Simplification of the Klein–Gordon Equation

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Abstract

In this note we are simplifying the Klein–Gordon Equation.

Keywords: Klein–Gordon equation, Planck mass, Compton wavelength.

Klein–Gordon in Simplified Notation

Haug (2016) has shown that the Planck mass can be rewritten in the form

$$m_p = \sqrt{\frac{\hbar c}{G_p}} = \frac{\hbar}{l_p}\frac{1}{c} \tag{1}$$

Basically any (uniform) mass can be written as[1]

$$m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c} \tag{2}$$

where $\bar{\lambda}$ is the reduced Compton wavelength of the mass of interest. For example, for a Planck mass the reduced Compton wavelength is l_p, for a electron it is $\bar{\lambda}_e$, and for a proton it is $\bar{\lambda}_p$. This form of notation for the mass of elementary particles does not change their values (weight) etc., it simply gives deeper insight and makes it easier to understand the subatomic world. The difference between different "elementary" masses is basically the Compton wavelength.

The Klein–Gordon equation is given by

$$\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\psi - \nabla^2\psi + \frac{m^2c^2}{\hbar^2}\psi = 0 \tag{3}$$

The last term can be simplified to:

$$\frac{m^2c^2}{\hbar^2} = \frac{\frac{\hbar^2}{\bar{\lambda}^2}\frac{1}{c^2}c^2}{\hbar^2} = \frac{1}{\bar{\lambda}^2}$$

In other words the Klein–Gordon equation can simply be written as

$$\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\psi - \nabla^2\psi + \frac{1}{\bar{\lambda}^2}\psi = 0 \tag{4}$$

It is only a simplified "notation", but still we hope it can be of interest to some people.

References

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[1]See also Haug (2014) where a similar mass formula is derived directly from ancient atomism.