ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

1: Michelsonâ€“Morley experiment - Wikipedia

The Relative Motion of the Earth and the Luminiferous Ether by Albert A. www.enganchecubano.com, U. S. Navy. The undulatory theory of light assumes the existence of a medium called the ether, whose vibrations produce the phenomena of heat and light, and which is supposed to fill all space.

Nineteenth-century scientists faced a conundrum: How does light work? While they understood that light was a wave â€" Newton and others had proved that it behaves like a wave in water, refracting and reflecting in the same way that waves do â€" they began to theorize about what the wave traveled through. The origins of the aether are with the Greek philosophers, who saw it as the divine element, different to the four classic elements earth, air, fire, and water. Ather was the fifth essence or quintessence , representing the breath of the gods â€" a divine element that the gods alone could use. By the 19th century, this theory was still around â€" but it had evolved through the ideas of many scientists, including Newton. While he was vague on the nature of the aether, he believed it was there, and that it underlay the structure of light and other phenomenon. He wrote in his textbook Opticks: It was the water that these electromagnetic waves moved through, and it was the reference frame against which everything could be measured. The aether was everywhere, forming the fundamental and absolute underlying framework of the universe. Unfortunately, the theory had some complications. Scientists knew that the Sun was moving through our galaxy and that the Earth was orbiting around the Sun. If this was the case, this meant that the Earth was constantly moving through the aether, producing a phenomenon they called the aetheric wind. Think of it as an airplane flying through still air: The air is not moving, but the airplane still feels pressure against it, like a wind. Similarly, if an electromagnetic wave were to move through the aether against this wind, it would experience drag, slowing it down slightly. As the Earth is spinning, scientists should have been able to detect this drag. They expected that the light would move slightly slower in one direction when moving into the aetheric wind. If they compared the speed of light in these two directions, they would see a difference, scientists said. By splitting a beam of light and bouncing the two beams between several mirrors, they created a device that could measure if there was any difference in the speed of light moving in one direction versus light moving at a degree angle. If the aether had the expected effect, one of the light beams would move slightly slower in one direction, due to the drag of the aetheric wind. This experiment was phenomenally difficult, though, because the difference they expected to find was tiny. It was small enough that even a slight movement of the device from a horse riding down the street threw the experiment off, as it made the device shake, which changed the distance between the mirrors. It took the scientists many years and many prototypes to finally get a measurement they thought was right, but in they published the results: They found a slight difference, but it was much less than expected. Others repeated the test using larger devices and different light sources, but by the early 20th century the luminiferous aether was in trouble. However closely they compared the speed of light from sources moving at different speeds or in different directions, they could not find any difference. Light, it seemed, moved at the same speed in a vacuum, however the observer was moving. Relativity This conclusion caused a crisis in the scientific community. While Michelson and Morely had set out to prove the existence of the luminiferous aether, their work called the whole concept into question and led to a fundamental change in how scientists regard time and space. Spurred on by this negative proof and other similar experiments that showed the same thing with increasing accuracy , scientists decided to rethink the nature of space. Briefly, your speed and location changes how you see something â€" a phenomenon called a Lorentz Transformation. Shortly afterwards, Albert Einstein published his theory of special relativity , which suggested that there was no absolute and underlying reference frame for the universe. Instead, any measurement is made within a frame of reference for the observer. In short, if you were to do the same measurement from another frame of reference, you might get a different result. The laws of physics remain the same in any frame of reference, but the observation can be different. To explain relativity, Einstein used the example of a railway carriage being hit by lightning at both ends, watched by someone inside the train and someone on the platform as the train approaches. For the person sitting in the middle of the carriage, the two lightning strikes seem to happen at the same time. But to the observer on the platform, the lightning appears to hit the front first, then the back because of the longer distance from the back to the eye of the platform observer. Both observations are right, but they are different because they are seen from a different place, or frame of reference. In other words, there is no absolute, independent, and correct frame of reference. It all depends on the observer. Einstein himself discounted this approach , writing: But the experiment gave a negative result â€” a fact very perplexing to physicists. The speed of light is constant in every frame of reference, but everything else is measured from a frame of reference that only exists for the observer. In other words, there was no absolute frame of reference that they could measure against to detect the aether. All of their measurements were valid only in their frame of reference. To boil it down even further: The accepted wisdom at the time was that light was a wave, which could still be described as traveling through the aether. Einstein and others challenged this, proposing that light existed as a particle that he called a photon, which had a certain, fixed energy level. This seemed to contradict the wave theory of light, which suggested that waves could be divided, but a photon could not. Eventually, Louis de Broglie made a startling suggestion in Light was both a wave and a particle. This led to the development of quantum theory, which held that photons and other particles existed as both waves and particles at the same time. A divine medium that made things work was no longer a necessity. By the late s, the aether was dead, replaced by quantum mechanics. The ancient Greek creation of a divine element beyond our reach sounds to some like the current arguments for dark matter and dark energy. This has caused some to refer to dark energy as quintessence , one of the many names that was applied to the aether over its history. Scientists argue that the two are not the same, though. We may not know exactly what dark matter and dark energy are, but experimental evidence shows they exist , which was never the case with the aether. Although the various types of aether theory have all been superseded, they still deserve some space in the science hall of fame. The desire of scientists in the 19th century to detect and measure the aether led to lots of great research. Their work contributed directly to many new theories and technologies, including quantum mechanics, radar, nuclear bombs and microwaves, to name but a few. Michelson and Morley failed to show that the aether existed, but in doing so they spawned a radical rethink of the nature of space and time that we are still struggling to understand. While at the time they may have felt they wasted several years in a dark basement, their work and persistence changed the world in ways they never could have dreamed. You can find more articles on the same topic here.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

2: Thoughts, and Visions: Luminiferous Aether

Luminiferous aether or ether ("luminiferous", meaning "light-bearing"), was the postulated medium for the propagation of light. It was invoked to explain the ability of the apparently wave-based light to propagate through empty space, something that waves should not be able to do.

