SSRG International Journal of Applied Physics
ISSN: 2350-0301/ https://doi.org/10.14445/23500301/IJAP-V12I2P102
Volume 12 Issue 2, 12-14, May-Aug 2025


*Original Article*

# Intrinsic Properties of a Quantum

Lim Sau Kong

*32, PSRN Wira Jaya Timur 40, TMN Leow Yan Sip,31350 Ipoh, Perak, Malaysia.*

*Corresponding Author : saukong@hotmail.com*

Received: 26 May 2025 Revised: 01 July 2025 Accepted: 17 July 2025 Published: 06 August 2025

***Abstract*** *- The paper aims to define rest mass, spin and charge of a particle by further extending the perspectives and concepts of Motion-Rest & Interval-Quantum. The concepts of rest mass, spin and charge developed lay under the framework of Galilean-Einstein relativity, thus partially fulfilling the unified theory proposed in the paper "Map of physics under Yin-Yang theory".*

***Keywords*** *- Charge, Quantum mechanics, Rest mass, Spin, Unified theory.*

## 1. Introduction

This paper aims to define intrinsic properties of a particle, as contemporary theories have not yet defined these particle properties. The concepts of rest mass, spin, and charge developed in this paper are based on the concept of a quantum in "rest" relative to a coordinate system, which *is a matter or particle with rest mass, $m_0$.*

Summaries as equations:

$$E = hf = m_0c^2 \tag{1}$$

$E$ =energy of a quantum
$h$ = Planck's constant
$f$ =frequency
$m_0$= rest mass
$c$ =speed of light

## 2. Literature Review

The standard model of particle physics did not define the intrinsic properties of particles; instead, the model had assumptions contradicting concepts in the macroscopic world, such as that electron has no size and exact position. Although de Broglie had postulated the concept of matter wave [1], the mathematical formalization of the matter wave did not conclude the wavelength of a rest particle either.

*Plank-Einstein Equation*

$$\mathrm{E} = \mathrm{hf} = \mathrm{mc}^2 \tag{2}$$

*de Broglie Equation*

$$E = hf = mv^2 \tag{3}$$

*V = speed of particle with rest mass*

The logical reasoning of de Broglie to derive equation (3) from (2) is simply too vague, as a photon doesn't have rest mass.

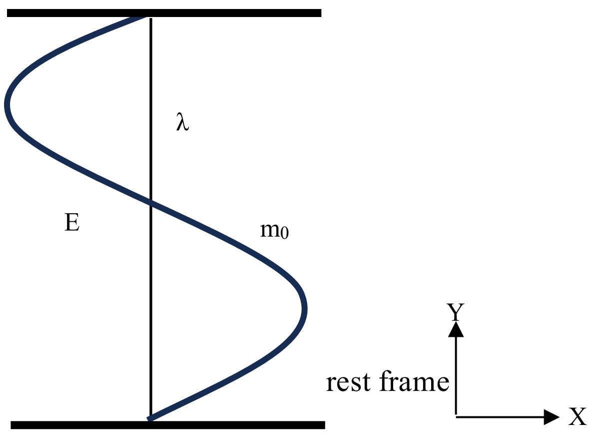
## 3. Intrinsic Properties of a Quantum

The following sections shall explore intrinsic properties of a quantum by using Yin-Yang theory philosophy reasoning:

1. Extend the perspectives of *Motion-Rest, Interval-Quantum* to acquire new perspectives with concept(s).
2. The physical law that governs the phenomenon in the macroscopic world manifests a similar physical law in the microscopic world (higher level).
3. A quantum is 1(one) wave; the intrinsic properties shall be the behaviors or characteristics of 1(one) wave derived based on the above two principles.

### *3.1. Rest Mass*

A quantum at rest is a (one) wave as shown in Fig. 1, repeatedly fluctuating within the wavelength, λ.




E=Intrinsic Energy
$m_0$=rest mass
λ=wavelength

**Fig. 1 One wave in rest relative to a coordinate system**

Hence, from above, the *invariant mass* of a particle with a single quantum, such as an electron, is the most basic energy level of a particle, which is $E=hf$.

#### *3.1.1. Wavelength*

The wavelength of a quantum at rest is the result of combining $E=mc^2$ with $E=hf=h\frac{c}{\lambda}$

$$\lambda = \frac{h}{mc} \quad (2)$$

Due to the relativity effect, the wavelength contracts as the particle moves from rest to a speed, $v$.

$$\lambda = \lambda_0\sqrt{1-\frac{v^2}{c^2}} \quad (3)$$

$\Lambda$ = $\lambda$ = $\lambda$=wavelength a moving quantum (one wave) measured by an observer at rest frame
$\lambda_0$= wavelength of a quantum (one wave) at rest measured by an observer at rest frame

Thus, from equation (2), the mass of a single quantum particle shall be increased when it is in motion. The relation of moving mass, m, with moving speed, v, shall be:

$$m = \frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}} \quad (4)$$

$m_0$=rest mass

### *3.2. Spin*

Spin is somehow related to the polarization of light; it is the circular motion of 1 one wave without the effect of superposition or interference. A particle with a single quantum as invariant mass, such as an electron, cannot have superposition or interference with itself. Thus, the spin of a quantum (one wave) is the rotational motion of a quantum energy, *E,* against an axis line characterized by the wavelength, $\lambda$.

