

New Thermodynamics: Understanding Temperature's Limitations

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ABSTRACT

We shall enhance our understanding of temperature, as was first discussed in a previous paper [1]. Temperature is traditionally treated as if it has a linear relation to a system's thermal energy, throughout most temperature regimes. The limitation of temperature's relations will be discussed. Also, an improved understanding as to why various system's measurement of temperature, does represent a measurement of that system's thermal energy. It will further be discussed why statistical thermodynamics is mistaken with its various assertions, ending with a discussion as to why Maxwell-Boltzmann's speed distribution is at best, only a rough to good approximation for what is witnessed in experimental gaseous systems.

Keywords: Temperature, Thermal Energy, Blackbody Radiation, Rayleigh-Jeans Approximation, Speed Distribution

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I. INTRODUCTION: TEMPERATURE

Via our sense of touch, we all have an intuitive understanding of temperature (T). When multiplied by a substance's heat capacity, temperature change defines a system's thermal energy change. The measurement of temperature requires a scale, i.e., in 1745, Carolus Linnaeus decided that 100°C would separate the freezing, and boiling points of water, thus creating the Centigrade scale, which was dropped in favor of the Celsius scale, in 1948.

In 1887, P. Chappuis studied constant volume thermometers, wherein a gas residing in a glass bulb acts as the thermometric medium. The gas's volume is held constant by either adding, or subtracting mercury through a tube into a reservoir. This was replaced by the mercury thermometer, and more recently by electronic based ones. Throughout the 20th and into the 21st century temperature has been associated with the kinematics of a system's matter, which includes the matter's translational, vibrational, and sometimes its rotational energy.

Phonons are the quantized energy associated with vibrating EM bonds within condensed matter. It is the motions associated with such EM bonds within crystalline solids that traditionally are mathematically related to blackbody radiation within cavities. This author has contemplated the plausibility that blackbody radiation is due to inelastic molecular collisions (both inter and intra?) [1]. This author has further argued that based upon heat capacities, that blackbody radiation must also be related to both liquids and amorphous solids, both of which lack crystalline structure [1], as well as, polyatomic gases.

Traditional kinetic theory is based upon equipartitions, degrees of freedom, and elastic collisions. This author has presented a new improved kinetic theory that not only allows

for inelastic collisions, but also is a superior fit to known heat capacities of gases, without any reliance upon degrees of freedom. Most importantly, this author's new kinetic theory does not require any of the numerous exceptions that plague traditional kinetic theory [2],[3].

Furthermore, this author has discussed how in experimental gaseous systems, that the system's walls will absorb and then re-radiate any heat generated by inelastic intermolecular collisions. This will then give the illusion of elastic collisions because thermal energy is now conserved, although the collisions are inelastic [2]-[4]. Note that: An inelastic collision means that momentum is conserved, and that in order for energy to be conserved, then photons (thermal?) must also be a result of the collision.

II. INTRODUCTION: LINEAR TEMPERATURE

The Stefan-Boltzmann law states that the total emitted power (P) is proportional to the matter's temperature to the fourth power, which is generally considered as being blackbody radiation [1],[5]:

$$P = A\epsilon\sigma T^4 \quad (1)$$

Where ϵ = emissivity $\sigma = 2\pi^5 k^4 / 15c^2 h^3 = 5.670400 \times 10^{-8} \text{ J/sm}^2 \text{ k}^4$, and A = surface area²

The spectral radiance gives the power emitted [$P_{B(\nu)}$] at each frequency (ν). Confusingly, the radiance (W/sr m^2) aka intensity, of a substance is the radiant flux emitted or received, by a surface in a given direction per unit solid angle per unit area. Irradiance is the power received per unit surface area with units being W/m^2 , and the spectral irradiance is the irradiance per unit wavelength or frequency.

