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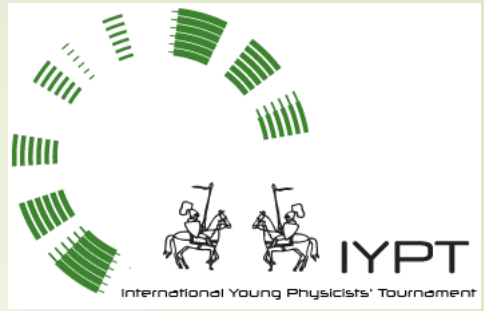

12. Strange Motion

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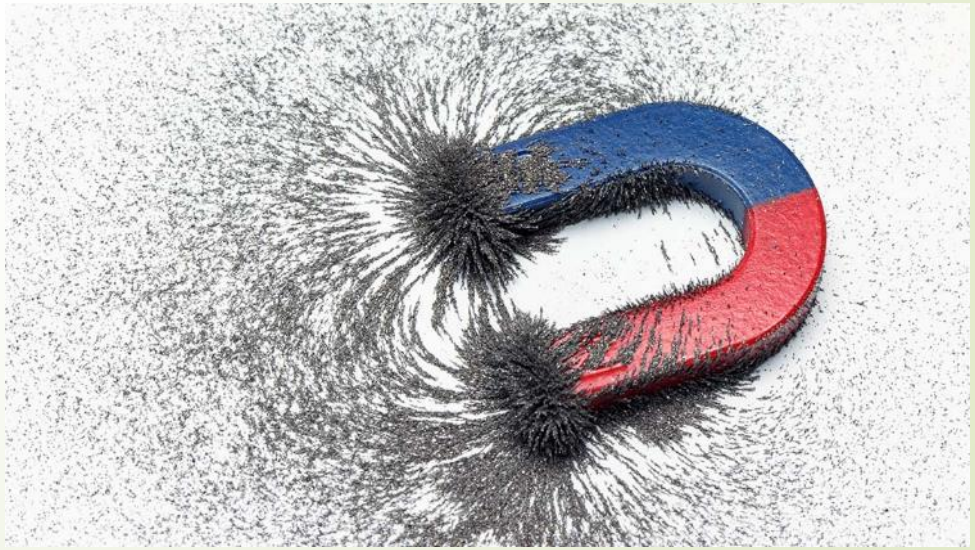
12. Strange Motion

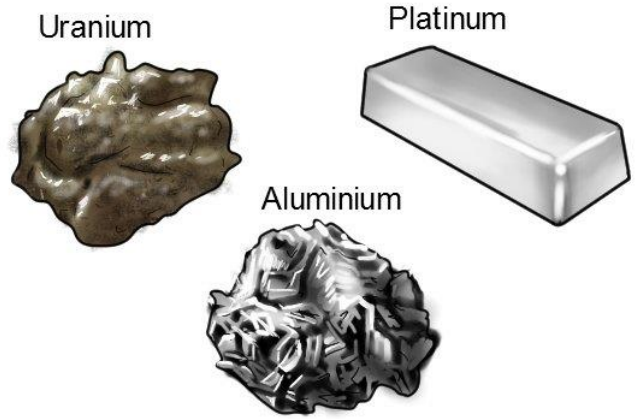
Sprinkle small floating particles on the surface of water in a bowl. Bring a strong magnet above and near to the water surface. Explain any observed motion of the particles.

