Gravity Conservation of Energy and Absorption of Two Zero Rest Mass Particles By a Spherical Mass

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Abstract

We compare the energy, including gravitational energy, of a system of two zero rest mass classical particles before and after absorption by a solid spherical mass and show energy is not conserved.

1 Introduction

Units are chosen so that $c = G = 1$. Let x, y, z be the coordinates of space. Consider a static spherical mass of uniform mass density, mass M, radius R, and centre at the origin. Let there be two classical particles with zero rest mass moving in opposite directions from infinity towards the origin along the x axis. Let E be the energy of each particle at infinity.

Let $W(M,R)$ be the gravitational energy of a system of just the spherical mass and no particles. Now $W(0,R) = 0$ and $W(M,R) \to 0$ as $R \to \infty$ hence there is a dimensionless function $f(M/R)$ having $f(0) \neq 0$ such that

$$W(M,R) = \frac{M^2}{R} f\left(\frac{M}{R}\right) \tag{1}$$

2 Energy of the system

When the two particles are at infinity the total energy of the system is using (1)

$$M + 2E + \frac{M^2}{R} f\left(\frac{M}{R}\right) \tag{2}$$

Simultaneous absorption of the two particles by the sphere results in a change of mass of the resulting mass to $M + 2E+$ correction term. The particles gain energy on moving from infinity to the sphere. This energy gain is zero if $ME = 0$. Consequently the correction term has a factor ME/R. We can conclude there is a dimensionless function $F(M/R, E/R)$ such that after the particles are absorbed the new mass of the resulting mass is

$$M + 2E + \frac{ME}{R} F\left(\frac{M}{R}, \frac{E}{R}\right) \tag{3}$$

Using (1) we have after the particles are absorbed by the sphere the new energy of the gravitational field is

$$\frac{1}{R}\left[M + 2E + \frac{ME}{R} F\left(\frac{M}{R}, \frac{E}{R}\right)\right]^2 g\left(\frac{M}{R}, \frac{E}{R}\right) \tag{4}$$

where $g(M/R, E/R)$ is a dimensionless function. This function is required since the mass may not be spherical or have uniform mass density after absorption of particles.

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3 Conservation of energy contradiction

Assuming conservation of energy we can equate (2) to the sum of (3) and (4) giving

$$M + 2E + \frac{M^2}{R} f\left(\frac{M}{R}\right) = M + 2E + \frac{ME}{R} F\left(\frac{M}{R}, \frac{E}{R}\right) + \frac{1}{R}\left[M + 2E + \frac{ME}{R} F\left(\frac{M}{R}, \frac{E}{R}\right)\right]^2 g\left(\frac{M}{R}, \frac{E}{R}\right) \quad (5)$$

Subract $M + 2E$ from (5), then multiply the result by R, and finally letting $R \to \infty$ gives

$$M^2 f(0) = MEF(0,0) + (M + 2E)^2 f(0) g(0) \quad (6)$$

This is a contradiction since $f(0)g(0) \neq 0$.

References

[1] K. De Paepe, Physics Essays, **30**, 2 (2017)