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Research Article

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SUPREME THEORY OF EVERYTHING: Theoretical Formulation of The Spectral Density of Electromagnetic Radiation Emitted By A Nonblack Body

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Abstract

Hertzsprung-Russel Diagram (HRD) plots each star on a graph measuring the star's brightness concerning its temperature (color) between 2000K and 50000 K. It registered about 90 percent of the stars in the universe, including the Sun, located in the main sequence branch of stars in HRD. HRD is an experimental diagram, and its theory could be supposed to be Planck's law. However, Planck's law itself is empirical and contradicts recorded astronomical experimental data. Modern astronomy can observe celestial bodies in space, with surface temperatures ranging from 0 Kelvin to millions of degrees. During this time either Planck's law or HRD didn't develop. In this paper, the spectral density of electromagnetic radiation of non-black bodies is described theoretically. The extracted parameters are compatible with the curve of main-sequence stars HRD, which indicates the spectral distribution of radiation. It proves the open hysteresis of the Supreme Theory of Everything led to the correct form of the spectral radiation distribution. I examine models that can be solved exactly with the tools of mathematics so that neither approximations nor computer simulations are required.

Keywords: HRD, Scaling Problem, Thermal Nonequilibrium, the second formula of the open Hysteresis, Modified Law of Spectral Density of Electromagnetic Radiation

Introduction

One of the biggest laws in quantum physics is Planck's law, which describes the spectral density of electromagnetic radiation emitted by a black body in thermal equilibrium at a given temperature T when there is no net flow of matter or energy between the body and its environment [1, 2]. In the last years of the 19th century, Max Planck was investigating the problem of black-body radiation first posed by Kirchhoff some 40 years earlier. Every physical body spontaneously and continuously emits electromagnetic radiation. There was no expression or explanation for the overall shape of the observed emission spectrum. At the time, Wien's law fits the data for short wavelengths and high temperatures but failed for long wavelengths [3]. Also around this time, Lord Rayleigh had derived theoretically a formula, now known as the Rayleigh–Jeans law, that could reasonably predict long wavelengths but failed dramatically at short wavelengths [4]. Approaching this problem, Planck hypothesized that the equations of motion for light describe a set of harmonic oscillators, one for each possible frequency. He examined how the entropy of the oscillators varied with the temperature of the body, trying to match Wien's law, and was able to derive an approximate mathematical function for the black-body spectrum, which gave a simple empirical formula for long wavelengths. Planck soon realized that his solution was not unique. There were several different solutions, each of which gave a different value for the entropy of the oscillators. To save his theory, Planck resorted to using the then-controversial theory of statistical mechanics [5], which he described as "an act of despair. I was ready to sacrifice any of my previous convictions about physics [6].

Planck's constant was formulated as part of Max Planck's successful effort to produce a mathematical expression that accurately predicted the observed spectral distribution of thermal radiation from a closed furnace (black-body radiation). This mathematical expression is now known as Planck's law [3]. In 1900, Max Planck derived the correct form for the intensity spectral distribution function by making some strange (for the time) assumptions. In particular, Planck assumed that electromagnetic radiation can be emitted or absorbed only in discrete packets, called quanta, of energy: $E_{quanta}=h\nu=h\, c/\lambda$, where h is Planck's constant, ν is the frequency of light, c is the speed of light and λ is the wavelength of light. Planck's assumptions led to the correct form of the spectral distribution functions [3]:

$$E_{quanta} = h\nu \quad \Rightarrow \quad E_\lambda(\lambda, T) = h \cdot \frac{2c^2}{\lambda^5} \frac{1}{e^{hc/(\lambda k_B)} - 1} \tag{1}$$

Albert Einstein (in 1905) and Satyendra Nath Bose (in 1924) solved the problem by postulating that Planck's quanta were real physical particles – what we now call photons, not just a mathematical fiction. They modified statistical mechanics in the style of Boltzmann to an ensemble of photons. Einstein's photon had energy proportional to its frequency and explained an unpublished law of Stokes and the photoelectric effect [7].

The achievements of astronomy and quantum mechanics show that this theory is flawed. But I have a reason to give Planck right. At the time, the theoretical expression was not established and astronomical instruments doesn't observe the ultra-dim stars and celestial bodies. However, in my opinion, Planck's law of black body radiation has some hot points to raise a query.

