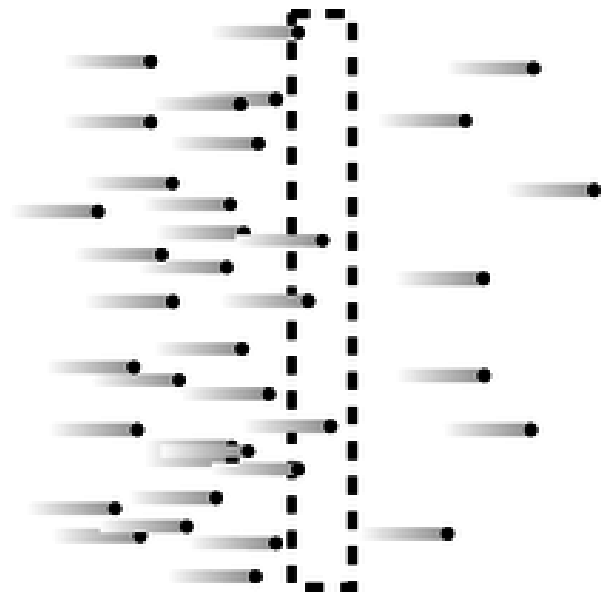
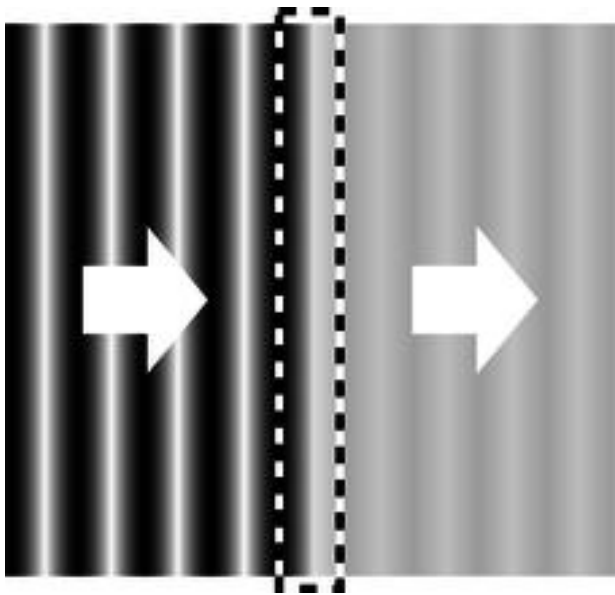


**Sir Isaac Newton  
(1642-1727)**



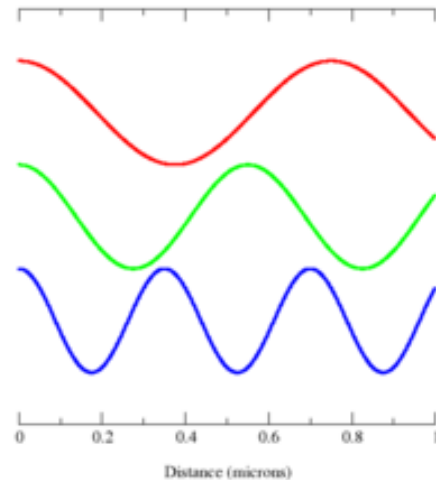
**Christiaan Huygens  
(1629-1695)**

**Figure 2**



# Kā to iedomāties

- Gaismas kvants – mazas viļņa «porcijņas»- reizē gan vilnis, gan daļiņa
- Gaismas kvantu sauc par **fotonu**
- Daudzu fotonu plūsma veido starojumu



# Kvanta energija

$$E = h\nu$$

frequency of radiation, sometimes written as  $f$   
giving expression  $E = hf$ .

