Temperature Of A Black Hole

10 June 2016
V1 By
Jerry L Decker Ph.D.
Retired Professional Engineer

Abstract

A calculation is given for equilibrium temperature of a black hole revised for blue shifted cosmic background microwaves. A high temperature limit is imposed at the Planck energy level

The result leads to a function of variant Planck constant for use in polarizable vacuum theory.

Introduction

Black hole theories were developed before the discovery of cosmic background microwaves. Theories of General Relativity have not previously reconciled with blue shifted microwaves. Previous work by Roger Penrose and Stephen Hawking laid a frame work for eventual resolution, by postulating thermal equilibrium based on quantum effects that predicted a low temperature of black holes.

In the present work a high temperature is predicted based upon the extent of gravitational blue shifting.

Temperature of a Black Hole

A calculation is given as estimate for temperature of a black hole in thermodynamic equilibrium with distant cosmic microwave background. It will differ from results of Stephen Hawking(1) but will use some of the concepts originated by Roger Penrose(2) and Stephen Hawking.

(1.1) $R = 2MG/c^2$ equivalent radius of event horizon

(1.2) $f/ f_o = 1/ (1 - 2MG/rc^2)^{(1/2)}$ metric frequency of curvature

(1.3) $c/ c_o = (1 - 2MG/rc^2)$ Einstein's GR (eq. 107) light speed

(1.4) $\lambda/ \lambda_o = (1 - 2MG/rc^2)^{(3/2)}$ length of cosmic microwave in (1.3)

(1.5) $E = h f_o/(1 - 2MG/rc^2)^{(1/2)}$ microwave energy in gravity field

(1.6) $c^2/c_o^2 = (E_o/E)^3$ to satisfy identity (1.13)

(1.7) $h^3/h_o^3 = 1/ (1 - 2MG/rc^2)^{(7/2)}$ consequence of (1.6)

(1.8) $h/h_o = (c_o/c)^{(7/6)}$ which may also be used in high speed model[3]

(1.9) $m = E/c^2 = (E^3/E_o^2 c_o^2)$ thermal mass of a microwave

(1.10) $dE = F * dr$ variable energy in gravity field

(1.11) $dE = GMEdr/r^2c^2$ increasing energy of a microwave

(1.12) $(E_o^2/ E^3)dE = GMdr/r^2c_o^2$

Equilibrium black hole is evoked to make constants G and M, not altered by a microwave.

(1.13) $(1/2)(1-E_o^2/E^2) = GM/R^2c_o^2 = (1/2)$

(1.14) $E = h_o f_o/(1 - 2MG/rc^2)^{(5/3)}$

Since GR with blue shifting predicts infinite temperature of a black hole, a quantum limit of the Planck temperature will be imposed with partition function Z of one half in flat space and zero at an event horizon.

(1.15) $h^2f^2 = (8/(1-Z))\, hc^5/ G$ Planck energy squared

(1.16) $hf = kT$ using Boltzmann constant

(1.17) $T = 2.7° K + (8 hc^5 / G)^{(1/2)} /k$ a very high temperature

Then the super hot photon attempting to leave the event horizon will be red shifted to 2.7° K at far distance, and the black hole will be slightly gray as Stephen Hawking predicted, but for other reasons. It makes a thermal equilibrium without which the black hole would continue to get hotter.

To be consistent the process of equilibrium may be thought of as a temperature so high inside a black hole that the mass expands to fill the volume inside the event horizon. In this way a black hole can evaporate slowly by a different process than was predicted by Stephen Hawking.

Conclusions

In conclusion there is prediction of high temperature in black holes limited by the Planck energy. General Relativity predict an infinite temperature which is interpreted as a limitation of GR.

A way was found to relate Planck constant to light speed that will be helpful in other articles modifying Polarizable vacuum theory.

Acknowledgements

Recognition is given to Ulla Mattfolk of Finland for help in developing the theories and recognizing the biological questions raised by microscopic and high energy physics.

Reference Notes

1) Stephen Hawking; The Universe In a Nutshell, Bantam, 2001; Reference Dover, New York, 1976. Page 118.

2) Stephen Hawking and Roger Penrose; The Nature of Space and Time, Princeton University Press, Princeton, 1996; Reference 2000 edition. Page 25, figure (1.17)

3) Jerry L. Decker, Polarizable Vacuum Theory in Deep Space Transport at High Speed, https://www.researchgate.net/publication/285404064_Polarizable_Vacuum_Theory_In_Deep_Space_Transport_At_High_Speed , 2015.