Inverse Square-Law Possibly-Followed by Single Photons

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Abstract:

Inverse square-law is followed by electric charges, gravity, and light. Light has shown even an unexpected property, of double-slit-interference of single photons. So it is not unreasonable to expect inverse-square-law to be followed by single photons. Assuming that the single photon is emitted either from the surface of an electron, or a globular-cluster, or a galaxy, the derivation presented here suggests that even a single photon seems to follow the inverse square-law.

The Derivation:

The inverse square-law followed by star-light is well known. Luminosity of a star is expressed as:

$$L = \sigma A T^4, \quad \text{.....(1)}$$

Where A is the area and σ is the Stefan–Boltzmann constant, with a value of: $5.670373(21) \times 10^{-8}$ Watt m^{-2} K^{-4} .

And the flux F is:

$$F = \frac{L}{4\pi r^2}, \quad \text{.....(2)}$$

where r is the distance from the observer to the light source.

We intend to consider three different cases of a single photon either emitted from the surface of an electron, or a globular-cluster, or a galaxy. Let us take energy lost by a single photon, ($h f_0 - h f$) and assume that this is the energy radiated by the source. We can take the initial area A in the expression-1, of emitting surface for electron as 4 pi r_e^2, for the globular-cluster 4 pi R_{globu}^2, and for a galaxy 4 pi R_{gal}^2. We can express a quantity comparable with luminosity of a star L as:

$L' = (4 \pi r_e^2) (h f_0 - h f)$ .....(3)

And we can express a quantity comparable with the flux L in the expression-2 as:

$F' = L' / (4 \pi D^2)$, where D is a very long distance away from the source.

Assuming that F' is gravitational potential-energy of the photon at that distance D:

$[G M_{gal} (h f / c^2) / D] = [(4 \pi R_{gal}^2) (h f_0 - h f)] / (2 \pi D^2)]$

i.e. $[G M_{gal} (h f / c^2) / D] [(4 \pi D^2) / (4 \pi R_{gal}^2)] = (h f_0 - h f)$

i.e. $[G M_{gal} / (R_{gal}^2] D (h f / c^2) = (h f_0 - h f)$ ……..(4)

Now, Sivaram C. has numerically shown that:

$[G M_{gal} / R_{gal}^2] = [G M_{globu} / R_{globu}^2] = [G m_e / r_e^2] = a_0$ of MOND $= H_0 c$,

Where H_0 is Hubble's constant, and c is speed of light, and 'a_0 of MOND' stands for the critical-acceleration of Milgom's Modified Newtonian Dynamics. So we can write the expression-4 as:

$(H_0 c) D (h f / c^2) = (h f_0 - h f)$

i.e. $(h f_0 - h f) / (h f) = (H_0 D / c)$ ……..(5)

We know that the expression-5 is a well known expression for the 'cosmological red-shift'. Therefore, our initial assumption, that even a single photon may be following the inverse square-law, leads to familiar observation of the 'cosmological red-shift'. This derivation leads us to a possibility that the 'cosmological red-shift' may be due to the inverse square-law followed by single photons.

References:

[1] Sivaram, C. (1994) *Astrophysics and Space science* 215, 185-189

[2] Tank Hasmukh K. "Some criteria for short-listing the cosmological red-shift's explanations" http://vixra.org/abs/1501.0193