American Journal of Science, , 34 The effect was attributed to a simple composition of the velocity of light with the velocity of the earth in its orbit. The difficulties in this apparently sufficient explanation were overlooked until after an explanation on the undulatory theory of light was proposed. This new explanation was at first almost as simple as the former. But it failed to account for the fact proved by experiment that the aberration was unchanged when observations were made with a telescope filled with water. For if the tangent of the angle of aberration is the ratio of the velocity of the earth to the velocity of light, then, since the latter velocity in water is three-fourths its velocity in a vacuum, the aberration observed with a water telescope should be four-thirds of its true value. These two hypotheses give a complete and satisfactory explanation of aberration. The second hypothesis, notwithstanding its seeming improbability, must be considered as fully proved, first, by the celebrated experiment of Fizeau , [2] and secondly, by the ample confirmation of our own work. If the earth were a transparent body, it might perhaps be conceded, in view of the experiments just cited, that the inter-molecular ether was at rest in space, notwithstanding the motion of the earth in its orbit; but we have no right to extend the conclusion from these experiments to opaque bodies. But there can hardly be question that the ether can and does pass through metals. Lorentz cites the illustration of a metallic barometer tube. When the tube is inclined the ether in the space above the mercury is certainly forced out, for it is imcompressible. But as Lorentz aptly remarks: Lorentz , [8] who finds that this effect can by no means be disregarded. In consequence, the quantity to be measured had in fact but one-half the value supposed, and as it was already barely beyond the limits of errors of experiment, the conclusion drawn from the result of the experiment might well be questioned; since, however, the main portion of the theory remains unquestioned, it was decided to repeat the experiment with such modifications as would insure a theoretical result much too large to be masked by experimental errors. The theory of the method may be briefly stated as follows: If then the paths ab and ac are equal, the two rays interfere along ad. Suppose now, the ether being at rest, that the whole apparatus moves in the direction sc, with the velocity of the earth in its orbit, the [ ] directions and distances traversed by the rays will be altered thus: Then , The whole time of going and coming is , and the distance traveled in this time is , neglecting terms of the fourth order. The length of the other path is evidently or to the same degree of accuracy,. The difference is therefore. In the first experiment one of the principal difficulties encountered was that of revolving the apparatus without producing distortion; and another was its extreme sensitiveness to vibration. Finally, as before remarked, the quantity to be observed, namely, a displacement of something less than a twentieth of the distance between the interference fringes may have been too small to be detected when masked by experimental errors. The apparatus is represented in perspective in fig. The stone a fig. A pin d, guided by arms gggg, fits into a socket e attached to the float. The pin may be pushed into the socket or be withdrawn, by a lever pivoted at f. This pin keeps the float concentric with the trough, but does not bear any part of the weight of the stone. The annular iron trough rests on a bed of cement on a low brick pier built in the form of a hollow octagon. At each corner of the stone were placed four mirrors dd e e fig. Near the center of the stone was a plane-parallel glass b. These were so disposed that light from an argand burner a, passing through a lens, fell on b so as to be in part reflected to d,; the two pencils followed the paths indicated in the figure, bdedbf and bd,e,d,bf respectively, and were observed by the telescope f. Both f and a revolved with the stone. The mirrors were of speculum metal carefully worked to optically plane surfaces five centimeters in diameter, and the glasses b and e were plane-parallel and of the same thickness. The second of these was placed in the path of one of the pencils to compensate for the passage of the other through the same thickness of glass. The whole of the optical portion of the apparatus was kept covered with a wooden cover to prevent air currents and rapid changes of temperature. The adjustment was effected as follows: The mirrors having been adjusted by screws in the castings which held the mirrors, against which they were pressed by springs, till light from both pencils could be seen in the telescope, the lengths of the two paths were measured by a light wooden rod reaching diagonally from mirror to mirror, the distance being read from a small steel scale to tenths of millimeters. The difference in the lengths of the two paths was then annulled by moving the mirror e,. This mirror had three adjustments; it had an adjustment in altitude and one in azimuth, like all the other mirrors, [ ] but finer; it also had an adjustment in the direction of the incident ray, sliding forward or backward, but keeping very accurately parallel to its former plane. The three adjustments of this mirror could be made with the wooden cover in position. The paths being now approximately equal, the two images of the source of light or of some well-defined object placed in front of the condensing lens, were made to coincide, the telescope was now adjusted for distinct vision of the expected interference bands, and sodium light was substituted for white light, when the interference bands appeared. These were now made as clear as possible by adjusting the mirror e, then white light was restored, the screw altering the length of path was very slowly moved one turn of a screw of one hundred threads to the inch altering the path nearly wavelengths till the colored interference fringes reappeared in white light These were now given a convenient width and position, and the apparatus was ready for observation. The observations were conducted as follows: Around the cast-iron trough were sixteen equidistant marks. The apparatus was revolved very slowly one turn in six minutes and after a few minutes the cross wire of the micrometer was set on the clearest of the interference fringes at the instant of passing one of the marks. The motion was so slow that this could be done readily and accurately. The reading of the screw-head on the micrometer was noted, and a very slight and gradual impulse was given to keep up the motion of the stone; on passing the second mark, the same process was repeated, and this was continued till the apparatus had completed six revolutions. It was found that by keeping the apparatus in slow uniform motion, the results were much more uniform and consistent than when the stone was brought to rest for every observation; for the effects of strains could be noted for at least half a minute after the stone came to rest, and during this time effects of change of temperature came into action. The readings are divisions of the screw-heads. The width of the fringes varied from 40 to 60 divisions, the mean value being near 50, so that one division [ ] means 0. The rotation in the observations at noon was contrary to, and in the evening observations, with, that of the hands of a watch.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

3: Luminiferous aether

The discovery of the aberration of light was soon followed by an explanation according to the emission www.enganchecubano.com effect was attributed to a simple composition of the velocity of light with the velocity of the earth in its orbit.

The Michelson-Morley experiment I would like to remark that I do not argue or deny the validity of this grand experiment in its technical aspects. Its premises and physical interpretations are another matter, however. On this page, there is the description of the physical experiment as a whole; i. On the one hand, I discuss suppositions of rest and relative movement concerning a luminiferous aether. On the other, I mention the orthodox interpretation of one of the core experiments in Modern Physics, as well as the alternative offered by Global Physics. The Michelson-Morley experiment attempted to confirm the classical model of luminiferous aether. This model assumed the following premises: Light needed aluminiferous aether to travel. The luminiferous aether had to be at absolute rest. The speed of light is independent of its source. The speed of light is constant in vacuum. Michelson and Morley devised an instrument capable of detecting the speed of the Earth regarding luminiferous aether at rest and, in this way, of obtaining a reference frame in absolute stillness. The following figures show the hypothetical journey of light in their physical experiment. The idea consists of comparing the two possible situations of relative motion of the interferometer concerning the supposed luminiferous aether. Interferometer of Michelson and Morley at rest and theluminiferous aether Light comes from a torch towards a semitransparent transversal mirror, in such a way that some rays go through it instant t1 , and continue their straight-line trajectory until they get to a non-transparent mirror instant t2. Because of research design, the different light beams of the instrument will reach the semitransparent mirror again at the same time instant t3 , and both will be deflected downwards, ending up on a plate instant t4 On the lower plate, there will appear the interferences between the two beams of light. The meaningful part of this physics experiment would not be the interference pattern, but the fact that this pattern would not change when the whole apparatus of the interferometer turns, given that distances traveled are equal, and speed of light seems constant and independent of its source. Michelson Morley interferometer in relative motion to luminiferous aether The intention was to measure differences in the time taken by light to travel equal spaces between various mirrors. The second figure shows light path when the mirrors are solidary with the Earth, and they move in relative motion concerning the supposed luminiferous aether. In this figure, there is an exaggeration of the velocity of the mirrors regarding the speed of light, to be able to visualize variations in distances produced by movements of the mirrors. However, the reasoning remains the same. Not to make the explanation too long and cumbersome, let us see the following case. In other words, increase in the distance will depend on the angle of the initial direction of the speed of light and the new direction towards the upper mirror. Interferometer of Michelson-Morley In motion with respect to luminiferous aether As we can see, the two distances traveled by light beams will no longer be equal, which will also happen on the way back to the semitransparent mirror. Therefore, there will appear variations in the interferences produced between the two light beams. Consequently, successive changes in the angle of disposition of the interferometer concerning the direction of the Earth should reflect the associated variations in interference fringes in the plate. Calculation of distances and their variations with the angle of motion and the interferences produced does not cause a problem. Moreover, it should have given the relative speed of light regarding luminiferous aether. However, this empirical experiment gave no variation on the interference fringes in the final plate with changes in the angle of the interferometer. In other words, the light behaves identically in both cases. Result and interpretation Let us see two slightly different interpretations of this experiment, though both accept the experimental results entirely. The result of this scientific experiment was utterly unexpected. Interference fringes did not vary at all when turning the interferometer. It was the predicted result in first scenario analyzed, where the Earth was supposed to be at rest with respect to luminiferous aether. Instead of resolving the problem of the speed of light, it heightened it. Consequently, the ephemeral luminiferous aether was lost indefinitely, as it was the primary goal of Michelson-Morley experiment and technical goodness of the experiment was clear. The search for an explanation of the weird behavior of light was starting. Desperate times call for desperate measures: The Theory of Relativity. Although Einstein said, he did not know the experiment! It could have been a joke! Global Physics The interpretation of Modern Physics in general â€”and of the Theory of Relativity in particularâ€” is erroneous, because it contains an implicit generalization, as it assumes the correction of the theoretical premises of the initial research. If these premises were partially incorrect, deductions based on them would also be a flaw. In other words, the fact that a fixed or absolute luminiferous aether does not exist does not prove that light does not have a mobile and non-homogenous supporting medium. A mobile supporting medium would only be coherent if it were moving with the Earth, i. Consequently, they improperly generalized the independence from its source of the speed of light. I imagine it was arbitrarily not accepted or not thought of a luminiferous aether moving with the Earth. The proposal of Global Physics is a reticular structure of matter, elastic and unbreakable, which supports the gravitational field, and this, in turn, is the supporting medium of electromagnetic energy. An interesting subject practically unknown by the public and little treated by the doctrine but generally accepted is the Lense-Thirring effect. This effect consists of dragging the energy-mass by a rotating field of gravity; within General Relativity, it alters space-time, but with a classical perspective, it could justify the results of the Michelson-Morley experiment. I would like to remark that the idea of a non-classical aether is not exclusive to Global Physics, as the well-known String Theory also proposes something like aether of small vibrating strings. Similarly, Quantum Mechanics uses the term quantum foam or quantum vacuum to emphasize that the classical vacuum is not empty. Of course, any term will do except the word aether. Even the famous fabric of space-time will be aether if it has any mechanical properties. Global Physics describes two types of supporting medium. Global aether or gravitational aether â€”reticular structure of matter supporting potential gravitational energy, kinetic energy, and mass Luminiferous ether â€”gravity field or tension of the longitudinal curvature of the reticular structure of matter Moreover, the classics also spoke of two types of the carrier medium, the gravitational ether, and the luminiferous ether. For example, Descartes, his disciple Christian Huygens, and Nikola Tesla Maxwell equations themselves include a dielectric constant of the vacuum. Therefore, there must be something provoking the physical existence of this dielectric constant. Another matter is that one may or may not want to understand the physical meaning behind the constant in the materials of vacuum and not merely the mathematical one; and if it is unknown, at least one should admit its existence. If you say something different to the prevailing orthodoxy, everyone thinks of religion, as if there were only two colors in the universe, white and black. Of course, we all know that black is the absence of light. It is funny, because I believe the result will be even more unexpected than the one obtained at the beginning of the 20th century, and will entail the disappearance of the Theory of Relativity. It could be an aspect of experimental science similar to the long-term cycles of the economy.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

