Mass Increase with Speed Explained as a Relativistic Doppler Effect

Constantin SANDU[1], Dan BRASOVEANU[2]

[1]Romanian Research and Development Institute for Gas Turbines-COMOTI,
220D, Iuliu Maniu Bvd., Sector 6, OP76, CP174, Bucharest, Romania
constantin.sandu@comoti.ro

[2]Systems Engineering Group Inc. (SEG), USA
9861 Broken Land Pkwy, suite 350, Columbia, MD, 21046, USA
brasovdx@yahoo.com

ABSTRACT

In this paper the authors show that the 'mechanism' of mass increase is simple and can be explained by the wave feature of body micro-components. From this point of view, the mass increase with speed perceived by a fixed observer is a Doppler relativistic effect.

Indexing terms/Keywords

Relativistic mass; explanation of mass increasing with speed

Academic Discipline And Sub-Disciplines

Physics, Relativity, Special Theory of Relativity

SUBJECT CLASSIFICATION

TYPE (METHOD/APPROACH)

Theoretical

1. INTRODUCTION

The Special Theory of Relativity (STR) states that the mass varies with speed and this prediction was experimentally validated. After over 100 years of relativity, this increase is still considered a weird thing because this phenomenon did not yet received an intuitive demonstration.

The phenomenon of mass contraction can be easily accepted by intuition if the wave feature of micro-components of body is considered. The Doppler effect for sound sources is easily understood by everybody: The frequency of sound heard by an observer increases when the sound source approaches by observer and decreases when the sound source departs by observer. Similar, the frequency of associated waves of micro-components of a body are subject to the Doppler relativistic effect when they are perceived by an external observer, i.e. the frequency of wave (of micro-component) which moves towards the observer is perceived as been higher than the frequency of the same wave (of micro-component) when it departs by observer. But the observer perceives only an average frequency. According to Doppler relativistic effect this average frequency is inversely proportional with the number $\sqrt{1-V^2/c^2}$ because the terms containing speed of body at the power of 1 disappear. The mass of a body at rest is proportional with the frequencies of the associated waves of its micro-components. When the body is moving with a given speed V, the average frequency 'seen' by observer increases and that observer must perceive accordingly that mass of body increases in the same proportion as the average frequency.

2. DEMONSTRATION

Assume that a massless reflective sphere contains a number of photons, n, which reflects inside forming stationary waves having frequency v_0 (see **Figure 1**; for simplicity only one stationary wave corresponding to photon no.1 was represented). The angle between the propagation direction of wave and the x-axis is θ. If the sphere begins to move with speed V in the x-direction, the observer will note a shift in the frequency of wave caused by the Relativistic Doppler effect [1]. When the wave propagates from A to B (case 1'), the observed frequency increase is:

$$v_{1'} = v_0 \frac{1+\frac{V}{c}\cos\theta}{\sqrt{1-\frac{V^2}{c^2}}} \tag{1}$$

When the wave propagates from B to A (case 1"), the observed frequency decreases:

4702 | P a g e
M a r c h , 2 0 1 7
w w w . c i r w o r l d . c o m

I S S N   2 3 4 7 - 3 4 8 7
V o l u m e   1 3   N u m b e r   2
J o u r n a l   o f   A d v a n c e s   i n   P h y s i c s

$$\nu_{1"} = \nu_0 \frac{1 - \frac{V}{c}\cos\theta}{\sqrt{1 - \frac{V^2}{c^2}}}$$

(2)

Equation (1) and (2), provide the average frequency ν_1 of photon:

