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On a Heuristic Point of View about the Generalization of Curie Law to Cosmic Higgs Fields with the Casimir Effect

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Abstract

Condensed state physics demonstrates that the Curie temperature is the point at which spontaneous magnetization drops to zero, marking the critical transition where ferromagnetic or ferrimagnetic materials transform into paramagnetic substances. Below the Curie temperature, a material remains ferromagnetic; above it, the material becomes paramagnetic, with its magnetic field easily influenced by external magnetic fileds. For example, the Curie temperature of iron (Fe) is 1043 K, while that of neodymium magnets ranges from 583 to 673 K. From both physics and mathematics perspectives, examining the temperature properties of materials is essential, as it provides valuable insights into their electromagnetic and thermodynamic behaviors. This paper makes a bold assumption and, for the first time, carefully verifies the existence of a Casimir temperature at 0.00206 K under conditions of one-atomic spacing.

Keywords

Curie Temperature, Curie Point, Casimir Temperature, Critical Point, Fields, Materials, One-Atomic Spacing

1. Introduction

In the history of physics, Dr. Curie's Mean Field Theory (MFT) is formally based on the Bogoliubov inequality. This inequality provides an upper bound $F \le F_0 \equiv \langle H_0 \rangle - TS_0$, on the free energy of a system with a Hamiltonian H,

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denoted as $H = H_0 + \int_{?}^{T} \mathrm{d}H$, but it lacks a corresponding lower bound. MFT assumes that interaction quantities cancel each other out at the microscopic level, requiring compensation for validity in practical applications (*i.e.*, $T \to T_{C'}$). In other words, MFT considers a system without fluctuations, replacing all interactions with mean fields. However, as an approximation method, MFT overlooks critical information, such as the lower bound of temperature. We conclude that MFT, while useful, is insufficient and must be supplemented with additional scientific perspectives. Although MFT remains valid in material sciences, it is not fully applicable to other realms of real mechanics, such as quantum mechanics. The significance of this limitation is highlighted by its implications for cosmic Higgs fields, as extensively discussed in the literatures (2012) [1]-[9]. Drawing an analogy with the Curie temperature in magnetism, we investigate the theoretical behavior of the mass or inertia of materials, revealing similarities to their polarizability in magnetism. This suggests that, once the lower bound is established, material inertia, much like magnetic properties, can be effectively eliminated.

Although we do not delve deeply into the specifics of material properties, we propose a mechanism for achieving the elimination of inertia. In this paper, by drawing an analogy between the Curie temperature of magnetism and Higgs fields, we explore how the physical behavior of mass or inertia in materials corresponds to their polarizability in magnetism. We propose that, once the lower limit is determined, the inertia of a material—much like magnetic behavior—can be eliminated.

Based on our calculations and historical data, we have identified a material, Alconi alloy, along with other similar high entropy alloys (HEAs), that satisfies both the lower limit requirements and the Curie temperature criteria. We suggest that microwave engineering be employed to investigate its unique and intriguing physical effects. We hypothesize that the Curie temperature of inertia applies universally, corresponding to a single point in a sombrero-like potential. Since there is only one peak in the sombrero shape, which maintains high symmetry at this point $T_{C'}$, experimental results showing Alconi as a material with high magnetic fields should also indicate a reversal solution at $T_{C'} \approx 0.00206\ \mathrm{K}$ (not at 3 K, due to considerations of naturalness $\zeta(3)\mathrm{K} \approx 1.20206\ \mathrm{K}$). This hypothesis aligns with the known entropy-temperature relationship related to the Casimir Effect, which approaches absolute zero (see Figure 3 of Ref. [10]). For effective application, the proportions of Al, Ni, and Co in the Alconi alloy can be adjusted to specific ratios, such as those found in hexagonal structures. Our work is grounded in the first fundamental theorem of calculus, which implies that a lower-bounded value must exist—a concept that has not been thoroughly explored in classical physics. In MFT, this lower-bound is typically considered as merely an internal cancellation term within the microscopic ensemble, with the fluctuation Hamiltonian treated as a zero-order expansion term.

During spontaneous symmetry breaking, the zero-order term of the MFT

Hionian assumes that the magnetic field is derived from its surroundings (magnetic saturation), rendering additional calculations of the lower-bounded value unnecessary for practical applications. As a result, this approach is seldom utilized in the study of magnetism. Since the concept of Higgs fields was established in 2012, it has been widely discussed that quantum particles acquire their mass through interactions with Higgs fields, a process that also involves spontaneous symmetry breaking.