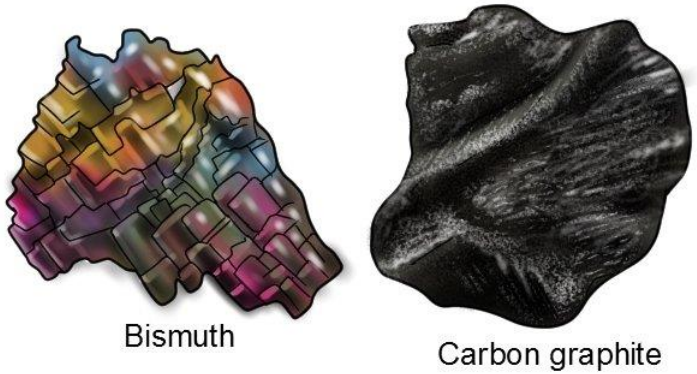


Magnetic materials

- Ferromagnetic – μ_r~100-1000 – strong attractive forces
- Paramagnetic – μ_r~1.000001-1.00001, $\chi = (\mu_r - 1) \sim +(10^{-6} – 10^{-5})$ – very weak attractive forces, mainly atoms of some metallic elements
- Diamagnetic - μ_r~0.999999-0.99999, $\chi = (\mu_r - 1) \sim -(10^{-6} – 10^{-5})$ – very weak repulsive forces, plastics, water, non-metallic elements

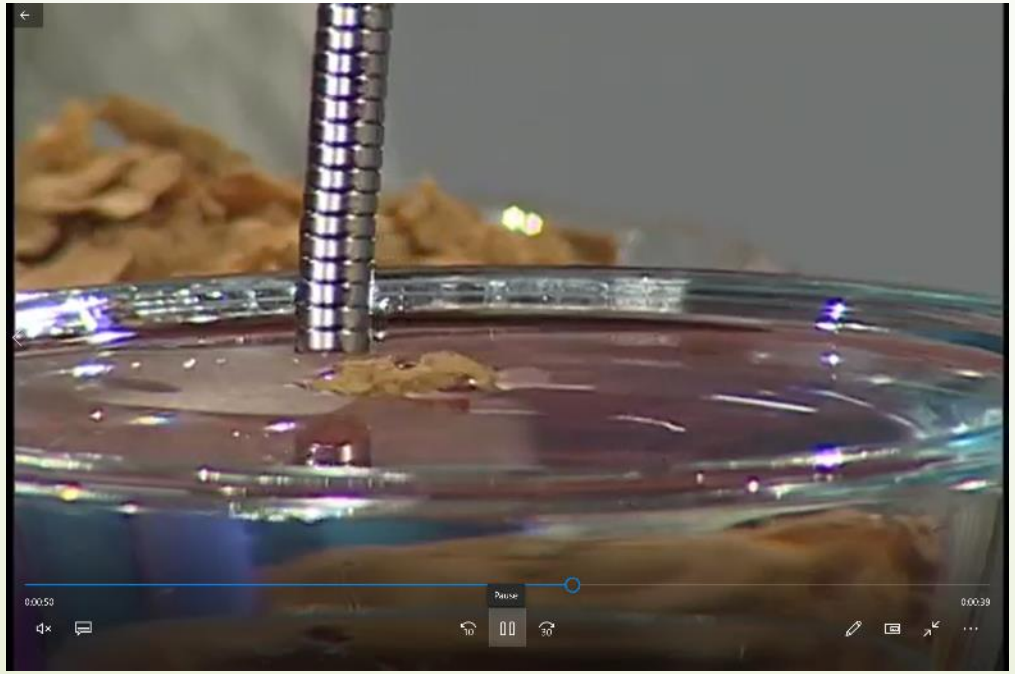

Magnetite





Ferromagnetic materials

- Can ferromagnetic particle float?
- Only if it is a small part of light particle
- See corn flakes floating on the water (iron compounds added as nutrition)

