Behavior of gas reveals the existence of antigravity
Gaseous nature more precisely described by gravity-antigravity forces

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Abstract: The gravitational attraction force has been accepted as proportional to mass for several hundred years now. However, gravitational attraction, acting on matter has been totally neglected in the thermodynamic calculations in the derivation of the ideal gas law. In addition to the gravitational attraction, this researchers work has revealed that a gravitational repulsion force which is proportional to the content of thermal energy of the particle is in existence in nature. Both the gravitational force and this speculated antigravity force have to be accommodated for an authentic elucidation of ideal gas behavior. The author has explained the behavior of large systems such as floating clouds in mid-air and the expansion and the acceleration of universe using both the gravity and antigravity forces. This article discusses how antigravity works along with gravity at microscopic level like in the gaseous state of air molecules under varying temperature.

Key words: gravitational attraction, gravitational repulsion, antigravity, intermolecular force, specific heat, thermal energy, adiabatic and isothermal expansion.

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1.0 Introduction:

As any new scientific revelation has a bearing on the accepted existing knowledge, some analysis of the ideal gas law becomes expedient. The introduction discusses the most fundamental concepts relating to the ideal gas law and they are recalled in this introduction with fine detail to show how they contradict the observations made in this discussion.

A major assumption in the classical derivation of ideal gas equation [1] is;

> **The intermolecular force in gaseous state is zero and as such molecules exhibit no force among themselves.**

One of the most fundamental forces, the gravitational attraction among matter has been overlooked, both with earth and among the air molecules themselves, in deriving the ideal gas law equation.

It is accepted that the atmosphere around the earth exists because of the gravitational force of earth and this is a major force between earth and the air molecules. Even Mars with a lower gravitational attraction accommodate an atmosphere ~6% of Earth –(610 pascal) [2]. Also, a denser atmosphere is found in planets with higher gravity such as Jupiter, holds even light gases such as hydrogen and helium in its atmosphere [3].

However, recently published data by the author [4-6] [7] show that there exists not only an attractive force acting on matter but also a repulsive force among them. And also, that these two forces act on any entity (matter, contain mass) regardless of its size/mass. This further suggests that natural phenomena such as the existence of clouds and the expanding and accelerating nature of the universe [8] [9] [10] [11] can be explained more precisely by considering both the gravitational attraction together with gravitational repulsion successfully [7] [12]. The novel theory states/experimentally shows that this gravitational repulsion force is proportional to the temperature [6] which is an indicator of the content of thermal energy of the entity, similar to the gravitational attraction that is proportional to the mass of the entity. Experimental proof of this has been given in a series of publications published by the author [4-6]. If these forces govern the universe, it must be the same everywhere both in the microscopic and macroscopic level. There are many similarities between the effect of thermal energy on expanding air and of it on the expanding universe. Alternative explanations have been discussed by other researchers in recent past [13] [14].

In one of the authors recent publications "Antigravity, an answer to nature's phenomena including the expansion of the universe" [7] suggests the following; "*In addition to attractive* *and repulsive forces of water-droplets of a cloud with earth, there exist attractive and repulsive forces among water droplets within the cloud. These forces acting inside the cloud explain the accumulative (flocking together) nature of the cloud which has not been explained by the classical theories. The equilibrium of these two forces will confine the droplets to a certain area as a floccule. The repulsiveness does not allow shrinking and finally collapsing the cloud while the attractive force keeps the droplets together without dispersion*" The above concept can also be applied to gas molecules which is an analogy to the water droplets in a cloud.

This paper discusses how the forces of gravity and antigravity (gravitational attraction and repulsion) explain the behavior of gases without hypothetical assumptions used in classical thermodynamics some of which are erroneous. A relevant mathematical relationship has been built-up with the available experimental data. However, the values used for the calculation in the derivation of parameters defined in this manuscript may not be an exact (as the values obtain by me are not of high in accuracy) but one sufficient to interpret the nature of the behavior under the newly revealed antigravity force. The mathematical interpretation worked up adequately explains the behavior of gases under the effect of antigravity. It also provides the order of magnitude of gravity and antigravity under the new concept.

