43 The Fundamental Emitter

A "fundamental emitter" may be compared to a "light sponge", it contains "photons" (or the energy equivalent of photons). If it is "squeezed" (stressed) the emitter will reduce in size (like a squeezed sponge) and some photons will be "squeezed out" (emitted).

There are two types of stress: pressure and shear. Both types are required to "activate" (squeeze) the emitter. Pressure is associated with a distribution of force over a surface area, and shear is associated with a sectional area.

Assume the emitter is spherical, while under stress it gets smaller, so the radius is changing. The instantaneous rate of change of the radius must have an exact speed: one quarter of the light constant.

The emitter may be "inactive" (not radiating) having an "inactive radius" (initial radius). If it is radiating, then it has an "active radius". The "radius ratio" (active/inactive) must agree with length contraction.

Stress may be represented as a ratio of force and area. Force is represented as a vector, and area may also be represented as a vector giving stress as a tensor. It is convenient to simplify stress, representing it as a vector (in 3D).

If four "radiant rules" are true, then the emitter activates (shrinks) releasing photons with a "brightness" which may be calculated.

The Stress Vector;

A fundamental emitter may be "squeezed" (stressed). Stress is normally represented as a tensor however it is convenient to represent it as a vector.

A 3D vector ($\boldsymbol{S}$) represents stress. The vector is:

$$\boldsymbol{S} = S_1\boldsymbol{i} + S_2\boldsymbol{j} + S_3\boldsymbol{k}$$

Where: S_1 , S_2 , S_3 are components of stress

$\boldsymbol{i}$, $\boldsymbol{j}$, $\boldsymbol{k}$ are directional vectors (unit vectors)

The vector has magnitude: $|\boldsymbol{S}| = S_4$

The magnitude is related to components: $S_1^2 + S_2^2 + S_3^2 = S_4^2$

A sub-component (S_5) is also related to components: $S_5^2 = S_4^2 - S_3^2 = S_1^2 + S_2^2$

Angular Geometry;

The Cartesian parts of stress are: S_1, S_2, S_3

The Polar parts of stress are: S_4, θ, ϕ

Compliment angle (θ') is: $\theta' = \frac{1}{2}\pi - \theta$

A 3D vector has angular geometry:

$S_1 = S_5 Cos(\phi)$ and: $S_2 = S_5 Sin(\phi)$

$S_3 = S_4 Cos(\theta)$ and: $S_5 = S_4 Sin(\theta)$

$S_5 = S_4 Cos(\theta')$ and: $S_3 = S_4 Sin(\theta')$

Any component of stress (S_n) may be represented as a scalar ratio of force (F_n) and area (A_n):

$S_n = F_n/A_n$

Radial Contraction;

An "inactive" emitter is not under stress and is represented as a sphere of constant radius (R_0). If stress is applied, the sphere contracts and the current radius (R) is smaller than the initial radius. The instantaneous change rate of the radius is the "speed of contraction" (v):

$$v = \partial R/\partial t$$

A "ratio of radial contraction" (R/R_0) is related to the speed of contraction (v), similar to "length contraction":

$$(R/R_0)^2 = 1 - (v/c)^2$$

The "first rule of radiation" defines the rate of contraction: $v = \frac{1}{4}c$

The radial ratio gives: $(R/R_0)^2 = 15/16$

$$R/(15)^{\frac{1}{2}} = \frac{1}{4}R_0$$

Radiation Rules;

Four "radiation rules" govern the emission of photons:

Rule 1: $v = \frac{1}{4}c$ giving: $R/(15)^{\frac{1}{2}} = \frac{1}{4}R_0$ (see above)

Rule 2: $\phi = \theta'$

Rule 3: $A_5^2 = A_4A_0$ where: $A_0 = \lambda^2$

Rule 4: $A_1 = \pi R_0^2$ (sectional area of inactive emitter)

The Radiation Equation;

The second rule of radiation is: $\phi = \theta'$

Giving: $\text{Cos}(\phi) = \text{Cos}(\theta')$

Giving stress ratios: $S_1/S_5 = S_5/S_4$

$S_1S_4 = S_5^2$

Force/area ratios are: $(F_1/A_1)(F_4/A_4) = (F_5/A_5)^2$

The third rule of radiation is: $A_5^2 = A_4A_0$

Giving the force/area equation: $(F_1/A_1)(F_4/A_4) = F_5^2/(A_4A_0)$

$F_1F_4 = (A_1/A_0)F_5^2$

The fourth rule of radiation is: $A_1 = \pi R_0^2$

Giving the radiation equation: $F_1F_4 = \pi R_0^2F_5^2/A_0$

Force Association;

Each force is associated with a corresponding energy.

F_1 is associated with radiant energy (E_1)

F_4 is associated with "emitter wave energy" (E_4): $F_4 = E_4/\lambda$

F_5 is associated with "emitter particle energy" (E_5): $F_5 = E_5^2/hc$

Where: h is the Plank constant

c is the light constant

λ is wavelength

The radiation equation is: $F_1F_4 = \pi R_0^2F_5^2/A_0$

The radiation equation may be written as: $F_1(E_4/\lambda) = \pi R_0^2(E_5^2/hc)^2/\lambda^2$

$F_1E_4\lambda = \pi R_0^2E_5^4/h^2c^2$

Energy Definition;

Energies may be defined as:

Emitter wave energy (E_4) is: $E_4 = ħc/\lambda$

Emitter particle energy (E_5) is: $E_5 = \pi k_B T$

Where: ħ is the reduced Plank constant

k_B is the Boltzmann constant

T is temperature (Kelvin)

Radiant Brightness;

The radiation equation may be written as: $F_1 E_4 \lambda = \pi R_0^2 E_5^4/h^2c^2$

Substituting energy definitions gives: $F_1(ħc/\lambda)\lambda = \pi R_0^2(\pi k_B T)^4/h^2c^2$

$F_1 ¼cħ = \pi(¼R_0^2)(\pi^4 k_B^4 T^4)/h^2c^2$

$F_1 ¼ch/2\pi = 4\pi(R_0^2/16)(\pi^4 k_B^4 T^4)/h^2c^2$

The “first rule of radiation” (v = ¼c) gives: $R/(15)^{½} = ¼R_0$

Substitution gives: $F_1 vh/2\pi = 4\pi(R^2/15)(\pi^4 k_B^4 T^4)/h^2c^2$

$(F_1 v)/2\pi = (4\pi R^2)(\pi^4 k_B^4 T^4)/15h^3c^2$

$F_1 v/4\pi R^2 = 2\pi^5 k_B^4 T^4/15c^2h^3$

Radiant power (P_1) is: $P_1 = F_1 v$ giving: $P_1/4\pi R^2 = 2\pi^5 k_B^4 T^4/15c^2h^3$

Surface area of active emitter (A_{1a}) is: $A_{1a} = 4\pi R^2$

giving: $P_1/A_{1a} = 2\pi^5 k_B^4 T^4/15c^2h^3$

Radiant brightness (B_1) is power per emissive area: $B_1 = P_1/A_{1a}$

Giving the equation of brightness: $B_1 = (2\pi^5 k_B^4/15c^2h^3)T^4 = \sigma T^4$

Where: σ is the Stefan-Boltzmann constant: $\sigma = 2\pi^5 k_B^4/15c^2h^3$

Conclusion;

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