Realizing that radiancy must be proportional to the energy density, then one can write [1],[5]:

$$\rho_B = aT^4 \quad (2)$$

where ρ_B is the power associated with the blackbody energy density, and a is the blackbody radiation constant $a = 8\pi^5 k^4 / 15c^3 h^3$. “

When $hc/\lambda = hv \ll kT$, then eq. (2) can be approximated by [1,5]:

$$\rho_B = a'T \quad (3)$$

Based upon eq. (3) being applied to our Sun's insolation here on Earth, this author has recently determined that the reason that most thermodynamic relations are linear functions of temperature is because our Sun's blackbody radiation's energy density (ρ_B) in the infrared is a linear relation, as defined by the Rayleigh-Jeans approximations. [1]

Specifically, Earth's atmosphere's thermal energy density is linearly proportional to temperature, and the measured temperatures of all systems here on Earth, are compared to our atmosphere, which happens to be massive [1]. This paper is in many ways a continuation of this last paper.

It is of interest that the linear relation between a system's energy states and temperature has been previously considered [6], although it is a view that is an unnecessary over-complication, based upon statistical assertions.

III. INTRODUCTION: INFRARED SPECTROMETRY

The heat capacity of homonuclear gases tells us that they actually absorb thermal energy. Strangely, it has been wrongly accepted that homonuclear atmospheric gases (N_2 , O_2) do not absorb infrared radiation because it did not show up in their infrared spectrums. As was discussed [1,7] the reason being that part of the calibration of spectrometers includes the subtraction of the blank, which happens to be the subtraction of the system's thermal signature. And if the thermal energy that gases absorb is blackbody, then we now understand that the subtraction of the blank, will also be a subtraction of the homonuclear gas's thermal signature.

The implication is that a polyatomic gas in an experimental system, absorbs and radiates thermal blackbody radiation [1]. Furthermore, for gases that were traditionally claimed to absorb infrared radiation, i.e., so-called greenhouse gases, this absorption is not necessarily thermal energy, e.g. energy associated with the gas molecule's dipole moments [1],[7].

Accordingly, the above thermal energy, which is blackbody in nature, must relate to the polyatomic gas's vibrational energy which can be defined in terms of Boltzmann's constant (k), temperature (T) and the number of atoms (n'') in the gaseous molecule by [1]:

$$\bar{E}_v \cong (n'' - 1)kT \quad (4)$$

It becomes interesting that all polyatomic gas molecules absorb and then re-radiate infrared centered blackbody radiation, as part of their vibrational energy. Such infrared centered blackbody radiation, can now be called “thermal blackbody radiation”.

The total energy (E_T) for N gas molecules in an experimental apparatus, becomes:

$$E_T \cong NkT(n'' + 1/2) \quad (5)$$

Eq. (5) is what one witnesses when measuring a gas' heat capacity [3], [4], [8]. That being the case then the thermal energy is a linear function of temperature, as indicated by both eq. (4) and eq. (5). This means that even if an absorption spectrum is not identical to a radiation spectrum, that the total flux of thermal energy can still be related to the total efflux of thermal energy, and that in thermal equilibrium these relationships are equal [1].

This author acknowledges that there may be other explanations that have not been thought of at this time. Even so, the above may help explain why so many thermodynamic equations have a linear relation between thermal energy and temperature [1].

The other side of the above explanation is that our Sun's insolation is blackbody radiation whose peak intensity is in the visible spectrum, and what is considered as thermal energy from our Sun fits with the requirement that the Rayleigh-Jeans approximation is valid i.e., eq. (3)'s validity requires that: $hc/\lambda = hv \ll kT$ [1].

It should be noted that in a rather simple experiment Allmendinger [9] has confounded the accepted sciences, by clearly showing that many polyatomic gases, including homonuclear gases, do absorb our Sun's thermal radiation.

