

# CAN ELECTRIC CHARGE EXIST IN THE ABSENCE OF A CHARGED PARTICLE?

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Up until the 1820's the only magnets that were known were lodestones and magnets made of iron such as compass needles. Then in 1820 Hans Christian Oersted was conducting a demonstration of the heating of a wire by means of an electric current. Coincidentally he also planned a demonstration of the effects of magnetism for which purposes he had provided himself with a compass needle mounted on a stand. He noticed that whenever he switched on the electric current, the compass needle moved. Oersted had unwittingly discovered a relationship between electricity and magnetism.

Oersted conducted further experiments and later published his results and this attracted the interest of other researchers. Andre Marie Ampere thought that the effect was due to a magnetic force being created by the electric current. He set up an experiment in which he was able to show that a force existed between two parallel wires each carrying an electric current. The force varied as the inverse of the square of the distance between the wires and was either attractive or repulsive depending upon whether the two currents were parallel or anti-parallel.

Between 1820 and 1835 Michael Faraday went on to discover more about the relationship between electricity and magnetism. He showed that when a current flowed in a conductor it induced or created a magnetic field around the conductor. He also showed that a change in magnetic field induces an electric current in a conductor. Faraday's discovery forms the basis of modern day electric generators, alternators, electric motors and transformers.

Much later, in 1897, J J Thomson discovered the electron to complete the picture of an electric current as a flow of electrons through a conductor. For various historical reasons the electron is described as having a negative electric charge. Other particles, notably protons carry equal but opposite positive electric charge. These same charged particles are also encountered in experiments to do with static electricity, when accumulations of one or other type of charged particles cause objects to become either positively or negatively charged.

The picture that emerges is one in which particles carry either positive or negative electric charge, that accumulations of such charged particles cause objects to become charged with static electricity, that a flow of such particles constitutes an electric current and that whenever an electric current flows it creates a magnetic field. Indeed whenever a charged particle is in motion it creates a magnetic field. Whenever a magnetic field is changing in the region of a conductor it causes an electric current to flow.

An electric field is then always associated with the presence of one or more charged particles.

Then along came James Clerk Maxwell in a series of papers culminating in 1873 with his Treatise on Electricity and Magnetism and which contains his eponymous equations. Maxwell's equations relate the strength of the magnetic field to the change in the electric field and the strength of the electric field to the change in the magnetic field. Taken together these interact to form a system which oscillates. Maxwell was able to show that the velocity of propagation of such an oscillation is related to properties of the medium in which the oscillation takes place. His equations involved two properties of empty space through which his waves are travelling, the Magnetic Permeability ( $\mu_0$ ) and the Electric Permittivity ( $\epsilon_0$ ). Maxwell was able to show that the velocity of propagation of such waves is given by

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

Equation 1

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Maxwell's equations bring together the electricity and magnetism into a single unified electromagnetism out of which came the realization that light was a form of electromagnetic wave. Other investigations notably by Hertz showed that there was a whole spectrum of electromagnetic radiation. It was Maxwell's equations which inspired the young Einstein to take an interest in physics, and it was Einstein who subsequently went on to show that electromagnetic radiation is in fact composed of a stream of particles.

There is however a problem with all of this, not with Maxwell's equations themselves, but with their interpretation. The current interpretation of Maxwell's waves is that they are able to propagate through space simply by virtue of the properties of space itself. That the permittivity of space combined with the change in magnetic field creates an electric field and the permeability of space in combination with a change in the electric field creates a magnetic field. This runs counter to what Faraday, Ampere and later Thomson had discovered which was that the presence of an electric field was always associated with the presence of a charged particle.

Thus in the modern interpretation of electromagnetism, an electric field can exist as a result of either one of two totally different effects. On the one hand there can be an electric field resulting from the presence of a charged particle and on the other hand an electric field can exist simply by virtue of a changing magnetic field.

It is highly improbable, verging on the impossible, that an electric field can have two such distinct causes, particularly since both involve similar interactions with magnetism. We know with absolute certainty that charged particles are surrounded by an electric field and that the motion of charged

particles creates a magnetic field which calls into question the idea that an electric field can be created solely by a change in a magnetic one.

The current interpretation of Maxwell's equation endows empty space with properties which allow a changing magnetic field to be the source of an electric field. Such an interpretation is in effect to endow empty space with the properties of an ether. In this interpretation permittivity and permeability are fundamental properties of space which cause this coupling between electric and magnetic fields. The existence of such an ether was however thoroughly discredited by Michelson and Morley and so we must seek an alternative explanation.

Such an alternative interpretation is possible if we assume that the electric fields associated with a photon exist as the result of the presence of one or more charged particles as constituent particles of the photon itself and that it is the dynamics of these particles and their interactions which cause us to measure the values for permeability and permittivity which we observe.

This is a of mirror image of the current interpretation where the speed of light is seen as a consequence of the values of permeability and permittivity in free space. Here it is the other way round. The photon has its velocity of propagation and it is this combined with the mass, the charge and other properties of the charged particles that make up the photon which cause us to measure permittivity and permeability in free space.

So can an electric charge exist in the absence of a charged particle? No it can't. An electric field can only exist in the region of one or more charged particles. And magnetic fields only exist where there is movement of electrically charged particles.