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ABERRATION OF ELECTRIC FIELD AND RADIATION POWER DUE TO A MOVING ELECTRON

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Abstract

An electron of mass m and charge $-e$ moving at angle θ to accelerating force due to electric field of intensity $\mathbf{E}$, is subject to aberration of electric field as a result of relativity of velocity ($\mathbf{c} - \mathbf{v}$) between the electric force, propagated with velodity of light $\mathbf{c}$ and the electron moving with velocity $\mathbf{v}$ at time t. The accelerating force $m(d\mathbf{v}/dt)$ is less than the electrostatic foce $-e\mathbf{E}$, the difference being the radiation reaction force. Motion of the electron with constant mass and radiation power are treated under acceleration with $\theta=0$ or deceleration with $\theta=\pi$ radians or in a circle of radiua r, with $\theta=\pi/2$ radians. It is shown that circular revolution of an electron round a central force of attraction is withouy radiation.

1. INTRODUCTION

Aberration of electric field is a phenomenon similar to aberration of light discovered by English astronomer, James Bradley, in 1728 [1]. This is one of the most significant discoveries in science. Aberration of light is a demonstration of relativity of velocity of light with respect to a moving object, contrary to the theory of special relativity [2, 3]. Aberration of light is hardly mentioned in physics because it is a contradiction of the principle of constancy of the speed of light accordin to the theory of special relativity. It is considered more of a subject in astronomy.

Electromagnetic radiation, as well as electric force, is propagated in space, along an electric field, with velocity of light. In the aberration of electric field there is relativity of velocity ($\mathbf{c} - \mathbf{v}$) between an electric force propagated with velocity of light $\mathbf{c}$ and an electron moving eith velocity $\mathbf{v}$. As such, the electric force cannot catch up and impact on an electron also moving with velocity of light $\mathbf{c}$. The velocity of light thus becomes the limit to which an electric field can accelerate an electron with emission of radiation and mass remaining constant.

As a result of aberration of electric field, for an electron of mass m and charge $-e$ movint at time t with velocity $\mathbf{v}$ and acceleration $d\mathbf{v}/dt$ in a field of intensity $\mathbf{E}$, the accelerating force $m(d\mathbf{v}/dt)$ is less than the electrostatic force $-e\mathbf{E}$, the difference is the radiation reaction force [4]. The radiation reaction force in rectilinear motion is $-e\mathbf{E}v/c$ and radiation power is eEv^2/c. In circular motion perpendicular to the electric field, the radiation power is zero. This makes motion of an electron, round a positively charged nucleus, as in the Rutherford's model of the hydrogen atom [5] without radiation and stable outside Bohr's quantum mechanics [6].

2. ABERRATION ANGLE

Figure 1 depicts an electron of mass m and charge $-e$ moving at P with velocity $\mathbf{v}$ at angle θ to to the force of attraction due to an electric field of intensity $\mathbf{E}$ from a stationary source charge $+Q$ at O. The electron is subjected to aberration of electric field whereby the direction of propagation of the force of attraction, given by velocity vector $\mathbf{c}$, is displaced from the the instantaneous line PO through angle of aberration α, such that:

$$\sin\alpha = \frac{v}{c}\sin\theta \tag{1}$$

3. RELATIVE VELOCITY OF TEANSMISSION OF ELECTRIC FORCE

With reference to Figure 1, the vector **z** = (**v** - **c**) is the relafive velocity of transmission between the electric force propagated with velocity of light **c** and the electron moving with velocity **v**, thus:

$$\mathbf{z} = (\mathbf{c} - \mathbf{v}) = -\sqrt{c^2 + v^2 - 2cv\cos(\theta - \alpha)}\,\hat{\mathbf{u}} \tag{2}$$

where $(\theta - \alpha)$ is the angle between the vectors **c** and **v** and **û** is a unit vector in the direction of the field **E**. The electron can move with $\theta = 0$, π, or $\pi/2$ radians.