1. Planck's Law Confronts with Experimental Data of Astronomy

The modern experimental data of the stars registered in the Hertzsprung-Russel diagram (HRD) does not fit Planck's law. It must be drawn the locations of stars in HRD as shown by the red curve in Figure 1.

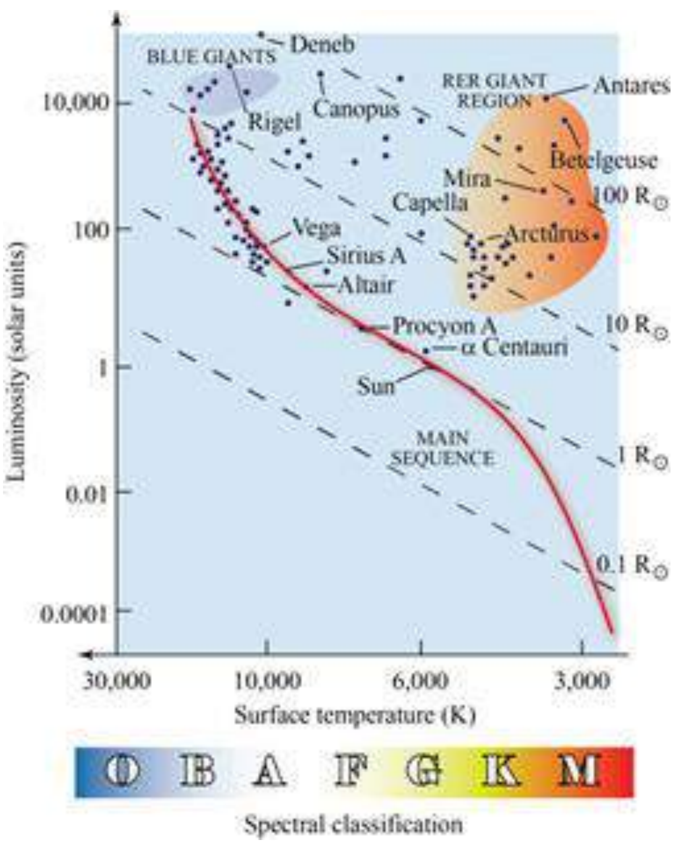

Figure 1: Hertzsprung-Russel diagram [8], [9] (red curve shows my assumption)

HRD plots each star on a graph measuring the star's brightness concerning its temperature (color) between 2000K and 30000 K (Figure 1). About 90 percent of the stars in the universe, including the Sun, located in the main sequence branch in HRD. Unfortunately, HRD shows only 4.0% of a selected ordinary matter. But where are the very hot celestial bodies? Where are we and the 96% of the universe in HRD? It includes a mysterious, invisible dark matter (23 percent) and dark energy (73 percent). From 1910 until now the HRD is always saying to us that the upper and lower pointers of the main sequence of stars continue upward and downward to infinity in the vertical axis or both ends of the horizontal axis are limited between positive infinite and 0 Kelvin temperature (Figure 1) [8]. I attempted not only to improve HRD and to transform it into the Everything Diagram. I sought its mathematical model. Astronomy registers the celestial bodies, surface temperatures of which oscillate 0 Kelvin to some million degrees in the universe. To accommodate everything in HRD we need to extend the effective temperature scale from 0 Kelvin to positive infinity. Unfortunately, the logarithm scale cannot capsulize the celestial bodies over 50000 K and lower than 2500 K in HRD. Since the logarithm-scale cannot grant a petition (Figure 2).

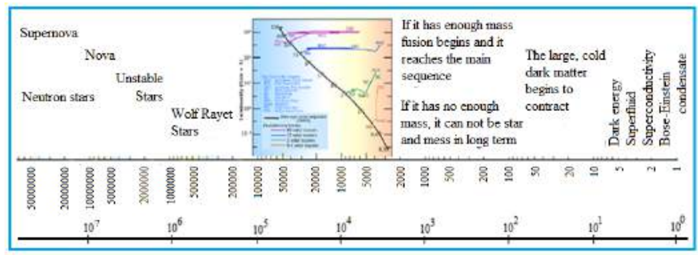

Figure 2: Logarithm scale interval in relation with HRD [9]

2. Scaling of Everything Diagram on the Horizontal Axis

The effective temperature of stars in HRD shows in logarithm scales, which is also not enough for the range of all the celestial bodies and everything. According to our study there exists a big problem in the logarithm scaling of effective temperature. So, we need to connect the HRD with the everything diagram (ED) [9].