4: The Aether â€“ How We Get To Next

Note: Citations are based on reference standards. However, formatting rules can vary widely between applications and fields of interest or study. The specific requirements or preferences of your reviewing publisher, classroom teacher, institution or organization should be applied.

Michelsonâ€”Morley experiment attempt to detect the relative motion of matter through the stationary luminiferous aether The Michelsonâ€”Morley experiment was a scientific experiment to find the presence and properties of a substance called aether , a substance believed to fill empty space. The experiment was done by Albert A. Michelson and Edward Morley in Since waves in water need something to move in water and sound waves do as well air , it was believed that light also needed something to move in. Scientists in the 18th century named this substance "aether," after the Greek god of light. They believed that aether was all around us and that it also filled the vacuum of space. Michelson and Morley created this experiment to try and prove the theory that aether existed. They did this with a device called an interferometer. The experiment Edit A Michelson interferometer uses the same principle as the original experiment. But it uses a laser for a light source. The Earth travels very quickly more than , km per hour around the Sun. To a person in the car , the air outside the car would seem like a moving substance. In the same way, aether should seem like a moving substance to things on Earth. The interferometer was designed to measure the speed and direction of the "aether wind" by measuring the difference between the speed of light traveling in different directions. It measured this difference by shining a beam of light into a mirror that was only partially coated in silver. Part of the beam would be reflected one way, and the rest would go the other. Those two parts would then be reflected back to where they were split apart, and recombined. By looking at interference patterns in the recombined beam of light, any changes in speed because of aether wind could be seen. They found that there was in fact no substantial difference in the measurements. This was puzzling to the scientific community at the time, and led to the creation of various new theories to explain the result.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

5: luminiferous aether - futurespaceprogram

The direction of this motion is inclined at an angle of about +26Â° to the plane of the equator, page and at this time of the year the tangent of the earth's motion in its orbit makes an angle of Â° with the plane of the equator; hence we may say the resultant would lie within 25Â° of the equator.

The difference depending on the square of the ratio of the two velocities, according to Maxwell, is far too small to measure. The following is intended to show that, with a wave-length of yellow light as a standard, the quantity â€” if it exists â€” is easily measurable. Using the same notation as before we have and. The whole time occupied therefore in going and returning. That is, the actual distance the light travels in the first case is greater than in the second, by the quantity. Considering only the velocity of the earth in its orbit, the ratio approximately, and millimeters, or in wave-lengths of yellow light, 2 , then in terms of the same unit,. The other pencil being at right angles to the motion would not be affected. The total change in the position of the interference bands would be of the distance between the bands, a quantity easily measurable. The conditions for producing interference of two pencils of light which had traversed paths at right angles to each other were realized in the following simple manner. Light from a lamp a, fig. The mirrors c and d were of plane d glass, and silvered on the front surface. From these the light was reflected to b, where the one was reflected and the other refracted, the two coinciding along be. The distance bc being made equal to bd, and a plate of glass g being interposed in the path of the ray bc, to compensate for the thickness of the glass b, which is traversed by the ray bd, the two rays will have traveled over equal paths and are in condition to interfere. The instrument is represented in plan by fig. The same letters refer to the same parts in the two figures. The source of light, a small lantern provided with a lens, the flame being in the focus, is represented at a. The telescope e, for observing the interference bands, is provided with a micrometer eyepiece. In the experiments the arms, bd, bc, were covered by long paper boxes, not represented in the figures, to guard against changes in temperature. They were supported at the outer ends by the pins k, I, and at the other by the circular plate o. The adjustments were effected as follows: The mirrors c and d were moved up as close as possible to the plate b, and by means of the screw m the distances between a point on the surface of b and the two mirrors were made approximately equal by a pair of compasses. The lamp being page lit, a small hole made in a screen placed before it served as a point of light; and the plate b, which was adjustable in two planes, was moved about till the two images of the point of light, which were reflected by the mirrors, coincided. Then a sodium flame placed at a produced at once the interference bands. These could then be altered in width, position, or direction, by a slight movement of the plate b, and when they were of convenient width and of maximum sharpness, the sodium flame was removed and the lamp again substituted. The screw m was then slowly turned till the bands reappeared. They were then of course colored, except the central band, which was nearly black. The observing telescope had to be focussed on the surface of the mirror d, where the fringes were most distinct The whole apparatus, including the lamp and the telescope, was movable about a vertical axis. It will be observed that this apparatus can very easily be page made to serve as an "interferential refractor," and has the two important advantages of small cost, and wide separation of the two pencils. The apparatus as above described was constructed by Schmidt and Haensch of Berlin. It was placed on a stone pier in the Physical Institute, Berlin. The first observation showed, however, that owing to the extreme sensitiveness of the instrument to vibrations, the work could not be carried on during the day. The experiment was next tried at night. When the mirrors were moved out to the ends of the arms, the fringes were only occasionally visible. It thus appeared that the experiments could not be performed in Berlin, and the apparatus was accordingly removed to the Astrophysicalisches Observatorium in Potsdam. Even here the ordinary stone piers did not suffice, and the apparatus was again transferred, this time to a cellar whose circular walls formed the foundation for the pier of the equatorial. Here, the fringes under ordinary circumstances were sufficiently quiet to measure, but so extraordinarily sensitive was the instrument that the stamping of the pavement, about meters from the observatory, made the fringes disappear entirely! If this was the case with the instrument constructed with a view to avoid sensitiveness, what may we not expect from one made as sensitive as possible! The nearer the two components are in magnitude to each other, the more nearly would their resultant coincide with the plane of the equator. In this case, if the apparatus be so placed that the arms point north and east at noon, the arm pointing east would coincide with the resultant motion, and the other would be at right angles. Taking the mean of these two numbers as the most probable, we may say that the displacement to be looked for is not far from one-tenth the distance between the fringes. The principal difficulty which was to be feared in making these experiments, was that arising from changes of temperature of the two arms of the instrument. These being of brass whose coefficient of expansion is 0. On the other hand, since the changes of temperature are independent of the direction of the arms, if these changes were not too great their effect could be eliminated. It was found, however, that the displacement on account of bending of the arms during rotation was so considerable that the instrument had to be returned to the maker, with instructions to make it revolve as easily as possible. It will be seen from the tables, that notwithstanding this precaution a large displacement was observed in one particular direction. On account of the sensitiveness of the instrument to vibration, the micrometer screw of the observing telescope could not be employed, and a scale ruled on glass was substituted. The distance between the fringes covered three scale divisions, and the position of the center of the dark fringe was estimated to fourths of a division, so that the separate estimates were correct to within. It frequently occurred that from some slight cause among page others the springing of the tin lantern by heating the fringes would suddenly change their position, in which case the series of observations was rejected and a new series begun. In making the adjustment before the third series of observations, the direction in which the fringes moved, on moving the glass plate b, was reversed, so that the displacement in the third and fourth series are to be taken with the opposite sign.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

