Frequency shift caused by gravitation, Doppler and aberration

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ABSTRACT

This paper describes a frequency shift with the difference in particle speed and effective potential. Gravitational frequency shift by the height difference is changing the frequency of the light source, and it is changing the wave speed and wavelength of the photon. The frequency of light source is offset by the increase in motion energy and the delay of the clock, and that Doppler shift is a synthesis of the classical Doppler shift and the aberrational Doppler shift. And the translational movement of longitudinal direction without aberration is only the primary Doppler shift occurs. In the case of Flyby anomalies explain that the difference of effective potential appears to frequency shift. If we do not use the absolute stationary coordinate, we had been lost the guarantee of the same inertial system. However, it is used as in the same inertial system if there is no occurrence of a frequency shift.

Keywords: particle speed, effective potential, gravitational, light source, wavelength, photon, motion energy, clock, translational, longitudinal, primary, Flyby anomalies, absolute stationary coordinate, inertial system.

1. INTRODUCTION

My previous research [1] involved representing energies (gravitational mass, inertial mass, and Planck's constant) of different particle speeds as an equivalence for quantum ($Mc = \Delta m \Delta w = hf/c$). In addition, $E = Mc^2$ (kinetic energy is changed to mass) does not indicate that the total energy change is always proportional to particle speed. Therefore, "energy representation of a mathematical action," and "energy change of a physical interaction" are not similar. The actual physical phenomenon should distinguish between these actions.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

The wave speed and total energy of the object to be resting at the invariant system is,

$$c = w_0 = f_0\lambda_0, \tag{1}$$
$$E_0 = M_0c^2. \tag{2}$$

2.1. Gravitational Red (Blue) Shift by the difference of the effective potential:

A state that has lost the effective potential energy from the Eq. (1,2) is,

$$w_L = (c^2 - 2\Phi_L)^{1/2} = (c^2 - 2GM/r + \omega^2 r^2 \cos^2\theta)^{1/2}, \tag{3}$$
$$E_L = (w_L/c)E_0. \tag{4}$$

When represent the energy quantum, it is,

$$hf_L = (w_L/c)hf_0, \tag{5}$$

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A state Eq. (3) was offset by the addition of effective potential energy to the Eq. (4) is,

$$w_H = (c^2 - 2\Phi_H)^{1/2} = (c^2 - 2GM/[r+h] + \omega^2[r+h]^2 cos^2\theta)^{1/2}, \quad (6)$$
$$E_H = (w_H/c)E_0. \quad (7)$$

When represent the energy quantum, it is,

$$hf_H = (w_H/c)hf_0, \quad (8)$$

Light emitted from the object to be still at an altitude ($r+h$) → Gravitational blue-shift when viewed from the observer of the altitude (r) is,

$$\lambda_0 > \lambda_L = w_L/f_H. \quad (9)$$

Light emitted from the object to be still at an altitude (r) → Gravitational red-shift when viewed from the observer of the altitude ($r+h$) is,

$$\lambda_0 < \lambda_H = w_H/f_L. \quad (10)$$

Gravitational red (blue) shift by the height difference ($r < r+h < \infty$) is changing the frequency ($f_L < f_H < f_0$) of the light source, and it is changing the wave speed ($w_L < w_H < w_0$) and wavelength ($\lambda_L < \lambda_0 < \lambda_H$) of the photon. These are supported by the following observations fact.

a) The difference between the progresses of clocks is not related to the propagation of photons [2].
b) The photon does not change the propagation speed by the difference in the energy (frequency) [3].
c) Strong gravitational field than observer delay the arrival time of the photons pass through [4].