Quantum energy  
of a photon.

$$h = \text{Planck's constant} = 6.626 \times 10^{-34} \text{ Joule}\cdot\text{sec} = 4.136 \times 10^{-15} \text{ eV}\cdot\text{s}$$

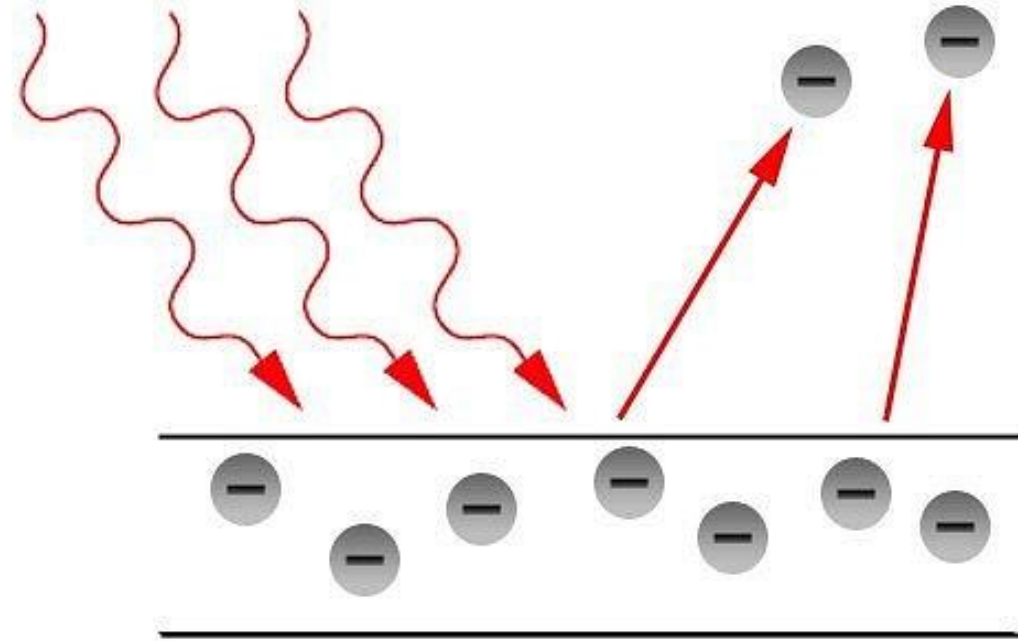
$$1 \text{ eV} = 1,60 \cdot 10^{-19} \text{ J}$$

$$1 \text{ J} = 6,24 \cdot 10^{18} \text{ eV}$$

$$E \text{ (eV)} = 1239 / \lambda$$

Starojuma veids	Viļņa garums	Starojuma frekvence, Hz	Kvanta enerģija, eV
Garie radioviļņi	$\approx 1000 \text{ m}$	$\approx 3 \cdot 10^5$	$\approx 2 \cdot 10^{-12}$
Sarkanā gaisma	$\approx 700 \text{ nm}$	$\approx 0,43 \cdot 10^{15}$	$\approx 1,86$
Dzeltenā gaisma	$\approx 570 \text{ nm}$	$\approx 0,53 \cdot 10^{15}$	$\approx 2,19$
Zilā gaisma	$\approx 460 \text{ nm}$	$\approx 0,62 \cdot 10^{15}$	$\approx 2,56$
Violetā gaisma	$\approx 400 \text{ nm}$	$\approx 3,10 \cdot 10^{15}$	$\approx 3,10$
UV starojums	$\approx 180 \text{ nm}$	$\approx 3 \cdot 10^{16}$	$\approx 120$
Rentgenstarojums	$\approx 10^{-12} \text{ m}$	$\approx 3 \cdot 10^{20}$	$\approx 10^6$
Gamma starojums	$< 10^{-12} \text{ m}$	$> 3 \cdot 10^{20}$	$> 10^6$

# Fotoefekts





# Interesantas lietas par fotoefektu

- Atkarība no gaismas intensitātes
- Ne visu viļņa garumu gaisma spēj izist elektronus no vielas