IV. INTRODUCTION: MAXWELL-BOLTZMANN

The traditional consideration for an enclosed system consisting of a large number of gas molecules (N) with mass (m) in a volume (V) is defined in terms of Boltzmann's constant (k) and its absolute temperature (T) are often related by Maxwell's distributions. This led to the Maxwell-Boltzmann distribution that being a probability density function, i.e., the probability per unit speed of finding a gas molecule with speed near v . This speed distribution is used to define the distribution of gaseous molecule's speeds, at a fixed pressure and temperature. It is generally written as follows [10],[11]:

$$f(v)dv = \left(\frac{m}{2\pi kT}\right)^{\frac{3}{2}} 4\pi v^2 e^{-mv^2/2kT} dv \quad (6)$$

Of interest is that this distribution is based upon traditional kinetic theory's degree of freedom assertion., wherein a gas molecule's mean translational energy is equated to $3kT/2$, where k is Boltzmann's constant. This becomes troublesome in light of this author's assertion that kinetic theory improves significantly when one realizes that a molecule's mean total translational plus rotational energy is $3kT/2$. That being the case, then eq. (6) can only be an approximation at best, and as such should be adjusted by those capable of doing so. Rewriting such distributions is not a goal of this paper, rather it becomes our intent to understand why such considerations have a proven reality although the logic they are based upon is a series of misunderstandings

V. THERMOMETER IN A VACUUM

Consider, that a thermometer is placed in a fully enclosed vacuum, at $T=300$ K, as is shown in Fig 1. In thermal equilibrium, the efflux of radiation from the thermometer equals the flux of radiation into the thermometer.

This radiation is most likely thermal blackbody radiation with its peak near $9 \mu\text{m}$, that being thermal blackbody radiation, as is shown on the R.H.S. in Fig 1.

Now consider that the vacuum is extremely cold, i.e. $T \rightarrow 0$. In this case the blackbody curve is the same shape except now the blackbody spectrum will be dominated by microwave's long wavelengths, e.g., the peak is now in the microwave spectrum for $T = 3$ K. This raises the following questions:

- 1) "Are microwave wavelengths thermal energy?"
- 2) "What would a thermometer measure at $T = 3$ K?"
- 3) "Should such a cold blackbody spectrum even be considered in terms of T ?"

The answer to 1) is debatable. A microwave oven works by di-electric heating of the water molecule, but this lacks the universality of thermal infrared heating. The answer to 2) may depend upon the thermometer's thermometric properties. e.g., how it reacts to microwave energy. For most conventional thermometers the answer should be no.

The answer to 3) is the least straight forward. Our atmosphere's thermal energy density being linearly proportional to its temperature has instinctively made us think that such linear proportionality is universal, when it is not. Certainly, up for debate.

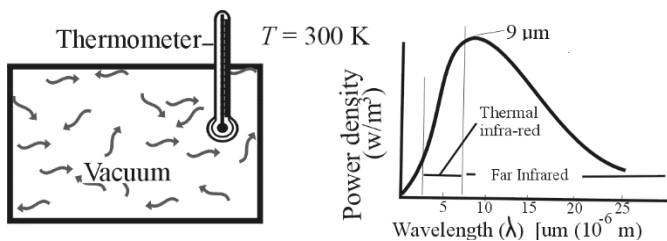


Fig. 1, on the L.H.S. is a sketch of a thermometer in a vacuum at $T=300$ K. The thermometer absorbs and radiates blackbody radiation, whose peak is around $9 \mu\text{m}$, as is shown on the R.H.S.

Then "does blackbody radiation at $T = 3$ K have thermal energy?" If blackbody radiation near absolute zero lacks a temperature, i.e., place a thermometer into a vacuum at $T = 3$ K, and then there is no way of really knowing what you are measuring. This metaphysical argument is now up for debate.

"What about our Sun?" Again, if temperature is a comparative linear measure of a system's thermal energy, as measured by a thermometer here on Earth, then there also may be an upper limit to measured temperature. The plausibility of an upper and lower limits also raises the question "does eq. (2) become limited to a certain temperature range?"