6: Luminiferous aether - Infogalactic: the planetary knowledge core

THE AMERICAN JOURNAL OF SCIENCE. [THIRD SERIES.] ART. XXXVI.â€”On the Relative Motion of the Earth and the Luminiferous Ether; by ALBERT A. MICHELSON and.

This implied that there must be a separate aether for each of the infinitely many frequencies. Under a Galilean transformation the equations of Newtonian dynamics are invariant , whereas those of electromagnetism are not. Basically this means that while physics should remain the same in non-accelerated experiments, light would not follow the same rules because it is travelling in the universal "aether frame". Some effect caused by this difference should be detectable. A simple example concerns the model on which aether was originally built: The speed of propagation for mechanical waves, the speed of sound , is defined by the mechanical properties of the medium. This explains why a person hearing an explosion underwater and quickly surfacing can hear it again as the slower travelling sound arrives through the air. Similarly, a traveller on an airliner can still carry on a conversation with another traveller because the sound of words is travelling along with the air inside the aircraft. This effect is basic to all Newtonian dynamics, which says that everything from sound to the trajectory of a thrown baseball should all remain the same in the aircraft flying at least at a constant speed as if still sitting on the ground. This is the basis of the Galilean transformation, and the concept of frame of reference. If these numbers did change, there should be noticeable effects in the sky; stars in different directions would have different colours, for instance. Maxwell noted in the late s that detecting motion relative to this aether should be easy enoughâ€”light travelling along with the motion of the Earth would have a different speed than light travelling backward, as they would both be moving against the unmoving aether. This was confirmed by the following first-order experiments, which all gave negative results. The following list is based on the description of Wilhelm Wien , with changes and additional experiments according to the descriptions of Edmund Taylor Whittaker and Jakob Laub He obtained a positive result, but Lorentz could show that the results have been contradictory. DeWitt Bristol Brace and Strasser repeated the experiment with improved accuracy, and obtained negative results. This experiment is a more precise variation of the famous Fizeau experiment Two light rays were sent in opposite directions â€” one of them traverses a path filled with resting water, the other one follows a path through air. He obtained a positive result, but this was shown to be an experimental error, because a repetition of the experiment by Haga gave a negative result. No change of the interference fringes occurred. Later, Mascart showed that the interference fringes of polarized light in calcite remained uninfluenced as well. Lord Rayleigh conducted similar experiments with improved accuracy, and obtained a negative result as well. The plates of a condenser are located in the field of a strong electromagnet. No such effect was observed. Lorentz could also show, that the sensitivity of the apparatus was much too low to observe such an effect. While the first-order experiments could be explained by a modified stationary aether, more precise second-order experiments were expected to give positive results, however, no such results could be found. The famous Michelsonâ€”Morley experiment compared the source light with itself after being sent in different directions, looking for changes in phase in a manner that could be measured with extremely high accuracy. In this experiment, their goal was to determine the velocity of the Earth through the aether. In this case the MM experiment yielded a shift of the fringing pattern of about 0. Therefore, the null hypothesis , the hypothesis that there was no aether wind, could not be rejected. It is obvious from what has gone before that it would be hopeless to attempt to solve the question of the motion of the solar system by observations of optical phenomena at the surface of the earth. However, all of them obtained a null result, like Michelsonâ€”Morley MM previously did. These "aether-wind" experiments led to a flurry of efforts to "save" aether by assigning to it ever more complex properties, while only few scientists, like Emil Cohn or Alfred Bucherer , considered the possibility of the abandonment of the aether hypothesis. Of particular interest was the possibility of "aether entrainment" or "aether drag", which would lower the magnitude of the measurement, perhaps enough to explain the results of the Michelson-Morley experiment. However, as noted earlier, aether dragging already had problems of its own, notably aberration. In addition, the interference experiments of Lodge , and Ludwig Zehnder , aimed to show whether the aether is dragged by various, rotating masses, showed no aether drag. The theory was again modified, this time to suggest that the entrainment only worked for very large masses or those masses with large magnetic fields. Another, completely different attempt to save "absolute" aether was made in the Lorentzâ€”FitzGerald contraction hypothesis , which posited that everything was affected by travel through the aether. In this theory the reason the Michelsonâ€”Morley experiment "failed" was that the apparatus contracted in length in the direction of travel. That is, the light was being affected in the "natural" manner by its travel though the aether as predicted, but so was the apparatus itself, cancelling out any difference when measured. FitzGerald had inferred this hypothesis from a paper by Oliver Heaviside. Sagnac in , was immediately seen to be fully consistent with special relativity. Over the years the experimental accuracy of such measurements has been raised by many orders of magnitude, and no trace of any violations of Lorentz invariance has been seen. Since the Miller experiment and its unclear results there have been many more experimental attempts to detect the aether. Many experimenters have claimed positive results. These results have not gained much attention from mainstream science, since they contradict a large quantity of high-precision measurements, all the results of which were consistent with special relativity. Lorentz ether theory Between and , Hendrik Lorentz developed an electron-aether theory, in which he introduced a strict separation between matter electrons and aether. Contrary to earlier electron models, the electromagnetic field of the aether appears as a mediator between the electrons, and changes in this field cannot propagate faster than the speed of light. Lorentz noticed that it was necessary to change the space-time variables when changing frames and introduced concepts like physical length contraction [A 7] to explain the Michelsonâ€”Morley experiment, and the mathematical concept of local time to explain the aberration of light and the Fizeau experiment. This resulted in the formulation of the so-called Lorentz transformation by Joseph Larmor , [A 8] [A 9] and Lorentz , , [A 10] [A 11] whereby it was noted by Larmor the complete formulation of local time is accompanied by some sort of time dilation of electrons moving in the aether. As Lorentz later noted , , he considered the time indicated by clocks resting in the aether as "true" time, while local time was seen by him as a heuristic working hypothesis and a mathematical artifice. He declared simultaneity only a convenient convention which depends on the speed of light, whereby the constancy of the speed of light would be a useful postulate for making the laws of nature as simple as possible. In June and July [A 16] [A 17] he declared the relativity principle a general law of nature, including gravitation. He corrected some mistakes of Lorentz and proved the Lorentz covariance of the electromagnetic equations. However, he used the notion of an aether as a perfectly undetectable medium and distinguished between apparent and real time, so most historians of science argue that he failed to invent special relativity. Instead of suggesting that the mechanical properties of objects changed with their constant-velocity motion through an undetectable aether, Einstein proposed to deduce the characteristics that any successful theory must possess in order to be consistent with the most basic and firmly established principles, independent of the existence of a hypothetical aether. In this way he demonstrated that the laws of physics remained invariant as they had with the Galilean transformation, but that light was now invariant as well. With the development of the special theory of relativity, the need to account for a single universal frame of reference had disappeared â€” and acceptance of the 19th century theory of a luminiferous aether disappeared with it. For Einstein, the Lorentz transformation implied a conceptual change: Moreover, in another paper published the same month in , Einstein made several observations on a then-thorny problem, the photoelectric effect. In this work he demonstrated that light can be considered as particles that have a "wave-like nature". Particles obviously do not need a medium to travel, and thus, neither did light. This was the first step that would lead to the full development of quantum mechanics , in which the wave-like nature and the particle-like nature of light are both considered as valid descriptions of light. In his lectures of around he pointed out that what "the theory of relativity has to say He concluded that "one cannot deny the bearer of these concepts a certain substantiality". Aether theories In later years there have been a few individuals who advocated a neo-Lorentzian approach to physics, which is Lorentzian in the sense of positing an absolute true state of rest that is undetectable and which plays no role in the predictions of the theory. No violations of Lorentz covariance have ever been detected, despite strenuous efforts. Hence these theories resemble the 19th century aether theories in name only. For example, the founder of quantum field theory, Paul Dirac , stated in in an article in Nature, titled "Is there an Aether? His initial proposal of research thesis was to do an experiment to measure how fast the Earth was moving through the aether. In his response Einstein wrote that one can actually speak about a "new aether", but one may not speak of motion in relation to that aether. This was further elaborated by Einstein in some semi-popular articles , , , In this lecture Einstein stressed that special relativity took away the last mechanical property of the aether: However, he continued that special relativity does not necessarily rule out the aether, because the latter can be used to give physical reality to acceleration and rotation. This concept was fully elaborated within general relativity , in which physical properties which are partially determined by matter are attributed to space, but no substance or state of motion can be attributed to that "aether" by which he meant curved space-time. And within the electromagnetic theory of Maxwell and Lorentz one can speak of the "Aether of Electrodynamics", in which the aether possesses an absolute state of motion. However, the difference from the electromagnetic aether of Maxwell and Lorentz lies in the fact, that "because it was no longer possible to speak, in any absolute sense, of simultaneous states at different locations in the aether, the aether became, as it were, four dimensional, since there was no objective way of ordering its states by time alone". Now the "aether of special relativity" is still "absolute", because matter is affected by the properties of the aether, but the aether is not affected by the presence of matter. This asymmetry was solved within general relativity. Einstein explained that the "aether of general relativity" is not absolute, because matter is influenced by the aether, just as matter influences the structure of the aether. As Einstein himself pointed out, no "substance" and no state of motion can be attributed to that new aether.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