If the principle of spontaneous symmetry breaking is evident in the Curie temperature, and cosmic Higgs fields represent a fundamental principle, then from the perspective of mathematical physics—where these concepts originate from symmetry, with magnetization *M* becoming directional and unified when external magnetic fields are applied—the analogy extends to mass and inertia (*m/I*). Just as particle masses arise from cosmic Higgs fields, which provide directional coupling cross-sections to particles, there must exist a common, shared lower-bounded value. The basic hypothesis of this paper is grounded in the principles of general covariance (e.g., Einstein's 1905 problem of a moving magnet and a conductor) and background independence (e.g., Higgs bosons). This paper demonstrates that the reference frame of a moving body can be massless, while an observer at rest perceives energy in the form of photons $E = nh\nu, n \gg 1$ or neutral currents with the same energy. Furthermore, the well-known Néel temperature naturally supports the derivations of scenarios for material low temperatures discussed in this paper.

2. Discussion: The Connection between Curie's Law and Cosmic Higgs Field Mechanisms: Electroweak (EW) Transition Phase

Calibration of Light Clocks and Atomic Clocks as a Cosmic Clock: Achieving the simultaneity of cosmic clocks requires careful derivation. The calibration of a cosmic clock hinges on the simultaneity of light clocks and atomic clocks, both constructed from a special alloy relevant to Curie's law and cosmic Higgs field mechanisms. For the first time, we derive the uniform field equation, highlighting the critical importance of synchronization[1].

$$dm = \frac{m_0}{\sqrt{1-u^2/c^2}} - m_0, u \neq 0 \tag{1}$$

Make a constraint: Let $dm \equiv 0$ for a moving particle relative to the rest-coordinate (S_0), and transform observation to the photons (S_0), *i.e.*,

$$dm \equiv m - m_0 = \frac{h\nu}{c^2} \neq 0 \tag{2}$$

Take logarithm for both, respectively. Therefore sequence

[1]This section was completed by the first author, with the derivation sourced from a private manuscript (intended for future publication), where Equation (4) includes terms involving Ricci curvature tensors. The work above, of course, includes the calibration of light clocks and atomic clocks at timescales of simultaneity.

$$\left.\begin{aligned} &\ln dm\big|_{dm=0} = -m_0 \cdot const \equiv -\gamma = -\infty, (S') \\ &\ln dm = \ln\frac{m}{m_0} = \ln\frac{hv}{c^2} = \ln h + \ln v - \ln c^2 \neq 0, (S_0) \\ &\ln dm = \ln\frac{1}{\sqrt{1-u^2/c^2}} \neq 0, u \to 0, (S_0) \end{aligned}\right\} \tag{3}$$

The first equation denotes that no inertia when moving since $dm = 0$, such that it can be directly to obtain

$$e^{-\gamma} = 0 \tag{4}$$

where $\gamma \to \infty$ or the expansion of the above equation, in terms of tensors representing electromagnetism (EM) fields and gravity, can potentially be introduced into Einstein's equation of unified fields (1930-1950). This relates to the missing manuscript [referred to as equation (g)] discovered by the Hebrew University of Jerusalem in 2019. The energy applied by S_0 can be transformed into S' through its acceleration in space, adhering to the principle of energy invariance, or the law of conservation of energy. Here, we provide a simplified derivation of this concept for the first time. This includes the calibration of light clocks and atomic clocks, alongside the ensemble of measured contracted lengths:

$$\left.\begin{aligned} &T = \infty, (S') \\ &T = \frac{x}{c} > 0, (S_0) \\ &T = T_0 > 0, u = 0, (S_0) \end{aligned}\right\}, \left.\begin{aligned} &L = x = x_0\sqrt{1-u^2/c^2} = 0, u = c, (S') \\ &x = cT > 0, (S_0) \\ &L = L_0, u = 0, (S_0) \end{aligned}\right\} \tag{5}$$

where x represents the distance that light has traveled, and L is defined as the matter length. Matter in S' can exist indefinitely (with *zero distance* traveled, and all clocks in this context are considered *cosmic clocks*). Clocks for photons and rest matter in S_0 are synchronized during calibration. The equation implies that particles would reach the speed of light C if the inertia were not considered.

Remark: The derivation in the above section aims to address simultaneity in relation to the Casimir force. [This is an upgraded version of Einstein's Thought Experiments: When an apple is thrown upward in a moving coordinate system and reaches the speed of light, the parabola (AC) observed from a stationary coordinate transform into the trajectory of a neutral flow, *i.e.*, photons (DC).]