Einšteina vienādojums  
fotoefektam

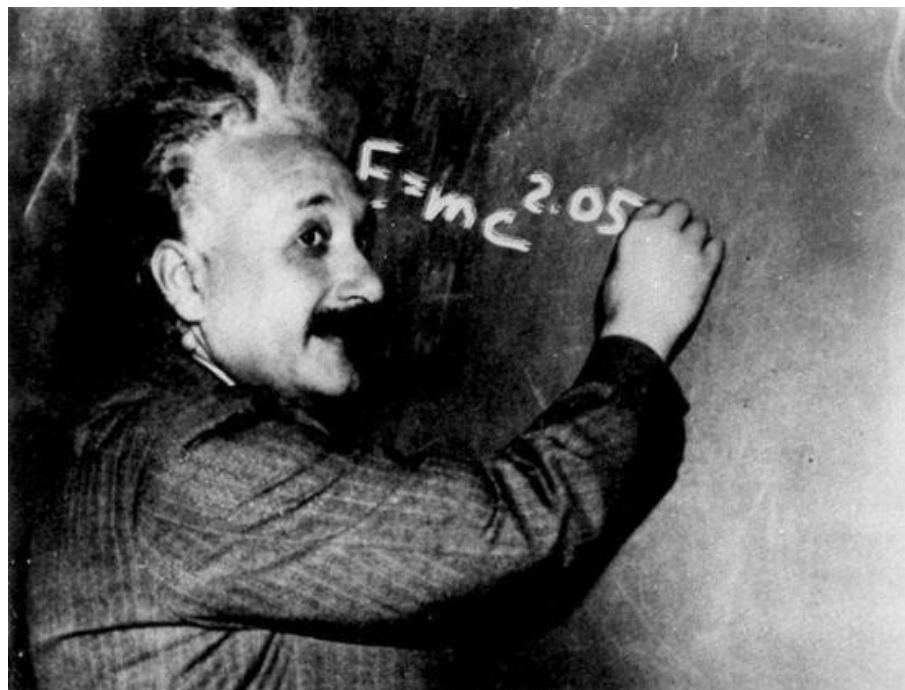
$$h\nu = A + \frac{mv^2}{2}$$

$h\nu$  — kvanta enerģija

$A$  — izejdarbs

$mv^2/2$  — elektrona kinētiskā enerģija

