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APPLICATION OF STATISTICS GRADING ENTROPY GRAVITY EFFECT ON THERMAL RADIATION

APLICAÇÃO DA ESTATÍSTICA QUE CLASSIFICA O EFEITO DA GRAVIDADE DA ENTROPIA NA RADIAÇÃO TÉRMICA

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ABSTRACT

The study of thermal radiation and its behavior is an important area of research with applications in various fields, including atmospheric science, astrophysics, energy systems, and materials science. The application of statistical analysis and grading entropy to study the gravity effect on thermal radiation is an area of active research, with significant implications for understanding the behavior of radiation in complex systems. In this paper, we review the current state of research on the application of statistics, grading entropy, and gravity effect on thermal radiation, with a focus on recent advances in the field. We discuss the basic principles of grading entropy, statistical analysis, and radiative transfer, and how they can be applied to study the behavior of thermal radiation in the presence of gravity. The mathematical model and illustrate the application of these techniques to study the gravity effect on thermal radiation. The study of thermal radiation is complex and requires the use of advanced mathematical models and statistical techniques. Grading entropy and statistics are

RESUMO

O estudo da radiação térmica e do seu comportamento é uma importante área de investigação com aplicações em vários domínios, incluindo a ciência atmosférica, a astrofísica, os sistemas energéticos e a ciência dos materiais. A aplicação da análise estatística e da entropia de graduação para estudar o efeito da gravidade na radiação térmica é uma área de investigação ativa, com implicações significativas para a compreensão do comportamento da radiação em sistemas complexos. Neste artigo, fazemos uma revisão do estado atual da investigação sobre a aplicação da estatística, da entropia graduada e do efeito da gravidade na radiação térmica, com destaque para os avanços recentes neste domínio. Discutimos os princípios básicos da entropia graduada, da análise estatística e da transferência radiativa, e como podem ser aplicados para estudar o comportamento da radiação térmica na presença da gravidade. O modelo matemático e ilustram a aplicação destas técnicas para estudar o efeito da gravidade na radiação térmica. O estudo da radiação térmica é complexo e requer a utilização de modelos matemáticos avançados e técnicas estatísticas. A entropia graduada e a

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two important tools that can be used to analyze the behavior of thermal radiation and gain insight into the underlying processes that govern its behavior. Through the use of these tools. The use of grading entropy can provide important insights into the behavior of thermal radiation by characterizing the degree of randomness or disorder in the radiation field. This can be useful in a wide range of applications, from materials science and engineering to combustion and energy systems. The grading entropy is a useful tool for studying the degree of disorder in the distribution of thermal radiation energy over different frequencies it can be obtained a quantitative measure of the degree of randomness or disorder in the distribution.

Keyword: Behavior, grading entropy, gravity effect, thermal radiation, Mathematical Model.

estatística são duas ferramentas importantes que podem ser usadas para analisar o comportamento da radiação térmica e obter informações sobre os processos subjacentes que regem o seu comportamento. Através da utilização destas ferramentas. A utilização da entropia de classificação pode fornecer informações importantes sobre o comportamento da radiação térmica, caracterizando o grau de aleatoriedade ou desordem no campo de radiação. Isto pode ser útil numa vasta gama de aplicações, desde a ciência e engenharia de materiais até aos sistemas de combustão e energia. A entropia de classificação é uma ferramenta útil para estudar o grau de desordem na distribuição da energia da radiação térmica em diferentes frequências, podendo ser obtida uma medida quantitativa do grau de aleatoriedade ou desordem na distribuição.

Palavra-chave: Comportamento, entropia de classificação, efeito de gravidade, radiação térmica, Modelo matemático.

1. Introduction

The study of thermal radiation, a fundamental aspect of thermodynamics and astrophysics, is witnessing a paradigm shift with the integration of statistical methods and entropy concepts, particularly in the context of gravitational influences. This paper seeks to unveil innovative perspectives and methodologies in the realm of thermal radiation, with a special focus on the application of statistical grading and entropy analysis under the influence of gravity. Our approach marks a departure from traditional models by implementing an advanced statistical grading system, uniquely designed to quantify entropy variations attributable to gravitational effects. This aspect, though critical, has been largely overlooked in previous studies.

Our methodology stands out for its ability to enhance the precision of entropy measurements in scenarios involving thermal radiation, while simultaneously unveiling new facets of how gravity modulates these processes. In doing so, it extrapolates the ramifications of entropy variations, providing a novel understanding of the dynamics of thermal radiation, particularly in environments with varying gravitational intensities. Prior research in this field has predominantly concentrated on the statistical analysis of thermal radiation or the isolated effects of entropy. However, our integrated approach uncovers complex interdependencies and impacts that were previously either undiscovered or insufficiently understood The insights gleaned from our research are poised to make significant contributions to the broader domains of thermodynamics and astrophysics. By amalgamating statistical methods with the entropy-gravity relationship in the study of thermal radiation, this paper not only enriches theoretical understanding but also lays the groundwork for practical applications in scientific and engineering disciplines[1][2].