If we see the logarithm scale in close, its intervals mathematically equal each other: 0 to 10 or 1-10, 10-100; 100-1000, 1000-10000, and so on. But these are not the same in the aspect of physics. For example, 0 to 10°C temperature has not so a big difference, but 100-1000°C can burn ordinary materials, and 10000°C to one million does not happen in everyday life, and so on. So, we need to develop another scale, which can abbreviate more strongly everything in HRD. The log-log scales cannot show all the electromagnetic spectrum. [9]

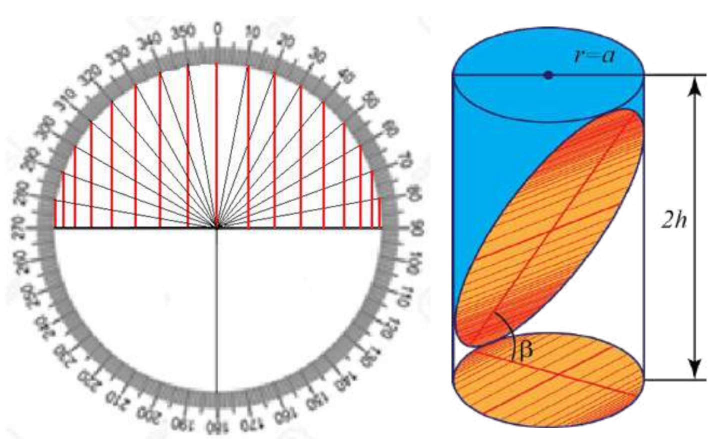

Figure 3: Projection scale of the circle on the horizontal axis

To avoid the disadvantage of traditional HRD we suggest and establish a new projection scale of a circle on the horizontal axis. The temperature range condenses only by the projection scale of the circle, which is most compressive than the logarithm scale used in HRD.

The projection of a circle on the tangent or horizontal axis as a Zeno-paradox indicates the scaling of everything diagram [9].

3. Everything in Thermal Nonequilibrium

Not only the universe isn't in thermal equilibrium, but everything is. Everything from elementary particles to celestial bodies is in eternal motions, which dissects only to circle [9]. So, non-equilibrium thermal condition dominates in the Universe. If the systems are in thermal equilibrium, no heat flow, and no motions will take place. Instead, it strives for thermal balance. The mathematical description of black body radiation is not theoretical, but empirical only.

Two physical systems are in thermal equilibrium if there is no net flow of thermal energy between them when they are connected by a path permeable to heat. A system is said to be in thermal equilibrium with itself if the temperature within the system is spatially uniform and temporally constant [10]. During thermal radiation, the body's thermal motion energy is converted into electromagnetic radiation energy, and during light absorption, the electromagnetic energy is converted into body heat energy. This energy exchange takes place through electrical fluctuations in the body. Therefore, the body's ability to emit and absorb radiation is closely related.

Before Kirchhoff's law was recognized, it had been experimentally established that a good absorber is a good emitter, and a poor absorber is a poor emitter. Naturally, a good reflector must be a poor absorber [11]. Kirchhoff's law: The ratio of the absorption capacity of a body in thermal equilibrium at a given temperature to its absorption capacity is constant regardless of body type.

$$\frac{r_A(\lambda)}{\alpha_A(\lambda)} = \frac{r_B(\lambda)}{\alpha_B(\lambda)} = \frac{r_c(\lambda)}{\alpha_c(\lambda)} = \cdots = const \qquad (2)$$

Where r(λ) is the emissivity at λ wavelength, α(λ) is the absorptivity

Absorptivity (α) is a measure of how much of the radiation is absorbed by the body. Reflectivity (ρ) is a measure of how much is reflected, and transmissivity (τ) is a measure of how much passes through the object. ... Emissivity (ε) is a measure of how much thermal radiation a body emits to its environment [12]. A black hole is a region of space-time where gravity is so strong that nothing- no particles or even electromagnetic radiation such as light-can escape from it. True that a good absorber has possible to become a good emitter. But it is not that good absorber must be a good emitter. Kirchhoff's law does not state that an absorber equals an emitter. Since a black hole is a good absorber and a white hole is a good emitter [13].

In the aspect of heat, the whole body is in a wide range of black and gray, then white, and finally rotates from white through gray to black.

