38 The Hawking Acceleration Field

A "radial field of acceleration" defines acceleration in a spherical region of space surrounding a spherical, stationary, massive object. If the object remains unchanged over time the acceleration field remains unchanged. A radial field assumes that all points on the surface of a spatial region surrounding the object have the same magnitude of acceleration, and different radial directions.

Acceleration may be represented as a "radial vector" connecting the center of the object to any surrounding point in space. Examples of radial acceleration are the "Newton gravitational field" (g_N), and the "Coulomb electro-static field" (g_C). These are scalars of acceleration, and represent the magnitude of a "radial vector" of acceleration. The vector tail is located at the center of the object and it can point in any direction away from the object as defined by the direction vectors (unit vectors) and the components.

The "Hawking field" may be represented as a radial vector, and is associated with Hawking temperature. If the components are suitably defined, and if one condition applies then the components will give the definition of Hawking temperature and length contraction.

The Radial Vector;

Acceleration may be represented as a "radial vector" connecting the center of an object to any surrounding point in space. Examples of radial vectors are the "Newton gravitational field" ($\boldsymbol{g_N}$), and the "Coulomb electro-static field" ($\boldsymbol{g_C}$);

$$|\boldsymbol{g_N}| = Gm/r^2 = g_{N4}$$

$$|\boldsymbol{g_C}| = k_e q_e/r^2 = g_{C4} \qquad \text{where; } k_e = 1/4\pi\varepsilon_0$$

These magnitudes (g_{N4} , g_{C4}) are scalars of acceleration, and represent the magnitude of a "radial vector" ($\boldsymbol{g_N}$, $\boldsymbol{g_C}$) of acceleration. The vector tail is located at the center of the object and it can point in any direction away from the center.

A radial vector of acceleration ($\boldsymbol{g}$) is associated with a massive object;

$$\boldsymbol{g} = g_1\boldsymbol{e_1} + g_2\boldsymbol{e_2} + g_3\boldsymbol{e_3}$$

Where; $\boldsymbol{e_1}$, $\boldsymbol{e_2}$, $\boldsymbol{e_3}$ are direction vectors (unit vectors)

g_1 , g_2 , g_3 are scalar components of acceleration

The vector has a magnitude; $|\boldsymbol{g}| = g_4$

The components are related to magnitude; $g_1^2 + g_2^2 + g_3^2 = g_4^2$

A sub-component (g_{n5}) is also related; $g_5^2 = g_1^2 + g_2^2 = g_4^2 - g_3^2$

Component Geometry;

Components and the sub-component have angular geometry;

$g_1 = g_5 Cos(A_1)$ and; $g_2 = g_5 Sin(A_1)$

$g_5 = g_4 Cos(A_2)$ and; $g_3 = g_4 Sin(A_2)$

The Radiant Condition;

A condition is required for emission; $A_1 = A_2$

The Acceleration Equation;

From the condition; $A_1 = A_2$

$Sin(A_1) = Sin(A_2)$

$g_2/g_5 = g_3/g_4$

A scalar equation of acceleration may be written as; $g_2 g_4 = g_3 g_5$

Definitions of Acceleration;

Components of acceleration may be defined as;

$g_1 = v_1 c/r_S$

$g_2 = c^2/r$

$g_3 = ½hc/(mn^2\lambda^2)$

$g_4 = k_B T_4/mr$

$g_5 = c^2/r_S$

Where; n is a quantum number (integer)

h is the Plank constant

c is the light constant

k_B is the Boltzmann constant

λ is wavelength of radiation

m is the mass of the object

r is radial distance from the center of the object

r_S is the Schwarzschild radius; $r_S = 2Gm/c^2$

G is the gravitational constant

T_4 is Hawking temperature

v_1 is average vibrational velocity

The Radiance Equation;

The scalar equation of acceleration is; $g_2 g_4 = g_3 g_5$

Definitions give; $(c^2/r)(k_B T_4/mr) = (½hc/mn^2\lambda^2)(c^2/r_S)$

$k_B T_4 = (hc/2n^2\lambda^2)(r^2/r_S)$

The quantization rule states that only an integer number of waves may be imposed upon a circumference; $n\lambda = 2\pi r$

giving; $k_B T_4 = (hc/8\pi^2 r^2)(r^2/r_S)$

$T_4 = hc/8\pi^2 k_B r_S$

Reduced Plank constant (ђ); $T_4 = ђc/4\pi k_B r_S$

The Schwarzschild radius is; $r_S = 2Gm/c^2$

Giving Hawking temperature; $T_4 = ђc^3/8\pi k_B Gm$

Length contraction;

From vector geometry; $\cos(A_1) = g_1/g_5 = (v_1 c/r_S)/(c^2/r_S) = v_1/c$

$\sin(A_1) = g_2/g_5 = (c^2/r)/(c^2/r_S) = r_S/r$

Geometry gives; $\cos^2(A_1) + \sin^2(A_1) = 1$

$r_S/r = (1 - v_1^2/c^2)^{½}$

$r = \gamma r_S$

Where; γ is the Lorentz factor

Conclusion;

A stationary, massive object is assumed to “deform” surrounding space. The deformation gives a “radial acceleration field”. The acceleration may be called “Hawking acceleration” if the magnitude is associated with Hawking temperature.