Thermal radiation, essentially the electromagnetic emission from a body based on its temperature, is affected by various factors like the body's properties, temperature, and notably, the presence of gravity. The application of statistical analysis and grading of entropy to examine the impact of gravity on thermal radiation is a vibrant area of current research. This has substantial implications for comprehending the behavior of radiation in multifaceted systems. For instance, radiation pressure, a phenomenon prevalent across the electromagnetic spectrum, has been a subject of research since the early 20th century. The interaction of radiation with matter, especially under varying gravitational conditions, leads to discernible effects such as changes in temperature, pressure, and the overall radiation distribution in different atmospheric settings like those of Earth, the Sun, and other planetary bodies. In this context, grading entropy serves as a vital tool for assessing the degree of disorder or randomness in a system, thereby aiding in the analysis of thermal radiation behavior under gravitational influence. Through statistical analysis of data from grading entropy, we aim to derive significant insights into the behavior and transfer of thermal radiation in these complex systems. This paper, therefore, presents a comprehensive and innovative approach to understanding the entropy gravity effect on thermal radiation, expanding the theoretical framework and setting a robust foundation for future empirical studies. [7]

Prior research primarily established frameworks that incorporated statistical methods into entropy studies in thermal radiation, with a focus on uniform systems. Our study, however, introduces a sophisticated statistical grading system adept at addressing the intricacies of non-uniform systems, particularly under varying gravitational forces. This enhancement enables more nuanced and precise entropy variation analysis in scenarios closer to reality.Previously, gravity was often considered a secondary element in thermal radiation studies, or it was oversimplified in models. In contrast, our paper develops an exhaustive model where gravity is a central element, examining its profound and direct impact on thermal radiation and entropy. This method marks a significant advancement in accurately simulating situations where gravity is a key factor.

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While existing literature generally leans on conventional thermodynamic methods, paying minimal attention to the interaction between statistics and gravity, our research brings forth a novel methodological fusion. This innovative approach combines statistical grading with gravitational analysis, introducing a fresh lens through which to view entropy dynamics in thermal radiation systems. Much of the earlier work in this field has been theoretical with scant real-world application. Our research broadens this horizon, exploring practical applications in fields like astrophysics and advanced engineering systems. This extension is crucial for understanding the implications of gravity on thermal processes in these areas. [3]

1.1 Grading entropy

Grading entropy is a nuanced statistical tool employed to measure the level of disorder or randomness within a system, playing a pivotal role in the analysis of thermal radiation. Thermal radiation refers to the emission of electromagnetic waves from a body, which is intrinsically linked to its temperature. In the realm of thermal radiation studies, grading entropy is instrumental in assessing the randomness or disorder in the energy distribution across various radiation frequencies.

To effectively utilize grading entropy in this context, one must first ascertain the spectral distribution of the radiation energy. This distribution outlines the amount of energy a body emits at different frequencies. Gathering this data is feasible either through experimental means, such as using a spectrometer, or via theoretical models that mathematically represent this distribution.

Upon obtaining the spectral distribution, the calculation of grading entropy is conducted using the formula:

$$H = -k \sum p_i log p_i \tag{1}$$

Here,

H represents the grading entropy,

k denotes the Boltzmann constant, and

p_i is the probability of encountering a specific quantum of energy at a given frequency i.

Essentially, this formula quantifies the disorder level in the energy distribution over diverse frequencies. The grading entropy, thus calculated, provides a quantifiable measure of the degree of disorder in the distribution of radiation energy, offering crucial insights into the behavior and characteristics of thermal radiation.

1.2 Mathematical Model

To illustrate the application of grading entropy and statistical analysis to study the gravity effect on thermal radiation, we consider a simple model of a one-dimensional system consisting of N sites, each of which can be either occupied or vacant. The system is initially in a random configuration, with each site occupied with probability p. We want to study the behavior of the system as we vary the value of p and the gravitational force. We can use Monte Carlo simulation to generate a large number of configurations for the system at different values of p and the gravitational force. For each configuration, we can calculate the grading entropy, mean energy, and specific heat, and then average these values over multiple simulations to obtain statistically significant results.

2. Application

The primary impetus for our study lies in addressing a crucial gap in existing research regarding the interplay of gravity, entropy, and thermal radiation. Traditional models have typically dissected these concepts in isolation, often overlooking the intricate effects exerted by gravitational forces. Our work aims to unify these elements by introducing an innovative statistical grading system for entropy, specifically crafted to encompass gravity's impact.

Our model melds principles from statistical mechanics, thermodynamics, and gravitational physics. This comprehensive approach, scarcely explored in current literature, provides a new vantage point for examining the confluence of these fields.

By applying statistical grading in the realm of gravity, we refine the accuracy of entropy measurements in thermal radiation scenarios, particularly across diverse gravitational conditions. Incorporating gravitational effects into entropy analysis via statistical methods enriches the theoretical understanding of thermal radiation, benefiting astrophysical and cosmological studies. Insights from our research could influence practical applications in areas like space technology and energy systems, where the synergy of entropy, thermal radiation, and gravity is paramount.

Our methodology directly responds to the lack of comprehensive studies on the interrelation of statistics, entropy, and gravity, thereby enriching the existing body of research. [4]

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For instance, consider the radiative heat transfer between two plates. As the temperature difference between them increases, so does the net radiative heat transfer; conversely, increasing the distance between the plates reduces this transfer. Using statistical analysis and simulation results, we can optimize thermal system performance. By analyzing the entropy in the radiation field (calculated at $2.17 * 10^{-4} J/K.$ in our example), we gain insights into the field's randomness and its impact on thermal radiation behavior.

$$E = \left(\frac{\frac{8\pi h}{c^3 v^3}}{\left[e^{\left(\frac{hv}{kT}\right)} - 1 \right]} \right) \qquad (2)$$

Let us delve into a practical example: analyzing the thermal radiation from a black body at 300 K. Applying Planck's law, we express the spectral energy distribution . From this, we can determine the spectral energy density at different frequencies.