2.0 Method and discussion:

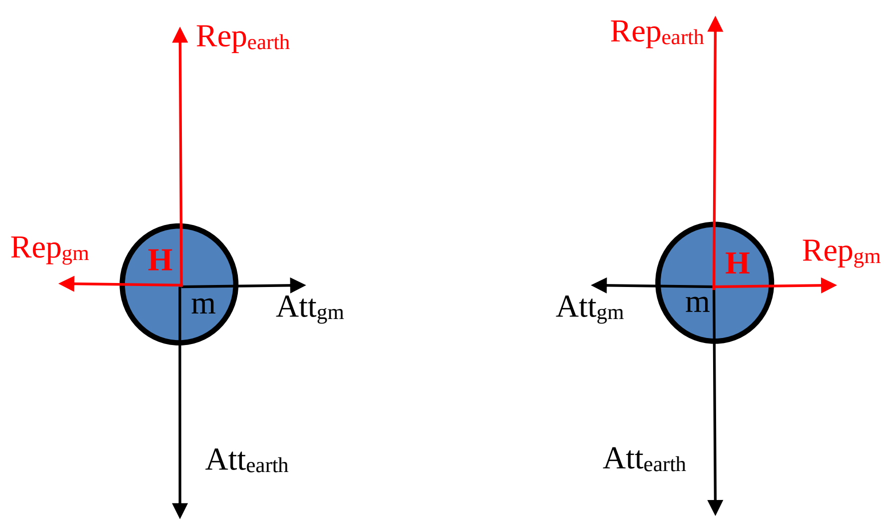


Fig. 1. Two air molecules with mass m and thermal energy H. Each molecule experiences gravitational attraction and repulsive forces from the other gas molecule (Att$_{gm}$ and Rep$_{gm}$) as well as from the earth (Rep$_{earth}$ and Att$_{earth}$)

Under the novel concept [6], the strength/intensity of the repulsive force (antigravity force) among objects in space depends on the energy (thermal energy) of entities (other than the distance which is the common factor for both cases) similar to the attraction force (gravity force) which depend on the masses of the respective entities.

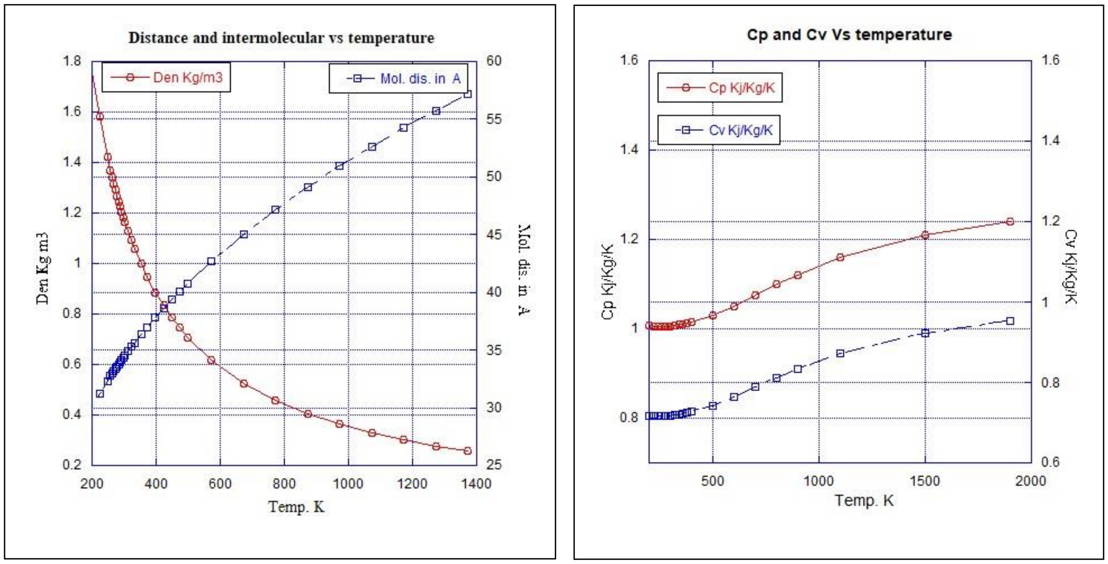
If we consider a given mass of air under this new antigravity concept (AGC), the repulsive forces would vary between molecules with the change of temperature while the attractive forces remain constant, as there is no change in mass (provided the distance among molecules are constant).

