

# **Aether Quantum theory according to Eddington**

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Eddington who supposedly proved Einstein's Relativity in 1919 believed in aether. Many Relativity texts falsely present that aether has been disproved by Relativity, so it's worth looking at Eddington on this issue.

## **1. Eddington on aether**

Eddington says: "Thirty years ago [this is 30 years back from 1927] there was much debate over the question of aether-drag - whether the earth moving round the sun drags the aether with it. At that time the solidity of the atom was unquestioned, and it was difficult to believe that matter could push its way through the aether without disturbing it. It was surprising and perplexing to find as the result of experiments that no convection of the aether occurred. But we now realize that the aether can slip through the atoms as easily as through the solar system, and our expectation is all the other way." [1]

On the issue of velocity through *the Aether* he says this: "The theory of relativity is evidently bound up with the impossibility of detecting absolute velocity." [2]

He compares two sets of observers – one here on Earth and another in a nebula, motion is relative between them, such that the Earth based observers observe the nebular observers moving and the nebular observers observe the Earth based observers moving.

He says this: "if in our quarrel with the nebular physicists one of us had been able to claim to be absolutely at rest, that would be

sufficient reason for preferring the corresponding frame. This has something in common with the well-known philosophic belief that motion must necessarily be relative. Motion is change of position relative to *something*; if we try to think of change of position relative to *nothing* the whole conception fades away. But this does not quite settle the physical problem. In physics we should not be quite so scrupulous as to the use of the word 'absolute'. Motion with respect to aether or to any universally significant frame would be called absolute.”

i.e. constant velocity motion is relative and not absolute. If we think of an aether frame as an absolute frame he says this:

“No aethereal frame has been found. We can only discover motion relative to the material landmarks scattered casually about the world; motion with respect to the universal ocean of aether eludes us. We say, "Let  $V$  be the velocity of a body through the aether," and form the various electromagnetic equations in which  $V$  is scattered liberally. Then we insert the observed values, and try to eliminate everything that is unknown except  $V$ . The solution goes on famously; but just as we have got rid of the other unknowns, behold!  $V$  disappears as well, and we are left with the indisputable but irritating conclusion:  $0=0$ ”

“This is a favorite device that mathematical equations resort to, when we propound stupid questions. If we tried to find the latitude and longitude of a point north-east from the north pole we should probably receive the same mathematical answer. 'Velocity through aether' is as meaningless as 'north-east from the north pole'. This does not mean that the aether is abolished.” [3]

i.e aether is not abolished but 'aether frame as absolute frame' is abolished.

This is where some Relativity texts go wrong, they claim 'aether frame as absolute frame' is abolished and then erroneously abolish aether along with it.

Eddington does not make that mistake. Instead he says aether exists and that: “We need an aether. The physical world is not to be analyzed into isolated particles of matter or electricity with featureless interspace. We have to attribute as much character to the interspace as to the particles, and in present day physics quite

an army of symbols is required to describe what is going on in the interspace. We postulate aether to bear the characters of the interspace as we postulate matter or electricity to bear the characters of the particles.”

“Perhaps a philosopher might question whether it is not possible to admit the characters alone without picturing anything to support them - thus doing away with aether and matter at one stroke. But that is rather beside the point.”

“In the last century [19<sup>th</sup>] it was widely believed that aether was a kind of matter, having properties such as mass, rigidity, motion, like ordinary matter. It would be difficult to say when this view died out. It probably lingered longer in England than on the Continent, but I think that even here it had ceased to be the orthodox view some years before the advent of the relativity theory. Logically it was abandoned by the numerous nineteenth-century investigators who regarded matter as vortices, knots, squirts, etc., in the aether; for clearly they could not have supposed that aether consisted of vortices in the aether. But it may not be safe to assume that the authorities in question were logical.”

“Nowadays it is agreed that aether is not a kind of matter. Being non-material, its properties are *sui generis*. We must determine them by experiment; and since we have no ground for any preconception, the experimental conclusions can be accepted without surprise or misgiving. Characters such as mass and rigidity which we meet with in matter will naturally be absent in aether; but the aether will have new and definite characters of its own. In a material ocean we can say that a particular particle of water which was here a few moments ago is now over there; there is no corresponding assertion that can be made about the aether. If you have been thinking of the aether in a way which takes for granted this property of permanent identification of its particles, you must revise your conception in accordance with the modern evidence. We cannot find our velocity through the aether; we cannot say whether the aether now in this room is flowing out through the north wall or the south wall. The question would have meaning for a material ocean, but there is no reason to expect it to have a meaning for the non-material ocean of aether.” [4]

So, its more like the “new” aether is a field; there are fields, and a unified field would be a unified aether.