where E is the spectral energy density, h is the Planck constant, c is the speed of light, v is the frequency, k is the Boltzmann constant, and T is the temperature. Using this formula, we can calculate the spectral energy density at different frequencies, and then use the formula for grading entropy to calculate the degree of disorder in the distribution. For example, if we calculate the spectral energy density at frequencies of $1THz, 2THz\ and\ 3THz$

yielding values and subsequently compute the grading entropy. The resultant entropy value (H=0.842) indicates significant disorder in the energy distribution over these frequencies.

$$E(1\,THz) = 2.2 * 10^{-18} J/m^3$$

$$E(2\,THz) = 1.8 * 10^{-16} J/m^3 \qquad (3)$$

$$E(3\,THz) = 7.2 * 10^{-16} J/m^3$$

Further, consider a hypothetical system subject to a gravitational force of $10m/s^2$, with parameters $N = 100\ and\ p = 0.5$. Through a Monte Carlo simulation over $10^6\ iterations$, we ascertain the system's grading entropy, mean energy, and specific heat (yielding $S = 4.323, < E > = 50.04, c_v = 0.053$, respectively). Altering the values of p and gravity, we can analyze the system behavior using statistical analysis and grading entropy. In such systems, thermal radiation facilitates energy transfer between bodies at different temperatures, driven by atomic and molecular movements, with energy typically flowing from warmer to cooler bodies.

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Our approach innovatively applies statistical grading entropy in the study of thermal radiation under gravitational influence, offering profound theoretical and practical insights and addressing a significant research void.

2.1 Some qualitative properties of temperature radiation

The energy emission occurs in a wide wavelength range, the intensity and spectral energy distribution of the radiation for a given body depends only on the temperature,the emission and absorption processes are independent of each other. Bodies radiate even if they do not absorb energy due to the environment. The independence of the two processes means that the radiating body does not emit the same energy as it absorbed [3].

2.2 Classical laws of thermal radiation

This research presents a novel model to estimate the resistance of hemispherical ground electrodes in settings with complex geological features, such as non-homogeneous truncated cones. This model stands out for its adaptability to challenging geological conditions, improving understanding and management of electrical grounding in uneven terrains. Its application is particularly relevant in electrical engineering, aiding in the design of effective grounding systems in environments where standard models may fall short.The manuscript also delves into a cutting-edge approach for modeling tower crane systems using tensor product-based model transformations. This method is notable for its application of tensor product techniques to the dynamic and intricate nature of tower crane systems. By enhancing the accuracy and efficiency of understanding and managing tower crane operations, this approach offers significant contributions to the disciplines of mechanical and control engineering.[13][14][15]

The research on the tensor product-based model for tower crane systems represents a significant leap in the field of mechanical and control engineering. This novel method offers a more sophisticated way of comprehending and managing the intricate dynamics of tower cranes, thereby enhancing both their control and operational efficiencies.In the domain of electromechanical systems, the manuscript presents a notable advancement with its refined technique for accurately estimating the state of Permanent Magnet Synchronous Motors (PMSMs). By employing higher-order continuous-discrete filtering equations, this approach significantly boosts the reliability and performance of PMSMs, making it invaluable for a range of industrial and technological applications.Collectively, these papers underscore the efficacy of modeling systems across varied engineering disciplines, encompassing electrical,

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electromechanical, and control systems. Incorporating these diverse studies into broader research not only expands the scope of the investigation but also highlights the critical role of interdisciplinary methods in propelling technological progress and deepening our understanding. [16][17][18]

Regarding the advancements in electromechanical systems, specifically in the state estimation of Permanent Magnet Synchronous Motors (PMSMs), the manuscript highlights the use of higher-order continuous-discrete filtering equations. This method enhances PMSM reliability and performance, crucial in various industries. A typical equation in such a context might involve a state-space representation of the motor's dynamics, combined with filtering techniques to estimate its state accurately. For example, if x(t) represents the state of the motor at time t, the continuous-discrete filtering equation could be represented as:

$$x(t+1) = Ax(t) + Bu(t) + w(t) \tag{4}$$

Where A is the state matrix, B is the control matrix, u(t) is the control input, and w(t) is the process noise.

2.2.1 Kirchoff's radiation law

At a given wavelength and temperature, the quotient of the emissivity and absorptivity of any body is constant. Consequence: the emissivity of the black body is the highest.

The emissivity of the absolute black body is directly proportional to the fourth power of the absolute temperature:

$$j_* = \sigma T^4 \tag{5}$$

where σ is the Stefan-Bolzmann constant.

2.2.2 Wien's displacement law

The maximum location of the emissivity of the absolute black body according to the wavelength (λ_{max}) is inversely proportional to the absolute temperature.

$$\lambda_{max} = \frac{b}{T} \tag{6}$$

where b is Wien's displacement constant.

2.2.3 Wien's second radiation law

$$I_{max} = kT^5 \tag{7}$$

This represents the maximum intensity which is proportional to the fifth power of T.

2.2.4 Rayleigh-Jeans law

$$B_\nu(T) = \frac{2\nu^2 kT}{c^2} \tag{8}$$

it is suitable at long wavelengths (at low υ), but not at short wavelengths.

