***FORCE EXERTED BY HAWKING RADIATION EMITTED BY BLACK HOLE***

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***Abstract:***

***Keywords:***

***Introduction***

**When quantum mechanical effects are taken into account one finds that Blackhole emit thermal radiation (hawking radiation) at a temperature(hawkingtemperature) is given by**

**T=hc^3/2 π (8 π GMk) where h=planck’sconstant, G=universal gravitational constant**

**M= Mass blackhole, k=Boltzmann constant, c=speed of light in vaccum /air**

**Schwarzschild radius of black hole can be given by rs =2GM/c^2**

**Thus T=hc^3/2 π (8 π GMk) becomes T=hc .c^2/8 π^2k 2GM i.e T=hc /8 π^2k rs**

**KT=hc/8 π^2rs**

**According to boltzmann’s law: Energy of emitted thermal radiation by black hole is directly proportional to it’s temperature given by E=KT where k= Boltzmann constant**

**Then the equation KT=hc/8 π^2rs becomes E=hc/8 π^2rs**

**Emitted thermal radiation by black hole will exert outward force to overcome the gravitational force of attraction of black hole. Hence energy of emitted thermal radiation can be given by E=F *λ where E= energy of emitted thermal radiation,F =force exerted by radiation, λ=wavelength of emitted radiation.***

***(PROOF FOR* E=F *λ IS SHOWN AT THE END OF THE DERIVATION)***

***Thus* E=hc/8 π^2rs becomes F *λ*=hc/8 π^2rs**

**Debroglie wavelength assosiated with the emitted hawking radiation can be given by *λ*=h/mc**

**Where m=relativistic mass of photon of emitted hawking radiation**

**Thus F *h/mc*=hc/8 π^2rs hence F=mc^2/8 π^2rs is obtained.**

**The rate of energy flow from black hole is given by P=e σ T^4 A.**

**Where P=rate of energy flow at temerature T,e=emissivity power(for black hole e=1)**

**A=surface area of black body. i.e P= σ T^4 A is obtained.**

**According to Stefan ‘s law :*Energy of emitted radiation from blackhole is* directly proportional to fourth power of it’s temperature E = σ T^4 .where σ=stefan’s constant**

***As we know* hawking radiation *is emitted in the form of photons,hence these photons carry mass along it’s motion.***

***Energy of each photon of* emitted hawking radiation *can be given byE=mc^2***

***By equivalence of stefan’s law and einstein’s mass energy equivalence law we get***

***mc^2=* σ T^4 then the equation P= σ T^4 A becomes P= mc^2A.**

**then P= mc^2A i.e P/A=mc^2**

**Then the equation F=mc^2/8 π^2rs becomes F=P/8 π^2rs A**

**where A=surface area of black hole emitting hawking radiation.**

**Entropy of black hole emitting hawking radiation is given by S=KA/4lp^2**

**Where lp = planck’s length ,S= entropy of black hole emitting hawking radiation**

**By rearranging the above equation we get A=4Slp^2/K**

**i.e F=P/8 π^2rs A becomes F=PK/8 π^2rs 4Slp^2 i.e F=PK/32 π^2rs Slp^2 .**

**Rate of rate of energy flow by blackhole is given by P=** **ρhG/180 π**

**where ρ=black hole** **density,G= universal gravitational constant.**

**then the equation F=PK/32 π^2rs Slp^2 becomes F= ρhG K/180 π(32 π ^2 rs Slp^2 )**

**Planck’s length is given by lp^2=Gh/2 πc^3.**

**Then F= ρhG K/180 π(32 π ^2 rs Slp^2 ) becomes F= ρhG K2 πc^3/5760 π ^3 rs Gh S**

**F= ρ K c^3/2880 π ^2 rs S**

**As *K* =KC^3/2880 π ^2 ,where *K=proportionality constant***

**Thus F = *K* ρ / rs S is obtained. Where F= force exerted by hawking radiation**

**ρ=black hole** **density, rs = schwarzschild radius, S= entropy of black hole emitting hawking radiation , k=Boltzmann constant , c=speed of light in vaccum /air**

**PROOF FOR THE EQUATION E=F *λ***

**Determination of the Photon Force and Pressure**

**References**

[Reissig, Sergej](http://adsabs.harvard.edu/cgi-bin/author_form?author=Reissig,+S&fullauthor=Reissig,%20Sergej&charset=UTF-8&db_key=PHY)

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In [1] the formula for the practical determination of the power of a light particle was derived: P = hf^2 (W) (1). For the praxis it is very usefully to define the forces and pressure of the electromagnetic or high temperature heat radiation. The use of the impulse equation F = fracdPdt = fracd(mc)dt (2) together with the Einstein formula for E = mc^2 leads to the following relationship: F = frac1cfracd(mc^2 )dt = frac1cfracdEdt (3) In [1] was shown: - fracdEdt = P (4). With the use the eq. (1), (3), (4) the force value could be finally determinated: | F | = frachf^2 c or | F | = frachcλ ^2 = fracEλ [N]. The pressure of the photon could be calculated with using of the force value and effective area: p = fracFA [Pa]. References 1. About the calculation of the photon power. S. Reissig, APS four corners meeting, Arizona, 2003 -www.eps.org/aps/meet/4CF03/baps/abs/S150020.html