2.2. The slowing of clocks is offset by the difference of motion energy:

A state that has added the motion energy from the Eq. (1,2) is,

$$w = (c^2 - v^2)^{1/2}, \quad (11)$$
$$E = (c/w)E_0. \quad (12)$$

When represent the energy quantum, it is,

$$hf = (c/w)hf_0, \quad (13)$$

The light source from a motion object → Doppler shift viewed from the invariant system is,

$$f_D = (w/c)f(1-[v\sin\theta/c]^2)^{1/2}/(1-v\cos\theta/c) = f_0(1-[v\sin\theta/c]^2)^{1/2}/(1-v\cos\theta/c), \quad (14)$$
$$\lambda_D = \lambda_0(1-v\cos\theta/c)/(1-[v\sin\theta/c]^2)^{1/2}. \quad (15)$$

The frequency of light source is offset by the increase in motion energy and the delay of the clock, and that Doppler shift is a synthesis of the classical Doppler shift and the aberrational Doppler shift. These are supported by the following.

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a) The space-time from Noether's theorem there is a translational invariance and time invariance [5].
b) In Inverse photo-electric effect [6], the frequency of photons emitted from the moving electron is increased.
c) In Inverse Compton scattering [7], when electrons and photons in the relative motion collide, electron motion energy are transferred to the energy of the photon.

3. RESULTS AND DISCUSSION

They are summarized that the frequency shift of the light source is caused by the difference in the gravitational potential in Table 1 and Fig. 1. A frequency shift of the light source if the **Effective** potential is the same does not occur. And the translational movement of longitudinal direction without aberration is only the primary Doppler shift occurs. However the red-shift in both directions with aberration in the rotational motion, such as the Mossbauer rotor experiment [8,9,10,11].

TABLE 1. Frequency shift caused by gravitation, Doppler and aberration

Viewing Source from Observer	Gravitational Blue Shift	Gravitational Red Shift	Doppler Shift	Doppler Shift	Aberrational Red Shift	Aberrational Red Shift
Total Energy	↑	↓	↑	↓	↑	↓
Particle Speed	–	–	↑	↓	↑	↓
Wave Speed	↑	↓	↓	↑	↓	↑
Effective Potential	↓	↑	–	–	–	–