With $\theta = 0$ there is motion in a straight line with acceleration and equations (1) and (2) give the relative speed of transmission of the electric force as:

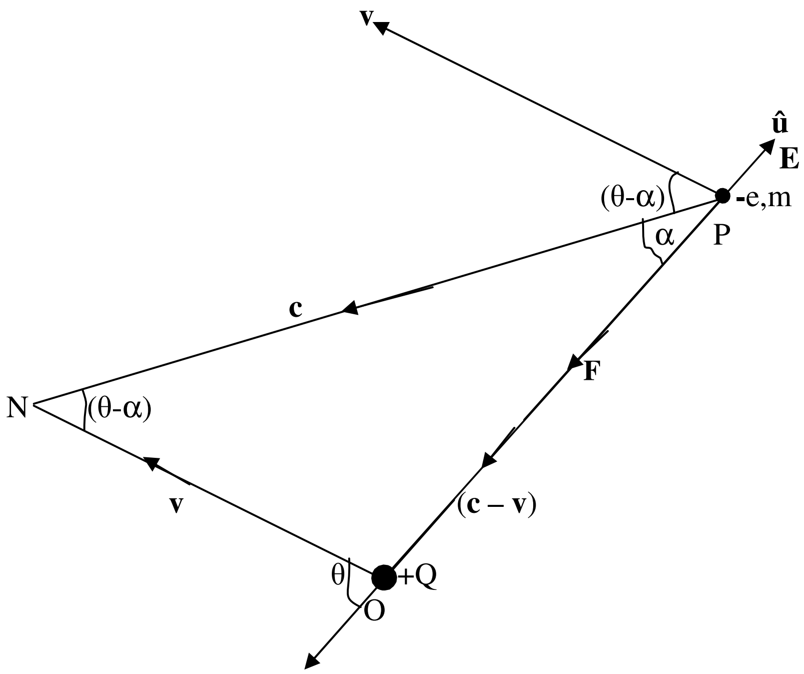

Figure 1. Depicting an electron of mass *m* and charge *–e* at a point *P* moving with velocity **v** at an angle θ to accelerating force **F** due to electric field of intensity of intensity **E** from to a stationary source charge $+Q$ at *O*.

$$z = c - v \tag{3}$$

Where $\theta = \pi$ radians there is motion in a straight line with deceleration and the relative speed of transmission of the force becomes:

$$z = c + v \tag{4}$$

If $\theta = \pi/2$ radians and noting that $\sin\alpha = v/c$, there is circular revolution with constant speed v, giving the speed of transmission of the force as:

$$z = \sqrt{c^2 - v^2} \tag{5}$$

Equatons (3), (4) and (5) demonstrate the relativity of speed of light with respect to an observer or an object moving with speed *v*, comtrsry to special relativity.

4. ACCELERATING FORCE

4.1 In Rectilinear Motion

The accelerating force **F** (Fig. 1) at time *t*, in an electric field of magnitude *E*, is put as:

$$\mathbf{F} = \frac{eE}{c}(\mathbf{c} - \mathbf{v}) = -\frac{eE}{c}\sqrt{c^2 + v^2 - 2cv\cos(\theta - \alpha)}\,\hat{\mathbf{u}} = m\frac{d\mathbf{v}}{dt} \tag{6}$$

where $\hat{\mathbf{u}}$ is a unit vector in the positive direction of the electric field **E**. For motion in a straight line under acceleration, with $\theta = 0$, equations (1) and (2) give the vector equation:

$$\mathbf{F} = -eE\left(1 - \frac{v}{c}\right)\hat{\mathbf{u}} = -m\frac{dv}{dt}\hat{\mathbf{u}} \tag{7}$$

The scalar first order differential equation, for an accelerated electron, is:

$$eE\left(1 - \frac{v}{c}\right) = m\frac{dv}{dt} \tag{8}$$

For motion in a straight line under deceleration, with $\theta = \pi$ radians, equations (1) and (2) give the vector equation:

$$\mathbf{F} = -eE\left(1 + \frac{v}{c}\right)\hat{\mathbf{u}} = m\frac{dv}{dt}\hat{\mathbf{u}} \tag{9}$$

The scalar first order differential equation, for a decelerated electron, is:

$$eE\left(1 + \frac{v}{c}\right) = -m\frac{dv}{dt} \tag{10}$$

Equations (8) and (10) are easily solved for a uniform electric field, of constant magnitude *E*, to give the speed *v* as a function of time *t*. Solutions of the first order differential equations, with constant coefficients, show that the speed of light is the maximum attainable by the electron, in accordabce with observations.