Curie's law is simulated in this section, incorporating associated ideas from cosmic Higgs fields to generate a series of new concepts. Curie's law is expressed as:

$$M = C \cdot \frac{B}{T} \tag{6}$$

where C is denoted as a universal constant in units of Kelvin. A similar physical behavior appears in cosmic Higgs fields, where the expectation of vacuum $\langle \phi_{vac} \rangle \neq 0$ undergoes spontaneous symmetry breaking. If inertia (generally the longitudinal mass m) follows the same form as Curie's law and T is fixed at the instant of Spontaneous Symmetry Breaking (SSB) within originally continuous, sufficiently small ranges (*i.e.*, mass m can be defined within an extremely small T-region), then we have the masses of quantum particles:

$$m = C'\frac{\left|\langle \phi_{vac} \rangle \mu^{-1}\right|}{T}, \text{SSB} \tag{7}$$

where $\mu^{-1} = 1/\mu$ represents the magnetic moment of a quantum particle in Higgs fields (with rotational symmetry, see Figure A1). Similar with Curie's law, we derive an expression for mass based on the results from the partition function:

$$m = \frac{n\langle \phi_{vac} \rangle}{|\mu|} = \frac{n\phi_{vac}}{|\mu|}\tanh\left(\frac{\phi_{vac}}{kT}\right) \tag{8}$$

Note that the equation is established under conditions of higher temperature and lower gravitational fields (e.g., in a vacuum). If $\frac{\phi_{vac}}{kT} \ll 1$ makes $\tanh\left(\frac{\phi_{vac}}{kT}\right) \approx \frac{\phi_{vac}}{kT}$ Therefore,

$$m = \left|\mu^{-1}\right|\frac{n\phi_{vac}^2}{kT} \tag{9}$$

By rotations on top of sombrero as expression in Higgs fields:

$$m = \left|\mu^{-1}\right|\frac{n\mathrm{e}^{i\theta}\phi_{vac}^2\left(\mathrm{e}^{i\theta}\right)^*}{kT} \tag{10}$$

Consider the property of conjugated variables in quantum mechanics, therefore

$$\langle \phi_{vac}^2 \rangle = \langle \mathrm{e}^{i\theta} | \phi_{vac}^2 | \mathrm{e}^{i\theta} \rangle, \phi_{vac} \to \phi_{vac}' = \mathrm{e}^{i\theta}\phi_{vac} \tag{11}$$

$\phi_{vac} \neq \phi_{vac}'$ unless $\theta = N \cdot 2\pi$. Assuming the inertia behaves similarly with χ (defined by Curie's law) so that

$$I \equiv \left|\mu^{-1}\right|\frac{\partial m}{\partial \phi_{vac}} = \underbrace{2n \cdot \left|\mu^{-1}\right|\frac{\phi_{vac}}{kT}}_{\equiv \frac{2C'}{T}} \approx 2\frac{m\left|\mu^{-1}\right|}{\phi_{vac}} \tag{12}$$

i.e., $I(T \to \infty) = \frac{2C'}{T}$ (e.g. substances have their inertia at $T = 300\ \text{K}$, and next, for convenience, set $\left|\mu^{-1}\right| \equiv 1/\mu$ in the following statement).

Where

$$C' \equiv \frac{n\phi_{vac}}{\mu k} = \frac{\mu_0 n \mu_B^2}{k} = n \cdot \frac{1.256 \times 10^{-6}\left(9.27 \times 10^{-24}\right)^2}{1.38 \times 10^{-23}} \text{K} \cdot \text{mol} \cdot \frac{\text{T}}{\text{J}} \approx 0 \tag{13}$$

Equation (13) is indicated as Curie constant for inertia (note that *n* can be 1 mole and units in terms of $[C']$ could be Tesla divided by *entropy* in terms of units $\text{K}^{-1}\cdot\text{mol}^{-1}\cdot\text{J}$).