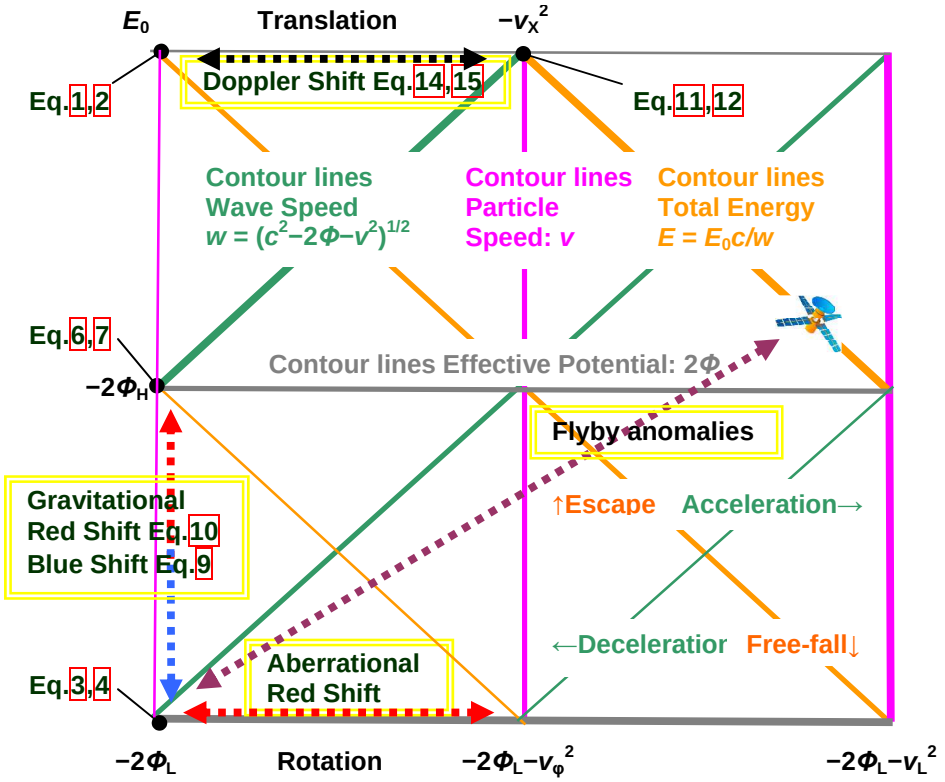

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FIG. 1. The frequency shift with the four-dimensional contour lines for the particle speed (Y axis), the effective potential (X axis), the total energy (＼Clinoaxis) and the wave speed (／ Clinoaxis).

In the case of the Flyby anomalies [12], the resting state in the Earth's surface Eq. (3,4) has lost the kinetic energy of effective potential worth by the free fall from infinity Eq. (1,2). The difference between the gravitational potential ($v_\infty^2 = v\,v - 2GM_E/r_E$) [13] of the Flyby anomalies and the effective potential of the equatorial surface ($\theta = 0°$ of Eq. [11,12]) appears to the centrifugal force potential like the empirical formula ($\Delta v_\infty = [v_\infty \times 2\omega_E r_E/c][\cos\delta_i - \cos\delta_o]$) of J.D. Anderson et al. [13]. It appeared to the difference between the Doppler shift and range data, and therefore is supporting the relationship of the frequency shift with the four-dimensional contour lines of Fig. 1. Fig. 2 is representing the difference between the Doppler shifts of relativity.

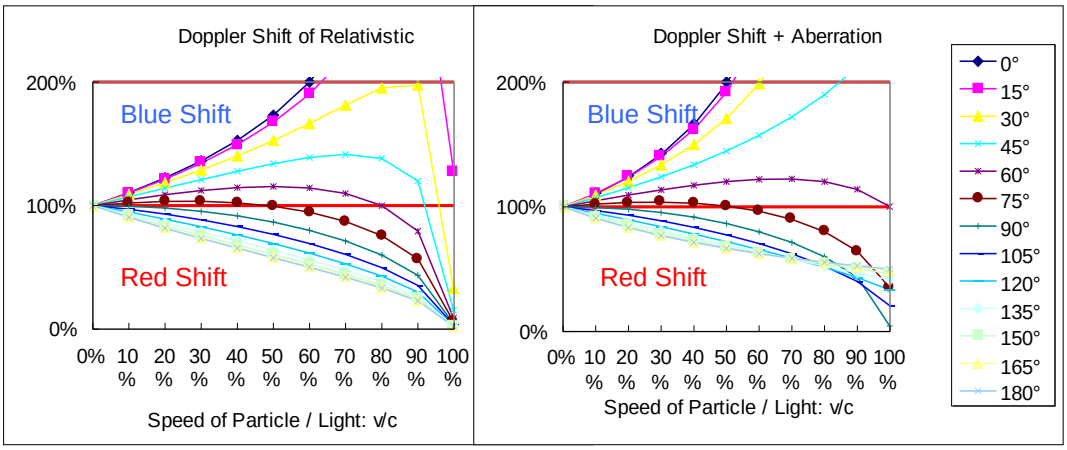

FIG. 2. Comparison of the Doppler shift of this paper and the relativity: A Doppler shift of this paper is the same as almost the relativity at a relative speed (v/c < 30%) of low-speed range or the transverse relative angle (θ = 90°). That aberration Doppler shift is smaller toward the longitudinal relative angle. It will have only the primary Doppler shift at the relative angle (θ = 0°, 180°). On the other hand, the transverse Doppler shift of Relativistic occurs with the relative speed, and the relative angle is not involved, and the frequency will be shifted as disappear at the speed of light.

4. CONCLUSION

This paper has been described a frequency shift with the difference in particle speed and effective potential. If we do not use the absolute stationary coordinate, we had been lost the guarantee of the same inertial system. However, it is used as in the same inertial system if there is no occurrence of a frequency shift.

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