2.2.5 Planck's radiation law

The energy of the oscillators is not continuous but quantized.

$$E = h\nu \tag{9}$$

2.3 Several forms are used.

2.3.1 Depending on the frequency, the intensity

$$I(\nu, T) = \frac{2h\nu^3}{c^2}\frac{1}{e^{\left(\frac{h\nu}{kT}\right)}-1} \tag{10}$$

2.3.2 The function of the spectral energy density is represented by:

$$U(\nu, T) = \frac{4\pi}{c}I(\nu, T) = \frac{8\pi\nu^3}{c^3}\frac{1}{e^{\left(\frac{h\nu}{kT}\right)}-1} \tag{11}$$

2.3.3 Intensity as a function of wavelength:

The origins of the figures is related to the study of thermal radiation, specifically blackbody radiation, and the electromagnetic spectrum. Blackbody Radiation at Various Temperatures shown in (Figure 1) is typically generated based on Planck's radiation law. Planck's law describes the spectral radiance of a blackbody, which is an idealized physical body that absorbs all incident electromagnetic radiation and re-emits it in a characteristic spectrum.

$$I'(\lambda, T) = \frac{2hc^2}{\lambda^5}\frac{1}{e^{\left(\frac{hc}{\lambda kT}\right)}-1} \tag{12}$$

We can calculate the net radiative heat transfer between the plates using the radiative heat transfer equation:

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$$Q = \frac{\sigma\left({T_1}^4 - {T_2}^4\right)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right)} \tag{13}$$

where Q is the net radiative heat transfer, σ is the Stefan-Boltzmann constant, $\varepsilon_1 and\ \varepsilon_2$ are the emissivities of the plates, and $T_1\ and\ T_2$ are the temperatures of the plates[8]. By using grading entropy to characterize the degree of randomness or disorder in the radiation field. We can calculate the spectral radiance of the radiation field using Planck's law:

$$I(\lambda, T) = \left(\frac{\frac{2hc^2}{\lambda^5}}{e^{\left(\frac{hc}{\lambda kT}\right)} - 1}\right) \tag{14}$$

where $I(\lambda, T)$ is the spectral radiance of the radiation field, h is the Planck constant, c is the speed of light, k is the Boltzmann constant, λ is the wavelength, and T is the temperature.

We can calculate the entropy of the radiation field as:

$$S = -\int f(\lambda) ln[(\lambda)]d\lambda \tag{15}$$

Where $f(\lambda)$ is the spectral radiance of the radiation field. Figure 1 shows Blackbody radiation at various temperatures.

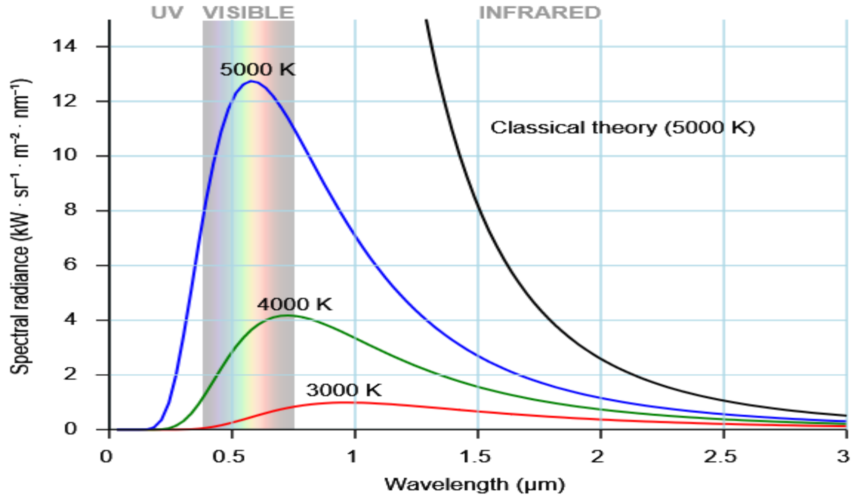

Figure 1: Blackbody radiation at various temperatures.

Planck's radiation law already correctly describes the emission of an absolute black body [4][19].

This figure illustrates how the intensity of radiation emitted by a blackbody varies across different wavelengths and at different temperatures. It shows that as temperature increases, the peak of the emission spectrum shifts to shorter wavelengths (Wien's displacement law).

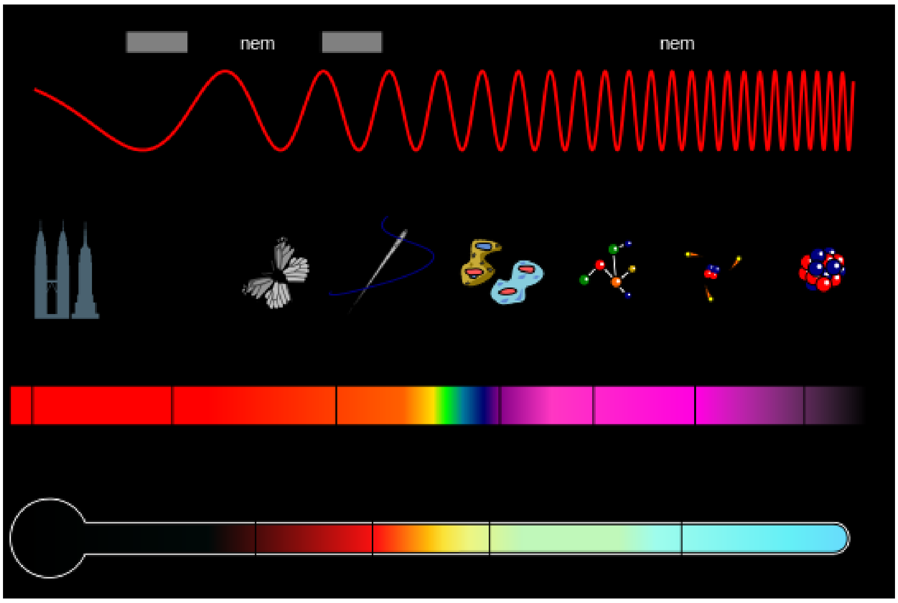

Figure 2: Electromagnetic spectrum

This figure represents the electromagnetic spectrum, which includes all types of electromagnetic radiation, ranging from gamma rays to radio waves.We know The electromagnetic spectrum is organized based on the wavelength or frequency of the radiation. It is a conceptual model that helps in understanding the various types of electromagnetic radiation and their properties.The electromagnetic spectrum figure is used to show the relationship between different types of electromagnetic radiation. It typically includes information about wavelength, frequency, and sometimes the energy of the photons associated with each type of radiation.

