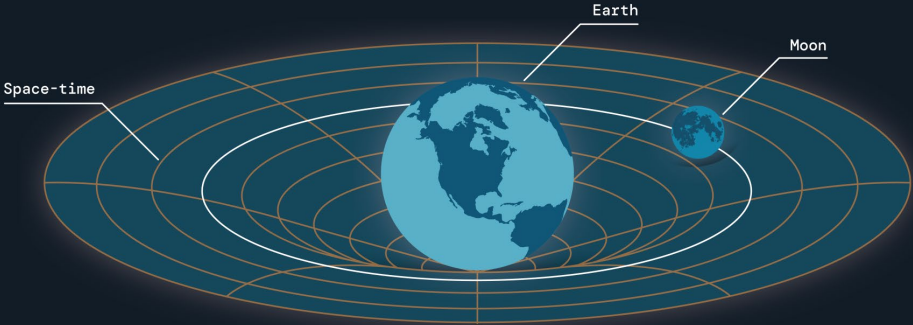


Fizika 2: Elektrodnamika

Bevezetés

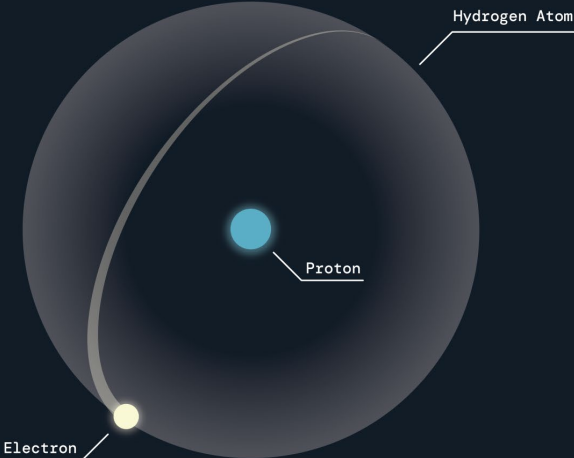
Gravitational Force

Gravity, the force that draws objects together, can be understood as bends and curves in the fabric of space-time. Anything with mass makes these dents, from the Earth and Moon to turtles and cats.



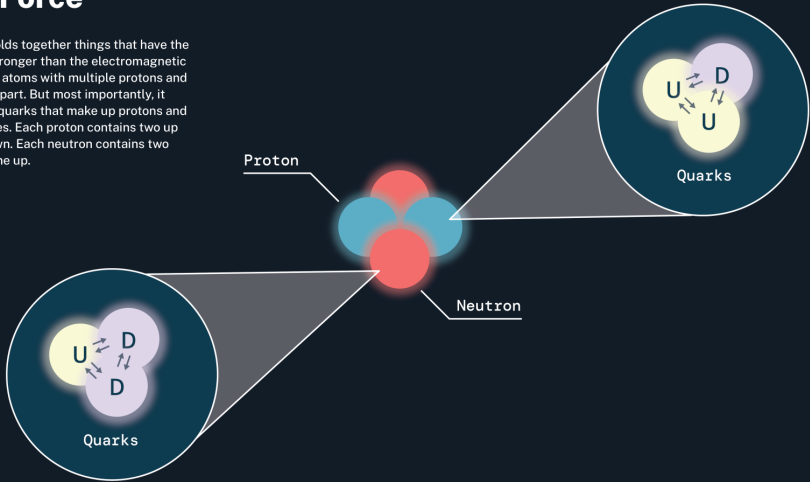
Electromagnetic Force

The electromagnetic force holds together objects with opposite electrical charges, like the proton and electron that make up one hydrogen atom.



Strong Force

The strong force holds together things that have the same charge. It's stronger than the electromagnetic force, so that's why atoms with multiple protons and neutrons don't fly apart. But most importantly, it holds together the quarks that make up protons and neutrons themselves. Each proton contains two up quarks and one down. Each neutron contains two down quarks and one up.



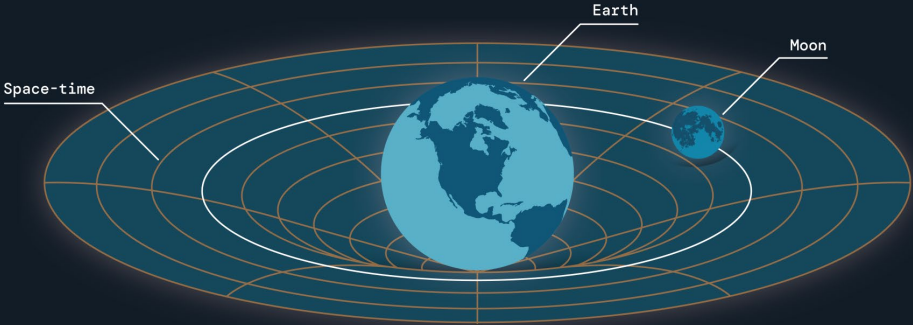
Weak Force

The weak force can change a quark from one type to another: from up to down. That change could turn a proton into a neutron or vice versa. This process would also produce a neutrino and an electron or anti-electron through a process called beta decay.



