Gravitational Redshift According to the Reciprocal System

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If the frequency of a photon is f', at a location where the gravitational potential is GM/r, then according to Relativity the gravitational redshift is given by

$$z_g = \frac{f' - f}{f} = \frac{-GM}{rc^2} \tag{1}$$

where

f = frequency of the radiation in its inertial rest frame,

G = gravitational constant,

M = mass of the object,

r = radial distance of the photon and

c = speed of light.

The account of the gravitational redshift in the Reciprocal System may be given as follows:

The gravitational motion of any material particle is inward in space, toward all other space-time locations. In a celestial object such as a star, which is an aggregate of such material units, this scalar inward motion of the individual units is counterbalanced by the physical contiguity of the neighboring units. This counterbalancing force is in the scalar direction of the space-time progression, being opposite to gravity and has the same magnitude as that of the gravitational motion at that location. Thus its measure is equal to the escape velocity, v. How, we can identify the coordinate time increase at a particular location to be v^2/c^2 (in fraction of units/unit), just like in the case of excess perihelion shift. This means that the total time involved per unit of clock time is $[1 + (v^2/c^2)]$ units. The frequency, f, denotes the number of oscillations per unit of tine in a gravity-free situation. In the location under gravity, then, this frequency becomes f number of oscillations per $[1 + (v^2/c^2)]$ units of time. Thus

$$f' = \frac{f}{1 + \frac{v^2}{c^2}} \quad or \quad \frac{f'}{f} = \frac{1}{1 + \frac{v^2}{c^2}} \tag{2}$$

Therefore, the redshift is

$$z_g = \frac{f'}{f} - 1 = \frac{-\left(\frac{v^2}{c^2}\right)}{\left[1 + \left(\frac{v^2}{c^2}\right)\right]} \tag{3}$$

Comparison of the results of the two Theories

The escape velocity, v, is evaluated as follows; The centrifugal force on a mass m rotating at the orbital speed of v at radius r is equal to the gravitational force by the central mass M, under equilibrium situation. Thus

$$m\frac{v^2}{r}=G\frac{M\,m}{r^{2,}}\quad i.e.,\quad v^2=\frac{G\,M}{r} \tag{4}$$

Substituting this in Equation (1) and rearranging, we have, according to Relativity,

$$\frac{f\,'}{f}=1-\left(\frac{v^2}{c^2}\right) \tag{5}$$

Comparing this with Equation (2) we can see that $1 - v^2/c^2 \approx (1 + v^2/c^2)^{-1}$ for small values of v. The divergence between them can be detected only (i) if the present experimental accuracies can be improved by many orders of magnitude, or (ii) if the test could be carried out for extremely large gravitational potentials such as encountered in the white dwarfs, etc.