7: The Relative Motion of the Earth and the Luminiferous Ether - Wikisource, the free online library

On the relative motion of the earth and the luminiferous Ã†ther. Albert A. Michelson & Edward W. Morley. Pages Relative motion of earth and Ã¦ther.

Timeline of luminiferous aether Particles vs. This theory was known to have its problems: Newton believed that these vibrations were related to heat radiation: And is not this Medium the same with that Medium by which Light is refracted and reflected, and by whose Vibrations Light communicates Heat to Bodies, and is put into Fits of easy Reflexion and easy Transmission? However, Newton considered them to be two different phenomena. He believed heat vibrations to be excited "when a Ray of Light falls upon the Surface of any pellucid Body". He wrote, "I do not know what this Aether is", but that if it consists of particles then they must be "exceedingly smaller than those of Air, or even than those of Light: The exceeding smallness of its Particles may contribute to the greatness of the force by which those Particles may recede from one another, and thereby make that Medium exceedingly more rare and elastic than Air, and by consequence exceedingly less able to resist the motions of Projectiles, and exceedingly more able to press upon gross Bodies, by endeavoring to expand itself. The main reason for his rejection stemmed from the fact that both men could apparently only envision light to be a longitudinal wave , like sound and other mechanical waves in fluids. However, longitudinal waves by necessity have only one form for a given propagation direction, rather than two polarizations as in a transverse wave , and thus they were unable to explain the phenomenon of birefringence , where two polarizations of light are refracted differently by a crystal. Instead, Newton preferred to imagine non-spherical particles, or "corpuscles", of light with different "sides" that give rise to birefringence. Bradley suggests particles In James Bradley carried out a series of experiments attempting to measure stellar parallax by taking measurements of stars at different times of the year. As the Earth moves around the sun, the apparent angle to a given distant spot changes, and by measuring those angles the distance to the star can be calculated based on the known orbital circumference of the Earth around the sun. He failed to detect any parallax, thereby placing a lower limit on the distance to stars. During these experiments he also discovered a similar effect; the apparent positions of the stars did change over the year, but not as expected. Instead of the apparent angle being maximized when the Earth was at either end of its orbit with respect to the star, the angle was maximized when the Earth was at its fastest sideways velocity with respect to the star. This interesting effect is now known as stellar aberration. To explain stellar aberration in the context of an aether-based theory of light was regarded as more problematic. As the aberration relied on relative velocities, and the measured velocity was dependent on the motion of the Earth, the aether had to be remaining stationary with respect to the star as the Earth moved through it. This meant that the Earth could travel through the aether, a physical medium, with no apparent effectâ€”precisely the problem that led Newton to reject a wave model in the first place. However, a transverse wave apparently required the propagating medium to behave as a solid, as opposed to a gas or fluid. The idea of a solid that did not interact with other matter seemed a bit odd[verification needed], and Augustin-Louis Cauchy suggested that perhaps there was some sort of "dragging", or "entrainment", but this made the aberration measurements difficult to understand. He also suggested that the absence of longitudinal waves suggested that the aether had negative compressibility. George Green pointed out that such a fluid would be unstable. George Gabriel Stokes became a champion of the entrainment interpretation, developing a model in which the aether might be by analogy with pine pitch rigid at very high frequencies and fluid at lower speeds. Thus the Earth could move through it fairly freely, but it would be rigid enough to support light. Electromagnetism In Wilhelm Eduard Weber and Rudolf Kohlrausch performed an experiment to measure the numerical value of the ratio of the electromagnetic unit of charge to the electrostatic unit of charge. The result came out to be equal to the product of the speed of light and the square root of two. The following year, Gustav Kirchhoff wrote a paper in which he showed that the speed of a signal along an electric wire was equal to the speed of light. These are the first recorded historical links between the speed of light and electromagnetic phenomena. In his paper On Physical Lines of Force he modelled these magnetic lines of force using a sea of molecular vortices that he considered to be partly made of aether and partly made of ordinary matter. He derived expressions for the dielectric constant and the magnetic permeability in terms of the transverse elasticity and the density of this elastic medium. On obtaining a value that was close to the speed of light as measured by Fizeau , Maxwell concluded that light consists in undulations of the same medium that is the cause of electric and magnetic phenomena. He wrote another famous paper in under the title of A Dynamical Theory of the Electromagnetic Field in which the details of the luminiferous medium were less explicit. The apparent need for a propagation medium for such Hertzian waves can be seen by the fact that they consist of perpendicular electric E and magnetic B or H waves. The E waves consist of undulating dipolar electric fields, and all such dipoles appeared to require separated and opposite electric charges. Electric charge is an inextricable property of matter , so it appeared that some form of matter was required to provide the alternating current that would seem to have to exist at any point along the propagation path of the wave. Propagation of waves in a true vacuum would imply the existence of electric fields without associated electric charge , or of electric charge without associated matter. That is, the aether must be "still" universally, otherwise c would vary along with any variations that might occur in its supportive medium. Maxwell himself proposed several mechanical models of aether based on wheels and gears, and George Francis FitzGerald even constructed a working model of one of them. These models had to agree with the fact that the electromagnetic waves are transverse but never longitudinal. Problems By this point the mechanical qualities of the aether had become more and more magical: It also had to be massless and without viscosity , otherwise it would visibly affect the orbits of planets. Additionally it appeared it had to be completely transparent, non-dispersive, incompressible , and continuous at a very small scale. The only aether which has survived is that which was invented by Huygens to explain the propagation of light. Contemporary scientists were aware of the problems, but aether theory was so entrenched in physical law by this point that it was simply assumed to exist. In Oliver Lodge gave a speech on behalf of Lord Rayleigh [4] to the Royal Institution on this topic, in which he outlined its physical properties, and then attempted to offer reasons why they were not impossible. Nevertheless he was also aware of the criticisms, and quoted Lord Salisbury as saying that "aether is little more than a nominative case of the verb to undulate". Others criticized it as an "English invention", although Rayleigh jokingly stated it was actually an invention of the Royal Institution. A series of increasingly complex experiments had been carried out in the late 19th century to try to detect the motion of the Earth through the aether, and had failed to do so. A range of proposed aether-dragging theories could explain the null result but these were more complex, and tended to use arbitrary-looking coefficients and physical assumptions. Lorentz and FitzGerald offered within the framework of Lorentz ether theory a more elegant solution to how the motion of an absolute aether could be undetectable length contraction , but if their equations were correct, the new special theory of relativity could generate the same mathematics without referring to an aether at all. The latter theory was not considered as correct, since it was not compatible with the aberration of light , and the auxiliary hypotheses developed to explain this problem were not convincing. Also, subsequent experiments as the Sagnac effect also showed that this model is untenable. This implied that there must be a separate aether for each of the infinitely many frequencies. Under a Galilean transformation the equations of Newtonian dynamics are invariant , whereas those of electromagnetism are not. Basically this means that while physics should remain the same in non-accelerated experiments, light would not follow the same rules because it is travelling in the universal "aether frame". Some effect caused by this difference should be detectable. A simple example concerns the model on which aether was originally built: The speed of propagation for mechanical waves, the speed of sound , is defined by the mechanical properties of the medium. This explains why a person hearing an explosion underwater and quickly surfacing can hear it again as the slower travelling sound arrives through the air. Similarly, a traveller on an airliner can still carry on a conversation with another traveller because the sound of words is travelling along with the air inside the aircraft. This effect