[ sui generis = Latin expression meaning of its own kind- unique in its characteristics]

Going now on to his considerations of space, he says: "We must rid our minds of the idea that the word 'space' in science has anything to do with *void*. As previously explained it has the other meaning of distance, volume, etc., quantities expressing physical measurement just as much as force is a quantity expressing physical measurement. Thus the (rather crude) statement that Einstein's theory reduces gravitational force to a property of space ought not to arouse misgiving. In any case the physicist does not conceive of space as void. Where it is empty of all else there is still the aether." [5]

i.e in otherwords when space is empty of matter, there is still aether; what I would call fields.

He continues: " Those who for some reason dislike the word 'aether', scatter mathematical symbols freely through the vacuum, and I presume that they must conceive some kind of characteristic background for these symbols. I do not think any one proposes to build even so relative and elusive a thing as force out of entire nothingness." [ 5]

Eddington's belief in aether led him to following interpretation of Quantum theory -

## **2. Aether Quantum theory**

Eddington believed in aether, and its connection to the atomic model of Bohr (electrons in orbit around nucleus) is as follows:

"According to this picture of the atom, which is due to Niels Bohr, the only possible change of state is the transfer of an electron from one quantum orbit to another. Such a jump must occur whenever light is absorbed or emitted. Suppose then that an electron which has been travelling in one of the higher orbits jumps down into an orbit of less energy. The atom will then have a certain amount of surplus energy that must be got rid of. The lump of energy is fixed, and it remains to settle the period of vibration that it shall have when it changes into aether waves. It seems incredible that the

atom should get hold of the aether and shake it in any other period than one of those in which it is itself vibrating. Yet it is the experimental fact that, when the atom by radiating sets the aether in vibration, the periods of its electronic circulation are ignored and the period of the aether waves is settled not by any picturable mechanism but by the seemingly artificial  $h$ -rule. It would seem that the atom carelessly throws overboard a lump of energy which, as it glides into the aether, molds itself into a quantum of action by taking on the period required to make the product of energy and period equal to  $h$ . If this unmechanical process of emission seems contrary to our preconceptions, the exactly converse process of absorption is even more so. Here the atom has to look out for a lump of energy of the exact amount required to raise an electron to the higher orbit. It can only extract such a lump from aether waves of particular period - not a period which has resonance with the structure of the atom, but the period which makes the energy into an exact quantum.

“As the adjustment between the energy of the orbit jump and the period of the light carrying away that energy so as to give the constant quantity  $h$  is perhaps the most striking evidence of the dominance of the quantum, it will be worth while to explain how the energy of an orbit jump in an atom can be measured. It is possible to impart to a single electron a known amount of energy by making it travel along an electric field with a measured drop of potential. If this projectile hits an atom it may cause one of the electrons circulating in the atom to jump to an upper orbit, but, of course, only if its energy is sufficient to supply that required for the jump; if the electron has too little energy it can do nothing and must pass on with its energy intact. Let us fire a stream of electron all endowed with the same known energy into the midst of a group of atoms. If the energy is below that corresponding to an orbit jump, the stream will pass through without interference other than ordinary scattering.

“Now gradually increase the energy of the electrons; quite suddenly we find that the electrons are leaving a great deal of their energy behind. That means that the critical energy has been reached and orbit jumps are being excited. Thus we have a means of measuring the critical energy which is just that of the jump - the difference of energy of the two states of the atom. This method of measurement has the advantage that it does not involve any

knowledge of the constant  $h$ , so that there is no fear of a vicious circle when we use the measured energies to test the  $h$  rule.” [6]

Eddington also deals with a sub-aether theory which I will not go into.

It is interesting then – with the bad education given physics students - that the aether picture of Quantum theory is omitted from their standard texts.

### **Reference**

- [1] The Nature of the Physical World, A. S. Eddington, Cambridge at the University Press, 1929 (based on 1927 lectures) UK p 3 -4
- [2] p 30
- [3] p 30 -31
- [4] p 31 -32
- [5] p 137
- [6] p 191- 192

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