Any hot object transfers heat to its cooler surroundings until everything is at the same temperature. For two objects at the same temperature as much heat flows from one body as flows from the other, and the net effect is no change. If the universe were infinitely old, there must have been enough time for the stars to cool and warm their surroundings. Everywhere should therefore be at the same temperature and there should either be no stars, or everything should be as hot as stars.

Since there are stars and colder objects, the universe is not in thermal equilibrium so it cannot be infinitely old. The paradox does not arise in Big Bang nor modern steady-state cosmology [14].

$$\frac{r_A(\lambda)}{\alpha_A(\lambda)} \neq \frac{r_B(\lambda)}{\alpha_B(\lambda)} \neq \frac{r_c(\lambda)}{\alpha_c(\lambda)} \neq \ldots \qquad (3)$$

The spectral radiation of the bodies is determined by the next relation:

$$0 \leq \frac{r_{\lambda,T}}{e_{\lambda,T}} \leq \infty \qquad (4)$$

Where $r_{\lambda,T}$ is the emissivity of a body, and $e_{\lambda,T}$ denotes its absorptivity. If the emissivity becomes 100% and absorptivity is 0%, the ratio is infinite

$$\frac{r_{\lambda,T}}{e_{\lambda,T}} = \frac{1}{0} = \infty \qquad (5)$$

it means a perfect white hole, but vice versa

$$\frac{r_{\lambda,T}}{e_{\lambda,T}} = \frac{0}{1} = 0 \qquad (6)$$

It shows a perfect black body. [9]

Emissivity values can range from 0 to 1. A blackbody has an emissivity of 1, while a perfect reflector or white body has an emissivity of 0. [12] If the black body radiated even a little, it would be a gray body, not black. The absolute black body cannot emit any energy. In other words, its emittance is zero. So, the expression "Electromagnetic radiation of black body" is false. The only grey body and white body can emit. They cannot absorb any energy.

4. Second Formula of the Open Hysteresis from Complex Circle

We have described the first formula extraction of open hysteresis in the case of electromagnetism [15] and [16]. Here we describe the Second formula extraction to open the hysteresis based on the complex ellipse [17].

Euler's formula and Equation (6) indicate that:

$$f(\theta) = \frac{r_\theta}{s_\theta} = \frac{Imaginary\ number}{Real\ number} = \frac{Im}{Re} = \frac{\sin(\theta)}{\cos(\theta)} \qquad (7)$$

In mathematics, a real number is a value of a continuous quantity that can represent a distance along a line (or a quantity that can be represented as an infinite decimal expansion) [18]. For this reason, the denominator must be written in absolute value.

$$k(x) = f_{circle}(\theta) = \frac{\sin(\theta)}{|\cos(\theta)|} \quad (8)$$

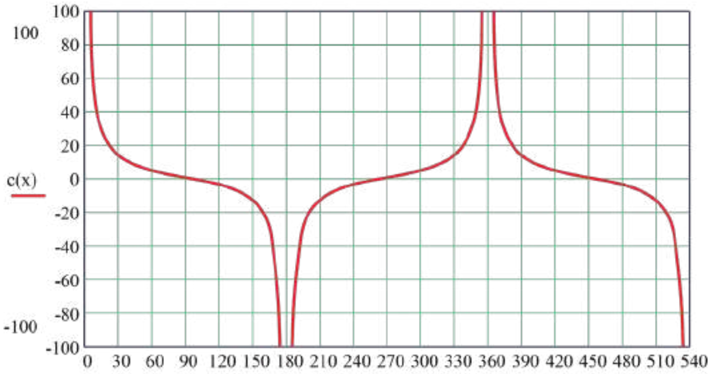

Figure 4: Everything Diagram (ED) plotted by Equation 8

Equation (8) and Figure 4 shows two large singularities:

- One is the white singularity (white hole) at $x = 90^0$ vertical axis of which shows very high temperature, and perfect emittance.
- The other is the black singularity (black hole at $x = 270^0$) axis of which lies at O Kelvin temperature. It cannot emit any radiation.

Figure 4 also discovers that after 0 Kelvin temperature the hotter temperature begins to maximal temperature and then maximal temperature follows colder [9] and [16]. Because the temperature principle goes by the complex circle and complex ellipse and 17]. If a black body exists, follows the white body.

