Tangential acceleration of emitted photon from the star

Manjunath. R. (Reader in physics)

#16, 8th Main road,

Shivanagar, Rajajinagar,

Bangalore-560010

Karnataka, India

manjunathr1988@yahoo.in

Abstract : It is shown that the equation for the calculation of tangential acceleration of emitted photon from the star accounts for the potential energy of gravitational field of star .The above equation $\mathbf{a_T=kE_g}$ (**k** = proportionality constant ,$\mathbf{a_T}$ = tangential acceleration of emitted photon from the star, , $\mathbf{E_g}$= potential energy of gravitational field of star) was developed based on the quantum mechanical concepts , gravitational concepts and classical mechanical concepts .The new mathematical model allows to calculate tangential acceleration of emitted photon from the star . The above equation also describes the variation of tangential acceleration of emitted photon with the potential energy of gravitational field of the star. [Academia Arena 2010;2(3):61-64]. (ISSN 1553-992X).

Key words: Force, photon, gravity, speed of light , acceleration

A star is a massive, luminous ball of plasma that is held together by gravity and it emits energy in the form of radiation . According to Boltzmann's law, Energy of emitted thermal radiation by star is directly proportional to it's absolute temperature .

$$\mathbf{E=KT} \quad (1)$$

Here **K** = Boltzmann constant, **T** = temperature of star , **E**= Energy of emitted radiation **.**

Energy can be emitted or absorbed ,they do so in the form of small packets of energy called photons . Although photons have zero rest mass ,it possess energy and momentum during its motion .Total energy of an object during its motion is also referred as "Relativistic mass" and it depends on the observer's frame of reference. Relativistic mass of photon can be given by $\mathbf{m=E/C^2}$ i.e $\mathbf{E=mC^2}$ (2)

In physics, the concept of force is used to describe an influence which causes a free massive body to undergo an acceleration. Force is an external agency that is responsible for motion of every object in this universe .
Force that moves photon can be given by $\mathbf{F= mC^2/\lambda}$ **i.e** $\mathbf{mC^2} = F\lambda$ (3)
Here $\boldsymbol{\lambda}$ =Debroglie wavelength associated with the emitted photon , **C**= Speed of light in vaccum .
Relativistic mass of photon emitted from the star (hot body) is directly proportional to its absolute temperature.

$$\mathbf{KT = mC^2} \quad (4)$$

Debroglie wavelength assosiated with the emitted radiation can be given by $\boldsymbol{\lambda=h/mc}$

$$\mathbf{KT} = F\lambda \quad (5)$$

$$\mathbf{KT} = F\,\mathbf{h/mC} \quad (6)$$

$$F= (KC/h) * mT \quad (7)$$

Let us take **(KC/h) = e** , where **e =** proportionality constant .
The value of **e** was found to be **6.249*10^18 m/Ks^2 .**

$$F= e\, mT \quad (8)$$

Here **F** = Force that moves photon , **T**=Temperature of star, **m** = Relativistic mass of photon .

Since photon in motion has mass, it has the center of mass as well .Work is performed by the tangential component of force . According to Newton's law of motion , force that produces tangential acceleration in photon of mass m can be given by

$$F= m\, a_r \quad 9)$$

Here a_r = tangential acceleration of emitted photon from the star

By comparison of (8) and (9) we get

$$a_r = e\, T \quad (10)$$

Hence tangential acceleration of emitted photon from the star varies directly with the Temperature of star. Newton's law of gravitation layed the ground work for the astronomical ideas for centuries to come.

The Schwarzschild radius (sometimes historically referred to as the gravitational radius) is a characteristic radius associated with every quantity of mass. It is the radius of a sphere in space, that if containing a correspondingly sufficient amount of mass (and therefore, reaches a certain density), the force of gravity from the contained mass would be so great that no known force or degeneracy pressure could stop the mass from continuing to collapse in volume into a point of infinite density: a gravitational singularity (colloquially referred to as a black hole). The term is used in physics and astronomy, especially in the theory of gravitation, and general relativity.

When the Schwarzschild radius has been attained ,the object will have a strong gravitational field that it will prevent even light from escaping out of its influence .

$$R_g =2GM/C^2 \quad (11)$$

Here **G**= universal gravitational constant, **M**= mass of star, **C**= speed of light in vaccum, R_g = gravitational radius .