According to the new AGC, an air molecule experiences both forces (gravity and antigravity) not only among surrounding air molecules, but also with the earth (see Fig. 1). Increase of thermal energy, H of air, increases the repulsive force among the surrounding air molecules (Rep_{gas}) as well as with the earth (Rep_{earth}) thereby **lowering its weight** (See Fig. 1). Temperature is an indicator of the thermal energy content.

Therefore, under AGC, there are two processes occurring with the increase of temperature;

i) Increase of intermolecular distance due to increase of intermolecular-repulsion which will accommodate a lesser number of molecules per unit volume and hence a lower density (Fig. 2(a)).
ii) Decrease of weight of individual air molecules due to increase of gravitational-repulsion (antigravity) with earth which also contributes to lower density

This implies that at a higher temperature, a larger number of molecules will be needed for **unit weight** relative to a lower temperature. However, the specific heat capacity remains constant per air molecule. Hence the thermal capacity increases due to higher number of molecules per unit mass. This increases the **specific heat capacity (SHC) of air per unit mass** with the increase of temperature. Therefore, this increase of SHC (C_p & C_v) with the temperature (see Fig. 2(b)) could be attributed to the increase of antigravity force (decrease of weight increases the number of molecules per unit mass and hence the heat capacity-thermal energy).



(a) (b)

Fig. 2. Change of parametric values of density, distance between molecules and Specific heat of air with temperature (a) Change of density of air and the intermolecular distance of air molecules with the temperature. (b) Change of specific heat Cp and Cv of air relative to the increase of temperature.

Increase of distance among molecules due to increase of repulsive force (antigravity) is also calculated and shown in Fig. 2(a). Distance to the nearest neighbor particle was discussed in literature [15,16]. However, here in this manuscript, it is assumed that air molecules with average molar mass of dry air 28.9 g/mol are evenly distributed in space and the distance between them are calculated accordingly.

The other major observation is the difference in specific heat capacity (i.e. C_p-C_v) of air at a given temperature value (Fig. 2(b)). In the classical explanation, this is attributed to the energy difference which is equal to the work done during the expansion of the gas molecules. Classically, the work done is defined as pressure (P) into change of volume (ΔV), (i.e. $P \times \Delta V$). In the gravity/antigravity explanation, when the gas is expanding, work is done against the gravitational attraction by the gravitational repulsive force which is increasing the distance between gas molecules. Thus, with an increase of volume or decrease of pressure, the distance between gas molecules increases (Fig, 2(a)) **due to the antigravity force** which is responsible for the work done against gravity. This work is done in expense of heat energy, (i.e lowering its temperature).

One of the examples of such a situation is adiabatic cooling in “air condition systems”.

It is noticed that the specific heat of a gas at constant pressure, C_p is always greater than the specific heat at constant volume, C_v (shown in Fig. 2(b)). This is because at constant volume

(C_v), heat energy is needed only to increase the heat (temperature) of the system (which leads to increase the antigravity repulsion/pressure), but at the constant pressure (C_p), it is needed not only to increase the temperature but also to do work against the attraction force (gravitational attraction), **keeping the system at constant temperature – isothermal expansion**. Therefore, the energy of the difference in specific heat constants (C_p-C_v) could be considered as (attributed to) the energy needed for the work done by the antigravity force against the gravitational attraction.