If $\langle \phi_{vac} \rangle = 0$, then inertia would be $I = 0$, *i.e.*, the inertia is frozen. Refer to

$$I = 0 = \frac{2C'}{T} \propto \frac{\phi_{vac}}{T} \tag{14}$$

Finding the maximum of the sombrero (see Figure A1):

$$0 = \left. \frac{\partial \phi_{vac}}{\partial T} \right|_{T=T_{C'}} \quad (15)$$

This implies that $T = T_{C'}$ results in the quantum particles $\langle \phi_{vac} \rangle = 0$ (the symmetry of the rotation) on top of the sombrero, so that $\langle I \rangle = \frac{\langle \phi_{vac} \rangle}{T_{C'}} = 0$. And there is only one point at $T = T_{C'} = Const$ which causes the inertia of quantum particles to be frozen. If $T_{C'} = Const$, $0 < T < T_N$ (which corresponds to the famous *Néel temperature*.) e.g. 0.00206 K or 0.2 K or 1 K ~ 2 K or 20 K, these truncated points within a certain range are analyzed by multipole expansions (see Appendix D, which reveals that the function exhibits a smooth and monotonic increase) [11] [12]. Assuming such a continuous-smooth range[2,3], then

$$\begin{aligned} I_\lambda &= 0 = \frac{2C'}{T} = \frac{2C'}{0.00206K}, \\ I_\lambda &= \frac{2C'}{0.00206\ \mathrm{K}} \approx \left(971\,\mathrm{K} \cdot \mathrm{mol} \cdot \frac{\mathrm{T}}{\mathrm{J} \cdot \mathrm{K}} \right) \lim_{C' \to 0} C' = 0 \end{aligned} \quad (16)$$

If a hypothetical material exists, as indicated in the examination table of Curie temperatures, it must adhere to

$$T_C \approx 971\,\mathrm{K} \quad (17)$$

with random errors ΔT (closer to 3 K of the Cosmic Microwave Background, CMB). This suggests that setting λ = Alconi [with Crconi being latent but considered outside the discussion due to its anti-ferromagnetic (AFM) properties, which differ from the B-fields analogous to Higgs fields—except for AlCrCoNi ($Cr_{0.25}Co_{0.25}Ni_{0.25}Al_{0.25}$) for due to the mixed species of atoms] and cooling it to Tc, would result in frozen inertia. However, this would require a scenario of weak gravity (e.g., outer space) or pulse cooling on Earth. Based on the above, we speculate that a Curie temperature of inertia exists for all substances (*i.e.*, the single point in the sombrero potential of Higgs fields) because there is only one peak on the sombrero, which maintains its high symmetry at T_c. Consequently, it is suggested that an experiment demonstrating the same pattern for Alconi as a material of inertia with high magnetic fields would also predict its reversal solution at T_C ≈ 0.00206 K. In scenarios where Alconi-Alconi (or HEAs) constitute parallel metals, and the Casimir effect occurs, the Casimir force at $T_{c'}$ would be the same as the Casimir force at absolute zero [10]. To avoid the problem of infinity, a finite temperature is chosen in Equation (15). This choice does not violate the general principles of Casimir temperature dependence found in the literature,

[2]Increasing the quantities of entropy per temperature in units of 1 K, where the quantities of magnetic fields within material bodies are measured (in Tesla), can be related to the concept of inertia. By utilizing appreciated ferrimagnetic materials (e.g., Alconi).

[3]It is possible to reduce the system's inertia to zero (rendering it massless) by operating it at T_C ≈ 0.00206 K (Alconi-Alconi plate temperature Tc with a pronounced Casimir effect). This artificial physical phenomenon could be termed "inertia negation." To support the statements regarding inertia in this section, one can refer to the widely known work of Dutch physicist Erik Peter Verlinde (2011) [13].

as deviations of less than ~0.1% are generally acceptable. Notably, if Equation (14) is applied to Figure 3 of Ref. [10], one can observe that the Casimir force remains unchanged. This indicates that the inertia of parallel metals remains stable (with no changes) in a specific system (e.g., a cavity filled with microwaves). As far as one can see, Equations (1) to (14) are well-verified and strongly support Equation (15) and its results in Equations (16) and (17).

Moreover, Equation (15) is self-consistent with the curve trend shown in Figure 3 of Ref. [10]. Therefore, it is crucial that the indicated parameter, Curie temperature in Equation (16), imposing the closely connected relativity equations (Equations (1) to (5)) upon a highly symmetrical pattern, is essential.

Justification: Equations (6) to (17) are referred to as the Curie-Higgs Exchanging Critical Conditions. This reveals the possibility of inertia negation under certain physical conditions.

