Physics

for students of dental medicine

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Sanja Dolanski Babić

dolanski@mef.hr

- **Physics**

1. Structure of matter
2. Basics of mechanics
3. Hydrodinamics
4. Thermodynamics
5. Electromagnetism
6. Optics
7. Oscillations and sound
8. Medical Physics

Models

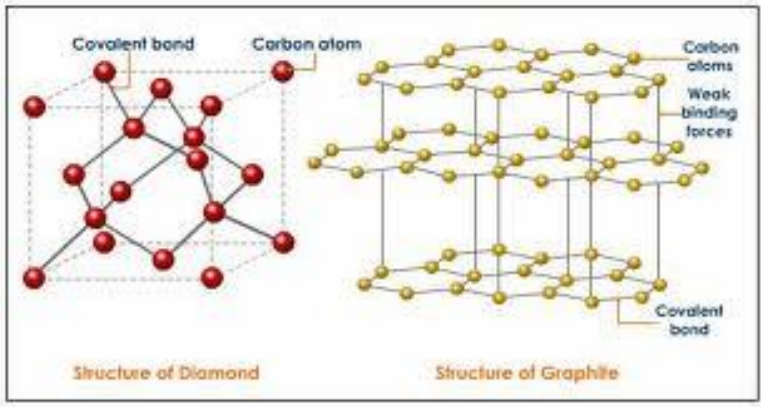
- Model – simplified presentation of the real system
- is used to study the functions of real systems

- Models:
  1. descriptive
  2. mathematical
  3. physical

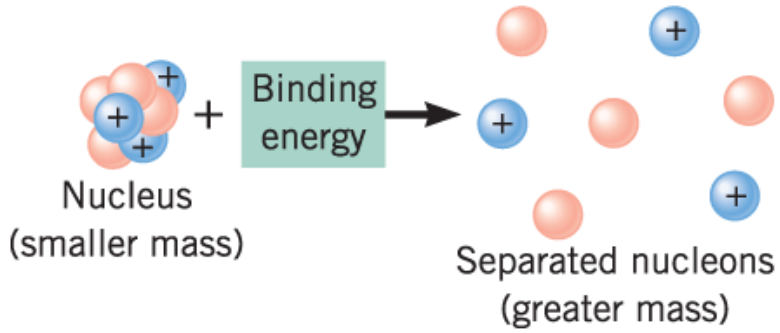
Matter

atoms **interactions**

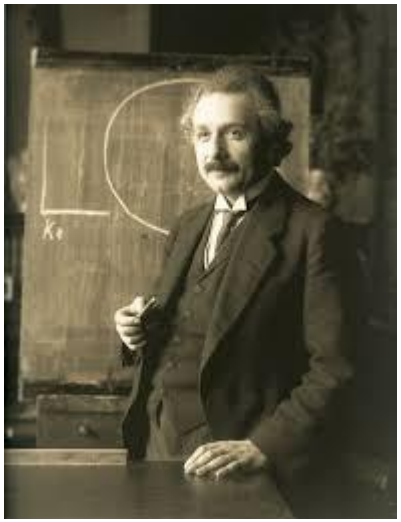
- An infinite number of forms of matter are built of atoms.