# Gaismai ir masa, impulss un spiediens!



$$p = \frac{h\nu}{c}, \quad p = \frac{h}{\lambda}$$

$p$  — kvanta impulss

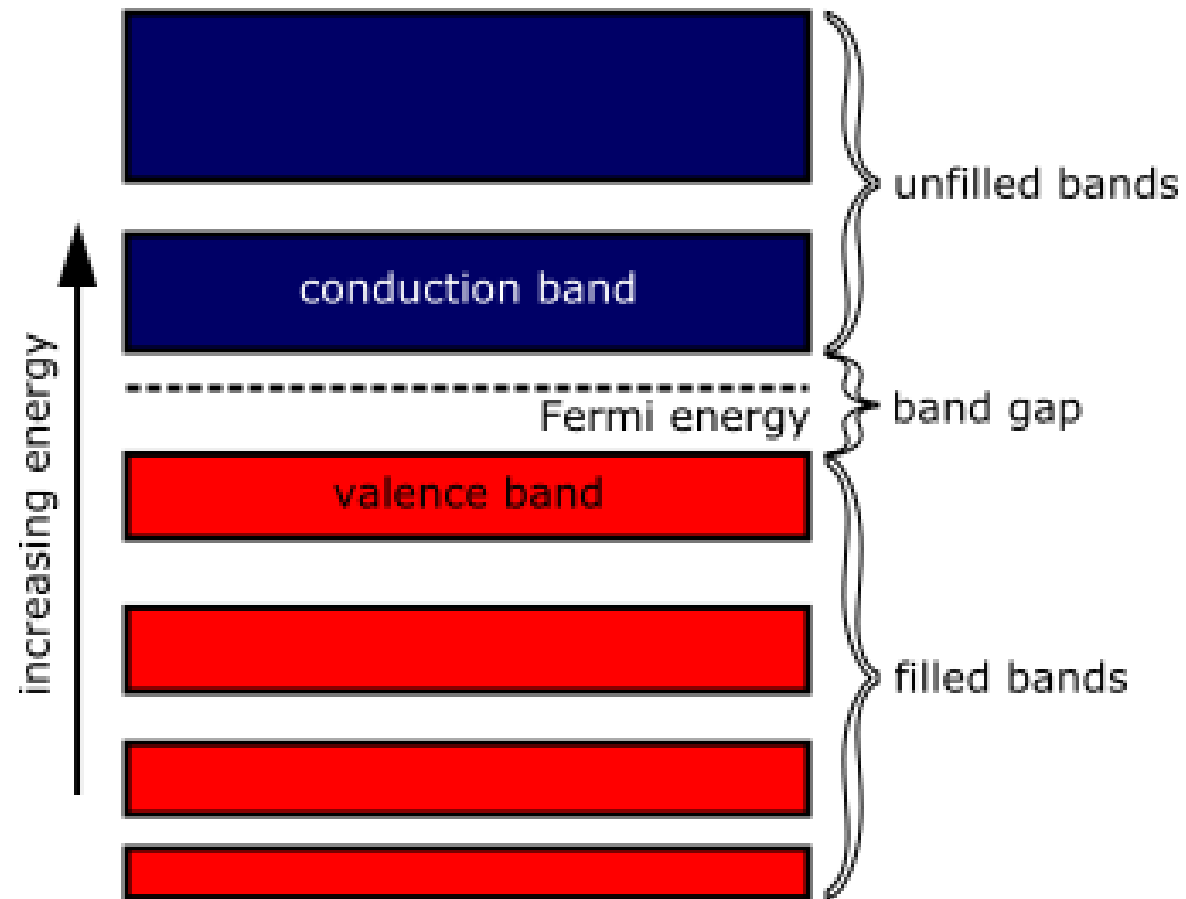
$\nu$  — kvanta frekvence