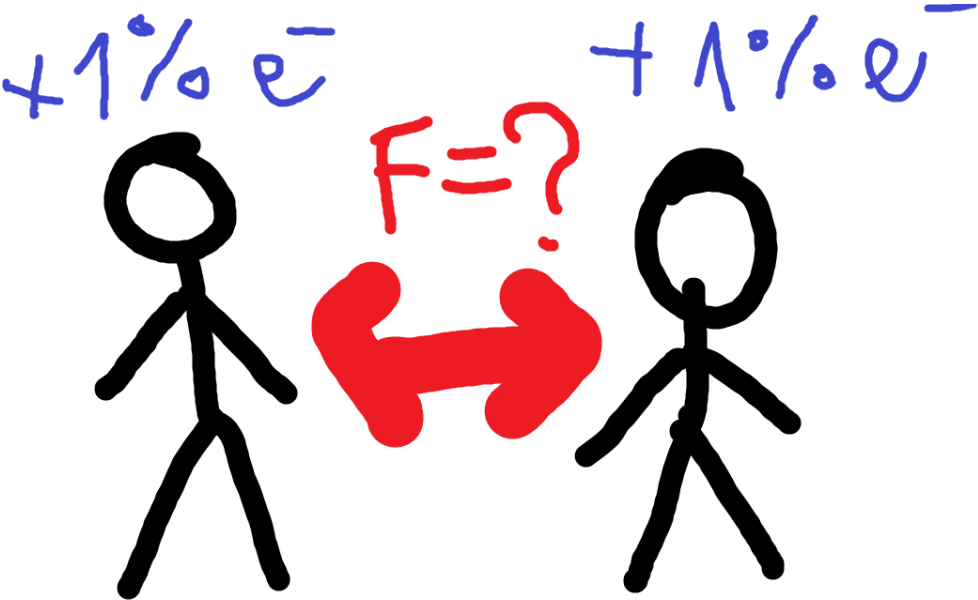
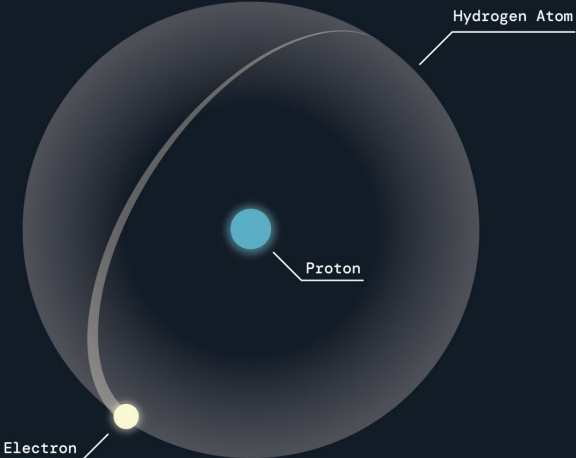
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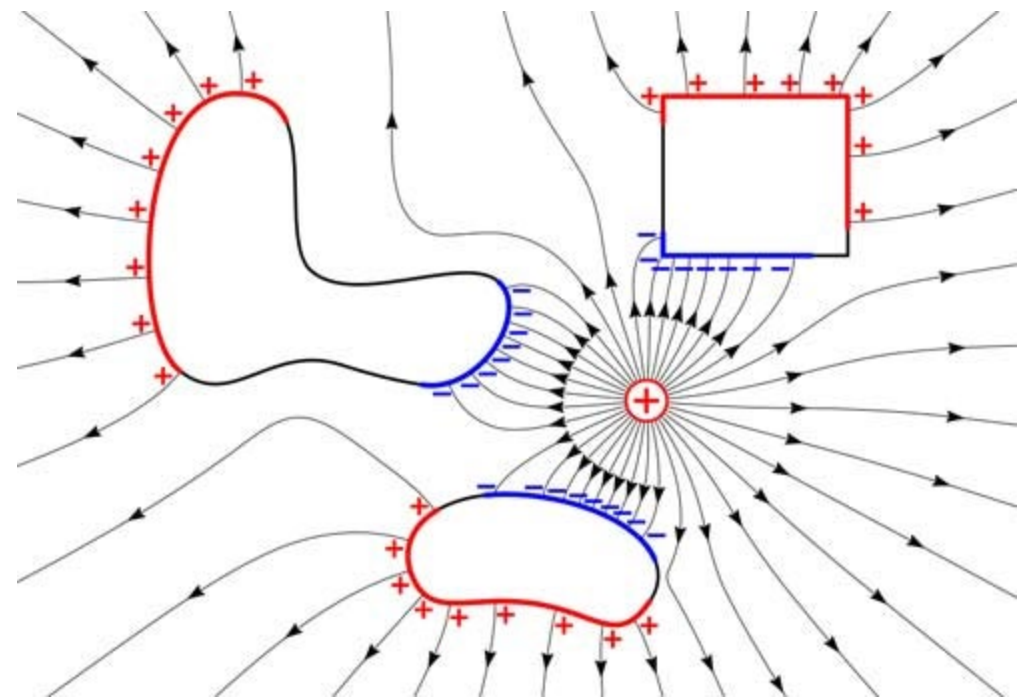
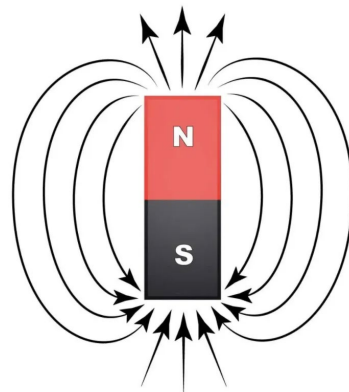
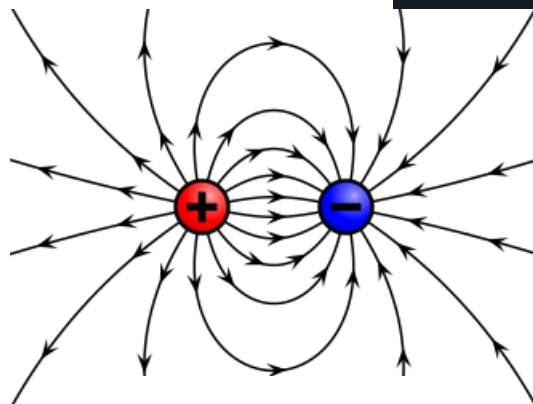
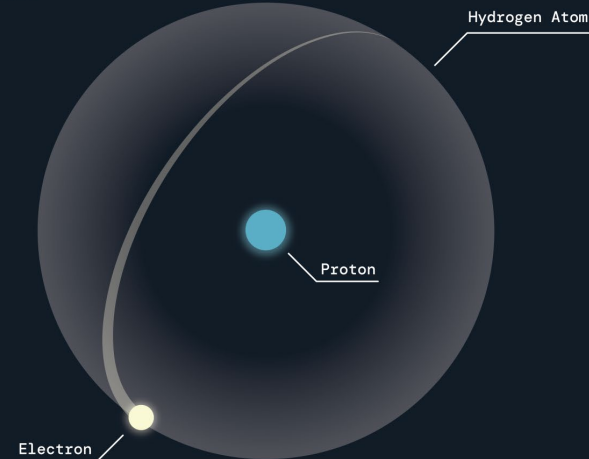




