1)

SOME NOTES ON THE CLASSICAL EXPLANATION OF EDDINGTON'S EXPERIMENT (1919 – 1922)

In these notes we use Jackson's notation unless otherwise indicated.

The Eddington experiment (1919 - 1922) observed refraction of starlight by the sun during an eclipse. This was explained using Einstein's 1916 theory of gravitation as essentially gravitational attraction between the photon and the sun.

A classical explanation requires a unified field theory of gravitation and electromagnetism. The Evans unified field theory explains the effect as follows:

$$\boxed{\begin{array}{l} d \wedge F = 0 \\ d \wedge \tilde{F} = 0 \end{array}} \xrightarrow{\text{GRAVITATION}} \boxed{\begin{array}{l} d \wedge F = \mu_0 j \\ d \wedge \tilde{F} = \mu_0 J \end{array}} \qquad (1)$$

In region of free space where gravitation is vanishingly weak, a beam of light is described by the left hand box of Fig (1).

2) In the presence of gravitation the charge-current densities j and J are non-zero:

$$j = -A^{(0)}(q \wedge R + \omega \wedge T) \neq 0 \quad -(2)$$

$$J = -A^{(0)}(q \wedge \tilde{R} + \omega \wedge \tilde{T}) \neq 0 \quad -(3)$$

Without going into details of the structure of j and J the well known methods of classical electrodynamics can be used to show that j and J cause the light beam to be refracted, or deflected, by the sun.

This is the first classical explanation of the Eddington experiment by a unified field theory.

The very fact that a light beam is refracted by a mass proves the Evans field theory experimentally. The Einstein theory is implicitly a quantum theory in the sense that the photon is used and does not offer a classical explanation such as in Fig (1). In the Maxwell Heaviside theory refraction by mass does not occur at all, because mass and gravitation do not occur in classical electrodynamics in which the source of electromagnetism is accelerated charge. The charge is a point charge without mass.

In the Evans field theory j and J are properties of spacetime with curvature and torsion, so mass can cause the refraction of light. There are also other effects such as absorption and dispersion due to gravity, and in general any classical electrodynamical effect of a "dielectric". The "dielectric" in this case is spacetime, more specifically the Evans spacetime defined by the presence of both curvature and torsion.

The simplest approximation to eqns. (2) and (3) is:

$$j = 0 \qquad -(4)$$

$$J = -A^{(0)} q \wedge \tilde{R} \qquad -(5)$$

i.e.

$$\boxed{\begin{aligned} d \wedge F &= 0 \qquad &-(6)\\ d \wedge \tilde{F} &= \mu_0 J = -A^{(0)} q \wedge \tilde{R} \qquad &-(7)\end{aligned}}$$

In this approximation:

$$q \wedge R = 0 \qquad -(8)$$

$$T = 0 \qquad -(9)$$

for gravitation, and

$$q \wedge R + \omega \wedge T = 0 \quad — (10)$$

for electromagnetism. Eqns (8) and (9) define <u>central gravitation</u> of Einstein / Newton type, and eqn. (10) defines the electromagnetic geometry in free space (regions remote from central gravitation).

So in this simplest approximation, the Eddington effect is caused by eqns (6) and (7) <u>simultaneously</u>. So to explain the effect quantitatively we must solve eqns (6) and (7) simultaneously, using the Einstein theory of gravitation to find $q \wedge \tilde{R}$. Qualitatively eqns (6) and (7) have the same mathematical structure as the Maxwell Heaviside eqns of classical electrodynamics. Therefore we can see that refraction occurs, plus other effects (see for example Jackson chapt. 7).

MWE,

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