Derivation of PLANCK's Constant from MAXWELL's Electrodynamics

Ulrich BRUCHHOLZ*

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

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

and

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

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

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

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.

*Dipl.-Ing. *Ulrich Bruchholz*, http://www.bruchholz-acoustics.de

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

$$E_y = \frac{\partial A_y}{\partial t} = \omega A_y'\Big(\omega \cdot (t - x)\Big) \qquad , \tag{4}$$

and

$$B_z = -\frac{\partial A_y}{\partial x} = \omega A_y'\Big(\omega \cdot (t - x)\Big) \qquad . \tag{5}$$

A_y' means the total derivative.
The energy density of the field results in

$$\eta = \frac{\varepsilon_\circ}{2} \cdot (E_y^2 + B_z^2) = \omega^2 \varepsilon_\circ {A_y'}^2\Big(\omega \cdot (t - x)\Big) \qquad . \tag{6}$$

The geometric theory of fields allows geometric boundaries from the non-linearities 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

$$\iiint \eta \, \mathsf{d}(t-x) \, \mathsf{d}y \, \mathsf{d}z \quad = \quad \omega \quad \varepsilon_\circ \iiint {A_y'}^2\Big(\omega \cdot (t-x)\Big) \, \mathsf{d}\Big(\omega \cdot (t-x)\Big) \, \mathsf{d}y \, \mathsf{d}z \quad . \tag{7}$$

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

$$E = \omega \; \hbar \qquad , \tag{8}$$

or

$$E = h \; \nu \qquad , \tag{9}$$

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 $\hbar/\varepsilon_\circ$.

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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