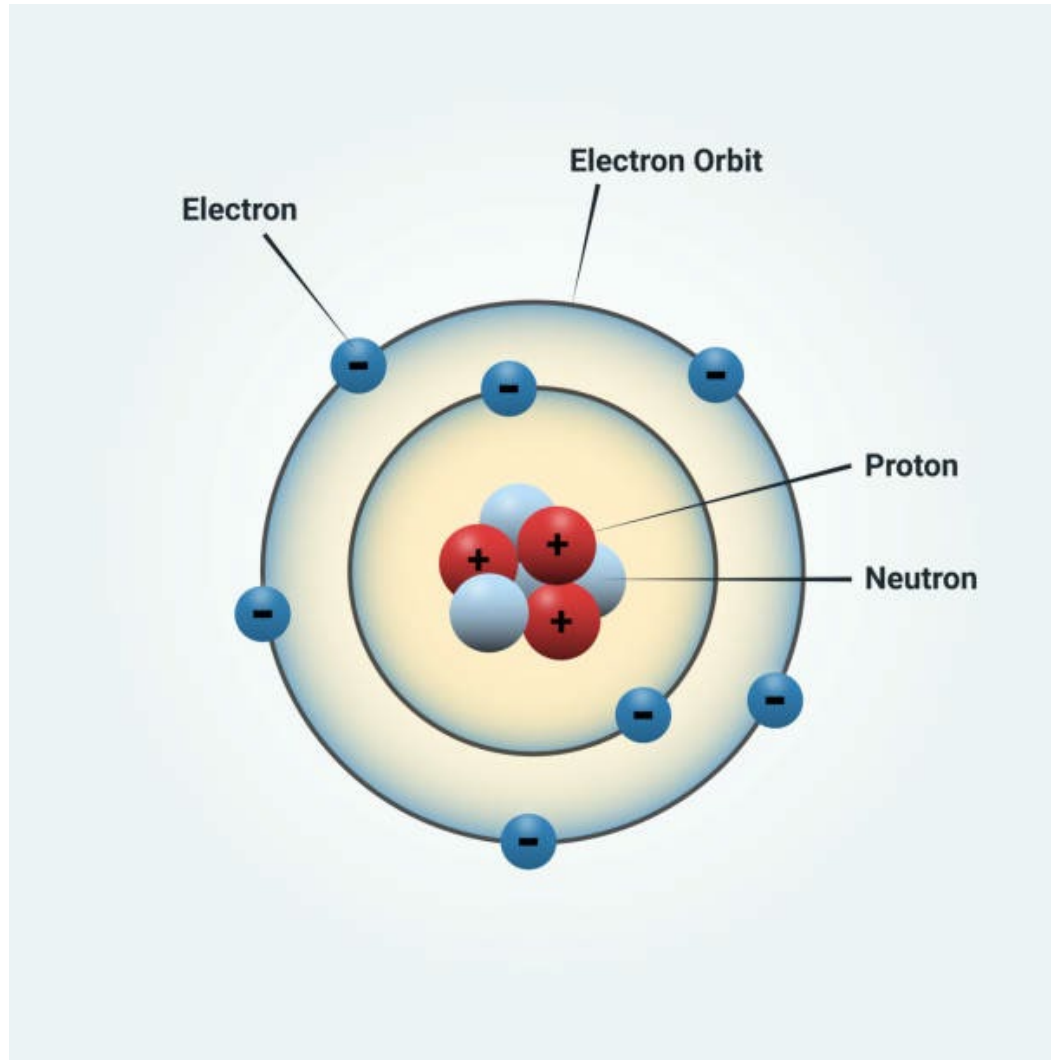
Foam peanuts clinging to a cat's fur due to static electricity. The electric field of the charged fur causes polarization of the molecules of the foam due to electrostatic induction, resulting in a slight attraction of the light plastic pieces to the fur.^{[1][2][3][4]} This effect is also the cause of static cling in clothes.