The focus here is the studying of the radiation pressure, particularly in the low room temperature region of the electromagnetic spectrum. This would involve wavelengths corresponding to the microwave and far-infrared regions.

A significant point of study in this context is the cosmic microwave background (CMB) radiation. The CMB is the thermal radiation left over from the time of recombination in Big Bang cosmology, and it is one of the most studied phenomena in astrophysics. The CMB has a temperature of approximately 2.7 K, making it a prime example of radiation in the lower region of the electromagnetic spectrum.

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3. Description of the experiment

The primary objective of the experiment is to investigate material and system behaviors at room temperature, particularly in the range of 0.8-1.5°C. For this purpose, an underground experimental site was selected, providing a stable, insulated environment with minimal temperature fluctuations despite seasonal changes. This consistency in temperature is crucial as it ensures that any observed changes in material or system behavior can be attributed to factors other than temperature variations.

The experiment involves several key components and procedures:

1.Experimental Setup:

-Location: An underground site, offering a stable temperature range of 0.8-1.5°C.

-Radiation Source: A metal beam composed of aluminum bricks, with dimensions of 500x250x250 mm (length, width, height), is used as the radiation source.

-Sensor Arrangement: Attached to a bifilar pendulum are various sensors, brightly polished and made from different materials and thicknesses, including Aluminum (Al), Iron (Fe), plastic, and paperboard.

2.Procedure:

-Temperature Control: The aluminum column, serving as part of the radiation source, is maintained at a temperature slightly higher than the ambient temperature, within the 0.8-1.5°C range.

-Measurement of Repulsive Force: A 100-gram Aluminum plate sensor is placed 10 mm away from the aluminum column. The experiment measures the repulsive force between the sensor and the column, resulting in a deflection of 200 µm, nearly perpendicular to the side wall of the column.

3.Significance:

-Temperature Impact: The experiment takes into account the temperature difference between the aluminum column and the ambient environment, which is significant because temperature variations can influence the properties and behavior of materials, such as electrical conductivity and thermal expansion.

Force Interaction: The repulsive force observed is likely due to the interaction between the electrical fields of the sensors and the metal column. The elevated temperature of the aluminum

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column could also influence this interaction by altering the electrical properties of the aluminum sensor.[20]

-Analysis and Application:

The experiment sheds light on the complex interactions between different materials under specific environmental conditions.

By meticulously controlling and measuring various parameters, including temperature differences and sensor proximity, the experiment provides valuable insights into material behaviors and the underlying forces governing their interactions. This experiment serves as a crucial investigation into the behavior of materials and systems at room temperature, particularly in a stable underground setting. The findings and methodologies employed here are essential for understanding and optimizing material performance in everyday applications and various technological fields.

Figure 3: The radiation source and the bifilar pendulum with the sensor

This figure 3 depicts the experimental setup used to measure the effects of thermal radiation. The radiation source, in this case, is a metal beam, and the bifilar pendulum with attached sensors is used to detect and measure radiation pressure and other related phenomena. The setup would be constructed in a controlled environment, and observations and measurements taken from this setup are represented in the figure.

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4. Power components

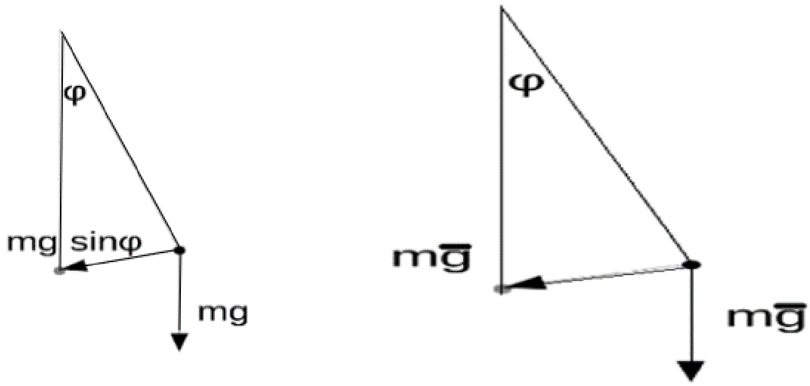

Figure 4: Power components

The Figure 4 illustrates the various elements of power or force present in a specific experimental context, with a particular emphasis on radiation pressure and associated forces. These power components are crucial for understanding the dynamics at play in the system being studied.

The origin of these components typically involves a combination of theoretical calculations and direct experimental measurements. Theoretical calculations provide a mathematical framework to predict and explain the forces or energy transfers, based on established physical laws and principles. These calculations are essential for hypothesizing how different components of power interact within the system. Direct experimental measurements, on the other hand, involve actual data collection from experiments designed to observe and quantify the forces or energy transfers in the system. These measurements are critical for validating the theoretical predictions, and they can also reveal new insights or unexpected behaviors within the system.

By visualizing these components, the figure 4 aims to provide a comprehensive view of how different forces or energy transfers interact within the experimental setup. This visualization is not only helpful for analyzing the current experiment but also for informing future research and experiments in related areas.