With all these explanations, according to the AGC, a primary/simple relationship/picture can be drawn between two air molecules as shown in the Fig. 3. It is assumed that only two molecules exist within a box that fits only these molecules. We also assume that the two molecules are at rest touching the walls of the box and in equilibrium under the gravitational/antigravitational force system. Let the force acted on/by the wall at this instant is equal to F.

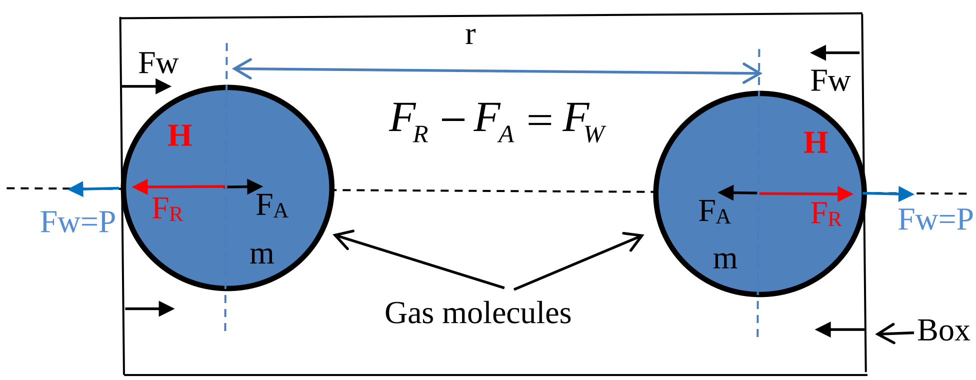


Fig. 3 Two molecules of mass m are with thermal energy H (corresponding to temperature is T) inside the box. It is assumed that the two molecules are at rest touching the walls of the box and in equilibrium ($F_R - F_A = F_W$) under the gravitational/antigravitational force system. Distance between them is r. F_A, F_R and F_w are attractive, repulsive and the force (the resulting force) acting on the wall by the air molecule. F_w is the resultant force exerted by the wall and identified in an actual system as **pressure P**.

Attraction force, F_A is proportional to the mass m and it is defined for the two molecules considered - Fig. 3 is as;

$$F_A = G_A \frac{m \times m}{r^x} \quad \text{.......................................(1)}$$

Where G_A is the constant depending on gravitational attraction. The distribution of force-field around the molecule with the distance is assumed unknown under AGC and hence the power of r is denoted by x.

Repulsive force, which is proportional to the thermal energy H is defined for the system shown in Fig. 3 is as follows;

$$F_R = G_R \frac{H \times H}{r^x} \quad \text{.................................(2)}$$

Where G_R is the constant depending on gravitational repulsion. H, thermal energy is given/define in this derivation by

$$H = m \times C \times T^y \quad \text{..................................(3)}$$

where C is the specific heat, T is the absolute temperature and y is the power of temperature T. Exact C values are uncertain that arises due to the uncertainty of the values of masses (m) as mass is derived by weight of the matter - experimentally. Now, we have shown that the value of weight of matter is influenced by the equally strong force of antigravity which was not counted before. A parameter y (power of T) is introduced as the effect of absolute temperature on the thermal energy/antigravity of a particle is not known.

For an equilibrium system, repulsive force must be equal to the attractive force and the force on the wall of the box. This relationship can be expressed as follows.

$$\left|\vec{F}_R - \vec{F}_A\right| = G_R \frac{H^2}{r^x} - G_A \frac{m^2}{r^x} = \left|\vec{F}_w\right| \quad \text{...................(4)}$$

where F_w is the resultant force exerted by/on the wall of the box and identified in an actual system as **pressure P**. G_R and G_A are arbitrary constants. This relationship can be used to describe the expansion of gases under constant pressure and constant volume.