3. New Concepts

3.1. The Failure of Mass Expansion: The Symmetry of Inertia Buried in the Higgs Valley

As discussed in Section 2.1, the Lorentz mass expansion of Special Relativity fails under the conditions of the electroweak (EW) transition phase. This breakdown is primarily due to the constraints imposed by the Curie temperature ($T_{C'} = 0.00206\ \text{K}$, Casimir temperature, as discussed later) in the Higgs fields, where such an extraordinary phase transition leads to abnormal behavior of matter. We can observe that broken EW gauge couplings (g, g') [14]-[16] are also related to this temperature range. According to statements made by Dr. 't Hooft, *the solutions at high temperatures are analogous to those at low temperatures*. The relevant temperatures are detailed in Appendices A and B.

3.2. Casimir Effects and Vacuum Fluctuations in Higgs Fields

We have compellingly argued that the temperature $T_{C'} = 0.00206\ \text{K}$ at a specific point within the Casimir effect acts as a watershed (barrier) in the EW-phase transition. Given the acceptability of such a low temperature influencing EW phases, it is both undoubted and natural[4] that the Casimir force does not originate from vacuum fluctuations in the Higgs fields. The material involved, specifically Alconi-Alconi plates, is precisely justified by this paper. To this point, the scalar $T_{C'} = 0.00206\ \text{K}$ represented as the z-axis in **Figure A1** illustrates that the Higgs mechanism, whereby particles acquire mass, occurs as they move away from this barrier ($T \neq T_C$). In other words, the valley of Higgs fields (the bottom of the sombrero) provides undeniable evidence of highly broken symmetry.

3.3. Revealing Two Higgs Valleys

The Higgs potential with two valleys is shown in **Figure 1**. The concept of "Two

[4]See Kazunori Kohri and Hiroki Matsui's work (2017-2018) [15].

Higgs Valleys" refers to the s-line and v-line potentials of the Higgs field, respectively, often visualized as a sombrero-shaped potential. In this model, the Higgs field has two valleys *s-line* and *v-line*, represented as the corresponding to the same Higgs potential energy but at different Higgs floors.

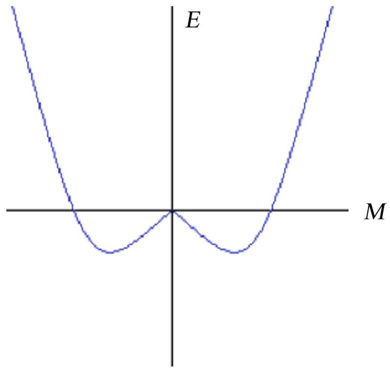

Figure 1. Higgs potential with two valleys. One of the hidden sectors in dimensions of Higgs fields is $\langle E \rangle = k_B T_{C'}$.

4. Conclusion

This paper has uncovered that inertia negation occurs at point $T \approx 0.00206\ \text{K}$, a specific point by examining the nature of cosmic Higgs field symmetry and, by analogy, the Curie temperature of magnetism. At this point, one can calculate the Higgs boson mass to be approximately 125.8 GeV/c^2, which aligns well with the data presented in Ref. [14]. This finding supports the notion that Higgs bosons may function as inflations, allowing researchers to derive useful results through precise calculations based on the law of conservation of energy and cosmological observations. Through this analogy (which we have justified as the Curie-Higgs Exchanging Critical Conditions) and the subsequent calculations presented in this paper, we can conclude that the identified point $T_{C'} \approx 0.00206\ \text{K}$ (*i.e.*, the Casimir temperature) is valid. The reversal of the calculated result $T_C \approx 971\ \text{K}$ suggests a mechanism for identifying materials capable of realizing inertia negation.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Stanley, H.E. (1971) Mean Field Theory of Magnetic Phase Transitions, Introduction to Phase Transitions and Critical Phenomena. Oxford University Press.

[2] Sakthivadivel, D.A.R. (2022) Magnetisation and Mean Field Theory in the Ising Model. *SciPost Physics Lecture Notes*, **35**, 1-16.

[3] CMS Collaboration (2017) Constraints on Anomalous Higgs Boson Couplings Using Production and Decay Information in the Four-Lepton Final State. *Physics Letters B*, **775**, 1-24.

[4] Gunion, J. (2000) The Higgs Hunter's Guide. Westview Press, 1-3.

[5] Randall, L. (2006) Warped Passages: Unraveling the Mysteries of the Universe's Hidden Dimensions.