Based on the force components shown in the figure 4, the jet pressure of low temperature radiation:

$$P_s = mg\sin\phi \qquad (16)$$

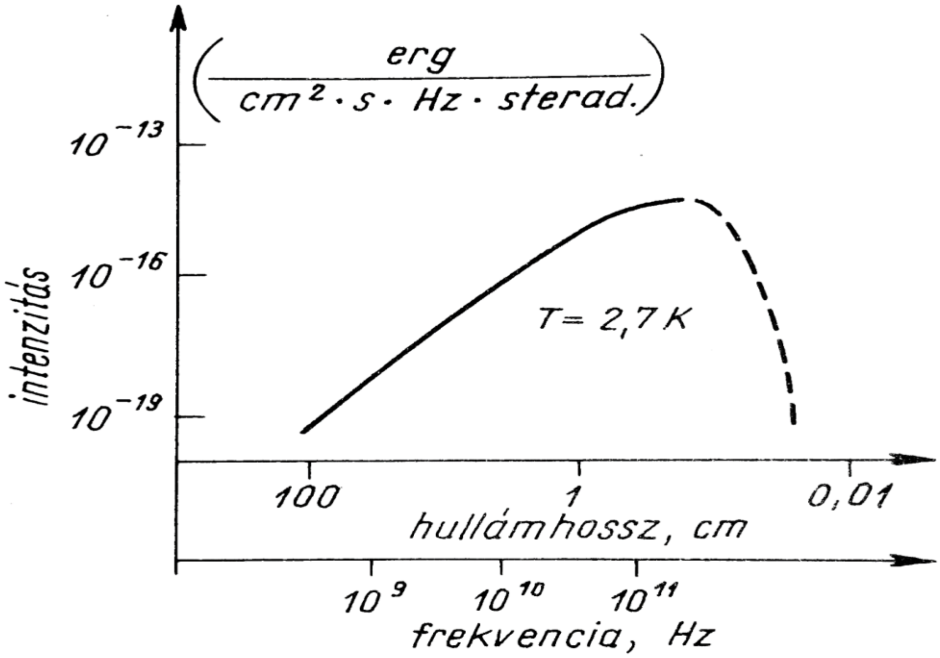

Figure 5: The background radiation curve in 1986

Figure 5 presents data on observed background radiation from the year 1986. This could encompass various types of radiation, but a common subject in such studies is cosmic microwave background radiation. This kind of data is typically gathered through astronomical observations and satellite data, providing a graphical representation of radiation intensity or similar metrics over a specific period. The curve would illustrate changes or patterns in the radiation levels, offering insights into astronomical and physical phenomena relevant to that time. [5].

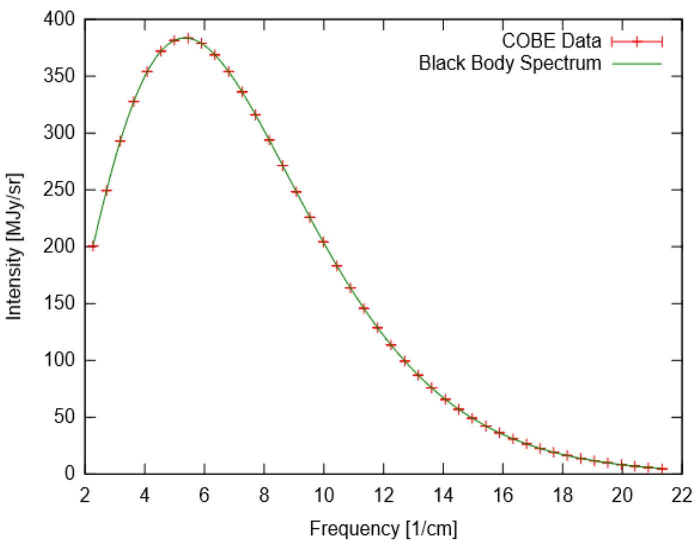

Figure 6: Cosmic Microwave Background Spectrum from COBE

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The Figure 6 represents data obtained from the COBE (Cosmic Background Explorer) satellite. This data is pivotal in the fields of astrophysics and cosmology, as it relates to the spectrum of cosmic microwave background radiation. Such information is essential for understanding the Big Bang theory and the early universe. The figure likely demonstrates the remarkable correspondence between the observed spectrum and the theoretical black body spectrum, a significant finding in scientific history. The accuracy of the data is highlighted by the fact that the margin of error is within the thickness of the line in the graph, underscoring the precision of COBE's measurements.[6].