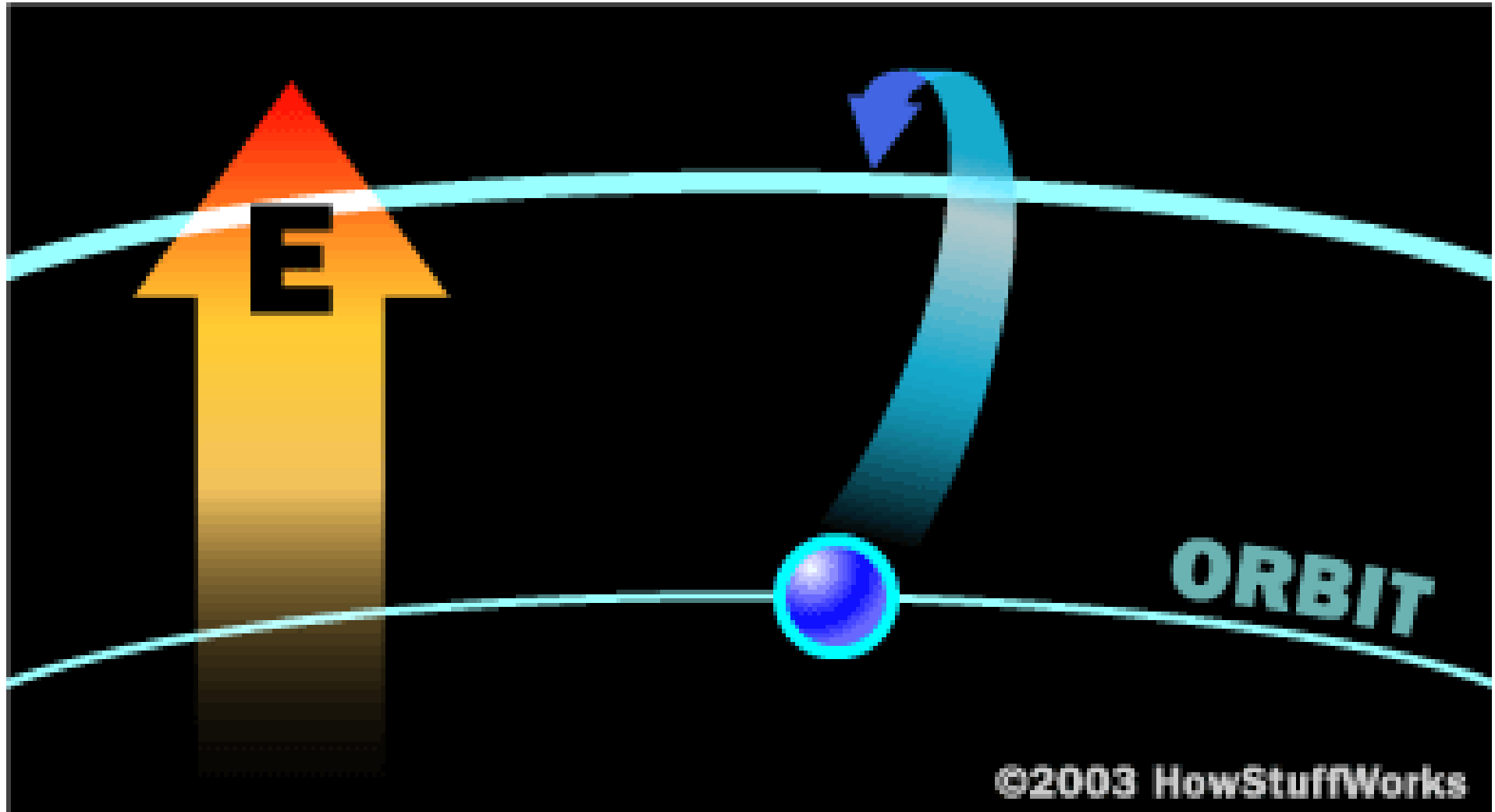
$c$  — gaismas ātrums vakuumā

$h$  — Planka konstante

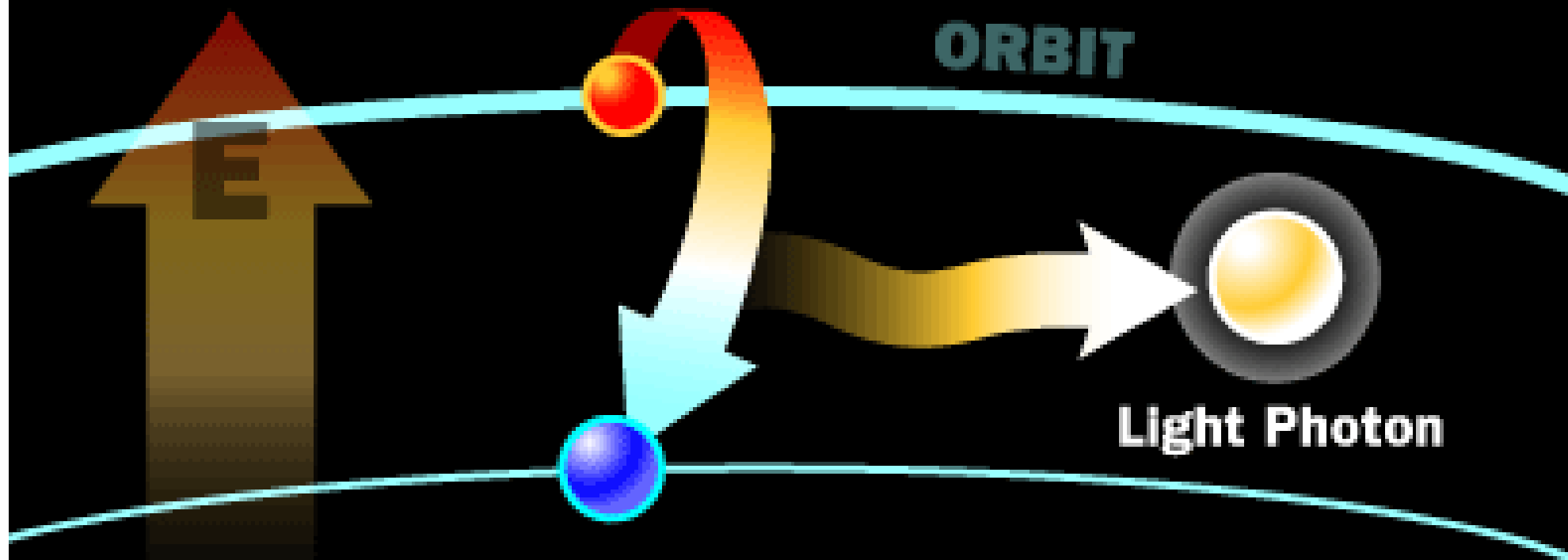
$\lambda$  — viļņa garums