[6] Sen, A. (2002) Rolling Tachyon. *Journal of High Energy Physics*, **2002**, Article 48. https://doi.org/10.1088/1126-6708/2002/04/048

[7] Kutasov, D., Mariño, M. and Moore, G. (2000) Some Exact Results on Tachyon Condensation in String Field Theory. *Journal of High Energy Physics*, **2000**, Article 45. https://doi.org/10.1088/1126-6708/2000/10/045

[8] Aharonov, Y., Komar, A. and Susskind, L. (1969) Superluminal Behavior, Causality, and Instability. *Physical Review*, **182**, 1400-1403. https://doi.org/10.1103/physrev.182.1400

[9] Feinberg, G. (1967) Possibility of Faster-Than-Light Particles. *Physical Review*, **159**, 1089-1105. https://doi.org/10.1103/physrev.159.1089

[10] Lim, S.C. and Teo, L.P. (2009) Repulsive Casimir Force at Zero and Finite Temperature. *New Journal of Physics*, **11**, Article 013055. https://doi.org/10.1088/1367-2630/11/1/013055

[11] Chiang, C.-L. (2009) Formation of Pt Based Cobalt Magnetic Ultra-Sharp Nano Tip.

[12] Brevik, I. and Høye, J.S. (2013) Temperature Dependence of the Casimir Force. *European Journal of Physics*, **35**, Article 015012. https://doi.org/10.1088/0143-0807/35/1/015012

[13] Verlinde, E. (2011) On the Origin of Gravity and the Laws of Newton. *Journal of High Energy Physics*, **2011**, Article No. 29. https://doi.org/10.1007/jhep04(2011)029

[14] CERN Courier (2013) Birth of a Higgs Boson. LHC Discovery, 22.

[15] Kohri, K. and Matsui, H. (2018) Electroweak Vacuum Instability and Renormalized Vacuum Field Fluctuations in Friedmann-Lemaitre-Robertson-Walker Background. *Physical Review D*, **98**, Article 103521. https://doi.org/10.1103/physrevd.98.103521

[16] Reyes, E. and Fazio, R. (2022) High-Precision Calculations of the Higgs Boson Mass. *Particles*, **5**, 53-73. https://doi.org/10.3390/particles5010006.

Appendix

A. The Simple Illustration of Higgs Fields

We illustrate the Higgs Fields by using a simple sombrero model, as shown in Figure A1. The detailed description is provided in Postscript I.

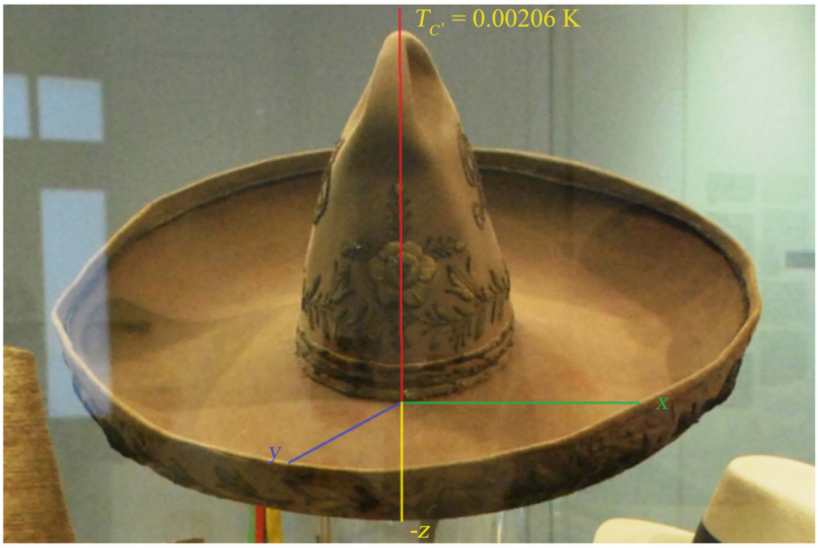

Figure A1. Rotations from vertical to horizontal direction (*i.e.*, $\pi/2+\pi/2=\pi$ for $\hat{x},\hat{y}$, $0+\pi=\pi$, for $-\hat{z}$. The angle rotated is in result of π. The edge is dangerous, like the universe is on this *critical state* (*i.e.*, the critical universe).