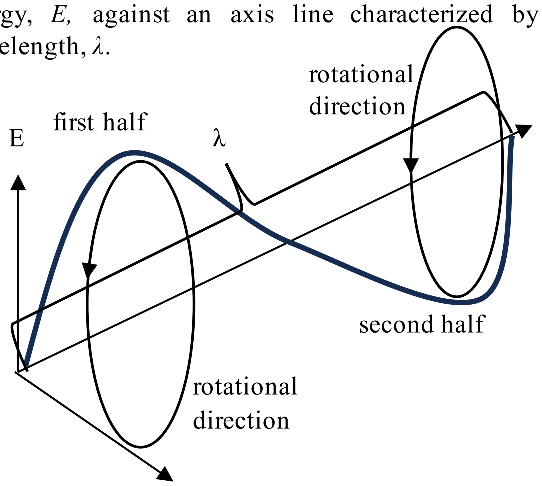



**Fig. 2 The spin of a quantum (one wave)**

Spin 1 represents the first and second half of a wave or quantum that are rotating at the same speed, thus the quantum or wave returns to its original state after a full rotation($2\pi$)

Spin 1/2 represents the first and second half of a wave or quantum are rotating at different speeds, thus the quantum or wave returns to its original state after two cycles of rotation ($4\pi$)

### *3.3. Charge*

Charge is a property possessed by a particle with rest mass. The charge of a quantum (one wave) is the fluctuation of the quantum (one wave) in a specific pattern within a finite boundary of length equal to wavelength, $\lambda$; the "virtual quantum or virtual wave" is entering the finite boundary form one side and then terminate at the other side (the speed shall be the speed of light, c. Thus, the quantum is fluctuating within the boundary observed by an observer at rest frame. "Virtual quantum or virtual wave" has no energy value outside the finite boundary.

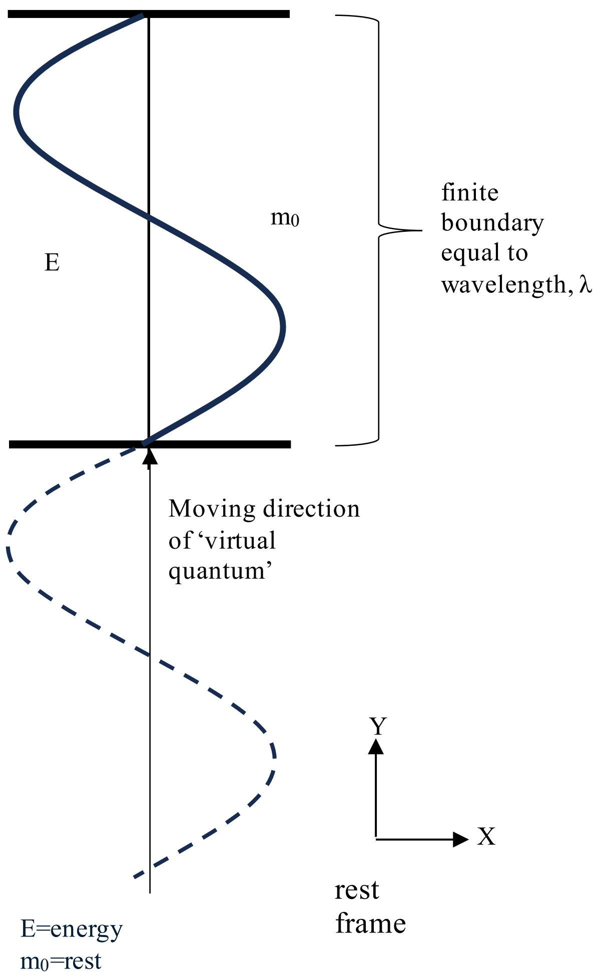



**Fig. 3 The concept of charge**

A photon is a quantum or 1(one) wave that moves with constant speed, c, in a straight line, inherently depicting a photon has an intrinsic tendency or force to move in the forward direction. Thus, a particle with a single quantum as invariant mass, such as an electron, has an intrinsic tendency or force to push other electrons.

## 4. Conclusion

The intrinsic properties of a quantum: rest mass, spin, and charge, have been discussed or defined. A quantum at rest is a (one) wave repeatedly fluctuating within the wavelength, $\lambda$, whereas the spin of a quantum (one wave) is the rotational motion of a quantum energy, E, against an axis line characterized by the wavelength, $\lambda$. Finally, charge is a property possessed by a particle with rest mass; the charge of a quantum (one wave) is the fluctuation of the quantum (one wave) in a specific pattern.

## References

[1] Nouredine Zettili, *Quantum Mechanics Concepts and Applications*, 2nd Ed., Wiley, 2009. [Google Scholar] [Publisher Link]