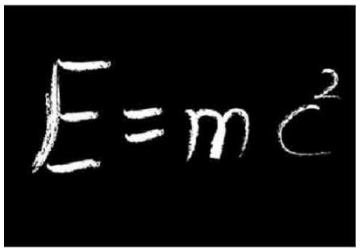


mass ⟷ ***energy***

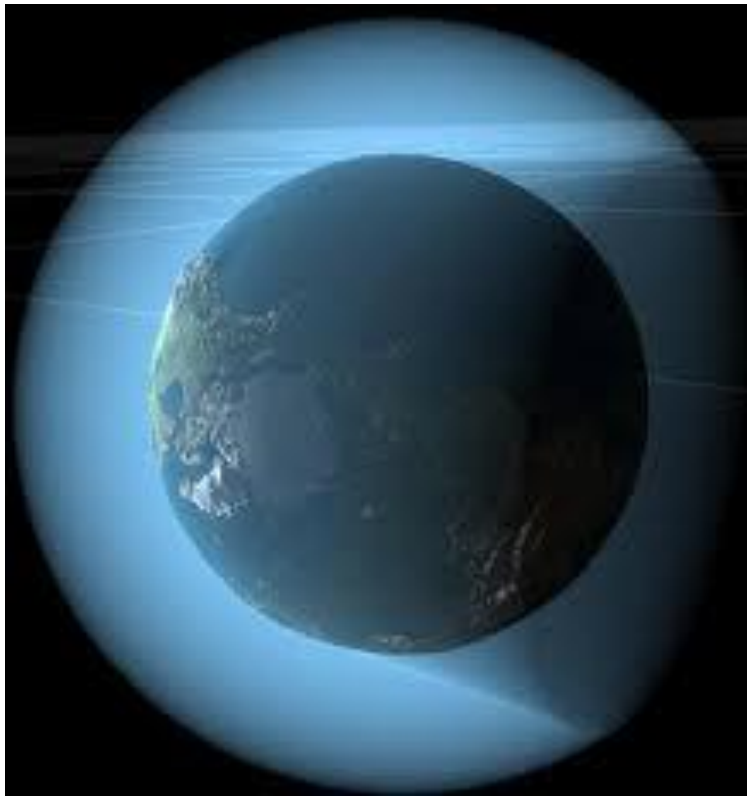


$$\Delta m = \frac{\Delta E}{c^2}$$





mass, charge and spin – properties of matter

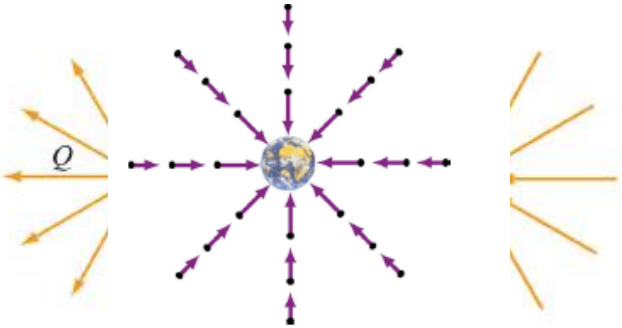


field → **force field**

field

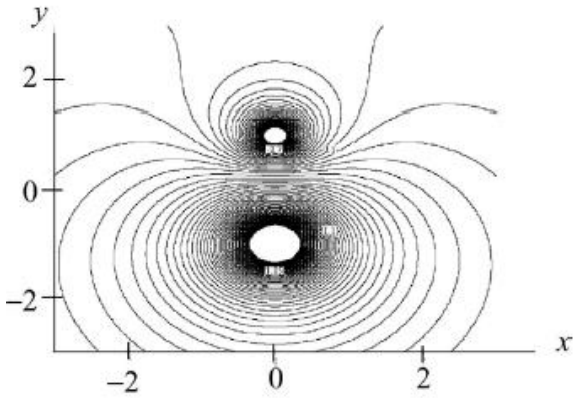
vector

electrical,
magnetic,
gravitational



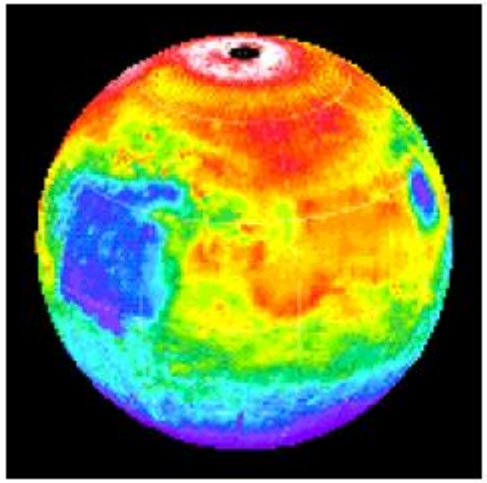
scalar

electrical potential –
energy per unit of charge