Could this also mean that "our Sun's temperature is not really $T=5,700$ K"? That becomes another interesting question because blackbody radiation inside a cavity at such a high temperature has never actually been measured, i.e., the blackbody radiation at our Sun's temperature is actually mathematically inferred. Even consider white hot here on

Earth, as occurs with matter where $T > 1,500$ K, its temperature is inferred, rather than actually measured with a mercury thermometer. Furthermore, white-hot is not limited to a cavity in crystalline matter, so like our Sun, white-hot challenges traditional assertions concerning blackbody radiation. Certainly, such glowing molten metal is too hot to maintain a crystalline structure, as required by traditionally accepted theory for blackbody radiation.

Another interesting question becomes, "is there a pressure functionality, with respect to how we define thermal energy hence temperature?" i.e., "does thermal energy here on Earth means one thing, while in our Sun it has an alternative meaning?" This elaborates upon, without actually answering this author's previous questions concerning the limitations one should have concerning temperature [1]. These may become even more interesting questions, if blackbody radiation becomes associated with inelastic collisions, as has been hypothesized by this author [1].

VI. GASEOUS EXPERIMENTAL SYSTEM

Consider that you are studying a sufficiently-dilute gas's temperature in some experimental apparatus, i.e., an enclosed gas in thermal equilibrium at temperature T , as is illustrated in Fig 2

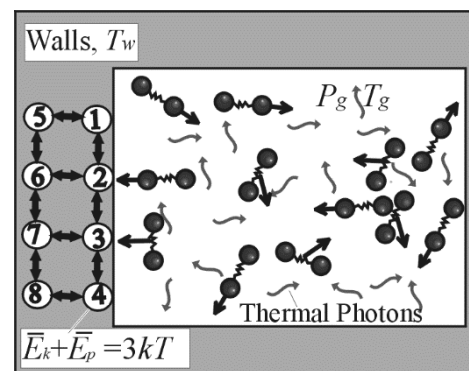


Fig. 2 shows a diatomic gas at pressure P_g and temperature T_g , surrounded by walls at T_w . The gas molecules all have vibrational energy and are surrounded by a spectrum of thermal photons, which may be blackbody.

- The walls are in thermal equilibrium with the enclosed blackbody radiation e.g. both are related to the same temperature, i.e., $T_w = T$.

The gas molecule's translational plus rotational

- energy is in energy equilibrium with the molecular vibrations of the wall molecules at $T_g = T$.
- The gas molecule's vibrational energies are in thermal equilibrium with the enclosed blackbody radiation, i.e., both are related to the same temperature $T_b = T$.

We understand how the above results in the illusion of elastic collisions [2,3,4], as it appears that both momentum and energy associated with the intermolecular collisions are conserved. However, the reality is that the momentum is conserved in the inelastic intermolecular collisions. Furthermore, total energy of the system is conserved only because the surrounding walls absorb, and then re-radiate any radiation generated by the inelastic collisions [4].

Again, the question becomes, “is the above generated radiation blackbody?” For a system whose temperature is such that eq. (2) is valid, e.g., $T=300$ K, then the surrounding thermal photons are probably all part of a blackbody spectrum, i.e., all thermal blackbody radiation. Importantly, this would not be readily discernible from the blackbody radiation emanating from, and being absorbed by, the system’s surrounding walls.

What about the diatomic gas molecules absorbing and then re-radiating the thermal blackbody radiation in their surrounding freespace. “How can this also be defined by eq. (4)?” Think about it, the blackbody radiation’s thermal energy density must equate to the atmosphere’s thermal energy density, both of which can be measured by the comparator, known as a thermometer. In order to better understand, let us now consider the measurement of temperature in our atmosphere.