Electromagnetic Force

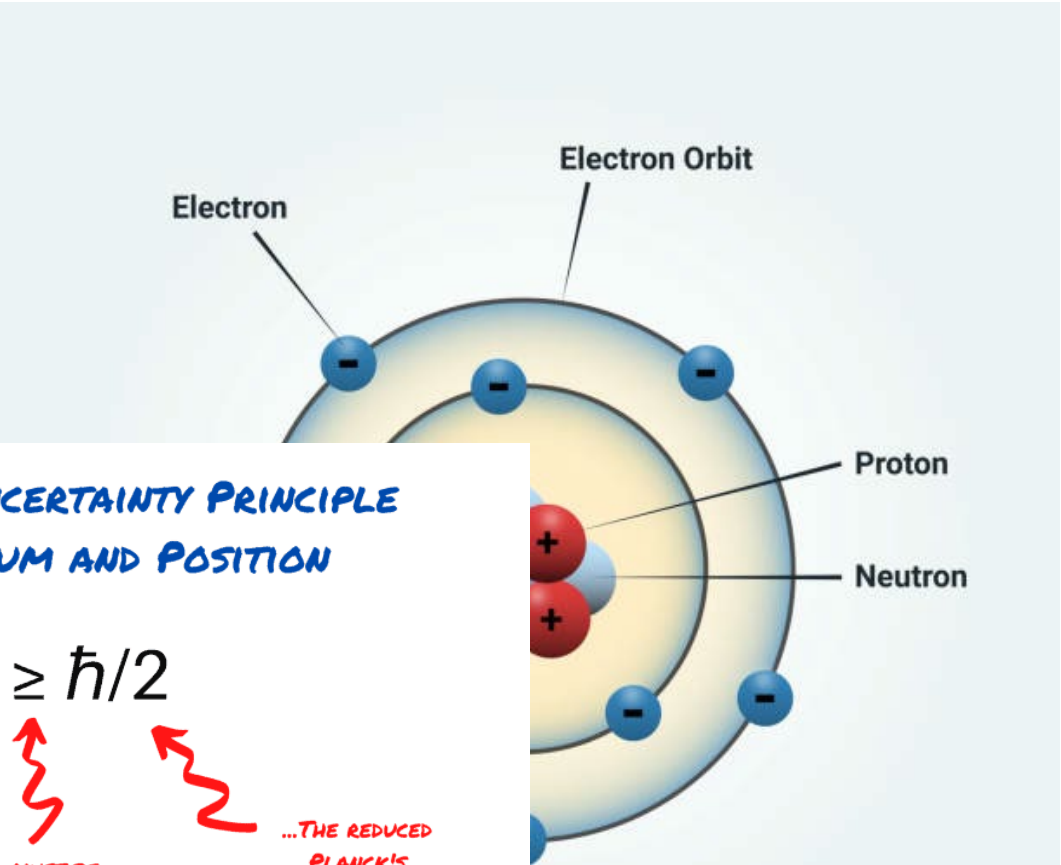
The electromagnetic force holds together objects with opposite electrical charges, like the proton and electron that make up one hydrogen atom.



Miért nem esnek be az elektronok az atommagba?



Miért nem esnek be az elektronok az atommagba?



**HEISENBERG'S UNCERTAINTY PRINCIPLE
FOR MOMENTUM AND POSITION**

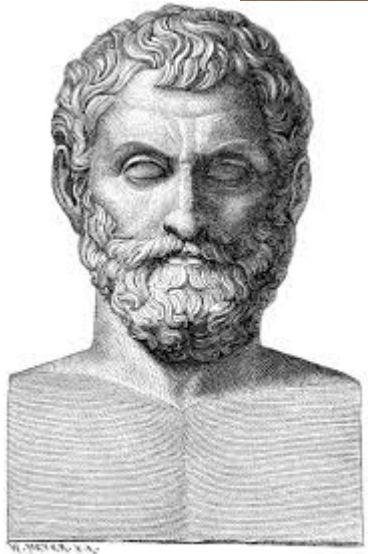
$$\Delta x \Delta p \geq \hbar/2$$

UNCERTAINTY IN POSITION
MULTIPLIED BY UNCERTAINTY
IN MOMENTUM...

...MUST BE
GREATER THAN
OR EQUAL TO...

...THE REDUCED
PLANCK'S
CONSTANT DIVIDED
BY 2

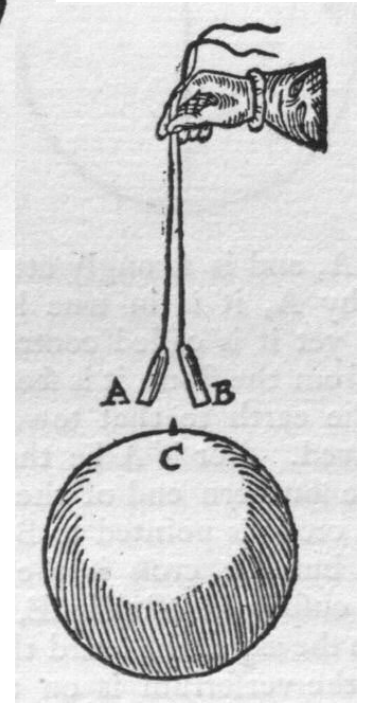
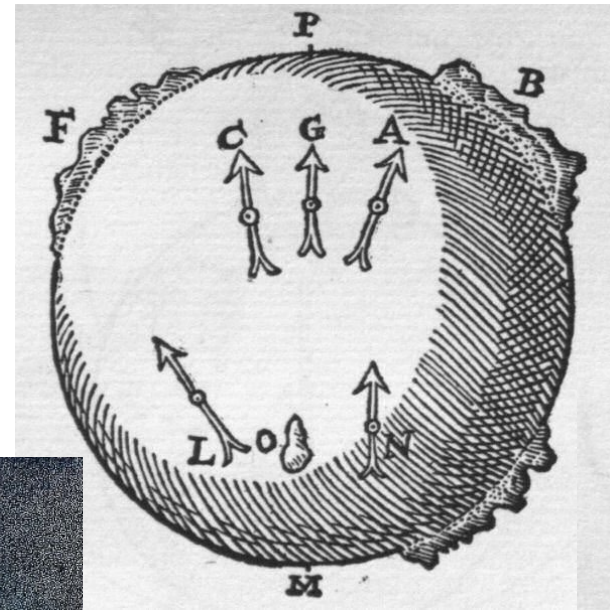
Elektron: hullámfüggvény (kvantummechanikai állapot)



Milétoszi Thalész (i.e. 600 körül)

