

# **Zero energy non-zero momentum particles**

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## Abstract

In the article with title “Matter-light duality and speed greater than light” [1], we formulated energy and momentum equations for particles with speed greater than light. In this article we see a special case of it where the energy becomes zero and momentum is non-zero for a particle (we named them as ZEN particles). These particles have infinite speed and thus exist only for an instance of time, being omnipresent at that time. These particles when present in any system can take away or add momentum without taking away or adding energy to the system. When these take away momentum, they lead to conversion of kinetic energy to mass. When these particles add momentum they lead to conversion of mass to kinetic energy. We conjecture that these particles form space component of space time and also the binding force in the atom nucleus.

*Keywords:* Matter light duality, speed greater than light, Zero energy non-zero momentum

## 1. Introduction

In the article “Matter-light duality and speed greater than light”, we formulated the energy and momentum of particles above the speed of light [1]. In this article we investigate a special case of it where the particles become zero energy but non zero momentum.

In section 2 we look at the condition in which a particle becomes zero energy non-zero momentum and in the section 3, we look at the significance of these for conversion of mass to energy and vice a versa.

## 2. Formulation

We formulated in the article with title “Matter-light duality and speed greater than light” the energy and momentum of particle with speed greater than light. We also formulated that a particle with speed greater than light will have dual measurements, one of which is positive and another one is negative. Taking the negative observation (same for positive observation but sign changes) of energy and momentum of a particle with the speed greater of light we have following:

$$E = -mc^2 / \sqrt{v^2 / c^2 - 1}$$

$$P = -mv / \sqrt{v^2 / c^2 - 1}$$

Taking limit  $v \rightarrow \infty$  we get:

$$E = 0$$

$$P = -mc$$

The above are the particles with 0 energy and finite momentum. As the speed of them is infinite they exist only for a particular instance of time, where they become omnipresent in the space.

## 3. Conclusion and Results

1. ZEN particles can add or take away momentum from particles without effecting the energy. This means that the when these particles take away momentum without taking away energy, they will lead conversion of kinetic energy to rest mass energy.
2. When the ZEN particles add momentum without adding energy, they effectively lead to conversion of mass to kinetic energy.

3. As these particles exist only for an instance of time but are omnipresent, we think that they might be forming the space component of the space time and are very important for understanding of the relation among mass, energy, space and time.

4. We predict that these particles form binding force in the nucleus of an atom because they have the ability to convert rest mass energy to kinetic energy and vice a versa.

## References

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