Now consider a system (i), (in Fig. 4 & 5) with two air molecules of mass m, at temperature T_1 (thermal energy of H_1) r_1 apart, under resultant force F_{w1}. Attraction force and repulsive forces are F_{A1} and F_{R1} respectively. Sum of forces F_{A1} and F_{w1} is equal to F_{R1} (indicated in Fig. 4 as the distance d_1).

$$F_{R1} - F_{1A} = F_{W1} \quad \text{..(5)}$$

Next stage, stage (ii), (in Fig. 4 & 5) the system undergoes increase of energy of each air molecule, from H_1 to H_2 (i.e. temperature T_1 to T_2) keeping the distance r_1 constant. In this situation, Repulsive force increases to F_{R2}. To keep the distance r_1 constant, F_{w1} has to increase simultaneously up to F_{w2}. Sum of forces F_{A1} and F_{w2} is equal to F_{R2} (indicated in Fig. 4 as the distance d_2).

$$F_{R2} - F_{A1} = F_{W2} \quad \text{..(6)}$$

In the third stage (iii), (in Fig. 4 & 5) let two molecules expand from r_1 to r_2 until the resulting force becomes F_{w1} again as shown in the Fig. 4 keeping the temperature at constant T_2 (isothermal). Sum of forces F_{A3} and F_{w1} is equal to F_{R3} (indicated in Fig. 4 as the distance d_3).

$$F_{R3} - F_{A3} = F_{W1} \quad \text{..(7)}$$

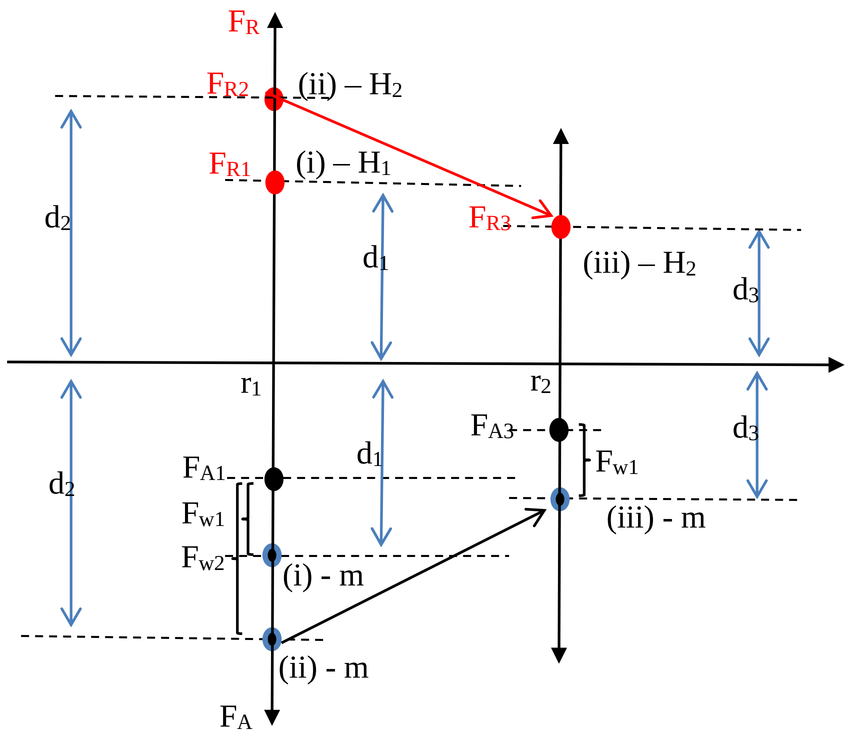


Fig. 4 Forces acting on air molecules when change the temperature from T_1 to T_2 (i) molecules at temperature T_1 and pressure F_{w1}. (ii) Temperature of the molecules increase T_2 at constant distance. Pressure goes from F_{w1} to F_{w2}. (iii) Pressure reduce back to F_{w1} from F_{w2} letting the distance expand from r_1 to r_2, keeping the temperature at T_2.

Fig. 5 shows the pictorial representation of the forces acting on two gas molecules as described in the Fig. 4.