But Planck's formula (1) hasn't any solution, except for approximations of the Wien law, Stephen-Boltzmann law, and Planck-Einstein relation [19-23] (Figure 5).

Wien's displacement law [19]:

$$\lambda_{max} \cdot T = 2898\ \mu mK \quad (9)$$

The Stefan–Boltzmann law, also known as Stefan's law, states that the total energy radiated per unit surface area of a black body in unit time (known variously as the black-body irradiance, energy-flux density, radiant flux, or the emissive power), E, is directly proportional to the fourth power of the black body's thermodynamic temperature T (also called absolute temperature) [23]:

$$E = \sigma T^4 \quad (10)$$

Planck-Einstein relation is next:

$$E = h\nu \quad (11)$$

OpenHys $(x) = \frac{1.38 \cdot \sin(x)}{|\cos(x)|}$, Wien(x)=2.76$x$,

StephBoltz(x)=1.38x^4, E(x)=6.62x

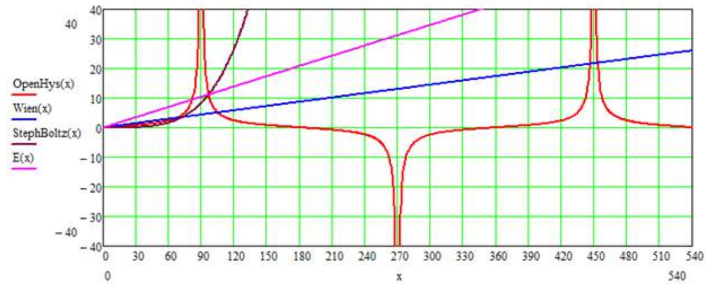

Figure 5: OpenHys(x) (Open hysteresis) is the calculation result by Equation (8) of spectral density of electromagnetic radiation and Wien(x) is the calculation by Wien's displacement law, StephBoltz(x) is the Stephan-Boltzmann's law and E(x) is the Planck-Einstein relation.

Note: Figure 5 is not to scale. It purposes only to show the trends of the different laws.

Figure 5 clearly illustrates the results of different laws of the spectral density of electromagnetic radiation.

One of the very important characteristics of the mathematical circle is hysteresis, which includes not only electromagnetism but everything in the universe.

The 90^0 and 270^0 singularities (0^0 and 180^0 singularities when the phase shifts by $\pi/2$) represent imaginary parts in mathematics, the spin-up and spin-down states in quantum mechanics, and black and white hole in cosmology, and so on.

We are interested in the ratio between the imaginary and real axis of the complex ellipse. This ratio shows the shape of the ellipse as follows:

$$f_{ellipse}(\theta) = \frac{A \cdot r_\theta}{s_\theta} = \frac{A \cdot Im}{Re} = \frac{A \cdot sin(\theta)}{|cos(\theta)|} \quad (12)$$

Where A is the amplitude of the sine function, $A=h=b \cdot tan\ \beta$

From all these the spectral density of electromagnetic radiation is described by Equation (12).

5. Applications of the Modified Law of Spectral Density of Electromagnetic Radiation

5.1. Planck's Law as the Theory of the Hertzsprung-Russel Diagram

Planck's law is arguably the most widely used empiric formula in electromagnetism. It is so popular that the question is rarely asked whether it is fit for purpose.

I have thought and ask myself for years that have me any right to break down this famous law and it is possible to change the famous Planck's theory of the spectral distribution function emitted by a black body is neither perfect nor final. Finally, contrary to the very popular belief, I decided that it was right to change Planck's law. This is the path of scientific development. Breakthroughs in physics are never the result of a lone person pontificating, but instead of a generation of scientists acting in concert, working on each other's results.

Planck's Law (1900) was born 10 years before the HDR. In my personal opinion, the experimental proof of Planck's law is the HRD. However, these two great scientific discoveries have been going on for more than 100 years without recognizing each other. We are necessary to develop HRD into Full Hertzsprung-Russel Diagram. HRD plots each star on a graph measuring the star's brightness concerning its temperature (color) between 2000K and 30000 K. HRD is Planck's law is a version of the spectral density of electromagnetic radiation in astronomy and cosmology [9].