VII. ATMOSPHERIC GASES

Consider our atmosphere’s polyatomic gases, e.g., mainly N_2 and O_2 . These gases absorb thermal radiation residing in our atmosphere, and hence should have a vibrational energy that is a linear function of temperature, as defined by eq. (4). For a diatomic gas molecule, $n''=2$, and hence eq. (4) becomes:

$$\bar{E}_v \cong kT \quad (7)$$

The atmosphere’s diatomic gases should be able to absorb our Sun’s insolation hence their mean thermal energy is a linear function of temperature, i.e., eq. (7) fits. Again, the question arises “do they radiate blackbody radiation, or is their radiation more similar to that which they adsorb?”

If our atmospheric gases radiate a blackbody spectrum, then when in thermal equilibrium, the blackbody’s efflux should still equate to the influx of thermal radiation, although once more the absorption and radiation spectrums are not identical. This concerns the atmospheric gas’s vibrational energy. Another question that arises is, “do the intermolecular collisions between various gas molecules, also result in blackbody radiation?”

At this point, we do not have all of the answers. Then again it may not matter, so long as the total efflux equals the influx, when in thermal equilibrium, with the vibrational energetics associated with the atmospheric gases being defined by eq. (4), which can be approximated by eq. (7).

Next consider that you have a thermometer in thermal equilibrium with the atmosphere at $T=300$ K. “What happens?” In thermal equilibrium the thermometer:

- Absorbs the thermal radiation energy from the surrounding atmosphere, whose thermal energy density is a linear function of temperature, and radiates energy so that influx equals efflux.
- Exchanges collisional energy with surrounding gas molecules, i.e., their inelastic intermolecular collisions are such that again, efflux equals influx.

The above stated collisional energy includes the surrounding gas’ translational plus rotational energy, as well as the gas molecule’s vibrational energy (kT). Therefore, our expectations become that on average the gas passes as much of their vibrational energy onto the thermometer, as they receive from it.

It raises the question, “do the inelastic intermolecular

collisions between the thermometer’s molecules and gas molecules, also result in blackbody radiation with its maximum intensity peak at $9 \mu m$?” Again, if the spectrum of energy produced by such inelastic intermolecular collisions is blackbody radiation, then the answer is, yes. This would not be easily witnessed, as it disperses throughout the atmosphere.

In terms of the atmosphere itself, one must also consider that the diatomic gas’s vibrational energies (kT) are initiated by absorbing our Sun’s/atmosphere’s thermal radiation. This energy would also be passed onto their neighboring gas molecule’s translational plus rotational energies, during their intermolecular collisions. How one precisely models this, could take some insight.

Another question arises, “do the inelastic intermolecular collisions mean that true thermal equilibrium is not possible in our open system atmosphere?” For the gas in the experimental apparatus, the illusion of thermal equilibrium existed because the radiated energy associated with inelastic collisions, is absorbed and then re-radiated by the system’s surrounding walls. And this gives the illusion of elastic collisions, [4] when in thermal equilibrium.

The atmosphere has no walls and therefore the illusion of elastic collisions may not exist, at least to the same extent. For thermal equilibrium to exist, all thermal radiation must be continually absorbed and re-radiated by the neighboring gas molecules. Therefore, the thought of precise thermal equilibrium may be more of an approximation, which is dependent upon the thermal photon’s actual mean free path.

VIII. CONDENSED MATTER

Place a thermometer in condensed matter that is in thermal equilibrium with the surrounding atmosphere. The thermometer’s molecules exchange kinematic energy with the surrounding molecules. The energy exchanges are related to Boltzmann’s constant multiplied by the temperature (kT), because the liquid exchanges thermal energy with the surrounding atmosphere, whose thermal radiation energy density is a linear function of the temperature. Moreover, the atmosphere acts as heat sink/bath, thus dominating any witnessed dynamics.