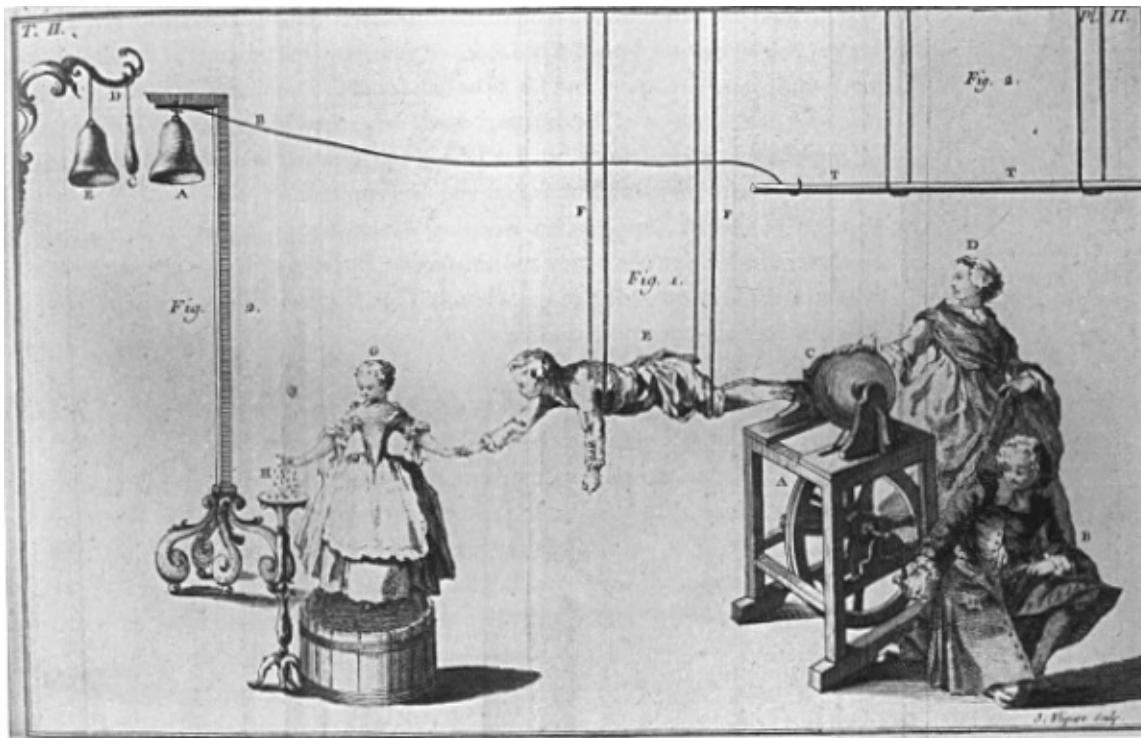


William Gilbert: elektromosság megnevezés + Föld mágneses mezeje (1600)





Stephen Gray: vezetők és szigetelők megkülönböztetése (1729)



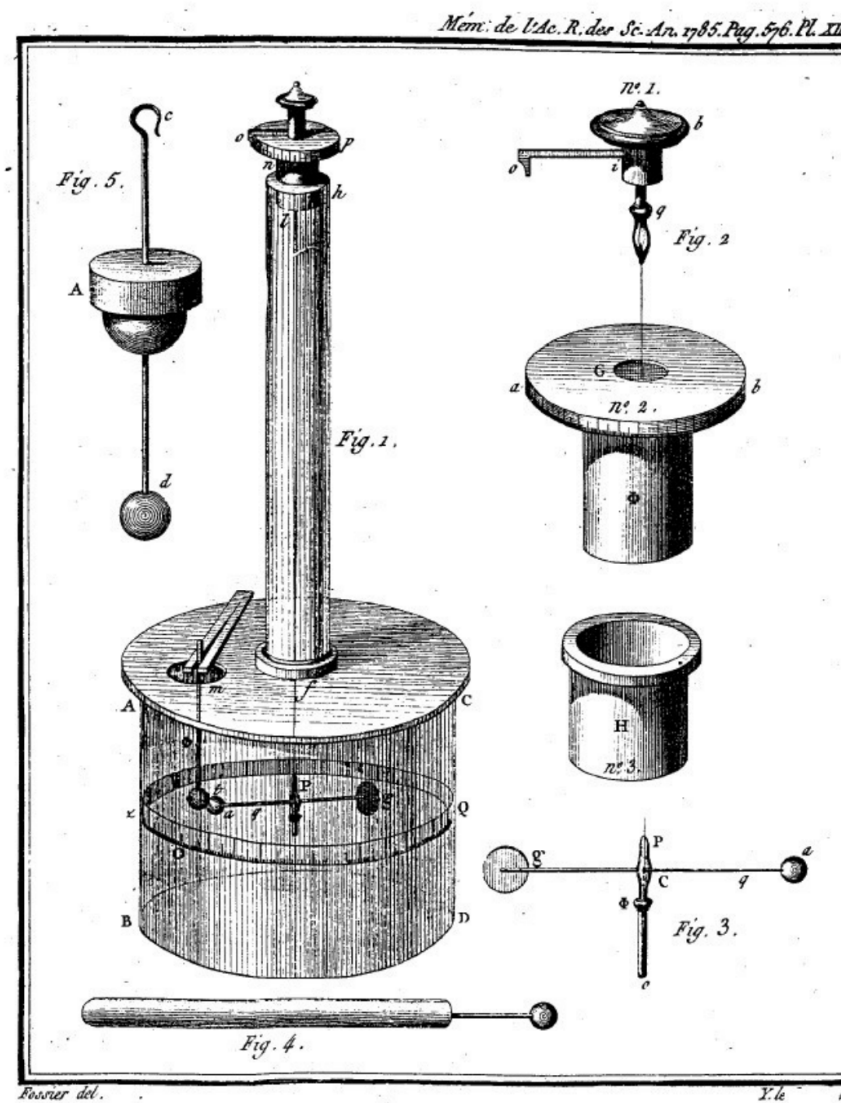
Charles du Fay: étféle elektromos töltés (1733)