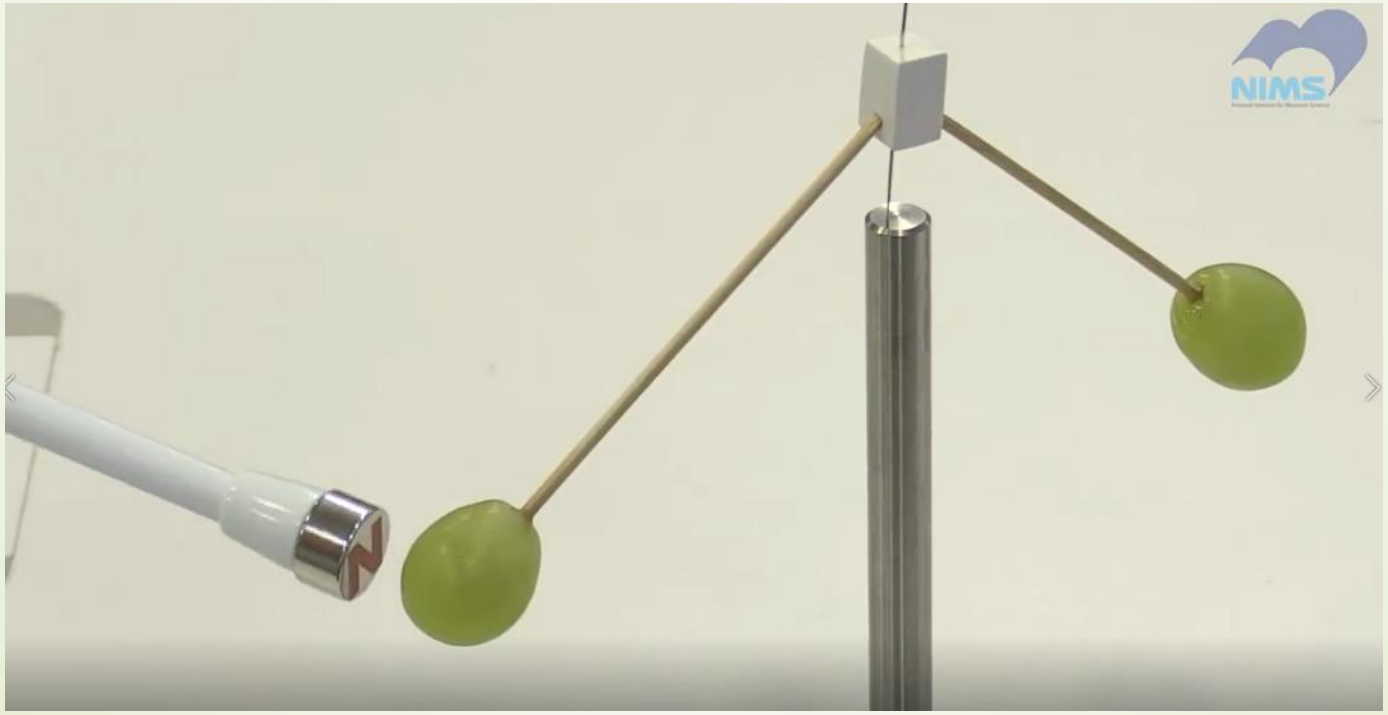


Dia-/Para-magnetic materials

- See brass and carbon floating on a boat

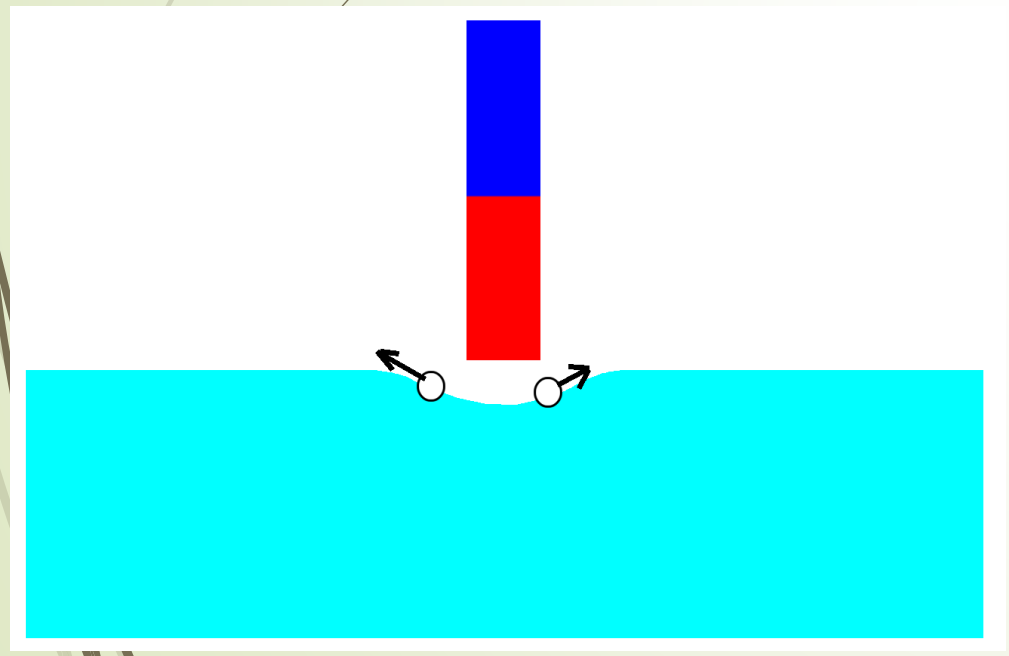
Water is diamagnetic

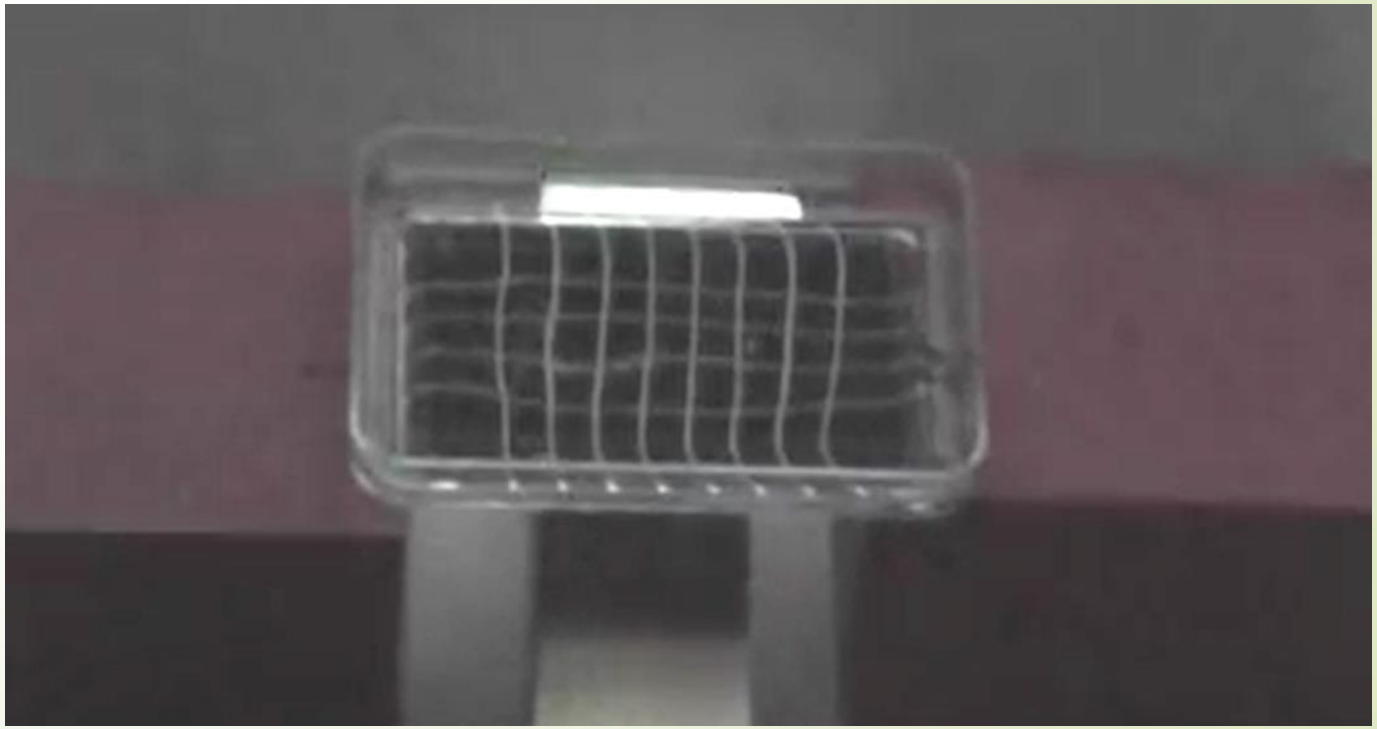
- See repulsing grapes



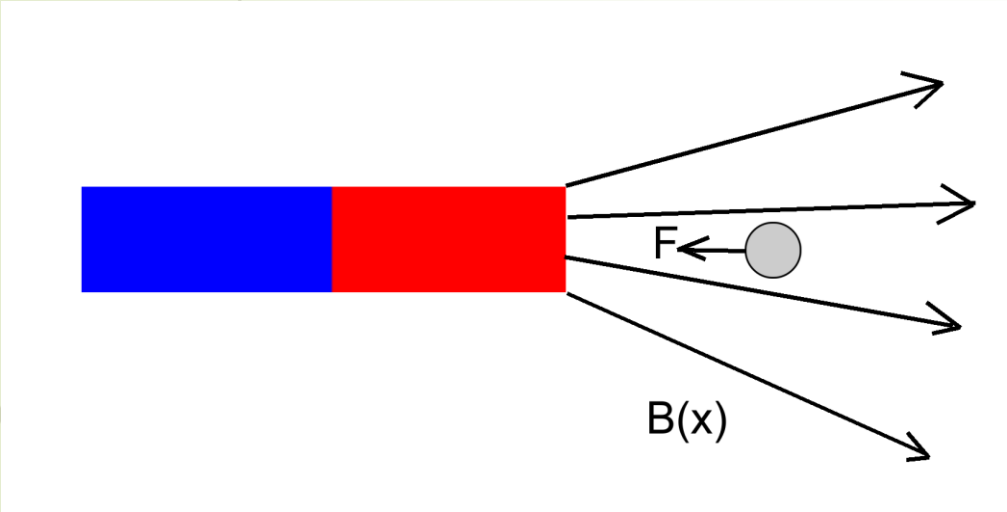
Water is diamagnetic

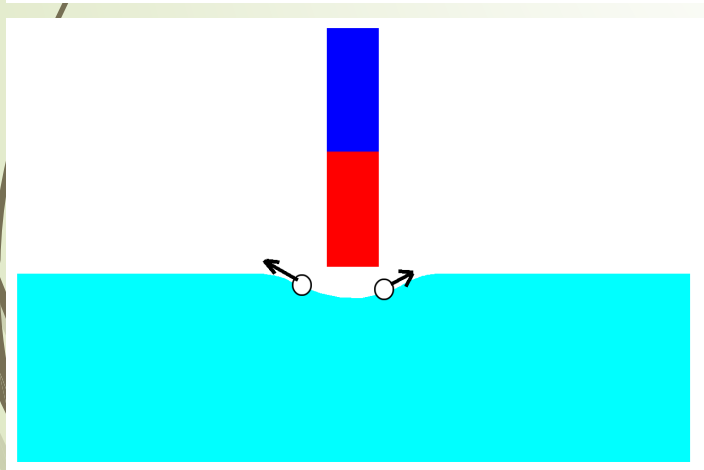
- See water level deformation caused by a magnet





Magnetic force acting on week magnetic materials





- Volume force density

$$f(x) = \frac{\chi}{\mu_O} B(x) \frac{\mathrm{d}B(x)}{\mathrm{d}x} \qquad \left[\frac{\mathrm{N}}{\mathrm{m}^3}\right]$$

- Example:
  magnet B=1T, dB/dT= 1T / 10^{-2} m = 100 T/m
  influences water to ca d = 1 cm depth
  $\chi \sim 10^{-6}$, $\mu 0 \sim 10^{-6}$

$$\frac{\chi}{\mu_O} B(x) \frac{\mathrm{d}B(x)}{\mathrm{d}x} . d . S = \rho g h . S$$

1x1x100x0.01=1000x10xh

$h \sim 10^{-4}$m=0.1mm

Strange motion – what to do?

- Buy strong neodymium magnets ☺
- Try to use various floating material (test the material of the particle)
- Try „airy“ material like styrofoam balls to test the deformation of the water level
- Map/calculate the magnetic field around the magnet (looks exactly like the field of solenoid) and try to calculate the deformation of the water level
- Compare observed motion with the predicted one