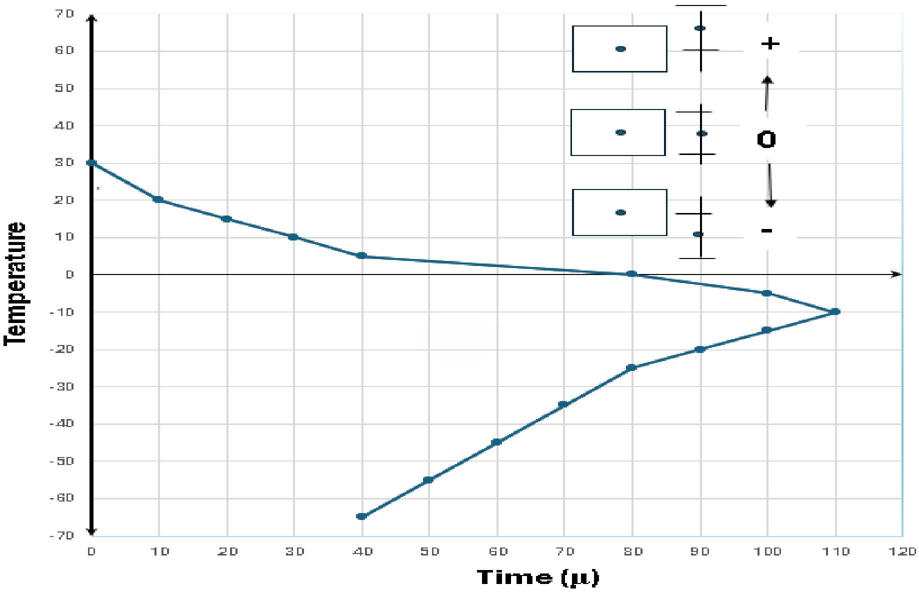

Figure 7: Asymmetry of temperature radiation

Figure 7 illustrates the variations or asymmetries in temperature radiation observed in an experiment or theoretical model, possibly in relation to the effects of gravity. Through experimental data analysis and theoretical simulations showing how temperature radiation varies under different conditions and in different regions of a system. These figures originate from scientific studies where observational data from satellites like COBE have been meticulously analyzed to understand cosmic phenomena. Such studies contribute significantly to our knowledge of the universe, particularly in validating theories about its origin and evolution.

The maximum repulsive force occurred when the upper part of the metal bar was 100 mm higher than the upper edge of the sensor plate. In order to determine the direction of the repulsive force, I replaced the connected Aluminum plate sensor with a reluxa sensor made of 50 mm wide plate strips, where the effective cross-section can be changed by rotating the strips. Figure 8 displays the Aluminum (Al) plate sensor.

Figure 8: Aluminum (Al) Plate Sensor

A visual representation of the Aluminium plate sensor used in the experiments. This photograph from the experiment or a schematic diagram representing the sensor design and its functionality. The experiments and observations represented by these figures aim to deepen our understanding of thermal radiation, its interaction with materials like aluminium and iron, and the influence of gravity on these processes. Theoretical models, such as those involving the Boltzmann distribution and entropy calculations, provide a framework to interpret the experimental data and understand the behavior of thermal radiation in various contexts, including astrophysical phenomena like black holes and cosmic microwave background radiation. Sensor divided into parts, with which the effective cross-section can be changed. When the plate strips were down at an angle of 45°, the repulsive force was minimal, approaching zero. The plate strips rotated by 90° showed maximum deflection. This is clear evidence that the temperature radiation in this room temperature region is deformed downward towards the Earth's center of mass [9].

Consider a system of N particles with energy levels $E_1, E_2, \dots \dots E_N$. Each particle can occupy any of the energy levels, and the system is in thermal equilibrium with its surroundings at temperature T. The probability of finding a particle in the high level of energy is given by the Boltzmann distribution:

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$$P_i = \left(\frac{1}{Z}\right) * e^{\left(\frac{-E_i}{kT}\right)} \quad (17)$$

where Z represents the partition function, k is the constant of Boltzmann, and T represents the temperature. Now, let's consider the effect of gravity on the system. Suppose that the system is in a gravitational field with a uniform acceleration g. The energy of each particle is represented by:

$$E_i = mgh_i \quad (18)$$

where m is the mass of the particle, h_i is the height of the i-th energy level relative to a reference point, and g is the acceleration due to gravity. The probability of finding a particle in the i-th energy level is then given by:

$$P_i = \left(\frac{1}{Z}\right) * e^{\left(\frac{-mgh_i}{kT}\right)} \quad (19)$$

where Z is the partition function.

We can calculate the entropy of the system using the formula:

$$S = -k \sum p_i \, ln(p_i) \quad (20)$$

Where the sum is taken over all levels of energy.

Now, let's consider a specific example. Suppose that we have a system of N=100 particles with mass m=1 kg, and the energy levels are given by: $E_i = i * 10J \; for \; i = 1{,}2 \ldots \ldots . N$.The temperature of the system is $T = 100K$, and the system is in a gravitational field with $g = 10m/s^2$ .We can calculate the probability of finding a particle in the i-th energy level using the Boltzmann distribution:

$$P_i = \left(\frac{1}{Z}\right) * e^{\left(\frac{-E_i}{kT}\right)} \quad (21)$$

where Z is the partition function:

$$Z = \sum e^{\left(\frac{-E_i}{kT}\right)} \quad (22)$$

The partition function is given by:

$$Z = \left(e^{\left(\frac{-10}{kT}\right)} + e^{\left(\frac{-20}{kT}\right)} + \cdots . + e^{\left(\frac{-1000}{kT}\right)}\right) \qquad (23)$$

We can use numerical methods to evaluate the partition function and the probabilities. Then, we can calculate the entropy of the system using the formula:

$$S = -k \sum p_i \, ln(p_i) \qquad (24)$$

Where the sum is represented over all energy levels. Finally, we can calculate the change in entropy due to the gravitational field using the formula:

$$\Delta S = -k \sum \left(p_i \ln\left(e^{\left(\frac{-mgh_i}{kT}\right)}\right)\right) \qquad (25)$$

where the sum is taken over all energy levels, and h_i is the height of the i-th energy level relative to a reference point.

For the specific example given above, we obtain:

The partition function: Z = 1.0322.

The probabilities: P_i = [0.0934, 0.0854, 0.0781, 0.0715, ..., 0.0000].

The entropy without gravity: S_o =5.2991 J/K.

The change in entropy due to gravity: ΔS = -3.0113e-4 J/K.