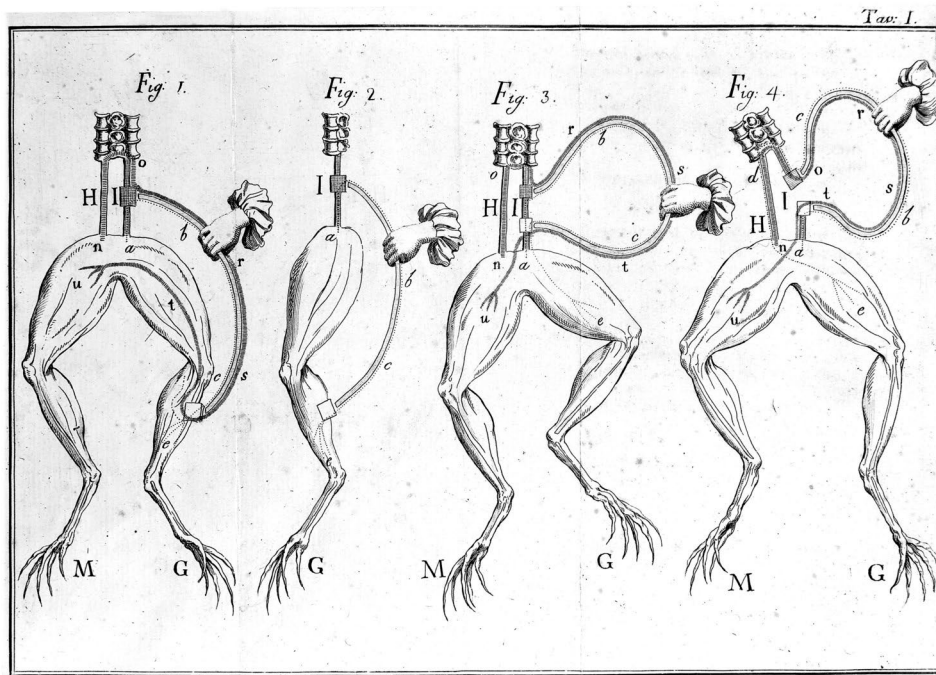
Benjamin Franklin: villámlás elektromos jellege (1753)



Johan Wilcke: elektrosztatikus indukció
(1763)



Charles-Augustin de Coulomb: pontszerű töltések között ható elektromos erő (1785)



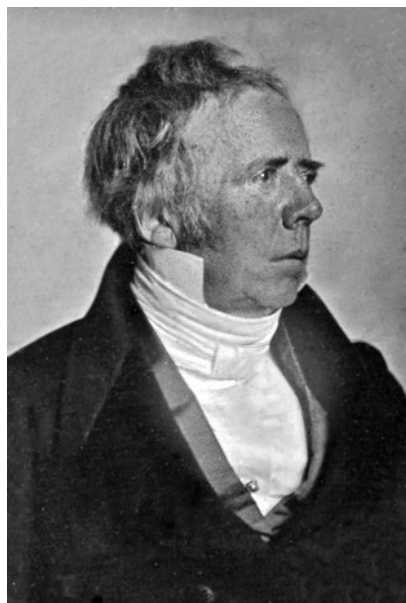
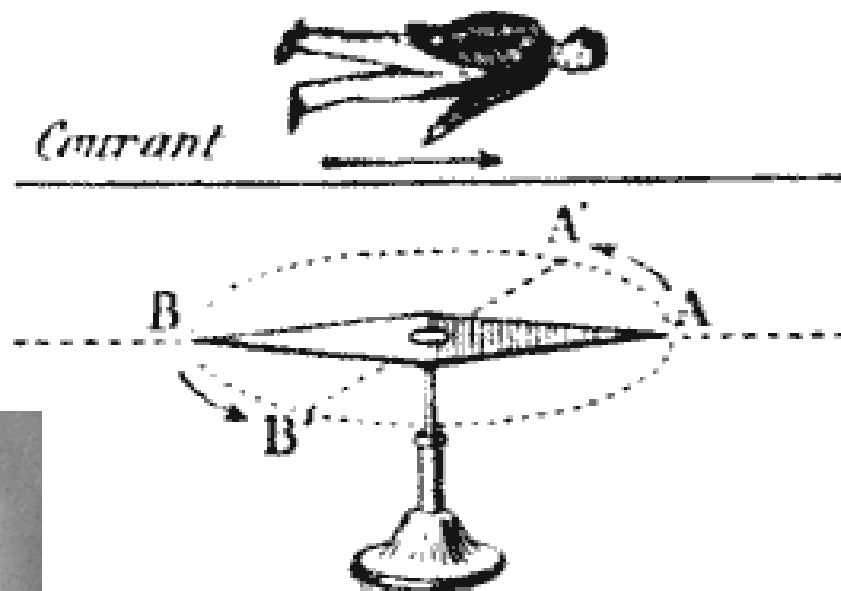
Luigi Galvani:
Békacomb (1780)

VS

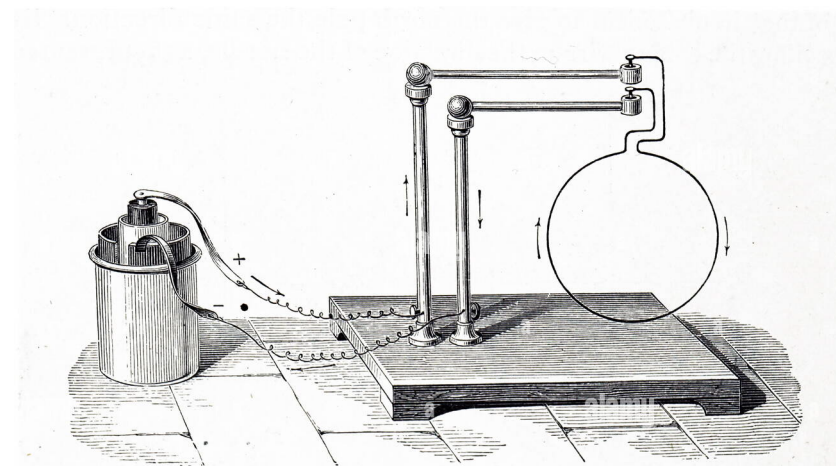


Alessandro Volta:
Volta-oszlop (1799)