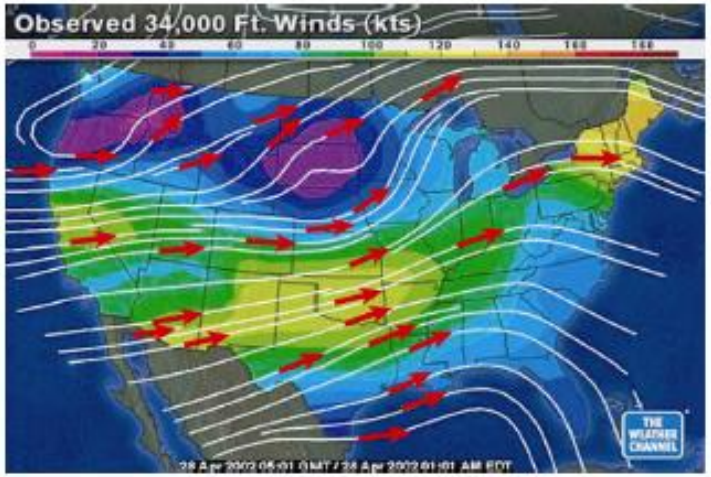


field

scalar



vector



FUNDAMENTAL FORCES IN NATURE

1. gravitational

2. electromagnetic

3. weak nuclear

4. strong nuclear

1. gravitational

- long range force
- attractive

- „hold" the stars in the galaxy

2. electromagnetic

$$F \sim \frac{1}{r^2}$$

- long range force
- attractive and repulsive

- ensures the stability of the atoms

3. weak nuclear

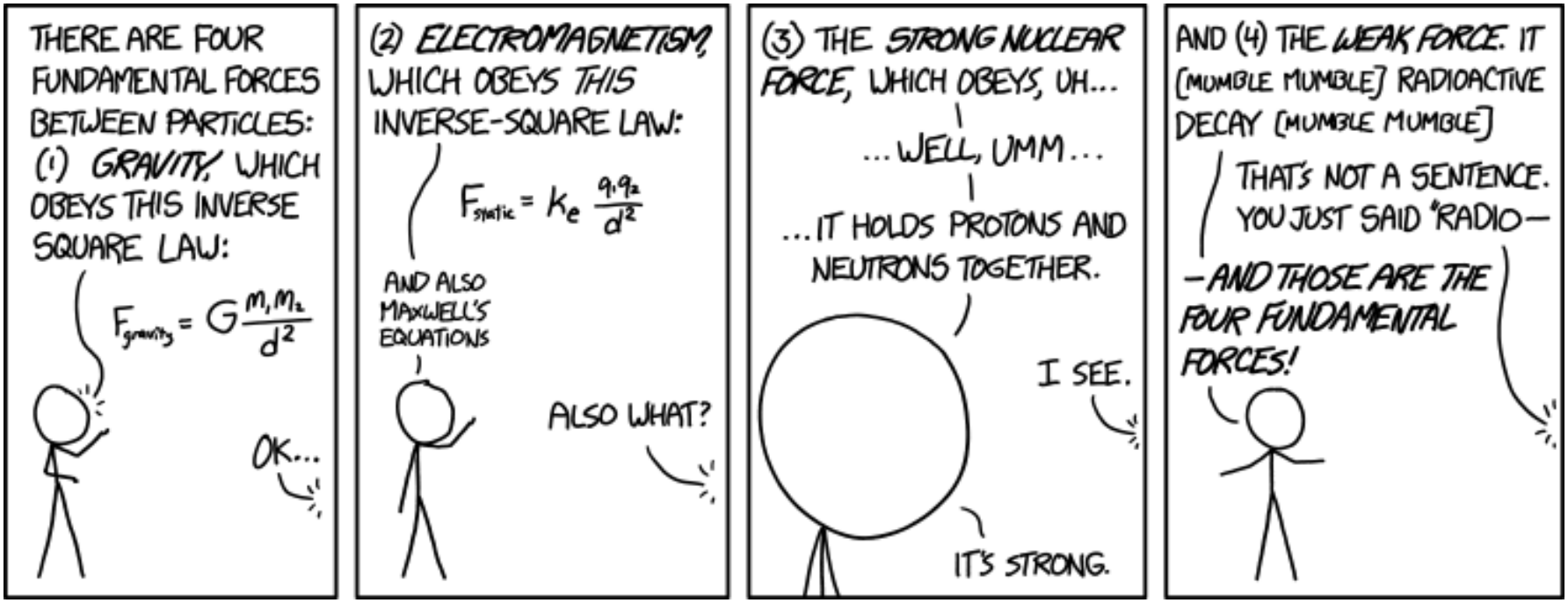
- short range force; < 10^{-18} m
- attractive