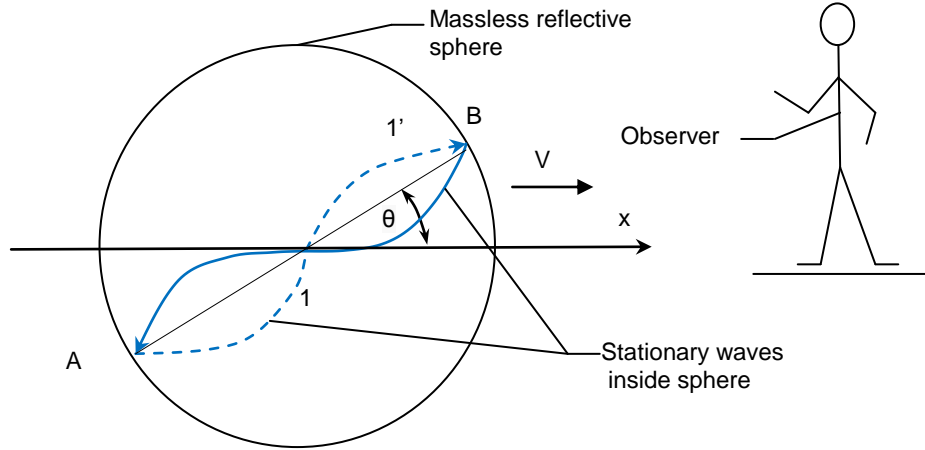

Fig.1: The Doppler Effect explains mass increase of mass with speed

$$\nu_1 = \frac{1}{2}(\nu'_1 + \nu''_1) = \frac{\nu_0}{\sqrt{1 - \frac{V^2}{c^2}}}$$

(3)

and the average energy E_1 of photon is therefore:

$$E_1 = h\nu_1 = \frac{h\nu_0}{\sqrt{1 - \frac{V^2}{c^2}}}$$

(4)

Obviously the average mass m_1 is:

$$m_1 = \frac{E_1}{c^2} = \frac{h\nu_0}{c^2\sqrt{1 - \frac{V^2}{c^2}}} = \frac{m_0}{\sqrt{1 - \frac{V^2}{c^2}}}$$

(5)

Taking into account that the sphere contains n photons, the total mass m_S of sphere moving with velocity V is:

$$m_S = n \cdot m_1 = \frac{n \cdot m_0}{\sqrt{1 - \frac{V^2}{c^2}}} = \frac{m_{0S}}{\sqrt{1 - \frac{V^2}{c^2}}}$$

(6)

The relativistic formula correlating mass and velocity was thereby determined in a manner that clarifies the interdependence 'mechanism'.

Similar, for a body composed of condensed matter which is moving with speed V with respect to a fixed observer, mass increase is a natural phenomenon because:

1) waves associated with body particles are subject to the Relativistic Doppler Effect, which causes frequency changes;

2) the observer can detect only the body's inertia, therefore he perceives only the average frequency of these associated waves;

3) the average frequency of associated waves increases with velocity. Therefore, the observer detects increased inertia of body with speed.

In other words, mass increase is a consequence of the Doppler relativistic effect and the wave aspect of its micro-components, waves which propagate between two positions A and B, which are virtually fixed.

3. CONCLUSIONS

Increase of body mass with speed is a natural phenomenon, which can be explained as a Doppler relativistic effect applied to the body micro-components seen as stationary waves in the matrix of body.

An external observer perceives the inertia of a body through the average frequencies of stationary waves of its components. When the speed of body increases, those average frequencies increase with speed due to Doppler effect.

ACKNOWLEDGMENTS

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Author' biography with Photo

Aerospace engineer, Romanian scientist. Scientific researcher at Romanian Research and Development Institute for Gas Turbines-COMOTI, Bucharest, Romania. PhD in power transmission through mechanical vibrations. Over 35 papers in the field of physics of flight and aerospace propulsion. Project manager in 5 national and European research projects, 8 inventions.

Dr. Dan Brasoveanu is an expert in theoretical and applied physics including physics of propulsion, guidance navigation and control (GNC). He is also an expert in satellite sensors and nuclear detection systems. He worked for NASA, USA Department of Defense and Department of Homeland Security. He is the author or co-author of more than 40 science papers on propulsion, satellite GNC and theoretical physics published in science journals and refereed conference publications and of a book on quantum and relativistic mechanics included in the library of Conseil Européen pour la Recherche Nucléaire (CERN).