

What Does Free-Fall Acceleration Due to Gravity Tell Us About the Speed of Light in the Space of the Earth?

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Abstract

It is a surprise to learn that free-fall acceleration in the space of the earth actually indicates that the speed of light in earth's space is reduced. We calculate the indicated reduction.

We begin with a right triangle rule for light,

$$v^2 + c^2 = c_0^2 \quad (1)$$

where c_0 is the speed of light in a vacuum, considered constant. We take the derivative of each term with respect to radial vector r :

$$2v \frac{dv}{dr} + 2c \frac{dc}{dr} = 0 \quad (2)$$

We then solve for the acceleration due to gravity,

$$v \frac{dv}{dr} = -c \frac{dc}{dr} \quad (3)$$

where we observe that free-fall acceleration in earth's space is associated with a reduction in the speed of light in the space of the earth.

To find out how much the speed of light is reduced, we solve equation (1) for c :

$$c = c_0 \sqrt{1 - \frac{v^2}{c_0^2}} \quad (4)$$

where v is escape velocity.

Bibliography

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