Furthermore, atmospheric gas molecules also exchange their kinematic energies with the condensed matter through intermolecular collisions. It is of interest that diatomic atmospheric gases have a mean vibrational energy defined by kT , and as previously stated, this will influence the gas molecule’s translational plus rotational energy, as well as its vibrational energy

The condensed matter also radiates a spectrum that is most likely blackbody in nature. However, due to the size of the atmosphere, any uniqueness of this spectrum will be quickly lost as the radiation disperses.

As was previously stated [1], the thermal radiation density in our atmosphere is a linear function of temperature, to which most all system’s here on Earth are compared. Furthermore, both polyatomic gases and condensed matter, absorb the atmosphere’s thermal energy, thus increasing the thermal energy density, wherever it is that the matter resides.

IX. TRADITIONAL ASSERTIONS

Current statistical thermodynamics is based upon the kinematics of matter possessing linear relations of temperature. Such linear relations have a temperature range

for their applicability, and this is not traditionally appreciated. It has been shown that a logical path exists, one that is void of entropy based statistical analysis. A question becomes “why did statistical thermodynamics take hold?”

Since an experimental system is compared via a thermometer to our atmosphere’s thermal energies, then the thermal energy relation can also be expressed as a linear function of temperature. Inside this experimental system, the gas’s actual energetics are defined by either: a) An energy spectrum whose curve is very similar to the blackbody radiation curve, at that temperature T . And/or, b) an energy spectrum whose thermal energy density is a linear function of temperature.

The above two are often interrelated, i.e. condensed matter may radiate a) while it absorbs b), such that its total flux equals its total efflux. Equally condensed matter and polyatomic gases in an enclosed system should absorb and radiate radiation (blackbody and/or thermal), e.g., results in the gas molecule’s vibrational energy adhering to eq. (4).

A gas in an experimental apparatus, has its translational plus rotational energy is imposed upon it by the surrounding more massive vibrating wall molecules. The wall molecule’s vibrational energies at any instant of time would be a distribution, e.g., approximated by a Boltzmann distribution.

Irrelevant of the exact nature of the wall molecule’s vibrations, one might expect that the gas molecules would adhere to a distribution that is similar to the Maxwell-Boltzmann speed distribution, i.e., eq. (6). Such speed distributions are currently used to approximate the distribution of gaseous molecule’s speeds, at fixed pressures and temperatures.

However, the Maxwell-Boltzmann distributions assumes that molecular collisions are elastic, and that gas molecules only attain their translational energy, as a function of $kT/2$, i.e., traditional kinetic theory. Such assertions are not correct. Namely, intermolecular collisions are inelastic, even though the illusion of elastic collisions exist. Therefore, distributions like Maxwell-Boltzmann’s, will require improvements by those inclined to do so.

Even so, the distribution will be somewhat similar to Maxwell’s distributions, at least for sufficiently-dilute gases in experimental systems. Since the concept of various distributions, i.e., binomial and Gaussian, are based upon probabilities, and have been instructed on the merits of all such distributions, then we now understand how entropy based statistical thermodynamics attained it’s status.

Arguably, our forefathers were sort of right. Even so, they were certainly wrong, to extend it to the point of limiting thermodynamics to only being completely explainable in terms of entropy related probabilities.

X. AN EXPERIMENT

If one needed to devise an experiment that shows what has been discussed. One might choose a cavity in condensed matter. Such a cavity is protected from the Sun’s insolation, hence any radiation within it would be due to the walls and/or the gas’s P - T relation within it, i.e., hidden from the atmosphere’s thermal radiation, whose density is proportional to T . If the cavity was a vacuum, then the radiation within that cavity should only be from its walls.

One might then consider putting a small hole into the cavity and measuring the spectrum that comes out of the cavity. Okay, this is the basis of the 19th century experiments on blackbody radiation. The point remains that such experiments can be taken as proof for more than one theory. It is the old adage that an experiment cannot prove a theory, it can only disprove a theory.