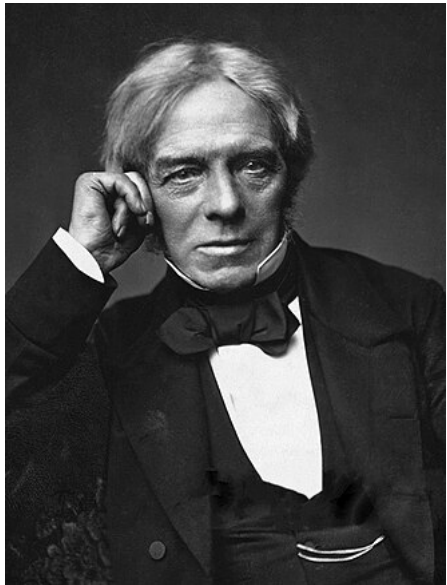
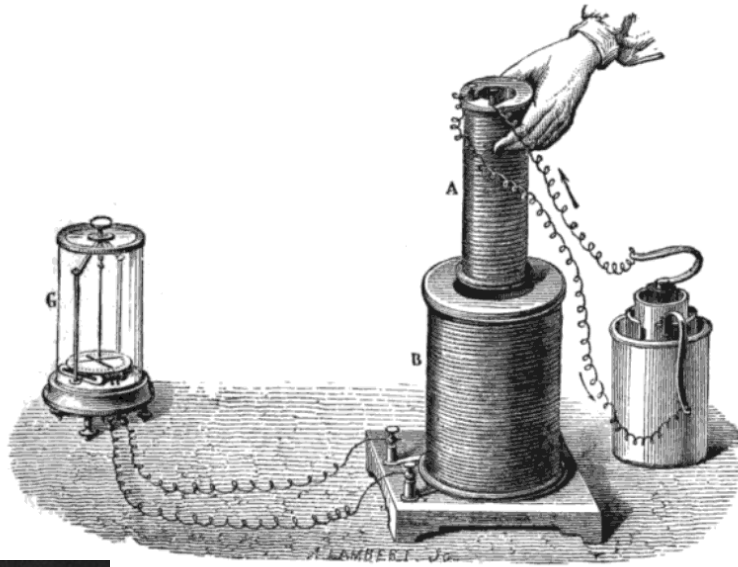




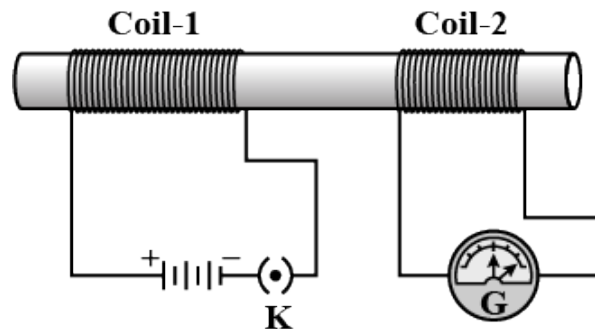
Hans Christian Ørsted: mágnes tűk elfordulnak elektromos áramok hatására (1820)



André-Marie Ampère: molekuláris áramok a mágnesesség okai (1822)



Michael Faraday: időben változó mágneses mező elektromos áramot indukál (1831)



James Clerk Maxwell: elektromágnesesség egyenletei (1861, 1873), elektromágneses fényelmélet (1864).

AND GOD SAID

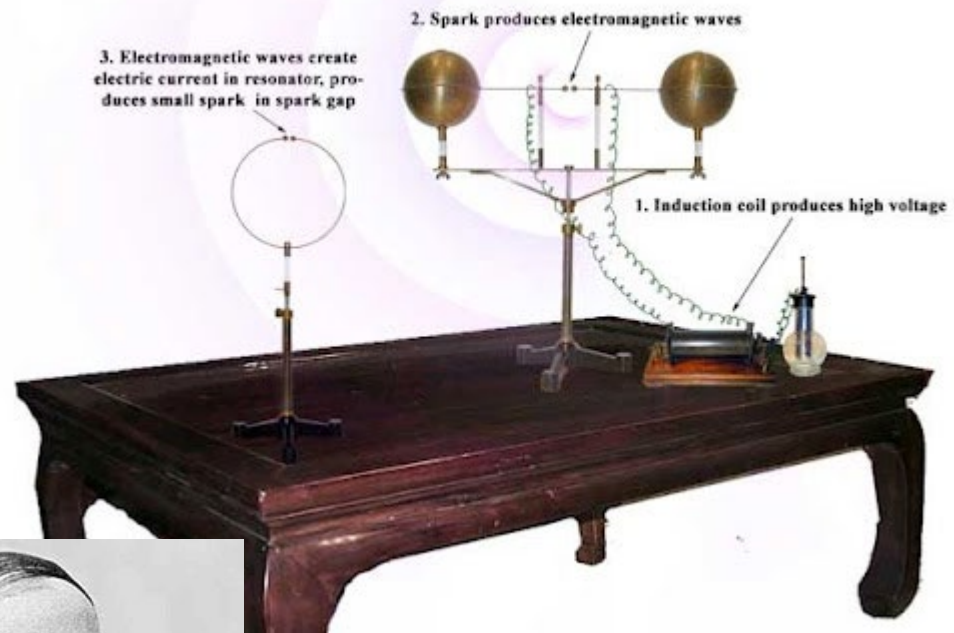
$$\nabla \cdot \vec{E} = \frac{\rho_e}{\epsilon_0}$$

$$\nabla \cdot \vec{B} = 0$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\nabla \times \vec{B} = \mu_0 \left(\vec{j} + \epsilon_0 \frac{\partial \vec{E}}{\partial t} \right)$$