is basic to all Newtonian dynamics, which says that everything from sound to the trajectory of a thrown baseball should all remain the same in the aircraft flying at least at a constant speed as if still sitting on the ground. This is the basis of the Galilean transformation, and the concept of frame of reference. If these numbers did change, there should be noticeable effects in the sky; stars in different directions would have different colours, for instance[verification needed]. Thus at any point there should be one special coordinate system, "at rest relative to the aether". Maxwell noted in the late s that detecting motion relative to this aether should be easy enoughâ€”light travelling along with the motion of the Earth would have a different speed than light travelling backward, as they would both be moving against the unmoving aether. This was confirmed by the following first-order experiments, which all gave negative results. The following list is based on the description of Wilhelm Wien , with changes and additional experiments according to the descriptions of Edmund Taylor Whittaker and Jakob Laub He obtained a positive result, but Lorentz could show that the results have been contradictory. DeWitt Bristol Brace and Strasser repeated the experiment with improved accuracy, and obtained negative results. This experiment is a more precise variation of the famous Fizeau experiment Two light rays were sent in opposite directions â€" one of them traverses a path filled with resting water, the other one follows a path through air. He obtained a positive result, but this was shown to be an experimental error, because a repetition of the experiment by Haga gave a negative result. No change of the interference fringes occurred. Later, Mascart showed that the interference fringes of polarized light in calcite remained uninfluenced as well. Lord Rayleigh conducted similar experiments with improved accuracy, and obtained a negative result as well. The plates of a condenser are located in the field of a strong electromagnet. No such effect was observed. Lorentz could also show, that the sensitivity of the apparatus was much too low to observe such an effect. It is commonly held to disprove light propagation through a luminiferous aether. While the first-order experiments could be explained by a modified stationary aether, more precise second-order experiments were expected to give positive results, however, no such results could be found. The famous Michelsonâ€"Morley experiment compared the source light with itself after being sent in different directions, looking for changes in phase in a manner that could be measured with extremely high accuracy. In this case the MM experiment yielded a shift of the fringing pattern of about 0. Therefore, the null hypothesis , the hypothesis that there was no aether wind, could not be rejected. It is obvious from what has gone before that it would be hopeless to attempt to solve the question of the motion of the solar system by observations of optical phenomena at the surface of the earth. A series of experiments using similar but increasingly sophisticated apparatuses all returned the null result as well. However, all of them obtained a null result, like Michelsonâ€"Morley MM previously did. These "aether-wind" experiments led to a flurry of efforts to "save" aether by assigning to it ever more complex properties, while only few scientists, like Emil Cohn or Alfred Bucherer , considered the possibility of the abandonment of the aether concept. Of particular interest was the possibility of "aether entrainment" or "aether drag", which would lower the magnitude of the measurement, perhaps enough to explain MMX results. However, as noted earlier, aether dragging already had problems of its own, notably aberration. In addition, the interference experiments of Lodge , and Ludwig Zehnder , aimed to show whether the aether is dragged by various, rotating masses, showed no aether drag. The theory was again modified, this time to suggest that the entrainment only worked for very large masses or those masses with large magnetic fields. Another, completely different attempt to save "absolute" aether was made in the Lorentzâ€"FitzGerald contraction hypothesis , which posited that everything was affected by travel through the aether. In this theory the reason the Michelsonâ€"Morley experiment "failed" was that the apparatus contracted in length in the direction of travel. That is, the light was being affected in the "natural" manner by its travel though the aether as predicted, but so was the apparatus itself, cancelling out any difference when measured. FitzGerald had inferred this hypothesis from a paper by Oliver Heaviside. Sagnac in , was immediately seen to be fully consistent with special relativity. Since the Miller experiment and its unclear results there have been many more experiments to detect the aether.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

8: On The Relative Motion Of The Earth And The Luminiferous Ether Pdf

Michelson, A () "The relative motion of the earth and the luminiferous ether", Am J Sci, August:5 Michelson, A & Morley, E () "On the relative motion of the earth and the luminiferous aether", Am J Sci,

Timeline of luminiferous aether To Robert Boyle in the 17th century, a little before Isaac Newton, the aether was a probable hypothesis and consisted of subtle particles, one sort of which explained the absence of vacuum and the mechanical interactions between bodies, and the other sort of which explained phenomenon such as magnetism and possibly gravity that were inexplicable on the basis of the purely mechanical interactions of macroscopic bodies: This theory was known to have its problems: Newton believed that these vibrations were related to heat radiation: And is not this Medium the same with that Medium by which Light is refracted and reflected, and by whose Vibrations Light communicates Heat to Bodies, and is put into Fits of easy Reflexion and easy Transmission? However, Newton considered them to be two different phenomena. He believed heat vibrations to be excited "when a Ray of Light falls upon the Surface of any pellucid Body". He wrote, "I do not know what this Aether is", but that if it consists of particles then they must be "exceedingly smaller than those of Air, or even than those of Light: The exceeding smallness of its Particles may contribute to the greatness of the force by which those Particles may recede from one another, and thereby make that Medium exceedingly more rare and elastic than Air, and by consequence exceedingly less able to resist the motions of Projectiles, and exceedingly more able to press upon gross Bodies, by endeavoring to expand itself. The main reason for his rejection stemmed from the fact that both men could apparently only envision light to be a longitudinal wave , like sound and other mechanical waves in fluids. However, longitudinal waves by necessity have only one form for a given propagation direction, rather than two polarizations as in a transverse wave , and thus they were unable to explain the phenomenon of birefringence , where two polarizations of light are refracted differently by a crystal. Instead, Newton preferred to imagine non-spherical particles, or "corpuscles", of light with different "sides" that give rise to birefringence. Although he failed to detect any parallax, thereby placing a lower limit on the distance to stars, he discovered another effect, stellar aberration , an effect which depends not on position as in parallax , but on speed. He noticed that the apparent position of the star changed as the Earth moved around its orbit. To explain stellar aberration in the context of an aether-based theory of light was regarded as more problematic, because it requires that the aether be stationary even as the Earth moves through itâ€”precisely the problem that led Newton to reject a wave model in the first place. However, a transverse wave apparently required the propagating medium to behave as a solid, as opposed to a gas or fluid. The idea of a solid that did not interact with other matter seemed a bit odd[verification needed], and Augustin-Louis Cauchy suggested that perhaps there was some sort of "dragging", or "entrainment", but this made the aberration measurements difficult to understand. He also suggested that the absence of longitudinal waves suggested that the aether had negative compressibility. George Green pointed out that such a fluid would be unstable. George Gabriel Stokes became a champion of the entrainment interpretation, developing a model in which the aether might be by analogy with pine pitch rigid at very high frequencies and fluid at lower speeds. Thus the Earth could move through it fairly freely, but it would be rigid enough to support light. The apparent need for a propagation medium for such Hertzian waves can be seen by the fact that they consist of perpendicular electric E and magnetic B or H waves. The E waves consist of undulating dipolar electric fields, and all such dipoles appeared to require separated and opposite electric charges. Electric charge is an inextricable property of matter , so it appeared that some form of matter was required to provide the alternating current that would seem to have to exist at any point along the propagation path of the wave. Propagation of waves in a true vacuum would imply the existence of electric fields without associated electric charge , or of electric charge without associated matter. That is, the aether must be "still" universally, otherwise c would vary along with any variations that might occur in its supportive medium. Maxwell himself proposed several mechanical models of aether based on wheels and gears, and George