B. Casimir Effect and Casimir Temperature at $T_C \approx 0.00206$ K

The famous Casimir effect reveals that the attractive force is denoted by

$$E^{Cas.Attr.}=\left|\varepsilon_g\right|d^2=\left|-\frac{\hbar c\alpha}{32\pi d^3}\right|d^2\approx 2.3\times10^{-26}\ \text{J},\ d\equiv 1\ \text{Å} \tag{B.1}$$

And results in an equivalent of $E=k_BT\sim 5.69\times10^{-26}$ J, $T_{C'}\approx 0.00206$ K under the condition of the naturalness by light-speed *C*, and the electrons are located on metal surfaces (*Alconi-Alconi plates*) possess the natural angular frequency of electron matter wave (ranges of microwaves) $\omega_0\sim 10^8$ Hz (low frequency optical response *s* = *4*). The below section is important to be underlined:

$$\begin{aligned}&E^{Cas.Attr.}=\left|\varepsilon_g\right|d^2=\left|-\frac{1}{137}\frac{3.147\times10^{-26}\ \text{J}}{32\pi}\right|\approx 2.30\times10^{-26}\ \text{J},\ d\equiv 1\ \text{Å}\\&E_{plate}=\frac{\hbar\omega_0}{2}+\frac{k_BT}{2},\\&E_{plate}=\frac{\hbar\omega_0}{2}+2.30\times10^{-26}\ \text{J}\approx 2.85\times10^{-26}\ \text{J}\end{aligned} \tag{B.2}$$

where

$$\frac{\hbar\omega_0}{2}\approx 5.0\times10^{-27}\ \text{J}+\Delta_{flct.},\ T=0\ \text{K},\ \omega_0\sim 10^8\ \text{Hz} \tag{B.3}$$

(The values with uncertainty: the vacuum fluctuation $\Delta_{flct.}$)

And $T_{C'}$ is unknown but the observable thermal temperature is given by

$$2.30\times10^{-26}\ \text{J}=\frac{k_B T}{2}, T\approx 0.00333\ \text{K}\left(\text{Thermal Noise}\right)>T_{C'} \tag{B.4}$$

Taken consideration of two plates at Casimir Effects (the zero-point energy included):

$$E_{2\,plates}\approx 5.69\times10^{-26}\ \text{J}=2k_B T_{C'} \tag{B.5}$$

Yields naturally

$$T_{C'}\approx 0.00206\ \text{K} \tag{B.6}$$

The footnote notation C can refer to either Curie or Casimir. In this paper, it specifically refers to Casimir temperature. The work presented here surpasses previous frameworks. Notably, the calculations are fully consistent with the results in Ref. [10] (e.g., Equation (B.1) accurately fits the data presented). The primary difference lies in the study objects: while previous studies focused on pistons, this paper examines Alconi parallel metals (Alconi-Alconi plates) at nanoscales (one-atomic spacing) in a vacuum.

C. The Microwave Engineering of Cavities Made of Alconi Alloys

The previous sections reveal that LASER cooling can promote the Alconi-alloys to be approaching closer to Casimir temperature: $T_{C'}=0.00206\ \text{K}$ and via the deductions we find that $T_{C'}=0.00206\ \text{K}$ exactly corresponds to *the indicated temperature dependence of Casimir fo*rce. However, the LASER cooling cannot filter the *quantum noise* with temperatures, because of the existence of cosmic Planck scales which hidden sectors in the Dirac Sea. Based on this, therefore in physical sense, the microwave engineering has to be used to supplement the LASER cooling in order to be an observation of reaching Casimir temperature $T_{c'}$, because of a band of wavelengths are provided by microwaves that filter the quantum noise with temperatures. Taking the average height(s) of human-beings as basis of calculations:

$$\begin{aligned} &3h=\lambda=3\times1.7\ \text{m}=\frac{c}{v}=\frac{2.997\times10^{8}\ \text{m}\cdot\text{s}^{-1}}{v}, \\ &v=\frac{2.997\times10^{8}\ \text{m}\cdot\text{s}^{-1}}{5.1\ \text{m}}=\frac{2.997\times10^{8}\ \text{s}^{-1}}{5.1} \\ &\approx 5.88\times10^{7}\ \text{Hz}=\left(4.29\pm\varepsilon'\right)\times10^{7}\ \text{Hz}\end{aligned} \tag{C.1}$$

That is, a metal plate that can accommodate about three astronauts is made into a resonance cavity (diameter $D=n\cdot(\lambda/2), n=1,2,3,\cdots$), the microwave band placed inside the cavity can produce a sound wave-like effect (the sonicity), so that its corresponding temperature can offset the background noise temperature, thereby obtaining Casimir temperature while the LASER cooling is applied on Alconi-alloys. Empirically, this microwave band is desirable $v\approx 4.29\times10^{7}\ \text{Hz}$, $\lambda\approx 7.0\ \text{m}$ (the averaged scale of surrounding objects) is better because of the optical interference conditions:

$$\frac{\lambda}{2}=2d, \lambda=4d=4\times1.75\ \text{m}\approx 7.0\ \text{m} \tag{C.2}$$

Interesting that, if the three astronauts also desire to global-reach Casimir temperature, in reasons that three ones have to put on the close-fitting metal suits made of Alconi alloys. However, note that technically these three astronauts cannot be formed the standing wave nodes during resonance to prevent the standing wave from being destroyed and losing the meaning of the discussion.