$$c(x) = \frac{A \cdot \sin(x)}{|\cos(x)|} \tag{13}$$

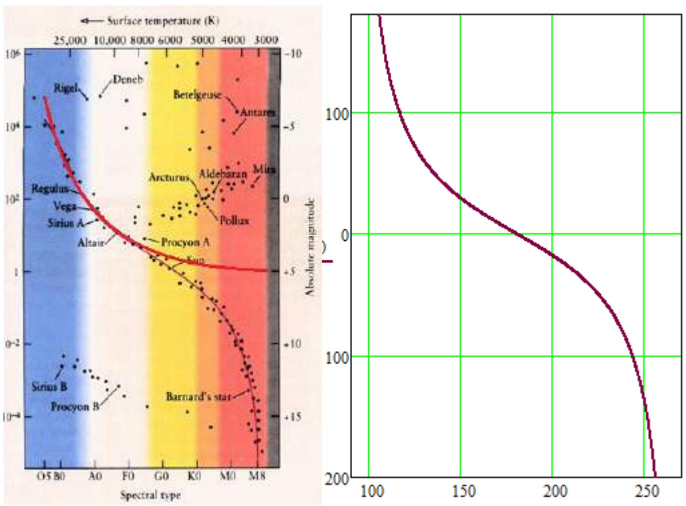

Figure 6: The high-resolution HRD [23] and right side Figure from the calculation of Equation (15)

We thank for the capacities of the modern astronomical high definition instruments, which could register less than the very dim and cold stars as Barnard's stars. [24-27].

One of the classical examples of HRD is Planck's law. If we exchange the wavelength by surface temperature based on the Wien-displacement law on the horizontal axis, there is the HRD and Wien-displacement law. The curves of Planck and Wien Laws are shown by the red curve in Figure 6.

The fitting of the curve between the interval 90^0 and 270^0 in Figure 6, and, the black curve in the right side Figure proves exactly that the open hysteresis of the Supreme Theory of Everything led to the correct form of the spectral distribution functions of radiation and is verified that it was in agreement with the available data. It is only a wing (90^0-270^0 in Figure 5) of the spectral density of electromagnetic radiation. Another wing continues after negative singularity to positive singularity (270^0 and 450^0 in Figure 5). Since the Modified Law of Spectral Density of Electromagnetic Radiation consists of left and right wings. We need to attend also that the curve in Figure 6 has two wings of a full period of HRD.

The secrets of the right wing of two laws remain open in front of you all.

Discussion and Comments

I do not want to delve into the next unresolved theoretical problems that can be studied based on the new spectral density of electromagnetic radiation:

1. Negative singularity (dim and cold) contains Bose-Einstein condensate, super-liquid, and superconductivity.
2. Two new worlds unknown us begin after negative singularity and before positive singularity.
3. Both regions are neither identified nor studied.
4. The electromagnetic spectrum distribution does not show a complex ellipse.
5. Planck's law:
   a. cannot specify complex circles.
   b. does not use Euler's formula
   c. cannot indicate open hysteresis.
   d. has no information

Conclusion

The main sequence branch of stars in HRD is nothing other than the spectral density of electromagnetic radiation. But Planck's law confronts with registered experimental data of astronomy.

1. There are stars and colder objects the universe is not in thermal equilibrium

$$\frac{r_A(\lambda)}{\alpha_A(\lambda)} \neq \frac{r_B(\lambda)}{\alpha_B(\lambda)} \neq \frac{r_c(\lambda)}{\alpha_c(\lambda)} \neq \dots$$

2. The fitting of the curves of theoretical calculation and experimental data of astronomy proves the open hysteresis of the Supreme Theory of Everything led to the correct form of the spectral radiation distribution, which is new by the next formulas:

$$f(\theta) = \frac{A \cdot r_\theta}{s_\theta} = \frac{A \cdot Im}{Re} = \frac{A \cdot sin(\theta)}{|cos(\theta)|}$$

The projection of a circle on the horizontal axis gives us to scaling of everything in a diagram.

3. If the emissivity becomes 100% and the absorptivity is 0%, the ratio is infinite

$$\frac{r_{\lambda,T}}{e_{\lambda,T}} = \frac{1}{0} = \infty$$

it means a perfect white hole, but vice versa

$$\frac{r_{\lambda,T}}{e_{\lambda,T}} = \frac{0}{1} = 0$$

It shows a perfect black body.

If the black body radiated even a little, it would be a gray body, not black. The absolute black body cannot emit any energy. In other words, its emittance is zero. So, the expression "Electromagnetic radiation of black body" is false. The only grey body and white body can emit. They cannot absorb any energy.

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