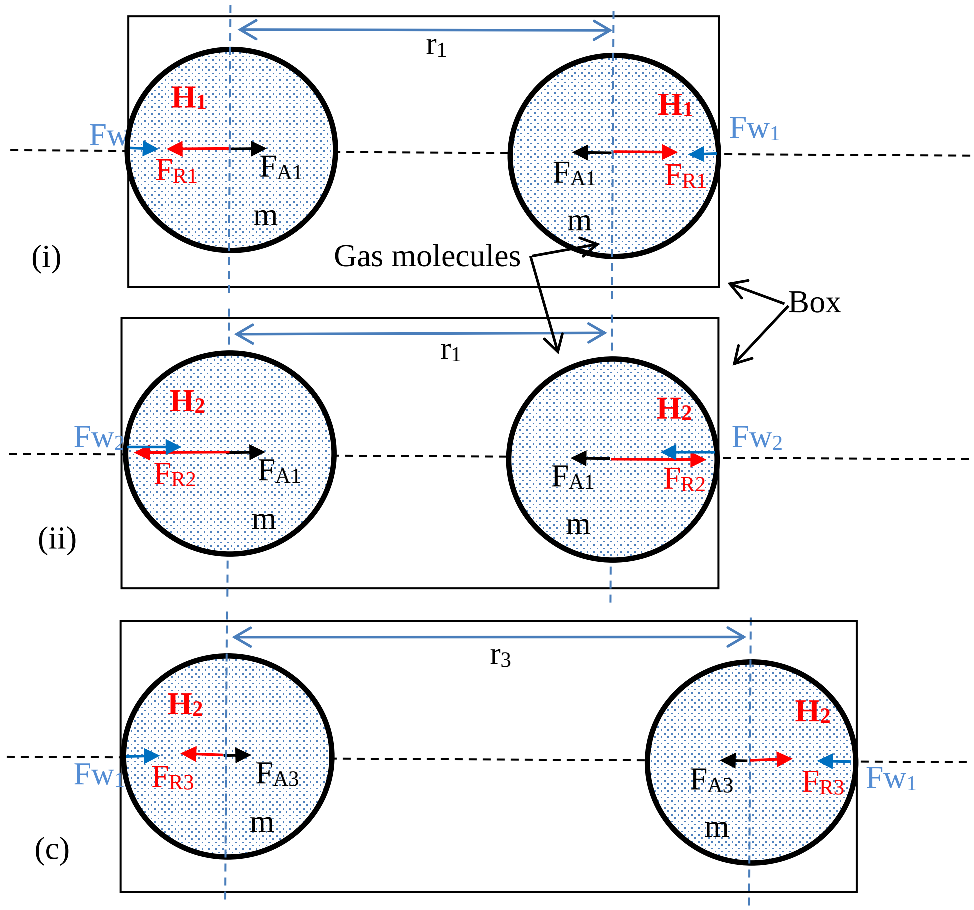


Fig. 5 Two air molecules under change of thermal energy (i) Temperature in the system is T_1 and the distance between them is r_1. External pressure F_{w1} is applied for the equilibrium (ii) Temperature increases from T_1 to T_2 ($T_1 < T_2$). Two molecules are at temperature T_2 but the distance, r_1 between them keep constant by applying an external pressure F_{w2}. (iii) Two molecules undergo isothermal expansion. Distance between molecules increases from r_1 to r_3 ($r_3 > r_1$) until pressure becomes F_{w1}

Case (i) forces act on two air molecules with mass m and thermal energy H_1 separated by a distance r_1.

$$\left|\vec{F}_{R1} - \vec{F}_{A1}\right| = G_R \frac{H_1^2}{r_1^x} - G_A \frac{m^2}{r_1^x} = \left|\vec{F}_{w1}\right| \qquad \text{.........................(8)}$$

For case (ii) – constant volume; Temperature of the system increases from T_1 to T_2. The distance between two molecules kept constant at r_1. External force, pressure increases from F_{w1} to F_{w2}.

