

Derivation of PLANCK's Constant from MAXWELL's Electrodynamics

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Let us go from MAXWELL's equations of the vacuum that culminate in wave equations for the electric potential

$$\square\varphi = 0 \tag{1}$$

and

$$\square\mathcal{A} = 0 \tag{2}$$

for the magnetic vector potential.

Take the wave solution from equ. (2), in which the vector potential consist of a single component vertical to the propagation direction

$$A_y = A_y(\omega \cdot (t - x)) \quad , \tag{3}$$

in which is set $c = 1$ (normalization).

ω is a constant, and is identical with the circular frequency at waves.

x means the direction of the propagation.

A_y is an *arbitrary* real function from $\omega \cdot (t - x)$, and independent on y, z .

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The field strengths respectively flow densities (which are the same in the vacuum) become

$$E_y = \frac{\partial A_y}{\partial t} = \omega A'_y(\omega \cdot (t - x)) \quad , \quad (4)$$

and

$$B_z = -\frac{\partial A_y}{\partial x} = \omega A'_y(\omega \cdot (t - x)) \quad . \quad (5)$$

A'_y means the total derivative.

The energy density of the field results in

$$\eta = \frac{\varepsilon_0}{2} \cdot (E_y^2 + B_z^2) = \omega^2 \varepsilon_0 A_y'^2(\omega \cdot (t - x)) \quad . \quad (6)$$

The geometric theory of fields allows geometric boundaries from the nonlinearities in the equations of this theory. [1] If one assumes such boundary, like those in stationary solutions of the non-linear equations, the included energy becomes the volume integral within this boundary

$$\iiint \eta \, d(t-x) \, dy \, dz = \omega \varepsilon_0 \iiint A_y'^2(\omega \cdot (t-x)) \, d(\omega \cdot (t-x)) \, dy \, dz \quad . \quad (7)$$

This volume integral were not possible without the boundary, because the linear solution alone is not physical for the infinite extension.

We can write the last equation as

$$E = \omega \hbar \quad , \quad (8)$$

or

$$E = h \nu \quad , \quad (9)$$

because the latter volume integral has a constant value. The fact that this value is always the same also means, that exactly one solution exists with ω as parameter.

With it, the fundamental relation of quantum mechanics follows from classical fields.

Summarizingly, the derivation involves two predictions:

- 1) The photon has a geometric boundary. That may be the reason of the particle behaviour.
- 2) There is exactly one wave solution.

This could be supported by numerical simulations, when the value of above volume integral became \hbar/ε_0 .

Reference :

[1] BRUCHHOLZ, U. : <http://bruchholz.psf.net/article2.txt> ,
with more references.

See also <http://bruchholz.psf.net/Geometry.pdf> .

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