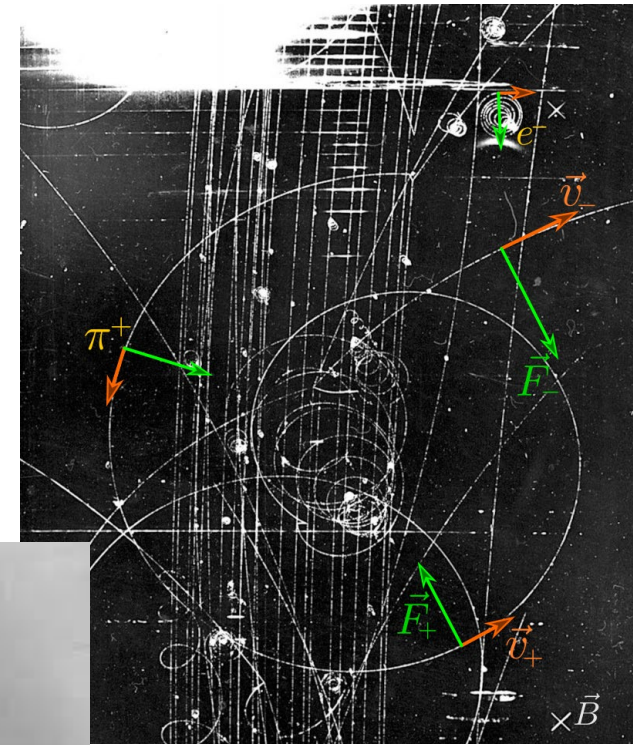
AND THERE WAS LIGHT

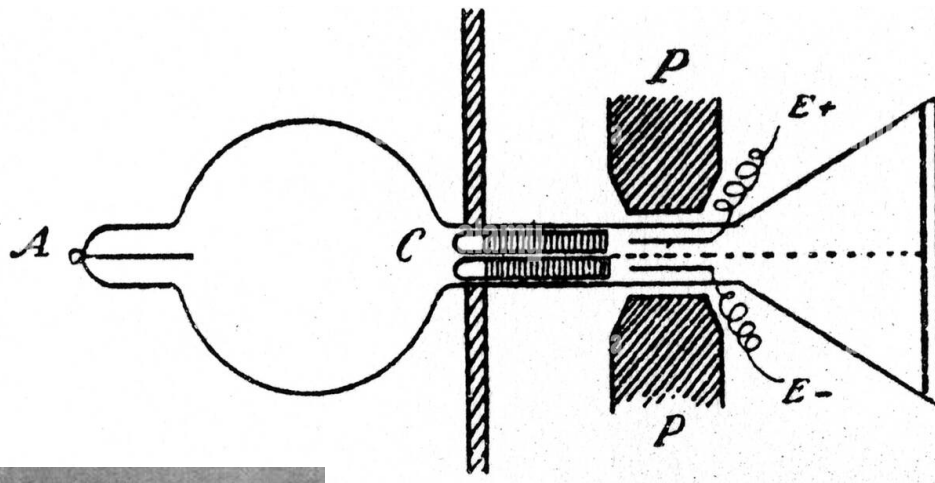


Heinrich Hertz: elektromágneses hullámok kísérleti kimutatása (1887)

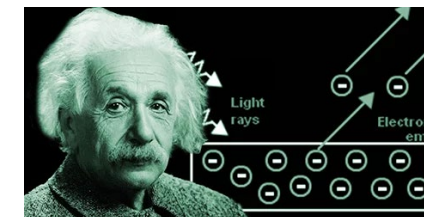
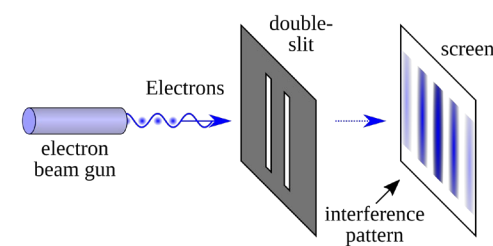
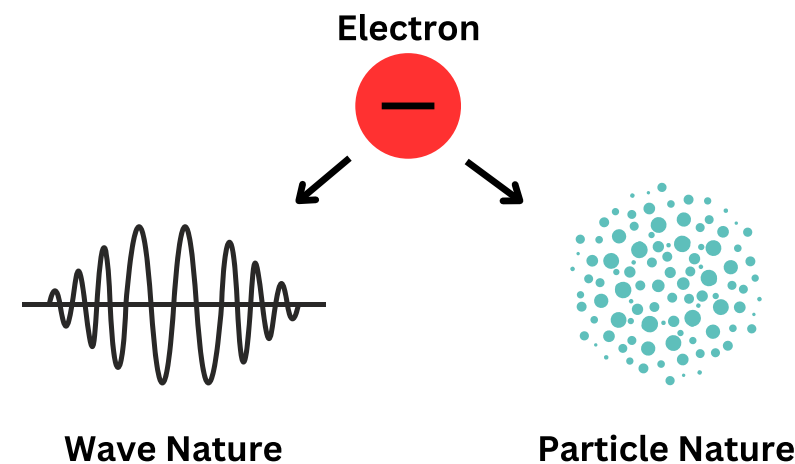
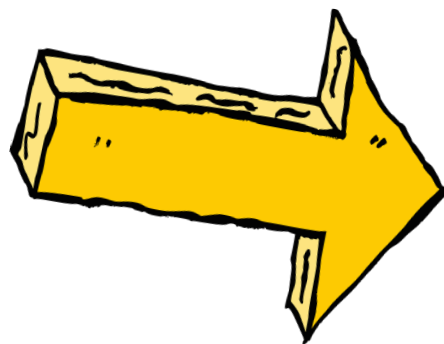


Hendrik Lorentz: Lorentz-erő (1895)





J. J. Thomson: Az elektron felfedezése (1897)



Cél: Maxwell-elmélet – Elektromágneses tér és hullámok

Jellemzői:

- Makroszkopikus
- Fenomenologikus
- Klasszikus térelmélet → Vektoranalízis
- Relativisztikus

AND GOD SAID

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