$$\left|\vec{F}_{R2} - \vec{F}_{A1}\right| = G_R \frac{H_2^2}{r_1^x} - G_A \frac{m^2}{r_1^x} = \left|\vec{F}_{w2}\right| \qquad \text{(9)}$$

Case (iii) – constant pressure; Let the system allowed to expand until the external force become P_1 again. The new distance between molecules are r_2.

$$\left|\vec{F}_{R3} - \vec{F}_{A3}\right| = G_R \frac{H_2^2}{r_3^x} - G_A \frac{m^2}{r_3^x} = \left|\vec{F}_{w1}\right| \qquad \text{(10)}$$

The transition from case (ii) to case (iii) in Fig. 4 and Fig. 5 could be considered as an adiabatic expansion if no thermal energy is supplied to keep the temperature constant in the system. Here, the cooling occurs due to the expending of thermal energy of two molecules to expand their distance between them from r_1 to r_3 (due to the reduction of pressure from F_{w2} to F_{w1}). The work is done by the repulsive force (antigravity) against the attractive force (gravity).

This work done has to be equal to the reduction of heat energy.

One of the examples of such a situation is adiabatic cooling in “air condition systems”.

From Eq.5 to Eq.7 gives solution for x as follows

$$x = Log\left(\frac{B\times m^2 - AH_1^2}{B\times m^2 - AH_2^2}\right)\Bigg/ Log\left(\frac{r_1}{r_2}\right) \qquad \text{(11)}$$

where $B = \dfrac{A \times H_1^2 - P_1}{m^2}$ and $A = \dfrac{P_2 - P_1}{H_2^2 - H_1^2}$

Table 1. Input parameters for the calculations and their output values.

(i) Physical measurements and properties of air at randomly selected temperatures [17]

Temperature in K^0 (T)	Molecular distance in Å (r)	Pressure Pascal (P)	C_v Kj/Kg K	Cp Kj/Kg K
273 (reference)	33.370	101325	0.7171	1.006
360	36.34	133615	0.72.23	1.010
499	40.780	185206	0.7424	1.030
1073	52.65	398248	0.8716	1.159

(ii) Calculated values for x, GR, GA, FR, FA and Fw (k=0.27)

Temperature in K^0 (T)	Value x	GR	GA	FR (P)	FA (P)	Fw - pressure (P)
360	2.99997	2.75×10^{59}	1.29×10^{60}	213678	80062	133615
499	3.00001	2.62×10^{59}	1.16×10^{60}	257031	71875	185206
1073	3.00000	2.15×10^{59}	0.65×10^{60}	438744	40496	398248
Average	~3.0	2.51×10^{59}	1.03×10^{60}			

With the help of available randomly selected molecular data as shown in the graph. 1 (i), the solution of eq. (11) gives (see graph 1 (ii)) the value r approximately ~3.0 and this gives that the gravitational and antigravitational field/flux flow is closer to volume ($\sim 4/3\pi r^3$) integral rather than surface integral ($\sim 4\pi r^2$) in classical definition. Calculations show that the x value is nearly a constant independent of mass m and SHC C, for randomly selected temperature data.

It is interesting that, the r^3 value has come up against the r^2 value of the classical explanation. With the interpretation of the antigravity effect, we have come up with a volume integral (r^3) which is more relevant to the gas model and spatial systems like the universe in general.

Rearranging the eq. 8 by substituting the value of x:

$$\frac{1}{r^3(volume-v)}\underbrace{\left(G_R H_1^2 - G_A m^2\right)}_{\text{Constant (K) under constant temperature}} = |F_{w1}|(pressure - p) \quad \ldots\ldots\ldots\ldots(12)$$

G_R, G_A, m are constants, for constant temperature H is also a constant, and this leads to Boyle's law

$$PV = \text{constant (K)} \quad \ldots\ldots\ldots\ldots(13)$$

Eq. (12) also shows that the constant, K is proportional to the temperature (via H) of the system