# Nedaudz no vielu fizikas





# Emission of Light

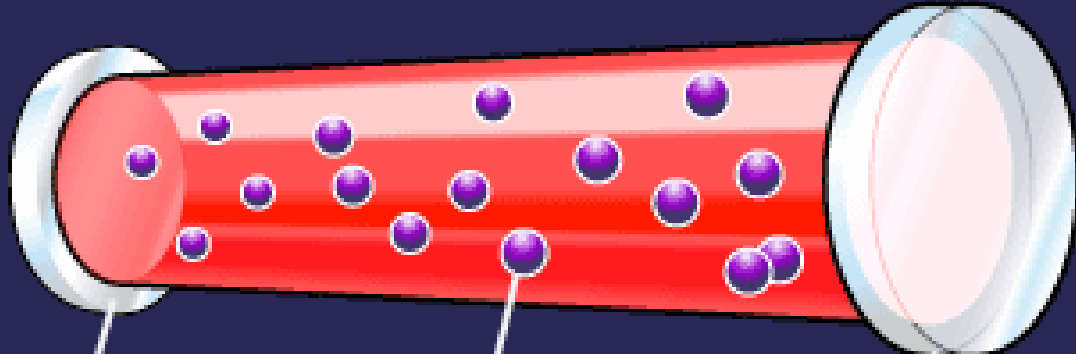


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Flash Tube



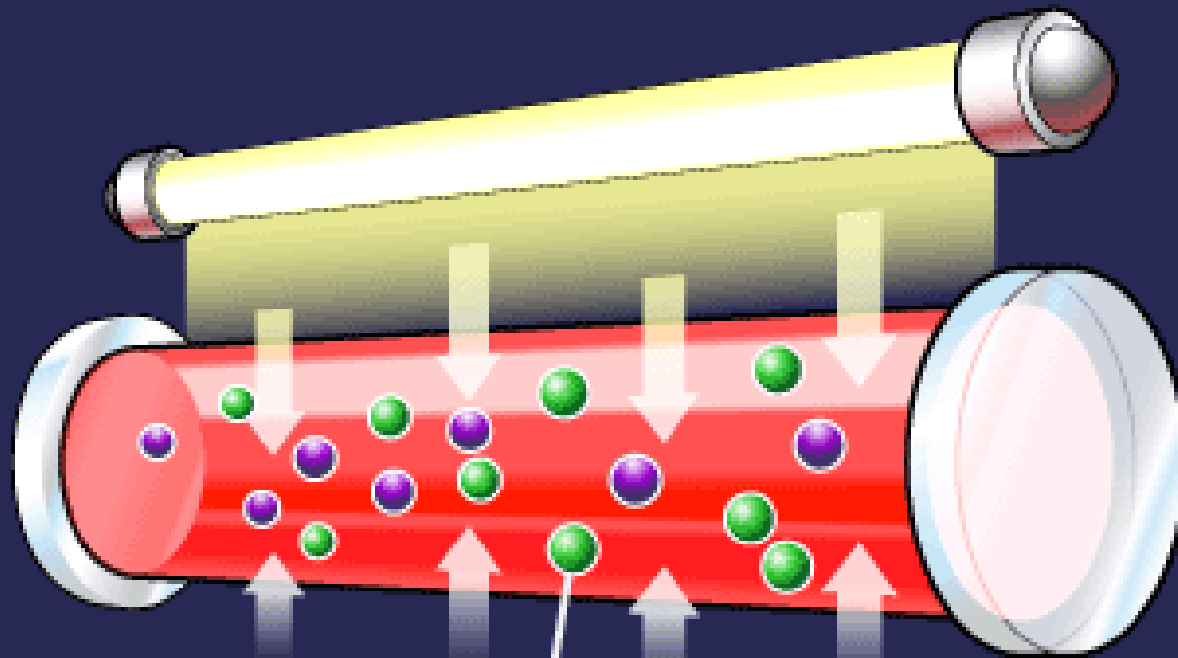