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

FitzGerald even constructed a working model of one of them. These models had to agree with the fact that the electromagnetic waves are transverse but never longitudinal. Nevertheless, by this point the mechanical qualities of the aether had become more and more magical: It also had to be massless and without viscosity , otherwise it would visibly affect the orbits of planets. Additionally it appeared it had to be completely transparent, non-dispersive, incompressible , and continuous at a very small scale. The only aether which has survived is that which was invented by Huygens to explain the propagation of light. Contemporary scientists were aware of the problems, but aether theory was so entrenched in physical law by this point that it was simply assumed to exist. In Oliver Lodge gave a speech in behalf of Lord Rayleigh [3] to the Royal Institution on this topic, in which he outlined its physical properties, and then attempted to offer reasons why they were not impossible. Nevertheless he was also aware of the criticisms, and quoted Lord Salisbury as saying that "aether is little more than a nominative case of the verb to undulate". Others criticized it as an "English invention", although Rayleigh jokingly corrected them to state it was actually an invention of the Royal Institution. A series of increasingly complex experiments had been carried out in the late 19th century to try to detect the motion of the Earth through the aether, and had failed to do so. A range of proposed aether-dragging theories could explain the null result but these were more complex, and tended to use arbitrary-looking coefficients and physical assumptions. Lorentz and Fitzgerald offered within the framework of Lorentz ether theory a more elegant solution to how the motion of an absolute aether could be undetectable length contraction , but if their equations were correct, the new special theory of relativity could generate the same mathematics without referring to an aether at all. The result came out to be equal to the product of the speed of light and the square root of two. The following year, Gustav Kirchhoff wrote a paper in which he showed that the speed of a signal along an electric wire was equal to the speed of light. These are the first recorded historical links between the speed of light and electromagnetic phenomena. In his paper On Physical Lines of Force he modelled these magnetic lines of force using a sea of molecular vortices that he considered to be partly made of aether and partly made of ordinary matter. He derived expressions for the dielectric constant and the magnetic permeability in terms of the transverse elasticity and the density of this elastic medium. On obtaining a value that was close to the speed of light as measured by Fizeau , Maxwell concluded that light consists in undulations of the same medium that is the cause of electric and magnetic phenomena. He wrote another famous paper in under the title of A Dynamical Theory of the Electromagnetic Field in which the details of the luminiferous medium were less explicit. The latter theory was not considered as correct, since it was not compatible with the aberration of light , and the auxiliary hypotheses developed to explain this problem were not convincing. Also, subsequent experiments as the Sagnac effect also showed that is model is untenable. This implied that there must be a separate aether for each of the infinitely many frequencies. Under a Galilean transformation the equations of Newtonian dynamics are invariant , whereas those of electromagnetism are not. Basically this means that while physics should remain the same in non-accelerated experiments, light would not follow the same rules because it is traveling in the universal "aether frame". Some effect caused by this difference should be detectable. A simple example concerns the model on which aether was originally built: The speed of propagation for mechanical waves, the speed of sound , is defined by the mechanical properties of the medium. This explains why, if you hear an explosion underwater and quickly surface, you will hear it again as the slower traveling sound reaches you through the air. And if you are in an airliner , you can still carry on a conversation with the person beside you because the sound of your words is traveling along with the air inside the aircraft. This effect is basic to all Newtonian dynamics, which says that everything from sound to the trajectory of a thrown baseball should all remain the same in the aircraft as sitting still on the Earth. This is the basis of the Galilean transformation, and the concept of frame of reference. If these numbers did change, there should be noticeable effects in the sky; stars in different directions would have different colors, for instance[verification needed]. Thus at any point there should be one special coordinate system, "at rest relative to the aether". Maxwell noted in the late s that detecting motion relative to this aether should be easy enoughâ€"light traveling along with the motion of the Earth would have a different speed than light traveling backward, as they would both be moving against the unmoving aether. This was confirmed by the following first-order experiments, which all gave negative results the following list is based on the description of Wilhelm Wien , with changes and additional experiments according to the descriptions of Edmund Taylor Whittaker and Jakob Laub He obtained a positive result, but Lorentz could show that the results have been contradictory. DeWitt Bristol Brace and Strasser repeated the experiment with improved accuracy, and obtained negative results. This experiment is a more precise variation of the famous Fizeau experiment Two light rays were sent in opposite directions â€" one of them traverses a path filled with resting water, the other one follows a path through air. He obtained a positive result, but this was shown to be an experimental error, because a repetition of the experiment by Haga gave a negative result. No change of the interference fringes occurred. Later, Mascart showed that the interference fringes of polarized light in calcite remained uninfluenced as well. Lord Rayleigh conducted similar experiments with improved accuracy, and obtained a negative result as well. The plates of a condenser are located in the field of a strong electromagnet. No such effect was observed. Lorentz could also show, that the sensibility of the apparatus was much too low to observe such an effect. It is commonly held to disprove light propagation through a luminiferous aether. While the first-order experiments could be explained by a modified stationary aether, more precise second-order experiments were expected to give positive results, however, no such results could be found. The famous Michelson-Morley experiment compared the source light with itself after being sent in different directions, looking for changes in phase in a manner that could be measured with extremely high accuracy. In this case the MM experiment yielded a shift of the fringing pattern of about 0. Therefore, the null hypothesis , the hypothesis that there was no aether wind, could not be rejected. A series of experiments using similar but increasingly sophisticated apparatuses all returned the null result as well. Conceptually different experiments that also attempted to detect the motion of the aether were the Trouton-Noble experiment [E 21] to detect torsion effects caused by electrostatic fields, and the Experiments of Rayleigh and Brace , [E 22] [E 23] to detect double refraction in various media. However, all of them obtained a null result like Michelson-Morley MM. These "aether-wind" experiments led to a flurry of efforts to "save" aether by assigning to it ever more complex properties, while only few scientists like Emil Cohn or Alfred Bucherer considered the possibility of the abandonment of the aether concept. Of particular interest was the possibility of "aether entrainment" or "aether drag", which would lower the magnitude of the measurement, perhaps enough to explain MMX results. However, as noted earlier, aether dragging already had problems of its own, notably aberration. In addition, the interference experiments of Lodge , and Ludwig Zehnder , aimed to show whether the aether is dragged by various, rotating masses, showed no aether drag. The theory was again modified, this time to suggest that the entrainment only worked for very large masses or those masses with large magnetic fields. Aether drag hypothesis Another, completely different, attempt to save "absolute" aether was made in the Lorentz-Fitzgerald contraction hypothesis , which posited that everything was affected by travel through the aether. In this theory the reason the Michelson-Morley experiment "failed" was that the apparatus contracted in length in the direction of travel. That is, the light was being affected in the "natural" manner by its travel though the aether as predicted, but so was the apparatus itself, canceling out any difference when measured. Fitzgerald had inferred this hypothesis from a paper by Oliver Heaviside. Sagnac in was immediately seen to be fully consistent with special relativity. Since the Miller experiment and its unclear results there have been many more experiments to detect the aether. Many of the experimenters have claimed positive results. These results have not gained much attention from mainstream science, since they are in contradiction to a large quantity of high-precision measurements, all of them confirming special relativity.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

9: Luminiferous aether - Wikipedia

The luminiferous aether: it was hypothesised that the Earth moves through a "medium" of aether that carries light In the late 19th century, luminiferous aether, aether or ether, meaning light-bearing aether, was the postulated medium for the propagation of light. [1].