D. Multipole-Expasions for Casimir Forces

s = 1 case:

$$\zeta(3) = 1.20206$$

$$F_{Casimir}^{Class.} = \frac{3\zeta(3)}{16\pi a^3} L_2 L_3 T \approx \left(0.06a^{-4}\right) \cdot \frac{(a + 0.20206a)}{1} L_2 L_3 T,$$

$$F_{Casimir}^{Class.} = \frac{3\zeta(3)}{16\pi a^3} L_2 L_3 T \approx \left(0.06a^{-4}\right) \cdot a\left(1 + 0.20206\right)^s L_2 L_3 T, s = 1 \tag{D.1}$$

$$F_{Casimir}^{Class.} = \frac{3\zeta(3)}{16\pi a^3} L_2 L_3 T \approx \left(\frac{T}{a^3} + \frac{0.20T}{a^3} + \frac{0.00206T}{a^3}\right) 0.06 L_2 L_3$$

Equation (D.1) shows that as the same significance as illustrated by Figure 3 of Ref. [10]. Such leads to the natural existence of *Casimir temperature* (while a = 0.1 nm).

s = 2 case:

$$F_{Casimir}^{Class.} = \frac{3\zeta(3)}{16\pi a^3} L_2 L_3 T \approx \left(0.06a^{-4}\right) \cdot a\left(1 + 0.20206\right)^s L_2 L_3 T, s = 2$$

$$F_{Casimir}^{Class.} = \frac{3\zeta(3)}{16\pi a^3} L_2 L_3 T \approx \left(\frac{T}{a^3} + \frac{0.20206T}{a^3} + \left(\frac{0.00206^4 T^2}{a^6}\right)^{1/2}\right) 0.06 L_2 L_3 \tag{D.2}$$

Equation (D.2) where obviously $\left(\frac{0.00206^4 T^2}{a^6}\right)^{1/2}$ implies one that fields of repulsive force are in a term of power-series and are in a hollow structure with dielectric ε. Here attached: Based on the T-axis in Figure 3 of Ref. [10], let T = 1 K is permitted.

E. The Casimir Temperature, the Speed of Light, and the Golden Ratio

It is interesting that

$$T_{C'} C = 0.00206\ \text{K} \times 3.0 \times 10^8\ \text{m/s} \approx 0.618\ \text{MK} \cdot \text{m/s} \tag{E.1}$$

Or

$$\frac{1}{T_{C'} C} \approx 1.618\ \mu\text{s}/(\text{K} \cdot \text{m}) \tag{E.2}$$

i.e., the significance is that the reciprocal golden ratio $\varphi^{-1} = 0.618$ times MK·m/s. And Equation (E.1) clearly reveals the interesting relationships between $T_{C'}$, C, and φ.

Postscript I:

In **Figure A1**, one may severely ask: why not place $T_C = 0\ \text{K}$ supposed on top of the sombrero? The answer is, if one has done it, Equation (8) would represent that objects acquire their masses due to Higgs fields (*i.e.*, $\langle \phi_{vac} \rangle = \phi_{vac}$, $T = 0$ with $E_0 = \hbar\omega/2$ (a supposed possible form of dark energy)).

By the widely-known experienced formula in case of Casimir Effects, one has

$$S = \frac{3k_B\zeta(3)}{2\pi}\left(\frac{k_BT}{\hbar c}\right)^2 - \frac{4k_B\pi^2 a}{45}\left(\frac{k_BT}{\hbar c}\right)^3, \frac{ak_BT}{\hbar c} \ll 1$$
$$S = 0, T = 0\ \text{K} \tag{I.1}$$

Here gives the better calculation as

$$S = \frac{3k_B\zeta(3)}{2\pi}\left(\frac{k_B \cdot 0.00206\ \text{K}}{\hbar c}\right)^2 - \frac{4k_B\pi^2 a}{45}\left(\frac{k_B \cdot 0.00206\ \text{K}}{\hbar c}\right)^3$$
$$S > 0, T_{C'} \approx 0.00206\ \text{K} \tag{I.2}$$

$S > 0$ actually causes SSB in Higgs fields.