XI. TEMPERATURE

“What then is temperature?” Consider temperature as being a measure of a system’s thermal energy, as measured by a thermometer’s thermometric medium ability to absorb the system’s thermal energy. Its linear scale can only be an approximation valid for the temperature regimes that are most often witnessed here on Earth. Temperature is related to a system’s thermal energy, and/or its thermal energy density, with the knowledge that, at a given temperature, both condensed matter and polyatomic gases tend to absorb and then concentrate thermal energy, thus increasing a system’s thermal energy density.

“What do we do with temperature? We can leave it as a linear function of a system’s thermal energy, with its hypothetical extension to -273°C being absolute zero, which is graphically based. It is probably too late to change that, at least as far as the general public is concerned.

Of course, from a scientific perspective we must be cognizant that temperature’s falters at its extremes. We could also change our understanding of temperature to being limited to systems whose blackbody radiation constitutes thermal energy, i.e., blackbody thermal radiation. Furthermore, there may be system pressure consideration in so far as what all constitutes thermal energy. Either way thermodynamics is in need of an overhaul.

What is also not traditionally appreciated is that it is temperature rather than entropy that defines the net direction in which thermal energy flows, i.e., heat flows from cold to hot, but the net flow is always from the hot to cold system. This is irrelevant of a system’s thermal energy density.

XII. CONCLUSIONS

We must change the way we think about thermodynamics. It was discussed how the Maxwell-Boltzmann distribution could have emboldened those promoting a statistical-based science. However, to fall into the eternal well of thinking that all processes can only be explained in terms of probabilities, whose foundation lays in the probability distributions (binomial, Gaussian), is more than troublesome. Although not fully discussed, such a mindset put blinders on those who subscribed to the over-complication that being entropy-based traditional thermodynamics.

The other side lay in statistical thermodynamics being based upon the kinematics of matter, which seemingly explained why most system’s energy is a linear function of temperature. This also led to the assertion that a vacuum has no temperature, which is something this author has previously challenged. Interestingly, herein it was discussed that a vacuum does have a temperature, but this has limitations, i.e., the radiation within the vacuum must contain thermal energy, e.g. be thermal blackbody radiation. This may not the case at the extremes (both hot and cold), at least here on Earth.

In this author's previous paper [1], it was discussed how the thermal energy from our Sun may explain the linear relations between a system's thermal energy, and its temperature. In many ways this paper is an elaboration of those thoughts.

Accepting that thermal energy consists of a range of frequencies, which are readily absorbed by both polyatomic gases and condensed matter, resulting in molecular vibration (intra and/or inter), then the notion of temperature, may also have its limitations. A final understanding being that the linear relations between temperature and a system's thermal energy, and/or its thermal energy density, is an approximation that we witness here on Earth.

Imposing a range on temperature's validity, will alter how we perceive our universe. Moreover, the concept of temperature may have different interpretations for different systems, such as in high pressures in stars. Or, it may alter how we view our Sun's temperature, or even place limits upon blackbody relations.

Our understanding as to how thermal energy is exchanged was considered for a vacuum, an experimental gaseous system, and our atmosphere, as well as, with condensed matter. The methods of exchange varied, with most, if not all, capable of being equated either directly or indirectly, to being functions of Boltzmann's constant (k) multiplied by the absolute temperature (T). This does not mean that the same spectrum of thermal radiation is always absorbed, as is radiated. Rather when in thermal equilibrium, the total influx of thermal energy equals the total efflux of thermal energy.

There is no claim of complete knowledge, at this time. No matter, headway has been made. The fact remains that most system's temperatures, as measured with a thermometer, can be directly compared to the thermal energy density that is witnessed in our massive heat bath/sink that being our atmosphere.

This paper and its predecessor [1], changes our perspectives on most everything in thermodynamics, with emphasis here being placed upon the true meaning of temperature. Importantly, these papers provide a logical sequence that explains what is witnessed without the mathematical enormity associated with the traditionally endorsed statistical arguments.

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