Mirrored Surface



Atoms

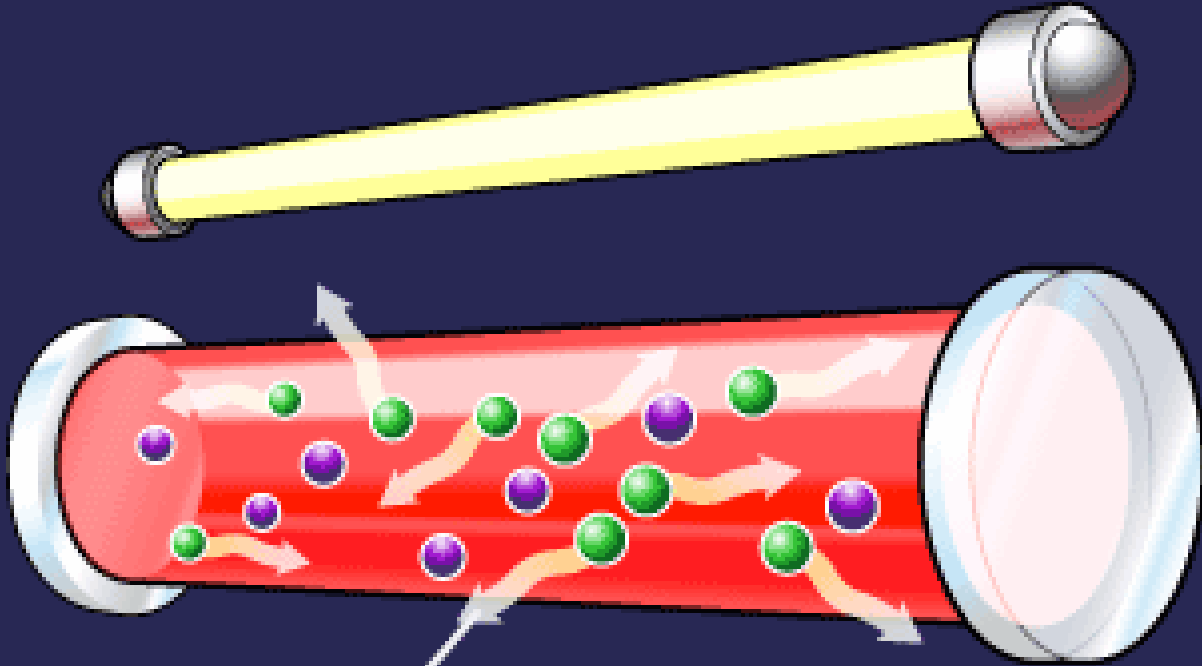
Partially Mirrored Surface

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Excited Atom

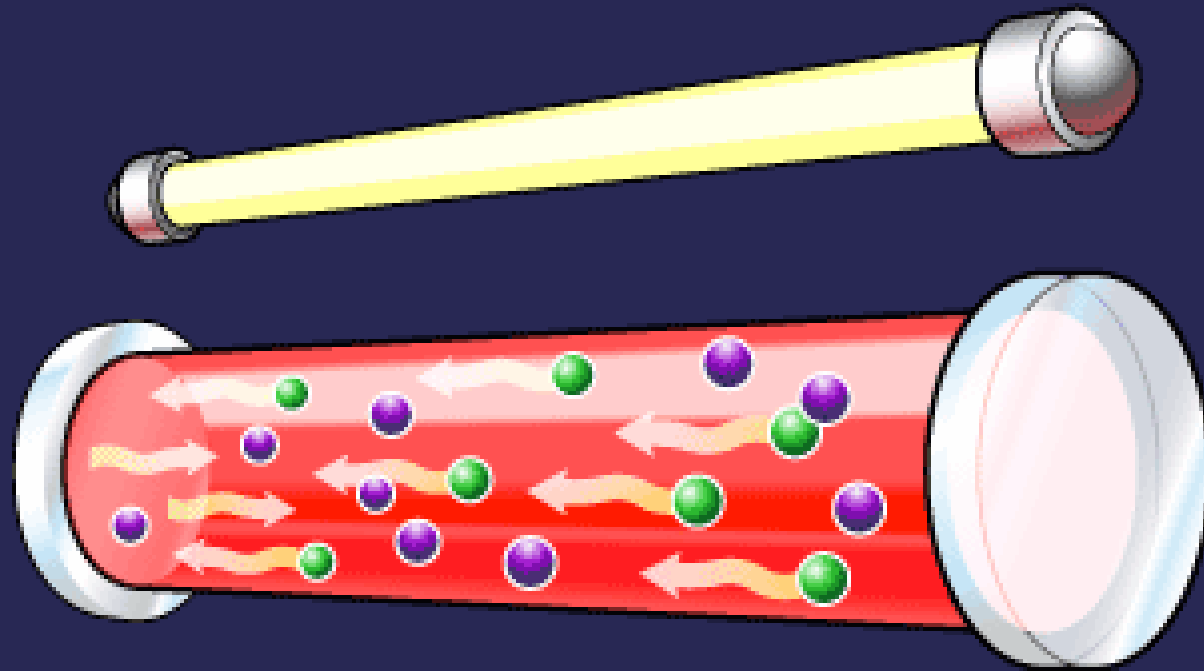