Aether also spelled ether is a philosophic and scientific concept denoting the existence of a fine substance ponderable or imponderable underlying the entirety of natural reality. Helios is surrounded on all sides by Aether, and orphism only recognized one god - Helios-Dionysus. Eusebius later amalgamates this god to Zeus. Nous was also the power of the lightest substance, and thus the principle of Levity or Celeritas. As Aether was also the lighest of substances, Nous was its principle. All matter was made up of Aether and Air, and created by virtue of the Nous. Nous will later be distorted to become the basis of the philosophical concept of Reason in post-Socratic philosophy. The Aether thus became known as "Quintessence". These different systematic thoughts share the concept of an imponderable substance that animates all physical reality, and are precursors to modern theories of a dynamic Aether. Stationary Luminiferous Classical Aether Conversely, the notion of a static Aether, a mechanical, jelly-like Aether, finds its classical origins in Newton. Maxwell for Encyclopedia Britannica, and O. The above definition encapsulates a mistake that is common to a whole epoch of classical and semi-classical modern physics: The Aether came to designate a stationary substance of space that transmitted light and permitted measurement of the motion of material bodies by the drag which they supposedly caused. Since light exhibited wave properties, the waves had to travel in a "signal-carrying medium" just as waves of sound or waves in water require a molecular medium. However, the null result of the Michelson-Morley experiment forced from onwards the demise of all Classic Static Aether models. Classical theories of the Aether that yesteryear were dominant the old cannon of Official Science have retained a certain currency to this day they are very popular in the fringes of physics , particularly in their Aether-drag variants eg. The demise of the classical Aether was equally due to the rise of the field concept - from Faraday, through Maxwell to Einstein and Quantum-Dynamics. Space now becomes treated as a given, and as being permeated by fields present and propagating even in the vacuum devoid of ordinary matter. The fields may be electromagnetic, gravitational or supermassive, and more recently have been belabored as a "quantum foam", a "space-foam", a Zero-Point Field ZPF or the Dark Energy of the missing Higgs particles. This rejoins Anaxagoras when he wrestled the original concept of the Aether from Greek mythology. Gravitational Aether Einstein In the period, A. Einstein proposed an interpretation of his General Relativity that took recourse to an Aether of Space, a Gravitational Aether, responsible for the production of space and gravity as physical effects: We may assume the existence of an aether; only To deny the aether is ultimately to assume that empty space has no physical qualities whatever. Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an aether" A. Einstein later abandoned this approach. Stern first proposed the notion of a cosmic heat bath whose function corresponded to their concept of a Zero Point Energy ZPE filling up space. Boyer and quantum models H. Modern ZPE theories have in common the notion that the "vacuum state" is an electromagnetic field ZPF present even near absolute zero temperature, the ZPF being homogeneous, isotropic and subject to Lorentz invariance. This is a hybrid concept in all of its forms. First of all, Einstein and Stern did not see their concept of a cosmic heat bath as being equivalent to that of an Aether. It really was an electromagnetic field that occupied space. Secondly, modern theories that interpret the mCBR as the ZPF are equally restricted and thus unable to account for how the mCBR is actually produced by the Aether, let alone for the physical properties of Space or gravitational fields. The Dynamic Aether Theories All theories of a dynamic Aether accept the null result of the Michelson-Morley experiment, the lack of Aether drag, and explain that null result by the properties of a massless or massfree Aether. Tesla envisioned an electrical Aether having incompressible and radiative properties. He presented experimental evidence for this physical reality in his studies on the wireless transmission of power and the resonant states of the longitudinal electric radiation that has become known as Tesla Radiation, but failed to provide a physico-mathematical model of this radiation. This left his followers mired in the premature identification of Aether with orgone. Moreover, only late in his investigation did Reich begin to realize that what he called Orgone energy was no different from what Tesla thought was the "aether electric radiation". The theory of the orgone remained prisoner of these shortcomings, and the premature death or murder of W. Reich damned its continuation and consistent development. Aspden The first cogent and comprehensive model of a dynamic Aether was proposed by Harold Aspden as far back as Aetherometry Since , Dr. Paulo Correa and Alexandra Correa have proposed an immanentist-monist model of an imponderable dynamic Aether. This model defines the Aether as primary massfree energy Dark Massfree Energy in electric ambipolar and nonelectric latent heat forms. Massfree energy also exists in secondary eg gravitons, kinetons and tertiary eg photons forms affected by matter, and no theory of a dynamic Aether can be complete without accounting for these massfree energy forms, or without providing a model for the creation of mass-energy from Aether energy processes. One of the fundamental characteristics of aetherometric theory is that light waves are not waves that transmit light, anymore than waves need to ride or require a medium. It is the medium or media that are already composed of waves, already undulatory; and what transmits the stimulus of light is not light or electromagnetic waves, but precisely the Tesla radiation or Orgone , the ambipolar radiation through its longitudinal waves. Aetherometry clarifies therefore the relationship between transmission of the light stimulus and a local generation of all blackbody photons that was once suggested by Einstein himself. Light waves are local and solidary with the photon particles, in full agreement with classical Quantum-Mechanics, and without need to resort to relativistic transformations. References Robert Fludd, "Mosaical Philosophy". London, Humphrey Moseley, Pg Nicholson, O. Some are enunciated by followers of N. DeMeo; for a critique, see http: External links and further reading.

ON THE RELATIVE MOTION OF THE EARTH AND THE LUMINIFEROUS AETHER pdf

History of poverty in nigeria Confinement, Topology, and Other Non-Pertubative Aspects of QCD (NATO Science Series II: Mathematics, Phy Care of children in the event of bioterrorism Subhash Chaudhary NATIONAL ROLL OF THE GREAT WAR Section IV Southampton The Shroud and the Grail The tales of Teddy Typhoon The unbeaten Lions The dark lord trilogy Abnormal psychology charles lyons 5th edition The diary : March 1762-November 1772 The Three Lost Books of Healing Gospel Stories for Pastors, Teachers, and Parents Tech mahindra placement papers 2016 Portfolios and publishing Ch. 19. Time-resolved fluorescence techniques applied to biological interfaces Baboushka and the Three Kings Michigan Manual of Plastic Surgery (Spiral Manual Series) Principles and practices of professional consulting The myth of root snorkels Sacred art of dying Approaching Democracy, California Edition (5th Edition) Java and its challenge Genie intellicode is550/a manual Predators and profits The Big Drop and Other Cliff Hardy Stories The Rose Garden, April 1945-November 1962. V. 13]. 1916-1917 Blossoms in the snow Interest groups and lobbying in Latin America, Africa, the Middle East, and Asia Your community and its young people Control structures Educational survey of Tattnall County, Georgia Sat 10 practice test 1st grade Danielle monsch entwined realms African immigrant churches in America. 3:00 to 6:00 P.M. RELAXATION AND MEDITATION 602 Website to find books Sport motivation among three levels of high calibre soccer players Rabbinix Judaism in the Making