Therefore, $\left(G_R H_1^2 - G_A m^2\right) \propto temperature\ (T^{y2}) = \text{constant} \times \text{T}^{y2}$ as in eq. 3

Which gives the final form $\frac{PV}{T} = \text{constant}$ if $y = \frac{1}{2}$ ………………………………….(14)

Solutions for G_R and G_A are given as (x~3.0);

$G_R = Ar_1^x$ ………………………….. (15)

$G_A = Br_1^x$ …………………………… (16)

Note that G_R, G_A, F_R & F_A are more realistic if y is less than 0.35. The most practical value obtained for y is 0.27 which gives more persistent value for GR and GA with all the randomly selected data (Table 1 (i)). The approximate values for G_R and G_A are in the order of $2.51x10^{59}$ and $1.03x10^{60}$ (see Table 1 (ii)). The magnitudes of F_R and F_A are also given in the table 1(ii). **However, these are yet uncertain values because the weight (hence mass), which is the base unit for almost all the rest of the measurements, estimated in the air molecules cannot be determined exactly due to the force of antigravity which has not been considered in classical theory.**

The values given in the table are approximate values. However, it gives a kind of feeling about the order of magnitude that can have for gravitational and antigravitational forces (when the antigravity is considered). Gravitational and anti-gravitational forces are massive forces as revealed by the above calculations. **For example, at room temperature 25^0C, F_A and F_R between air molecules are approximately 190892N and 80289N. The resultant is 110603N which is the pressure caused/generated by the molecules to the external world.** According to classical physics, gravity is the weakest force; It is 10^{-36} weak as the electromagnetic force, a negligible force, accordingly. The interpretation of gravity as a weak force has resulted from the gross overlooking of the repulsive antigravity force. Upto date, classical physics has overlooked this antigravity force which labelled: “gravity is a weak force!”

Note that; in any system with two equal forces which act in opposite direction are in equilibrium, the apparent (resultant) force seems to be zero.

A massive amount of water is thrust up and down by tides brought above by moon’s gravitational force. The solar system and the entire universe are said to be kept together by the force of gravity. Hence, gravity cannot be a weak force as believed.

3.0 Conclusion:

In the theory of thermodynamics, we neglect the gravitational attractive force among air molecules and as well as with the earth, in the derivations in gas–laws taking it as negligible.

However, we see that the atmospheres of planets are kept in by their gravitational attraction [2] [3]. At the same time, we also accept that there is a substantial gravitational attractive force between all forms of matter. There appears to be a paradox here in labelling gravity as weak.

It is worth mentioning that in the classical definition, the pressure is created by the mechanical impingement upon a surface by the particle with certain mass. However, according proposed concept, the pressure is created by a force field. This will eliminate the hypothesis "Perfectly elastic collations among gas molecules and the wall" in classical theory.

Similarly, novel concept doesn't depend on the number of molecules in a certain mass or volume of the air as defined in classical interpretation of ideal gas law. In practice/principle, even a tiny amount of air could produce the same pressure as a huge amount of air at same temperature. It also implies that the force between individual gas molecules represents the pressure in the system. This observation validates the model (even with two gas molecules) forwarded here in this manuscript.

The interpretation here is simple as shown in the calculations. Stable systems, such as gases in the atmosphere, clouds etc, [7] are almost in equilibrium and only a weak resultant force is observed. On the other hand, the entire universe is also manifested by two massive forces; the gravity-force and the anti-gravity force which are not in a state of equilibrium [7]. The antigravity force here supersedes the gravitational force as explained due to the continual production of thermal energy by mass-energy conversion ($E=mc^2$) with the continual expansion and acceleration of galaxies

Summarizing the argument, one force (gravity) cannot exist without the other (antigravity); the twin effect has to considered in all relevant physical phenomena although one cannot be easily discerned against the other. Once fully understood we would learn to control and manipulate this antigravity force to achieve hitherto unknown results, outcomes and developments.

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Abbreviations:

AGC – antigravity concept

SHC – specific heat capacity

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