4.1 In Circular Revolution

Where $\theta = \pi/2$ radians there is revolution in a circle of radius *r* with constant speed *v* and centripetal acceleration $-v^2/r$. Noting that $\sin\alpha = v/c$, equation (1) and (2) gives the vector:

$$\mathbf{F} = -eE\sqrt{1 - \frac{v^2}{c^2}}\,\hat{\mathbf{u}} = -m\frac{v^2}{r}\hat{\mathbf{u}} \tag{11}$$

The scalar equation is:

$$eE\sqrt{1-\frac{v^2}{c^2}} = m\frac{v^2}{r} = m_o\frac{v^2}{r} \tag{12}$$

where mass m is a constant equal to the rest mass m_o. This is in contrat to the theory of special relativity where m is dependent on speed of the electron.

Equation (12) can be written as:

$$\frac{eEr}{v^2} = \zeta = \frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}} \tag{13}$$

The theory of special relativity mistakingly identifies ζ (zeta) in equation (13), with mass m of the moving electron. The mass-velocity formula of special relativity gives the mass m is:

$$m = \frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}} \tag{14}$$

Equation (14) is wrong, more so by applying it in rectilinear motion.

Equation (12) gives the radius of revolution, with mass m = rest m_o, as:

$$r = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\frac{mv^2}{eE} = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\frac{m_o v^2}{eE} = \gamma r_o \tag{15}$$

where r_o is the classical radius of revolution. In accordance with special relativity (equation 14) the radius of revolution should be:

$$r = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\frac{m_o v^2}{eE} = \gamma r_o \tag{16}$$

The radius of revolution in relativistic electrodynamics turns out to be the sane as in an alternative electrodynamics but for different reasons.

5. RADIATION POWER

The difference between the accelerating force **F**, as given by equation (6), and the electrostatic force or impressed force –e**E**, is the radiation reaction force, a vector $\mathbf{R}_f$ given by:

$$\mathbf{R}_f = \frac{eE}{c}(\mathbf{c}-\mathbf{v}) + e\mathbf{E} \tag{17}$$

The radiation power R_p is the scalar product $-\mathbf{v}.\mathbf{R}_f$, thus:

$$R_p = -\mathbf{v}.\mathbf{R}_f = -\frac{eE}{c}(\mathbf{c}-\mathbf{v}).\mathbf{v} - e\mathbf{E}.\mathbf{v} \tag{18}$$

With reference to Figure 1, radiation power R_p is expressed in terms of the angles θ and α, as:

$$R_p = \frac{eEv^2}{c} - eEv\cos(\theta-\alpha) + eEv\cos\theta \tag{19}$$

Equation (19) shows that the readiation power is eEv^2/c under acceleration with $\theta = 0$ or under deceleration with $\theta = \pi$ radians. For $\theta = \pi/2$ radians, there is circular motion, round a central force of attraction, with zero radiation power.

6. CONCLUSION

Equations (3), (4) and (5) show that the speed of light, relative to an observer, can be subtracted from or added to, contrary to the relativistic principle of constancy of the speed of light for all observers, statioary or moving. So, a cardinal principle of the theory of special relativity becomes questionsble.

Equations (8), (10) and (12) show that accelerating force, on an electron, depends on speed of the electron. Accelerating force reducing to zero at the speed of light gives the same effect as apparent increase of mass with speed to become infinite at the speed of light c,

In equation (13) the relativistic mass-velocity formula is rationalised. Here, ζ (zeta) is not a physical mass but the ratio of electrostatic force ($-eE$) to centripetal acceleration ($-v^2/r$) in circular motion. This ratio becomes infinitely large for rectilinear motion, without any problem of infinite masses. In a straight line, which is the arc of a circle of infinite radius, the centripetal acceleration is zero. Dismissing equation (14) and doing away with infinite masses at the speed of light, should bring great relief to physicists all over the world.

Equations (15) and (16) give the same radius of revolution as $r = \gamma r_o$. for the relativistic and an alternative electrodybanics. The radius can become infinitely large for motion in a straight line, which is the arc of a circle of infinite radius. This increase of radius was misconstrued by special relativity as due to increase in mass with velocity.

An important result of this paper is contained in equation (18). Here, if $\theta = \pi/2$ radians, there is circular motion, round a central force of attraction, with zero radiation power. This makes Ruthrford's nuclear model of the hydrogen atom inherently stable. Radiation takes place only where the electron is somehow dislodged from a circular orbit. It then revolves in an unclosed elliptic orbit with emission of radiation at the frequency of revolution, before reverting back to the stable circular orbit.

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