- stability of the nucleons

4. strong nuclear

- short range force; < 10^{-15} m
- attractive

- stability of the nucleus



http://www.youtube.com/watch?v=o-9yt7OAYmE&feature=related

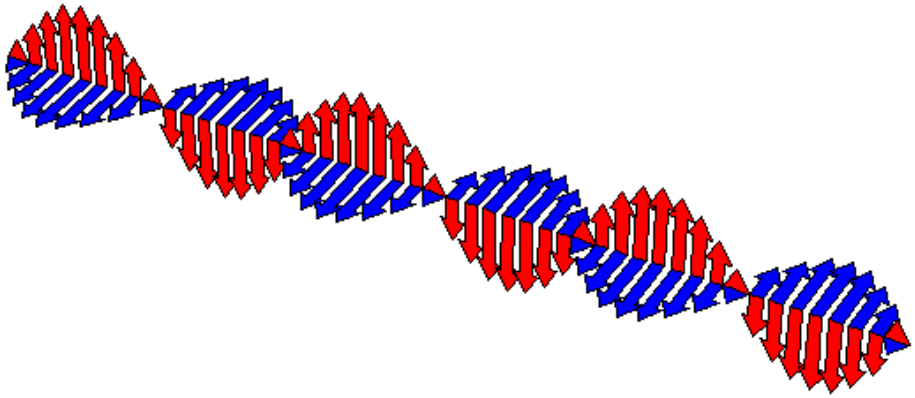
force	compared to electromagnetic force
electromagnetic	1
gravitational	10^{-38}
weak nuclear	10^{-3}
strong nuclear	10^{2}

Friction force?

field → (waves) → energy

- transfer of energy,

NOT transfer of mass



Sources of electromagnetic waves (field, radiation)

natural: atoms, molecules, cosmic rays, stars

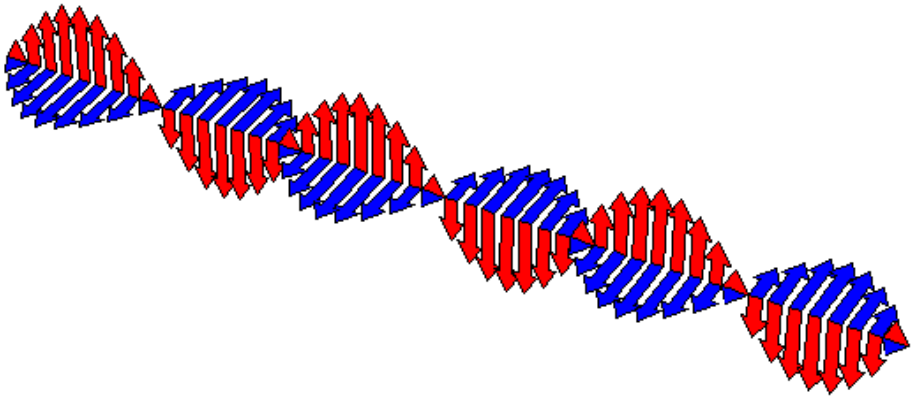
artificial: aerials, lamps, X-ray tube, cobalt bomb

Application of light therapy for jaundice in newborns (blue light; 420-470 nm)

Heat lamps (1000-2000 nm)

Electromagnetic waves

- communication with the outer world: sight, the sense of heat
- electromagnetic field

