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A Detail Explanation of Electromagnetic Forces and its Applications

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Opinion Article

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ABOUT THE STUDY

The electromagnetic force is one of the four known fundamental forces and the second strongest (after the strong nuclear force), operating with infinite range; other fundamental forces are: the strong nuclear force, which binds quarks to form nucleons, and binds nucleons to form nuclei; it is the strongest of the four known fundamental forces, but operates only at short range; weak nuclear force, which binds to all known particles in the Standard Model, and causes certain forms of radioactive decay; it is the second weakest of the four fundamental forces and, like the strong nuclear force, operates only at short range (in particle physics, the electroweak interaction is the unified description of two of the four known fundamental interactions of nature: electro-magnetism and the weak interaction).

The gravitational force is the only one of the four fundamental forces that is not part of the Standard Model of particle physics; while by far the weakest of the four fundamental forces, the gravitational force, along with the electro-magnetic force, operates at infinite range. All other forces (e.g., friction, contact forces) are derived from these four fundamental forces and they are known as non-fundamental forces. Roughly speaking, all the forces involved in interactions between atoms can be explained by the electromagnetic force acting between the electrically charged atomic nuclei and electrons of the atoms. Electromagnetic forces also explain how these particles carry momentum by their movement. This includes the forces we experience in "pushing" or "pulling" ordinary material objects, which result from the intermolecular forces that act between the individual molecules in our bodies and those in the objects. The electromagnetic force is also involved in all forms of chemical phenomena.

A necessary part of understanding the intra-atomic and intermolecular forces is the effective force generated by the momentum of the electrons' movement, such that as electrons move between interacting atoms they carry momentum with them. As a collection of electrons becomes more confined, their minimum momentum necessarily increases due to the Pauli Exclusion Principle. The behavior of matter at the molecular scale including its density is determined by the balance between the electromagnetic force and the force generated by the exchange of momentum carried by the electrons themselves.

In 1600, William Gilbert proposed, in his De Magnete, that electricity and magnetism, while both capable of causing attraction and repulsion of objects, were distinct effects. Mariners had noticed that lightning strikes had the ability to disturb a compass needle. The link between lightning and electricity was not confirmed until Benjamin Franklin's proposed experiments in 1752 were conducted on 10 May 1752 by Thomas-François Dalibard of France using a 40-foot-tall (12 m) iron rod instead of a kite and he successfully extracted electrical sparks from a cloud.

One of the first to discover and publish a link between man-made electric current and magnetism was Gian Romagnosi, who in 1802 noticed that connecting a wire across a voltaic pile deflected a nearby compass needle. However, the effect did not become widely known until 1820, when Ørsted performed a similar experiment.[18] Ørsted's work influenced Ampère to produce a theory of electromagnetism that set the subject on a mathematical foundation.

CONCLUSION

A theory of electromagnetism, known as classical electromagnetism, was developed by various physicists during the period between 1820 and 1873 when it culminated in the publication of a treatise by James Clerk Maxwell, which unified the preceding developments into a single theory and discovered the electromagnetic nature of light. In classical electromagnetism, the behavior of the electromagnetic field is described by a set of equations known as Maxwell's equations, and the electromagnetic force is given by the Lorentz force law.