Let us divide the above equation by **m** ,where **m=** Relativistic mass of photon.

$$R_g /m=2GM/mC^2 \quad (12)$$

As we know **KT = mC^2** then

$$R_g = 2GMm / KT \quad (13)$$

Here **K**= Boltzmann constant

As tangential acceleration of emitted photon from the star can be given by $a_r = e\,T$ then $T= a_r / e$

$$R_g = 2GMme / K\, a_r \quad (14)$$

$$\mathbf{a_T = (GMm / R_g) * (2e/ K)} \quad (15)$$

Let us take **(2e/ K) = k , Here k =** proportionality constant

The value of **k** was found to be **9.04*10^41m/Js^2** .

$$\mathbf{a_T = (GMmk / R_g)} \quad (16)$$

Gravitational energy is the potential energy associated with gravitational force. If an object falls from one point to another inside a gravitational field, the force of gravity will do positive work on the object and the gravitational potential energy will decrease by the same amount . Potential energy of gravitational field of star can be given by

$$\mathbf{E_g = GMm / R_g} \quad (17)$$

Here $\mathbf{E_g}$ = potential energy of gravitational field of the star ,**M**= Mass of star, $\mathbf{R_g}$ = gravitational radius, **m**= relativistic mass of photon ,**G** = universal gravitational constant

Thus the equation (16) becomes $\mathbf{a_T = k\, E_g}$ (18)

Here **k =** proportionality constant (**9.04*10^41m/Js^2)** .

$\mathbf{a_T}$ = tangential acceleration of emitted photon from the star .

$\mathbf{E_g}$ = potential energy of gravitational field of the star.

If potential energy of gravitational field of the star increases then tangential acceleration of emitted photon from the star also increases by the same degree.

Does Relativistic mass of photon affected by gravity ?

Although photon has zero rest mass (Photon can never be at rest in any frame of reference) but it possess momentum and energy during its motion.Energy carries mass along with it . Hence photon's energy is a measure of mass known as "Relativistic mass" .

Consider a trapped photon escapes from the gravitational field of blackhole .then we observe difference in frequency(Energy) i.e frequency '***f*** ' of photon has decreased . As ***f a*** **m(**Frequency of photon is directly proportional to its Relativistic mass) then there is change in relativistic mass of photon. Part of the energy of trapped photon is utilized to do work against gravitational field of black hole . Thus the Relativistic mass of photon is affected by gravity of black hole .

Conclusion : As Potential energy of gravitational field of the star varies directly with the tangential acceleration of emitted photon from the star i.e $\mathbf{a_T}$ ***a*** $\mathbf{E_g}$. According to equation $\mathbf{a_T = k\, E_g}$, tangential acceleration of photon should be greater then the Potential energy of gravitational field of the star to overcome the gravitational force of star. If potential energy of gravitational field of the star increases then tangential acceleration of emitted photon from the star also increases by the same degree. The value of tangential acceleration of emitted photon can be calculated using the value of potential energy of gravitational field of the star.

Acknowlegement:

I would like to express my deep gratitude to all those who gave me the possibility to complete this thesis.

Correspondance to :

Manjunath. R.(Reader in physics)

#16,8th Main road,

Shivanagar, Rajajinagar,

Bangalore-560010

Karnataka, India

manjunathr1988@yahoo.in

manjunath5496@gmail.com

References :

1) Star (From Wikipedia,the free encyclopedia)

2) Classical mechanics (From Wikipedia,the free encyclopedia)

3) Thermal radiation(From Wikipedia,the free encyclopedia)

4) Gravitation (From Wikipedia, the free encyclopedia)

5)Mass –energy equivalence(From Wikipedia,the free encyclopedia).

6)Newton 's law of motion (From the free Wikipedia encyclopedia)

7) Newton's law of Gravitation (From the free Wikipedia encyclopedia)

8) Gravitational radius of blackhole **:** www.journaloftheoretics.com/Articles/4-1/Kanarev-GravRadBH.pdf - Similar

9) Schwarzschild radius (From the free Wikipedia encyclopedia)

Date of submission: 9.2.2010