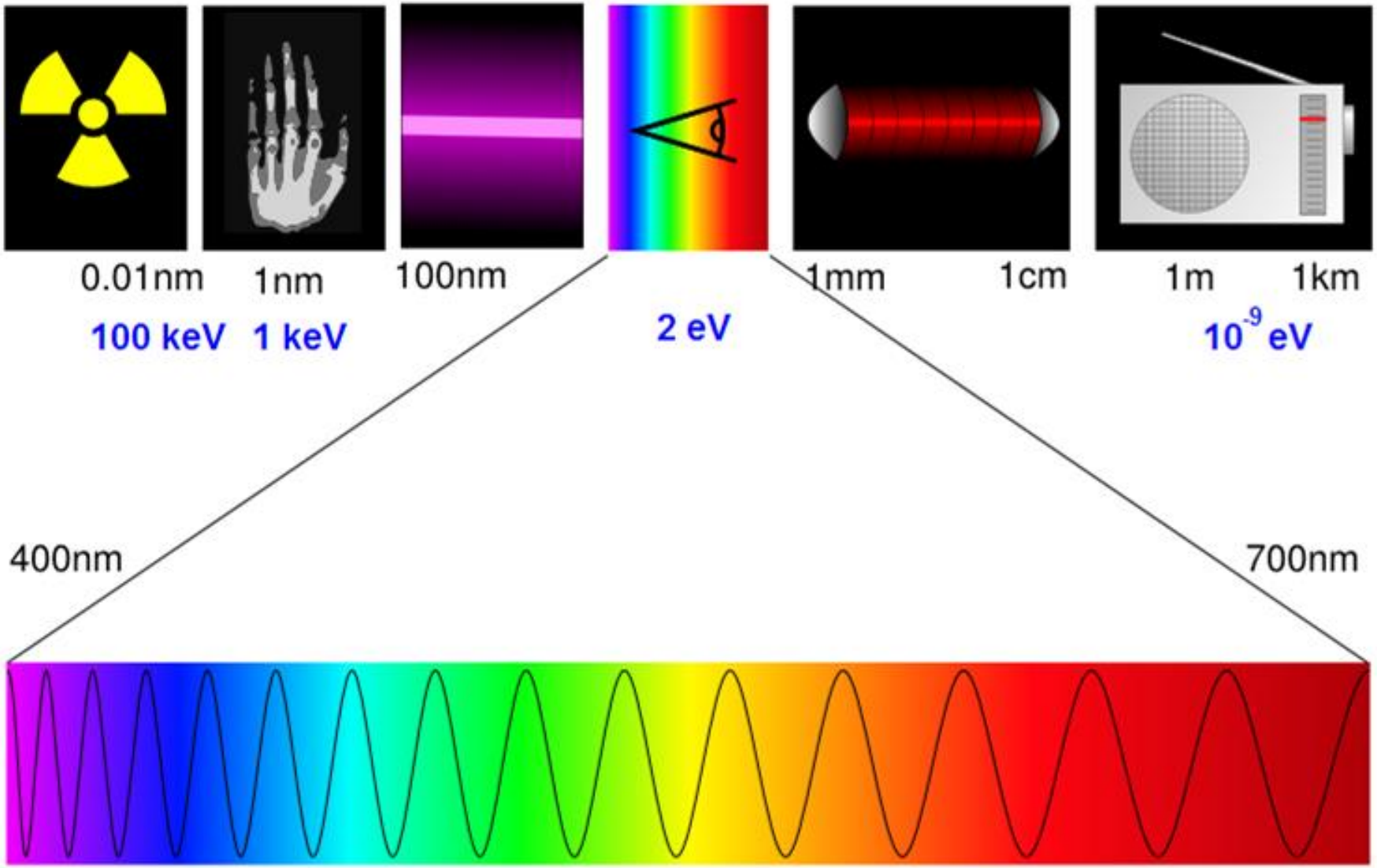


$$E = E_0 \sin \omega t$$
$$B = B_0 \sin \omega t$$

- frequency (f)
- wave length (λ)

$\lambda = v/f$

- speed (v)
- intensity (**I**)


0.01nm
1nm
100nm
1mm
1cm
1m
1km
100 keV
1 keV
2 eV
10^{-9} eV
400nm
700nm

Energy density of electromagnetic waves

- in vacuum: $\frac{U}{V}=\frac{1}{2}(\varepsilon_0 E^2+\frac{B^2}{\mu_0})$

- in the medium: $\frac{U}{V}=\frac{1}{2}(\varepsilon_0\varepsilon_r E^2+\frac{B^2}{\mu_0\mu_r})$

- in vacuum: $c=\sqrt{\frac{1}{\varepsilon_0\mu_0}}$

spreading of EM waves

- in the medium: $v=\sqrt{\frac{1}{\varepsilon_0\varepsilon_r\mu_0\mu_r}}$