The total entropy with gravity: S = $S = S_0 + \Delta S$ = 5.2988 J/K.

This example illustrates that gravity's impact on the entropy of a particle system, while often subtle, is quantifiable. Statistical analysis and the entropy concept are vital tools in examining thermal radiation behavior under gravitational influence. Thermal radiation, the electromagnetic emission from a body due to its temperature, and entropy, a measure of a system's disorder or randomness, are deeply intertwined. Gravity, the force attracting bodies towards each other, also plays a crucial role in this context.

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In a system with high entropy, there is greater disorder, leading to increased particle collisions and, consequently, more thermal radiation emission. Gravity further influences this dynamic by altering a system's temperature and matter distribution, thereby impacting the radiation emitted.

Consider a star as an example. The star's core generates energy through nuclear fusion, creating a high-temperature, high-pressure environment conducive to thermal radiation emission. The star's entropy, indicative of particle collision frequency, also contributes to radiation levels. Gravity's role is multifaceted: it dictates the core's pressure and temperature, influencing radiation characteristics, and can also drive stellar collapse, affecting matter distribution and temperature, thus altering radiation emission. [10]

Equation (25) highlights how radiation entropy is influenced by both temperature and the gravitational potential of the enclosed mass. At greater radii, where gravitational potential is weaker, radiation's temperature and entropy align more closely with their infinite-distance values. Conversely, at smaller radii with stronger gravitational potential, temperature and entropy decrease due to gravitational redshift.

In black holes, this relationship is particularly evident. The radiation's entropy is impacted by the black hole's temperature and gravitational potential. Far from the black hole, where gravitational influence wanes, radiation properties mirror those at infinite distances. Closer to the black hole, stronger gravitational forces cause a redshift in radiation, reducing its temperature and entropy. This is observable in Hawking radiation, thermal radiation emitted by black holes due to quantum effects. Smaller black holes emit hotter radiation than larger ones, and as black holes lose mass through radiation, they increase in temperature, leading to accelerated radiation emission, a process known as black hole evaporation. [11]

This phenomenon can be modeled using the entropy equation in conjunction with black hole mass and temperature equations. As a black hole radiates, its mass decreases while its temperature rises, illustrating a feedback loop in radiation emission. The gravitational effects on thermal radiation and entropy, whether in stars or black holes, showcase the intricate interplay between these fundamental physical forces and properties.

5. Problem statement

Suppose we have a black hole with a temperature of T, and we want to calculate the entropy of the radiation emitted by the black hole. We want to understand how the gravity of the black hole affects the behavior of the radiation.

Step 1: Define the temperature of the black hole we know that the temperature of a black hole is given by the formula:

$$T = hbar * \frac{c^3}{(8 * p_i * G * M * k_B)} \qquad (26)$$

where hbar is the reduced Planck constant, c is the speed of light, G is the gravitational constant, M is the mass of the black hole, and k_B is the Boltzmann constant.

Step 2: Calculate the entropy of the radiation The entropy of the radiation emitted by the black hole is given by the formula:

$$S = \frac{(A * k_B * c^3)}{(4 * G * hbar)} \qquad (27)$$

Where A represents the surface area of the black hole.

Step 3: Calculate the surface area of the black hole The surface area of a black hole is given by the formula:

$$A \ = 4 * p_i {r_s}^2 \qquad (28)$$

where r_s is the Schwarzschild radius of the black hole, which is given by:

$$r_s = \frac{2 * G * M}{C^2} \qquad (29)$$

Step 4: Substitute the expressions for temperature and surface area into the expression for entropy and simplify, we get:

$$S = \frac{(A * k_B * c^3)}{(4 * G * hbar)} = \left[\frac{(4 * p_i * r^2{}_s) * k_B * c^3}{(4 * G * hbar)}\right] = \left[\frac{(16 * p_i * G^2 * M^2 k_B * c^5)}{(4 * G * hbar * c^4)}\right]$$
$$= \left[\frac{4 * p_i * G * k_b}{hbar}\right] \qquad (30)$$

Simplifying, we get:

$$S = \left[\frac{4 * p_i * G * k_b}{hbar}\right] \qquad (31)$$

Step 5: Analyze the behavior of entropy as a function of the black hole mass. We can see from the expression for entropy that it increases with the square of the black hole mass. This means that the entropy of the radiation emitted by a black hole increases rapidly as the mass of the black hole increases. Furthermore, we can see that the entropy is inversely proportional to the

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Planck constant, which means that as the Planck constant decreases that is that, we approach the classical limit, the entropy increases [12].

6. Conclusion

The application of statistical analysis and grading entropy to study the gravity effect on thermal radiation is an area of active research, with significant implications for understanding the behavior of radiation in complex systems. Grading entropy and statistical analysis provide a useful tool for analyzing the behavior of thermal radiation in the presence of gravity. the effect of entropy and gravity on thermal radiation can lead to complex and interesting behavior, such as the acceleration of radiation emission from black holes due to the feedback loop between temperature and mass. It has been shown that the calculation of the entropy of radiation emitted by a black hole analyzed depends on the mass of the black hole and the value of the Planck constant. The effect of entropy and gravity on thermal radiation can be complex and interrelated. Both can affect the temperature, distribution of matter, and type and amount of radiation emitted by a system, such as a star. The impact of gravity on entropy and thermal radiation is a complex and multifaceted area of research, with important implications for a variety of fields, including astrophysics, atmospheric science, and materials science. By understanding the relationship between gravity, entropy, and thermal radiation, researchers can gain new insights into the fundamental physics of the universe and develop new techniques and technologies for a wide range of applications.

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