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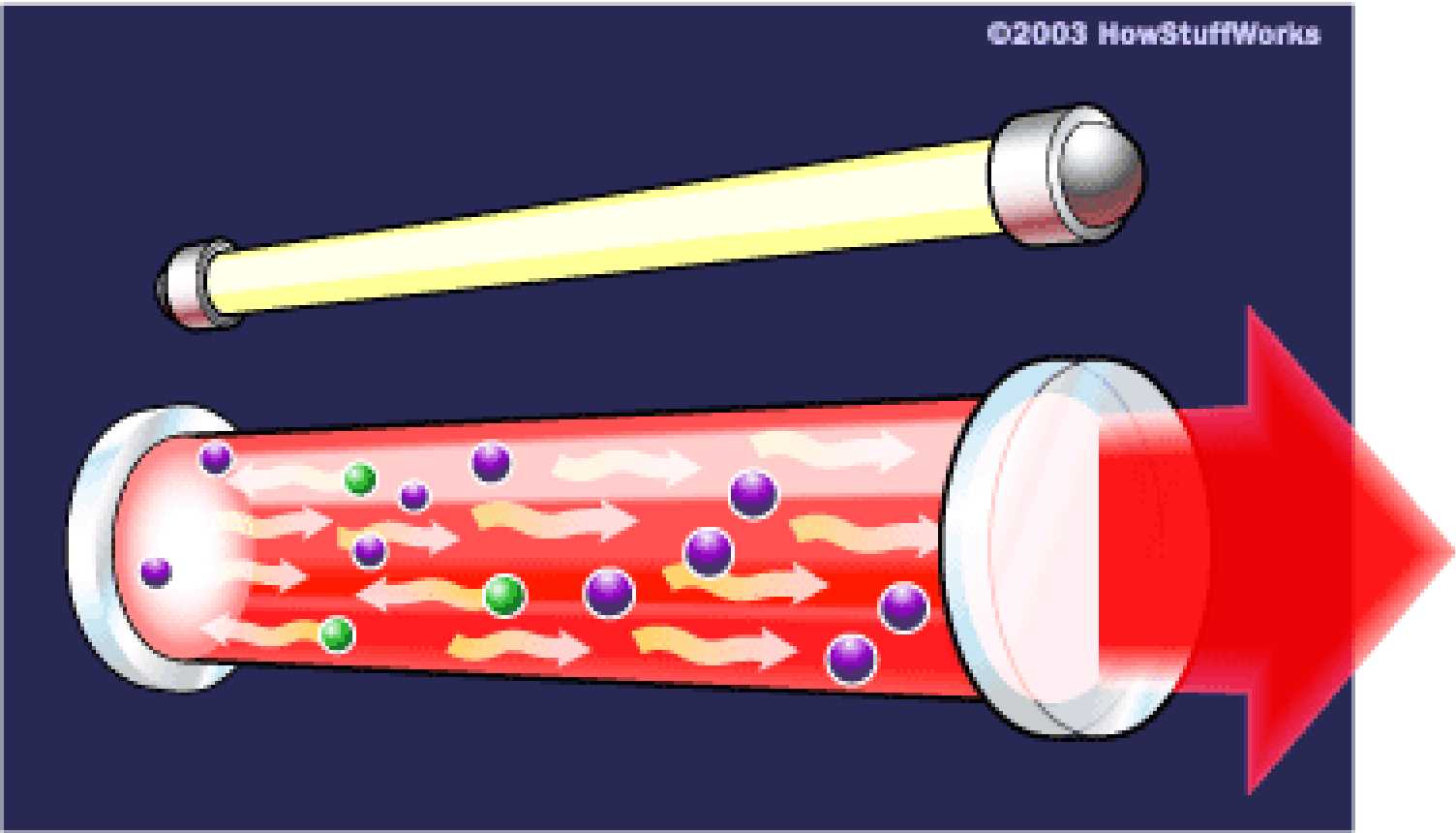
Emitted Light



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Nē, nu paldies!

